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MR02-K05 Leg.2

10.Oct.-6.Nov. 2002

Preliminary Cruise Report

Dec. 2002

Japan Marine Science and Technology Center

Executive Summary:

R/V Mirai Cruise; Voyage MR02-K05
October-November 2002

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As the result of the R/V Mirai Cruise, the foundation of the Northwestern Pacific Time-series Station Array has been established by settling 3- stations, K-1, K-2 and K-3. Each station consists of a pair of advanced moorings: A moored profiler mooring (MMP) that scans from the mixed layer (approximately 50-m) to 4,600 m and a 30-m to >5,200 m biogeochemical mooring with euphotic layer instrument packages and sediment trap arrays. In addition, we have collected sufficient sets of radio-biogeochemical samples from all depths. These default stations for this program are;

K-1; 51N 165E
K-2; 47N 160E (Designated as "Main Station" of this program)
K-3; 39N 160E

Mutsu Institute for Oceanography (MIO)/JAMSTEC intends to maintain these stations for a decade in order to understand seasonal and annual variability in a high latitude open ocean, particularly in the Pacific Subarctic Gyre, with international collaboration. More specifically;

- Precision bathymetry for PS-mooring deployment has been completed. Approximately 220 square n. miles at K-1, 2 (in 2001) and 3 (in 2002) was made by SeaBeam (SeaBeam 2100) at each K-station to find the appropriate anchor positions. After identifying tectonic trends, depositional and eroding topography, several 100 m areas with approximately 100 m radius in relatively flat depositional basins were chosen and they were surveyed with an acoustic altimeter at 1-m resolution to find default location for repeating deployment of PS-moorings.

- Lead by John Kemp, WHOI Rigging Laboratory, the WHOI-MIO Joint Team successfully deployed all 9-precision moorings (6 of them were PS-moorings) within these 100 m circles all of which were >5,200 m deep assuring the moorings' apex depth at approximately 30 m fro PS-moorings and 50 m for non-PS MMP moorings. The minimum error was 4-m and maximum was 60 m from the virtual targets (the center of a virtual circle at the bottom).

- This incredibly successful mooring deployment was essentially supported by R/V Mirai's super-precision navigation procedure that was founded and competed by Dr. Masaharu

Akamine, Master of R/V Mirai.

- We found that despite demanding sea-conditions, particularly in the northern area of the Subarctic Front, sensitive oceanographic work including the turn-around of 30-5,000 m PS-moorings, could be executed during the deep autumn/early winter of the NW Pacific, from the R/V Mirai. However, an October-November cruise takes far more ship time to do the same amount of work than does that of a September cruise according to our experiences during the 2001 and 2002 cruises.

- The pre-stretched (PS) moorings, (developed/designed by WHOI Rigging Laboratory and co-produced with MIO Rigging Group) worked as expected at >5,000 m water. The apex and the euphotic layer instrument packages were safely kept at 30 m below the surface for 13-months while the anchor was settled at over 5,200 m deep. Three deep-ocean PS-moorings were recovered in perfect shape. No obvious after-stretch, unusual wearing nor evidence of suffering unusual shocks was observed during the 2001-2002 deployment.

- High-resolution, (up to 3 days during expected bloom period to 4-weeks in winter), time-series instrumentation was deployed at each station from October, 2002 to September 2003. These 15 time-series instruments were synchronized:

  1. Optical oceanographic package (BLOOMS; UCSB, every 20 minutes)
  2. Autonomous time-series C-14 incubator for primary production (SID); 48-events
  3. Time-series phytoplankton/nanno-plankton sampler (WTS); 24-events
  4. Time-series water sampler for nutrient analysis (RAS); 48-events
  5. Time-series zooplankton sampler (ZPS); 50-events

- We recovered a BLOOMS, a SID, a WTS, a RAS and a ZPS from both 2001stations K-1 and K-2. They all worked as we expected in regards to the engineering aspects except the SIDs which failed totally. Although the data and sample quality must be further evaluated, we have gained a strong confidence that all euphotic time-series instruments should work during 2002-2003deployment and beyond. One of our objectives: The comparative evaluation with ADIOS-2 ocean environmental sensors (NASDA, Japan) shall be achieved as soon as that satellite is launched in early 2003.

- The in-situ C-14 incubators designed to access ocean productivity (SID) did not work due to their mechanical design failure. This problem was detected in a parallel deployment by WHOI using an identical SID. The newly deployed SIDs were all renovated and extensively tested at WHOI and MRL, N. Falmouth, and we are confident all design flaws have been eliminated.

- Sufficient particle samples were collected by underway filtration program (6-m) for N-15, Ra, Th and Pa isotope chemistry and biocomplexity investigation from Dutch Harbor to Mutsu via the Attu Passage, in the western Aleutian.

- Hydrographic profiling and water sampling including many surface-to-bottom-layer castings were completed as we planned. Special casting to assess trace and rare-earth elements from the water column were also successfully attempted as an ancillary program. The Dynacon heave-compensated winch was found to be essential to operating the hydro-casting under the higher sea conditions (within limits). SeaBird CTD system that was used during the MR05-K02 cruise involves software defects although unessential for our objective. They should be corrected immediately.

- Sufficient amounts of suspended particle samples were collected by *in situ* large volume filtration pump arrays covering near-surface to near-seabed for N-15 and other radio-biogeochemical research programs. The total volume of water that filtered during this cruise was approximately 60 tons of seawater.

- A total of 16 time-series sediment traps were deployed at 3-stations in synchronization. At all stations 3-sediment traps were deployed to cover the Bathypelagic layer: 1,000 to 300 m above the sea floor. At station K-2, 6-traps were added to cover the Mesopelagic layer from 150 to 800 m. operating only during the expected bloom period at 4-day intervals to avoid excessive swimmer zooplankton (MEX Program). Also a newly designed trap to investigate the export fluxes in the Mesopelagic layer, was deployed 50-m above the deepest trap (4,867 m) for inter-calibration with a conventional trap.

- Owing to a relatively simple software error, all 2001-2003 sediment traps (9) did not make the complete collection program and the samples were incomplete. The error was corrected on the16 traps that were deployed during this cruise. All of them should work.

- MIO plans a 2003 recovery and turnaround cruise in mid-September. Bottom sediment samplings including multi-core and piston core castings will be added to the default operation at K-stations.

MR02-K05 Leg2 Preliminary Cruise Report

Contents (pages)

1. Outline of MR02-K05 Leg.2

1.1Cruise summary of MR02-K05 Leg.2

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This cruise was mainly devoted to the biogeochemical study in the northwestern North Pacific conducted by Mutsu Institute for Oceanography (MIO) of JAMSTEC and Joint Pacific Research Center (J-PAC) of Woods Hole Oceanographic Institution (WHOI).

R/V Mirai left Dutch Harbor on 11 October. The northwestern North Pacific including the Bering Sea during autumn and winter are expressed as “the cemetery of the low pressures”, which means the low pressure takes place so often during these seasons. Soon after the departure, in the Bering Sea, Mirai was forced to make her speed down because of the high wave height and wind velocity (see section 3.1) and we already were delayed for the arrival time to station K1.

Station K1 (51N, 165E)

Recovery and Re-Deployment of PO and BGC mooring system

We succeeded to recovery time-series mooring systems for physical oceanography (PO mooring) and for biogeochemistry (BGC mooring) deployed in September 2001. On board, time-series samples taken during approximately one year were pre-treated and stored. After the replacement of new battery, filter and collecting cups, maintenance and the initialization of sampling schedule, these mooring systems were re-deployed at the same point precisely thanks to the exact work by ship crew and ship operation by captain Akamine.

Hydrocasts

We deployed water samplers (carousel multiple sampler with CTD sensor) 5 times. Water samples taken were or will be used for the following chemical analysis.

- the routine chemical analysis (Sal, DO, SiO_2,PO_4, NO_3, NO_2, NH_4, TDIC, TALK, Chl-*a*)
- trace / rare elements analysis
- Ba, Sr analisys
- N-15 analysis
- Th-234 analysis
- Th-230, Pa-231 analysis

In situ pumping

In order to collect suspended particles in the water column, large volume pumps (LVP) were lowered. 7 casts of LVP were conducted and 8 LVP were deployed at once for respective casts. Suspended particles were pre-treated on board and will be used for the following analysis.

- Ba, Sr analisys (see section 2.3)
- N-15 analysis (see section 2.4)
- POC, Th-234 analysis (see section 2.6)

・Th-230, Pa-231 analysis (see section 2.5)

Planlton netsampling

Twin-typeplankton net called “NORPAC” plankton net with 100 m mesh and 300 m mesh nets were deployed twice and zoo plankton in the upper 300 m water depth were collected. The plankton sample will be used for the identification of zooplankton species and N-15 measurement.

Although we were behind schedule, all observations we planned previously were successfully conducted at station K1.

Station K2 (47N, 160E)

We were in trouble for the bad weather at station K2. We could not but leave station K2 for the northward to avoid the storm for one day and half. One hydrocast for Ba, Sr and N-15 analysis, plankton net sampling and 5 casts of LVP could not but be cancelled. However the recovery of BGC mooring system and deployments of PO mooring and BGC mooring systems were conducted successfully. This BGC mooring system has 10 time-series sediment traps installed between 150 m and 5000 m in order to study the export flux in the mesopelagic layer or “twilight zone (see section 2.2.8). This unique and challenging mooring system should become a great step to “twilight zone”.

Station K2.5 (43N, 160E)

At the middle point between station K2 and K3, several hydrocasts and LVP casts were conducted. Nutrients and trace / rare elements analysis were or will be conducted. These samples will also be used for Th-230 and Pa-231 analysis to study the water structure such as the North Pacific Intermediate Water (NPIW). We could complete all observations fortunately.

Station K3 (39N, 160E)

This station is a new time-series station for our study and located in the boundary zone between sub-arctic gyre and sub-tropical gyre. SST increased to 20 degree centigrade and salinity in the upper layer was higher than 34 PSU in contrast to those at the northern stations (SST: ~ 5 °C, Sal: ~ 32.5 at station K1). In order to characterize the biogeochemistry in the northwestern North Pacific, this station is important as comparison area. However the weather was the worst during this cruise. We should wait the good day for observation for approximately three days. At this point, we unfortunately decided to give up the station KNOT’s visit, which is Japanese biogeochemical time-series station in the northwestern North Pacific.

After all, sea condition had never become calm. Even under the bad condition with wave height of > 4 m and wind speed of > 10 m/sec, we conducted 5 hydrocasts. Most of LVP casts were suspended because ship pitching motion was too large to attach LVP on wire rope.

There was one day only for the deployment of PO and BGC mooring systems. This was usually “mission impossible”. However, thanks to big efforts by captain Akamine, ship crew and WHOI-MIO mooring team, we could succeed to deploy both mooring systems on one day. Long waiting, inversely, enabled us to conduct the survey of sea floor topography and draw the precise sea floor map at this new station.

We were really toyed by the natural power during cruise. However, from the view point of time-series observation or mooring works, this cruise was 100 % successful. On the other hand, cruise participants whose hydrocasts and LVP casts were cancelled must be frustrated. But this is the oceanography and this is the northwestern North Pacific ! We hope we will be back to this area during autumn and winter and be able to conduct observation as we needs.

Table 1.1.1 Time schedule (station K1)

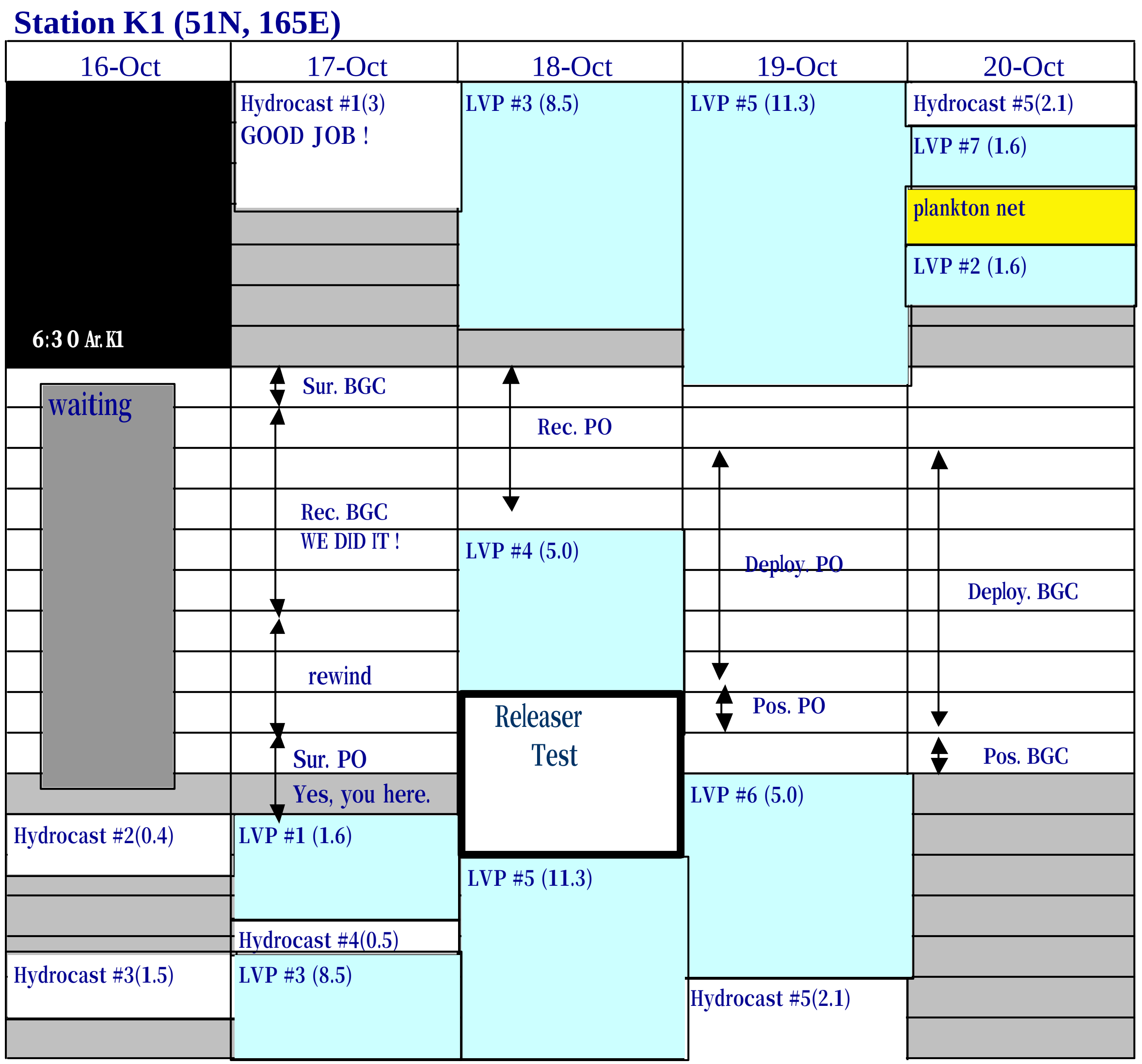


Table 1.1.1 Time schedule (station K2)

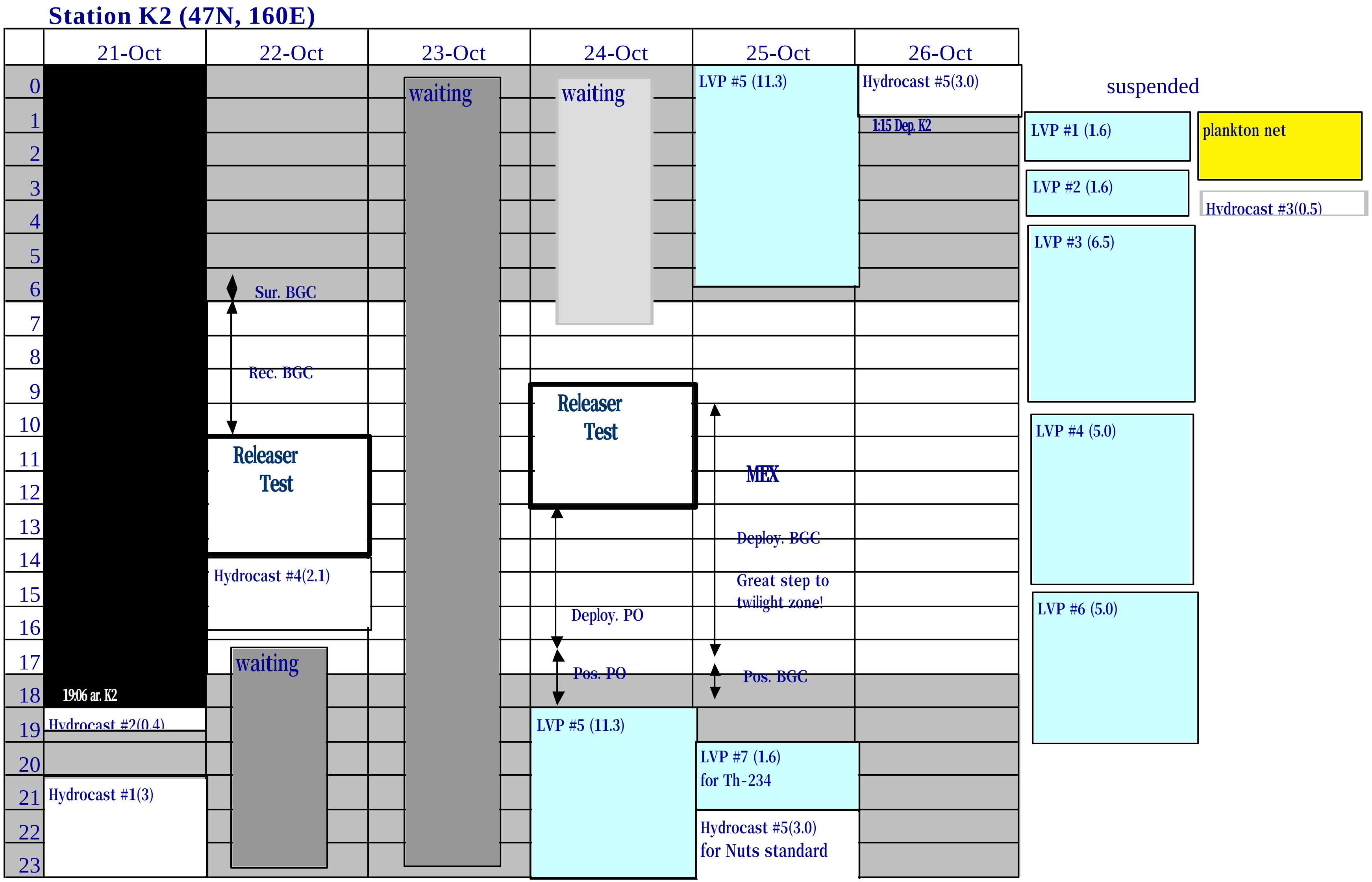


Table 1.1.1 Time schedule (station K2.5)

station K2.5 (43N, 160E)

	26-Oct	27-Oct
0		Hydrocast #2(1.5)
1		
2		
3		LVP #2 (11.3)
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		Hydrocast #3(3)
15	15:30 ar. K2.5	
16	Hydrocast #1(3)	
17		17:00 Dep. K2.5
18		
19	LVP #1 (5.0)	
20		
21		
22		
23		

Table 1.1.1 Time schedule (station K3)

station K3 (39N,160E)

	28-Oct	29-Oct	30-Oct	31-Oct	1-Nov	2-Nov
0			wait ing	wait ing	wait ing	Hydrocast #3(3.0)
1						
2						Pos. BGC
3		SeaBeam				
4						
5						LVP #7 (2.6) Th-234
6		Hydrocast #5(5.0) (Altimeter)				
7						7:00 lv. K3
8						Time limit at K3
9			SeaBeam	SeaBeam	Deploy. PO	
10					Time limit for Hydro at KNOT	
11		LVP #1 (1.6)				
12		Hydrocast #4(0.5)			Pos. PO	
13						
14		LVP #2 (1.6)				
15						
16						
17					Deploy. BGC	
18	18:30 ar. K3					
19	Hydrocast #2(0.4)	SeaBeam				
20	Hydrocast #1(3) Temp. for Sea Beam					
21					Pos. BGC	
22						
23					Hydrocast #3(3.0)	

Time limit for drug at KNOT

suspended

LVP #5 (11.3)

plankton net

LVP #3 (6.5)

LVP #4 (5.0)

LVP #6 (5.0)

We overcame "mission impossible" !

Table 1.1.2 List of Hydrocasts (station K1)

Station K1 (51N, 165E)

Hydrocast 1 — ship time (hr): 2.98

Routine and Trace metal

		Depth (m)	for	Note
1	*	500	trace metal (Ezoe)	remains is used for filteration (WHOI)
2	*	750	trace metal (Ezoe)	remains is used for filteration (WHOI)
3	*	1000	trace metal (Ezoe)	remains is used for filteration (WHOI)
4	*	1500	trace metal (Ezoe)	remains is used for filteration (WHOI)
5	*	2000	trace metal (Ezoe)	remains is used for filteration (WHOI)
6	*	2500	trace metal (Ezoe)	remains is used for filteration (WHOI)
7	*	3000	trace metal (Ezoe)	remains is used for filteration (WHOI)
8	*	3500	trace metal (Ezoe)	remains is used for filteration (WHOI)
9	*	4000	trace metal (Ezoe)	remains is used for filteration (WHOI)
10	*	4500	trace metal (Ezoe)	remains is used for filteration (WHOI)
11	*	5000	trace metal (Ezoe)	remains is used for filteration (WHOI)
12	*	bottom	trace metal (Ezoe)	remains is used for filteration (WHOI)
13		10	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
14		30	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
15		50	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
16		75	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
17		100	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
18		125	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
19		150	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
20		200	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
21		250	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
22		300	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
23		400	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
24		500	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
25		600	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
26		800	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
27		1000	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
28		1500	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
29		2000	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
30		2500	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
31		3000	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
32		3500	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
33		4000	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
34		4500	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
35		5000	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI
36		bottom	routine (MWJ)	includes 620ml for NO3 and Ba, Sr (WHOI

* Niskin-X

from routine bottle, the following components are measured
Sal, DO, PO4, NO2+NO3, SiO4, TCO2, TALK, chl-a (shallow)

Hydrocast 2 — ship time (hr): 0.37

Trace metal and 234Th

		Depth (m)	for	Note
1	*	5	trace metal (Ezoe)	fil(WHOI)
2	*	10	trace metal (Ezoe)	fil(WHOI)
3	*	25	trace metal (Ezoe)	fil(WHOI)
4	*	50	trace metal (Ezoe)	fil(WHOI)
5	*	75	trace metal (Ezoe)	fil(WHOI)
6	*	100	trace metal (Ezoe)	fil(WHOI)
7	*	125	trace metal (Ezoe)	fil(WHOI)
8	*	150	trace metal (Ezoe)	fil(WHOI)
9	*	175	trace metal (Ezoe)	fil(WHOI)
10	*	200	trace metal (Ezoe)	fil(WHOI)
11	*	250	trace metal (Ezoe)	fil(WHOI)
12	*	300	trace metal (Ezoe)	fil(WHOI)
13		10	234Th (Kawakami)	300nl (WH
14		10	234Th (Kawakami)	300nl (WH
15		10	234Th (Kawakami)	300nl (WH
16		20	234Th (Kawakami)	300nl (WH
17		20	234Th (Kawakami)	300nl (WH
18		20	234Th (Kawakami)	300nl (WH
19		40	234Th (Kawakami)	300nl (WH
20		40	234Th (Kawakami)	300nl (WH
21		40	234Th (Kawakami)	300nl (WH
22		60	234Th (Kawakami)	300nl (WH
23		60	234Th (Kawakami)	300nl (WH
24		60	234Th (Kawakami)	300nl (WH
25		80	234Th (Kawakami)	300nl (WH
26		80	234Th (Kawakami)	300nl (WH
27		80	234Th (Kawakami)	300nl (WH
28		100	234Th (Kawakami)	300nl (WH
29		100	234Th (Kawakami)	300nl (WH
30		100	234Th (Kawakami)	300nl (WH
31		150	234Th (Kawakami)	300nl (WH
32		150	234Th (Kawakami)	300nl (WH
33		150	234Th (Kawakami)	300nl (WH
34		200	234Th (Kawakami)	300nl (WH
35		200	234Th (Kawakami)	300nl (WH
36		200	234Th (Kawakami)	300nl (WH

* Niskin-X

Hydrocast 3 — ship time (hr): 1.31

Sediment trap and N-15

		Depth (m)	for	Note
1	*	225	N15 (WHOI)	
2	*	275	N15 (WHOI)	
3	*	350	N15 (WHOI)	
4	*	450	N15 (WHOI)	
5	*	550	N15 (WHOI)	
6	*	700	N15 (WHOI)	
7	*	900	N15 (WHOI)	
8	*	1250	N15 (WHOI)	
9	*	1000	N15 (WHOI)	
10	*	1000	N15 (WHOI)	
11	*	1000	N15 (WHOI)	
12	*	1000	N15 (WHOI)	
13		1000	N15 (WHOI)	
14		1000	N15 (WHOI)	
15		1000	N15 (WHOI)	
16		1000	N15 (WHOI)	
17		2000	Sediment Trap (Kaz)	
18		2000	Sediment Trap (Kaz)	
19		2000	Sediment Trap (Kaz)	
20		2000	Sediment Trap (Kaz)	
21		2000	Sediment Trap (Kaz)	
22		2000	Sediment Trap (Kaz)	
23		2000	Sediment Trap (Kaz)	
24		2000	Sediment Trap (Kaz)	
25		2000	Sediment Trap (Kaz)	
26		2000	Sediment Trap (Kaz)	
27		2000	Sediment Trap (Kaz)	
28		2000	Sediment Trap (Kaz)	
29		2000	Sediment Trap (Kaz)	
30		2000	Sediment Trap (Kaz)	
31		2000	Sediment Trap (Kaz)	
32		2000	Sediment Trap (Kaz)	
33		2000	Sediment Trap (Kaz)	
34		2000	Sediment Trap (Kaz)	
35		2000	Sediment Trap (Kaz)	
36		2000	Sediment Trap (Kaz)	

* Niskin-X

Trap water collected here will be used for all trap water.

Hydrocast 4 — ship time (hr): 0.48

PO15N, Ra, Ba and Sr

		Depth (m)	for	Note
1	*	30	PO15N, Ra, Ba, Sr (WHOI)	
2	*	30	PO15N, Ra, Ba, Sr (WHOI)	
3	*	30	PO15N, Ra, Ba, Sr (WHOI)	
4	*	30	PO15N, Ra, Ba, Sr (WHOI)	
5	*	30	PO15N, Ra, Ba, Sr (WHOI)	
6	*	30	PO15N, Ra, Ba, Sr (WHOI)	
7	*	80	PO15N, Ra, Ba, Sr (WHOI)	
8	*	80	PO15N, Ra, Ba, Sr (WHOI)	
9	*	80	PO15N, Ra, Ba, Sr (WHOI)	
10	*	80	PO15N, Ra, Ba, Sr (WHOI)	
11	*	80	PO15N, Ra, Ba, Sr (WHOI)	
12	*	80	PO15N, Ra, Ba, Sr (WHOI)	
13		80	PO15N, Ra, Ba, Sr (WHOI)	
14		120	PO15N, Ra, Ba, Sr (WHOI)	
15		120	PO15N, Ra, Ba, Sr (WHOI)	
16		120	PO15N, Ra, Ba, Sr (WHOI)	
17		120	PO15N, Ra, Ba, Sr (WHOI)	
18		120	PO15N, Ra, Ba, Sr (WHOI)	
19		120	PO15N, Ra, Ba, Sr (WHOI)	
20		120	PO15N, Ra, Ba, Sr (WHOI)	
21		230	PO15N, Ra, Ba, Sr (WHOI)	
22		230	PO15N, Ra, Ba, Sr (WHOI)	
23		230	PO15N, Ra, Ba, Sr (WHOI)	
24		230	PO15N, Ra, Ba, Sr (WHOI)	
25		230	PO15N, Ra, Ba, Sr (WHOI)	
26		230	PO15N, Ra, Ba, Sr (WHOI)	
27		230	PO15N, Ra, Ba, Sr (WHOI)	
28		230	PO15N, Ra, Ba, Sr (WHOI)	
29		500	PO15N, Ra, Ba, Sr (WHOI)	
30		500	PO15N, Ra, Ba, Sr (WHOI)	
31		500	PO15N, Ra, Ba, Sr (WHOI)	
32		500	PO15N, Ra, Ba, Sr (WHOI)	
33		500	PO15N, Ra, Ba, Sr (WHOI)	
34		500	PO15N, Ra, Ba, Sr (WHOI)	
35		500	PO15N, Ra, Ba, Sr (WHOI)	
36		500	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Hydrocast 5 — ship time (hr): 3.05

PO15N, Ra, Ba and Sr

		Depth (m)	for	Note
1	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
2	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
3	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
4	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
5	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
6	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
7	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
8	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
9	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
10	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
11	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
12	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
13		3500	PO15N, Ra, Ba, Sr (WHOI)	
14		3500	PO15N, Ra, Ba, Sr (WHOI)	
15		3500	PO15N, Ra, Ba, Sr (WHOI)	
16		3500	PO15N, Ra, Ba, Sr (WHOI)	
17		3500	PO15N, Ra, Ba, Sr (WHOI)	
18		3500	PO15N, Ra, Ba, Sr (WHOI)	
19		4800	PO15N, Ra, Ba, Sr (WHOI)	
20		4800	PO15N, Ra, Ba, Sr (WHOI)	
21		4800	PO15N, Ra, Ba, Sr (WHOI)	
22		4800	PO15N, Ra, Ba, Sr (WHOI)	
23		4800	PO15N, Ra, Ba, Sr (WHOI)	
24		4800	PO15N, Ra, Ba, Sr (WHOI)	
25		4800	PO15N, Ra, Ba, Sr (WHOI)	
26		4800	PO15N, Ra, Ba, Sr (WHOI)	
27		4800	PO15N, Ra, Ba, Sr (WHOI)	
28		4800	PO15N, Ra, Ba, Sr (WHOI)	
29		5126	PO15N, Ra, Ba, Sr (WHOI)	
30		5126	PO15N, Ra, Ba, Sr (WHOI)	
31		5126	PO15N, Ra, Ba, Sr (WHOI)	
32		5126	PO15N, Ra, Ba, Sr (WHOI)	
33		5126	PO15N, Ra, Ba, Sr (WHOI)	
34		5126	PO15N, Ra, Ba, Sr (WHOI)	
35		5126	PO15N, Ra, Ba, Sr (WHOI)	
36		5126	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Table 1.1.2 List of Hydrocasts (station K2)

Station K2 (47N, 160E)

Hydrocast 1 ship time (hr): 2.98

Routine and Trace metal

		Depth (m)	for	Note
1	*	500	trace metal (Ezoe)	remains is used for filteration (WHOI)
2	*	750	trace metal (Ezoe)	remains is used for filteration (WHOI)
3	*	1000	trace metal (Ezoe)	remains is used for filteration (WHOI)
4	*	1500	trace metal (Ezoe)	remains is used for filteration (WHOI)
5	*	2000	trace metal (Ezoe)	remains is used for filteration (WHOI)
6	*	2500	trace metal (Ezoe)	remains is used for filteration (WHOI)
7	*	3000	trace metal (Ezoe)	remains is used for filteration (WHOI)
8	*	3500	trace metal (Ezoe)	remains is used for filteration (WHOI)
9	*	4000	trace metal (Ezoe)	remains is used for filteration (WHOI)
10	*	4500	trace metal (Ezoe)	remains is used for filteration (WHOI)
11	*	5000	trace metal (Ezoe)	remains is used for filteration (WHOI)
12	*	bottom	trace metal (Ezoe)	remains is used for filteration (WHOI)
13		10	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
14		30	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
15		50	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
16		75	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
17		100	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
18		125	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
19		150	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
20		200	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
21		250	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
22		300	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
23		400	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
24		500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
25		600	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
26		800	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
27		1000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
28		1500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
29		2000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
30		2500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
31		3000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
32		3500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
33		4000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
34		4500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
35		5000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
36		bottom	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)

* Niskin-X

from routine bottle, the following components are measured
Sal, DO, PO4, NO2+NO3, SiO4, TCO2, TALK, chl-a (shallow)

Hydrocast 2 ship time (hr): 0.37

Trace metal and 234Th

		Depth (m)	for	Note
1	*	5	trace metal (Ezoe)	WHOI
2	*	10	trace metal (Ezoe)	WHOI
3	*	25	trace metal (Ezoe)	WHOI
4	*	50	trace metal (Ezoe)	WHOI
5	*	75	trace metal (Ezoe)	WHOI
6	*	100	trace metal (Ezoe)	WHOI
7	*	125	trace metal (Ezoe)	WHOI
8	*	150	trace metal (Ezoe)	WHOI
9	*	175	trace metal (Ezoe)	WHOI
10	*	200	trace metal (Ezoe)	WHOI
11	*	250	trace metal (Ezoe)	WHOI
12	*	300	trace metal (Ezoe)	WHOI
13		10	234Th (Kawakami)	
14		10	234Th (Kawakami)	
15		10	234Th (Kawakami)	
16		20	234Th (Kawakami)	
17		20	234Th (Kawakami)	
18		20	234Th (Kawakami)	
19		40	234Th (Kawakami)	
20		40	234Th (Kawakami)	
21		40	234Th (Kawakami)	
22		60	234Th (Kawakami)	
23		60	234Th (Kawakami)	
24		60	234Th (Kawakami)	
25		80	234Th (Kawakami)	
26		80	234Th (Kawakami)	
27		80	234Th (Kawakami)	
28		100	234Th (Kawakami)	
29		100	234Th (Kawakami)	
30		100	234Th (Kawakami)	
31		150	234Th (Kawakami)	
32		150	234Th (Kawakami)	
33		150	234Th (Kawakami)	
34		200	234Th (Kawakami)	
35		200	234Th (Kawakami)	
36		200	234Th (Kawakami)	

* Niskin-X

Hydrocast 3 ship time (hr): 0.53

PO15N, Ra, Ba and Sr

Suspended

		Depth (m)	for	Note
1	*	40	PO15N, Ra, Ba, Sr (WHOI)	
2	*	40	PO15N, Ra, Ba, Sr (WHOI)	
3	*	40	PO15N, Ra, Ba, Sr (WHOI)	
4	*	40	PO15N, Ra, Ba, Sr (WHOI)	
5	*	40	PO15N, Ra, Ba, Sr (WHOI)	
6	*	40	PO15N, Ra, Ba, Sr (WHOI)	
7	*	100	PO15N, Ra, Ba, Sr (WHOI)	
8	*	100	PO15N, Ra, Ba, Sr (WHOI)	
9	*	100	PO15N, Ra, Ba, Sr (WHOI)	
10	*	100	PO15N, Ra, Ba, Sr (WHOI)	
11	*	100	PO15N, Ra, Ba, Sr (WHOI)	
12	*	100	PO15N, Ra, Ba, Sr (WHOI)	
13		100	PO15N, Ra, Ba, Sr (WHOI)	
14		250	PO15N, Ra, Ba, Sr (WHOI)	
15		250	PO15N, Ra, Ba, Sr (WHOI)	
16		250	PO15N, Ra, Ba, Sr (WHOI)	
17		250	PO15N, Ra, Ba, Sr (WHOI)	
18		250	PO15N, Ra, Ba, Sr (WHOI)	
19		250	PO15N, Ra, Ba, Sr (WHOI)	
20		250	PO15N, Ra, Ba, Sr (WHOI)	
21		450	PO15N, Ra, Ba, Sr (WHOI)	
22		450	PO15N, Ra, Ba, Sr (WHOI)	
23		450	PO15N, Ra, Ba, Sr (WHOI)	
24		450	PO15N, Ra, Ba, Sr (WHOI)	
25		450	PO15N, Ra, Ba, Sr (WHOI)	
26		450	PO15N, Ra, Ba, Sr (WHOI)	
27		450	PO15N, Ra, Ba, Sr (WHOI)	
28		450	PO15N, Ra, Ba, Sr (WHOI)	
29		600	PO15N, Ra, Ba, Sr (WHOI)	
30		600	PO15N, Ra, Ba, Sr (WHOI)	
31		600	PO15N, Ra, Ba, Sr (WHOI)	
32		600	PO15N, Ra, Ba, Sr (WHOI)	
33		600	PO15N, Ra, Ba, Sr (WHOI)	
34		600	PO15N, Ra, Ba, Sr (WHOI)	
35		600	PO15N, Ra, Ba, Sr (WHOI)	
36		600	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Hydrocast 4 ship time (hr): 2.87

PO15N, Ra, Ba and Sr

		Depth (m)	for	Note
1	*	110	PO15N, Ra, Ba, Sr (WHOI)	
2	*	110	PO15N, Ra, Ba, Sr (WHOI)	
3	*	110	PO15N, Ra, Ba, Sr (WHOI)	
4	*	110	PO15N, Ra, Ba, Sr (WHOI)	
5	*	110	PO15N, Ra, Ba, Sr (WHOI)	
6	*	110	PO15N, Ra, Ba, Sr (WHOI)	
7	*	110	PO15N, Ra, Ba, Sr (WHOI)	
8	*	250	PO15N, Ra, Ba, Sr (WHOI)	
9	*	250	PO15N, Ra, Ba, Sr (WHOI)	
10	*	250	PO15N, Ra, Ba, Sr (WHOI)	
11	*	250	PO15N, Ra, Ba, Sr (WHOI)	
12	*	250	PO15N, Ra, Ba, Sr (WHOI)	
13		250	PO15N, Ra, Ba, Sr (WHOI)	
14		250	PO15N, Ra, Ba, Sr (WHOI)	
15		3000	PO15N, Ra, Ba, Sr (WHOI)	
16		3000	PO15N, Ra, Ba, Sr (WHOI)	
17		3000	PO15N, Ra, Ba, Sr (WHOI)	
18		3000	PO15N, Ra, Ba, Sr (WHOI)	
19		3000	PO15N, Ra, Ba, Sr (WHOI)	
20		3000	PO15N, Ra, Ba, Sr (WHOI)	
21		3000	PO15N, Ra, Ba, Sr (WHOI)	
22		4800	PO15N, Ra, Ba, Sr (WHOI)	
23		4800	PO15N, Ra, Ba, Sr (WHOI)	
24		4800	PO15N, Ra, Ba, Sr (WHOI)	
25		4800	PO15N, Ra, Ba, Sr (WHOI)	
26		4800	PO15N, Ra, Ba, Sr (WHOI)	
27		4800	PO15N, Ra, Ba, Sr (WHOI)	
28		4800	PO15N, Ra, Ba, Sr (WHOI)	
29		4800	PO15N, Ra, Ba, Sr (WHOI)	
30		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
31		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
32		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
33		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
34		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
35		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
36		Bottom	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Hydrocast 5 ship time (hr): 2.98

For Nutrient standard

		Depth (m)	for	Note
1	*	2000	Nutrient standard	MWJ
2	*	2000	Nutrient standard	MWJ
3	*	2000	Nutrient standard	MWJ
4	*	2000	Nutrient standard	MWJ
5	*	2000	Nutrient standard	MWJ
6	*	2000	Nutrient standard	MWJ
7	*	2000	Nutrient standard	MWJ
8	*	2000	Nutrient standard	MWJ
9	*	2000	Nutrient standard	MWJ
10	*	2000	Nutrient standard	MWJ
11	*	2000	Nutrient standard	MWJ
12	*	2000	Nutrient standard	MWJ
13		2000	Nutrient standard	MWJ
14		2000	Nutrient standard	MWJ
15		2000	Nutrient standard	MWJ
16		2000	Nutrient standard	MWJ
17		2000	Nutrient standard	MWJ
18		2000	Nutrient standard	MWJ
19		2000	Nutrient standard	MWJ
20		2000	Nutrient standard	MWJ
21		2000	Nutrient standard	MWJ
22		2000	Nutrient standard	MWJ
23		2000	Nutrient standard	MWJ
24		2000	Nutrient standard	MWJ
25		5000	Nutrint standard	MWJ
26		5000	Nutrint standard	MWJ
27		5000	Nutrint standard	MWJ
28		5000	Nutrint standard	MWJ
29		5000	Nutrint standard	MWJ
30		5000	Nutrint standard	MWJ
31		5000	Nutrint standard	MWJ
32		5000	Nutrint standard	MWJ
33		5000	Nutrint standard	MWJ
34		5000	Nutrint standard	MWJ
35		5000	Nutrint standard	MWJ
36		5000	Nutrint standard	MWJ

* Niskin-X

Table 1.1.2 List of Hydrocasts (station K2.5)

Station K2.5 (43.5N, 160E)

Hydrocast 1 ship time (hr): 2.98

Routine and Trace metal

		Depth (m)	for	Note
1	*	500	trace metal (Ezoe)	remains is used for filteration (WHOI)
2	*	750	trace metal (Ezoe)	remains is used for filteration (WHOI)
3	*	1000	trace metal (Ezoe)	remains is used for filteration (WHOI)
4	*	1500	trace metal (Ezoe)	remains is used for filteration (WHOI)
5	*	2000	trace metal (Ezoe)	remains is used for filteration (WHOI)
6	*	2500	trace metal (Ezoe)	remains is used for filteration (WHOI)
7	*	3000	trace metal (Ezoe)	remains is used for filteration (WHOI)
8	*	3500	trace metal (Ezoe)	remains is used for filteration (WHOI)
9	*	4000	trace metal (Ezoe)	remains is used for filteration (WHOI)
10	*	4500	trace metal (Ezoe)	remains is used for filteration (WHOI)
11	*	5000	trace metal (Ezoe)	remains is used for filteration (WHOI)
12	*	bottom	trace metal (Ezoe)	remains is used for filteration (WHOI)
13		10	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
14		30	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
15		50	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
16		75	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
17		100	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
18		125	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
19		150	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
20		200	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
21		250	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
22		300	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
23		400	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
24		500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
25		600	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
26		800	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
27		1000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
28		1500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
29		2000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
30		2500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
31		3000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
32		3500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
33		4000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
34		4500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
35		5000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
36		bottom	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)

* Niskin-X

from routine bottle, the following components are measured

Sal, DO, PO4, NO2+NO3, SiO4, TCO2, TALK, chl-a (shallow)

Hydrocast 2 ship time (hr): 1.31

Trace metal

		Depth (m)	for	Note
1	*	5	trace metal (Ezoe)	fil.(WHOI)
2	*	10	trace metal (Ezoe)	fil.(WHOI)
3	*	25	trace metal (Ezoe)	fil.(WHOI)
4	*	50	trace metal (Ezoe)	fil.(WHOI)
5	*	75	trace metal (Ezoe)	fil.(WHOI)
6	*	100	trace metal (Ezoe)	fil.(WHOI)
7	*	125	trace metal (Ezoe)	fil.(WHOI)
8	*	150	trace metal (Ezoe)	fil.(WHOI)
9	*	175	trace metal (Ezoe)	fil.(WHOI)
10	*	200	trace metal (Ezoe)	fil.(WHOI)
11	*	250	trace metal (Ezoe)	fil.(WHOI)
12	*	300	trace metal (Ezoe)	fil.(WHOI)
13		20	N15 (WHOI)	
14		40	N15 (WHOI)	
15		60	N15 (WHOI)	
16		175	N15 (WHOI)	
17		225	N15 (WHOI)	
18		275	N15 (WHOI)	
19		2000	Th-234 (Kawakami)	
20		2000	Th-234 (Kawakami)	
21		2000	Th-234 (Kawakami)	
22		2000	Th-234 (Kawakami)	
23		2000	Th-234 (Kawakami)	
24		2000	Th-234 (Kawakami)	
25		2000	Sediment trap (Mak)	
26		2000	Sediment trap (Mak)	
27		2000	Sediment trap (Mak)	
28		2000	Sediment trap (Mak)	
29		2000	Sediment trap (Mak)	
30		2000	Sediment trap (Mak)	
31		2000	Sediment trap (Mak)	
32		2000	Sediment trap (Mak)	
33		2000	Sediment trap (Mak)	
34		2000	Sediment trap (Mak)	
35		2000	Sediment trap (Mak)	
36		2000	Sediment trap (Mak)	

* Niskin-X

Hydrocast 3 ship time (hr): 2.98

230Th and 231F

		Depth (m)	for	Note
1	*	50	230Th, 231Pa (Kaz)	
2	*	50	230Th, 231Pa (Kaz)	
3	*	100	230Th, 231Pa (Kaz)	
4	*	100	230Th, 231Pa (Kaz)	
5	*	200	230Th, 231Pa (Kaz)	
6	*	200	230Th, 231Pa (Kaz)	
7	*	300	230Th, 231Pa (Kaz)	
8	*	300	230Th, 231Pa (Kaz)	
9	*	400	230Th, 231Pa (Kaz)	
10	*	400	230Th, 231Pa (Kaz)	
11	*	500	230Th, 231Pa (Kaz)	
12	*	500	230Th, 231Pa (Kaz)	
13		700	230Th, 231Pa (Kaz)	
14		700	230Th, 231Pa (Kaz)	
15		1000	230Th, 231Pa (Kaz)	
16		1000	230Th, 231Pa (Kaz)	
17		1500	230Th, 231Pa (Kaz)	
18		1500	230Th, 231Pa (Kaz)	
19		2000	230Th, 231Pa (Kaz)	
20		2000	230Th, 231Pa (Kaz)	
21		3000	230Th, 231Pa (Kaz)	
22		3000	230Th, 231Pa (Kaz)	
23		3500	230Th, 231Pa (Kaz)	
24		3500	230Th, 231Pa (Kaz)	
25		4000	230Th, 231Pa (Kaz)	
26		4000	230Th, 231Pa (Kaz)	
27		4500	230Th, 231Pa (Kaz)	
28		4500	230Th, 231Pa (Kaz)	
29		5000	230Th, 231Pa (Kaz)	
30		5000	230Th, 231Pa (Kaz)	
31		bottom	230Th, 231Pa (Kaz)	
32		bottom	230Th, 231Pa (Kaz)	
33			DO (MWJ)	
34			DO (MWJ)	
35			DO (MWJ)	
36			DO (MWJ)	

* Niskin-X

Table 1.1.2 List of Hydrocasts (station K3)

Station K3 (39N, 160E)

Hydrocast 1 — ship time (hr): 2.98

Routine and Trace metal

		Depth (m)	for	Note
1	*	500	trace metal (Ezoe)	remains is used for filteration (WHOI)
2	*	750	trace metal (Ezoe)	remains is used for filteration (WHOI)
3	*	1000	trace metal (Ezoe)	remains is used for filteration (WHOI)
4	*	1500	trace metal (Ezoe)	remains is used for filteration (WHOI)
5	*	2000	trace metal (Ezoe)	remains is used for filteration (WHOI)
6	*	2500	trace metal (Ezoe)	remains is used for filteration (WHOI)
7	*	3000	trace metal (Ezoe)	remains is used for filteration (WHOI)
8	*	3500	trace metal (Ezoe)	remains is used for filteration (WHOI)
9	*	4000	trace metal (Ezoe)	remains is used for filteration (WHOI)
10	*	4500	trace metal (Ezoe)	remains is used for filteration (WHOI)
11	*	5000	trace metal (Ezoe)	remains is used for filteration (WHOI)
12	*	bottom	trace metal (Ezoe)	remains is used for filteration (WHOI)
13		10	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
14		30	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
15		50	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
16		75	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
17		100	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
18		125	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
19		150	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
20		200	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
21		250	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
22		300	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
23		400	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
24		500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
25		600	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
26		800	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
27		1000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
28		1500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
29		2000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
30		2500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
31		3000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
32		3500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
33		4000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
34		4500	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
35		5000	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)
36		bottom	routine (MWJ)	620ml for NO3 and Ba, Sr (WHOI)

* Niskin-X

from routine bottle, the following components are measured

Sal, DO, PO4, NO2+NO3, SiO4, TCO2, TALK, chl-a (shallow)

Hydrocast 2 — ship time (hr): 0.37

Trace metal and 234Th

		Depth (m)	for	Note
1	*	5	trace metal (Ezoe)	fil
2	*	10	trace metal (Ezoe)	fil
3	*	25	trace metal (Ezoe)	fil
4	*	50	trace metal (Ezoe)	fil
5	*	75	trace metal (Ezoe)	fil
6	*	100	trace metal (Ezoe)	fil
7	*	125	trace metal (Ezoe)	fil
8	*	150	trace metal (Ezoe)	fil
9	*	175	trace metal (Ezoe)	fil
10	*	200	trace metal (Ezoe)	fil
11	*	250	trace metal (Ezoe)	fil
12	*	300	trace metal (Ezoe)	fil
13		10	234Th (Kawakami)	
14		10	234Th (Kawakami)	
15		10	234Th (Kawakami)	
16		20	234Th (Kawakami)	
17		20	234Th (Kawakami)	
18		20	234Th (Kawakami)	
19		40	234Th (Kawakami)	
20		40	234Th (Kawakami)	
21		40	234Th (Kawakami)	
22		60	234Th (Kawakami)	
23		60	234Th (Kawakami)	
24		60	234Th (Kawakami)	
25		80	234Th (Kawakami)	
26		80	234Th (Kawakami)	
27		80	234Th (Kawakami)	
28		100	234Th (Kawakami)	
29		100	234Th (Kawakami)	
30		100	234Th (Kawakami)	
31		150	234Th (Kawakami)	
32		150	234Th (Kawakami)	
33		150	234Th (Kawakami)	
34		200	234Th (Kawakami)	
35		200	234Th (Kawakami)	
36		200	234Th (Kawakami)	

* Niskin-X

Hydrocast 3 — ship time (hr): 2.98

230Th and 231P

		Depth (m)	for	Note
1		50	230Th, 231Pa (Kaz)	
2		50	230Th, 231Pa (Kaz)	
3		100	230Th, 231Pa (Kaz)	
4		100	230Th, 231Pa (Kaz)	
5		200	230Th, 231Pa (Kaz)	
6		200	230Th, 231Pa (Kaz)	
7		300	230Th, 231Pa (Kaz)	
8		300	230Th, 231Pa (Kaz)	
9		400	230Th, 231Pa (Kaz)	
10		400	230Th, 231Pa (Kaz)	
11		500	230Th, 231Pa (Kaz)	
12		500	230Th, 231Pa (Kaz)	
13		700	230Th, 231Pa (Kaz)	
14		700	230Th, 231Pa (Kaz)	
15	*	1000	230Th, 231Pa (Kaz)	Ezoe
16		1000	230Th, 231Pa (Kaz)	
17		1500	230Th, 231Pa (Kaz)	
18		1500	230Th, 231Pa (Kaz)	
19		2000	230Th, 231Pa (Kaz)	
20		2000	230Th, 231Pa (Kaz)	
21		3000	230Th, 231Pa (Kaz)	
22		3000	230Th, 231Pa (Kaz)	
23		3500	230Th, 231Pa (Kaz)	
24		3500	230Th, 231Pa (Kaz)	
25		4000	230Th, 231Pa (Kaz)	
26		4000	230Th, 231Pa (Kaz)	
27		4500	230Th, 231Pa (Kaz)	
28		4500	230Th, 231Pa (Kaz)	
29		5000	230Th, 231Pa (Kaz)	
30		5000	230Th, 231Pa (Kaz)	
31		bottom	230Th, 231Pa (Kaz)	
32		bottom	230Th, 231Pa (Kaz)	
33		60	N15(WHOI)	
34	*	225	N15(WHOI)	Ezoe
35		350	N15(WHOI)	
36		450	N15(WHOI)	

* Niskin-X

Hydrocast 4 — ship time (hr): 0.64

PO15N, Ra, Ba and Sr

		Depth (m)	for	Note
1	*	40	PO15N, Ra, Ba, Sr (WHOI)	
2	*	40	PO15N, Ra, Ba, Sr (WHOI)	
3	*	40	PO15N, Ra, Ba, Sr (WHOI)	
4	*	40	PO15N, Ra, Ba, Sr (WHOI)	
5	*	40	PO15N, Ra, Ba, Sr (WHOI)	
6	*	40	PO15N, Ra, Ba, Sr (WHOI)	
7	*	110	PO15N, Ra, Ba, Sr (WHOI)	
8	*	110	PO15N, Ra, Ba, Sr (WHOI)	
9	*	110	PO15N, Ra, Ba, Sr (WHOI)	
10	*	110	PO15N, Ra, Ba, Sr (WHOI)	
11	*	110	PO15N, Ra, Ba, Sr (WHOI)	
12	*	110	PO15N, Ra, Ba, Sr (WHOI)	
13		110	PO15N, Ra, Ba, Sr (WHOI)	
14		250	PO15N, Ra, Ba, Sr (WHOI)	
15		250	PO15N, Ra, Ba, Sr (WHOI)	
16		250	PO15N, Ra, Ba, Sr (WHOI)	
17		250	PO15N, Ra, Ba, Sr (WHOI)	
18		250	PO15N, Ra, Ba, Sr (WHOI)	
19		250	PO15N, Ra, Ba, Sr (WHOI)	
20		250	PO15N, Ra, Ba, Sr (WHOI)	
21		400	PO15N, Ra, Ba, Sr (WHOI)	
22		400	PO15N, Ra, Ba, Sr (WHOI)	
23		400	PO15N, Ra, Ba, Sr (WHOI)	
24		400	PO15N, Ra, Ba, Sr (WHOI)	
25		400	PO15N, Ra, Ba, Sr (WHOI)	
26		400	PO15N, Ra, Ba, Sr (WHOI)	
27		400	PO15N, Ra, Ba, Sr (WHOI)	
28		400	PO15N, Ra, Ba, Sr (WHOI)	
29		800	PO15N, Ra, Ba, Sr (WHOI)	
30		800	PO15N, Ra, Ba, Sr (WHOI)	
31		800	PO15N, Ra, Ba, Sr (WHOI)	
32		800	PO15N, Ra, Ba, Sr (WHOI)	
33		800	PO15N, Ra, Ba, Sr (WHOI)	
34		800	PO15N, Ra, Ba, Sr (WHOI)	
35		800	PO15N, Ra, Ba, Sr (WHOI)	
36		800	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Hydrocast 5 — ship time (hr): 2.98

PO15N, Ra, Ba and Sr

		Depth (m)	for	Note
1	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
2	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
3	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
4	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
5	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
6	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
7	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
8	*	2000	PO15N, Ra, Ba, Sr (WHOI)	
9	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
10	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
11	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
12	*	3500	PO15N, Ra, Ba, Sr (WHOI)	
13		3500	PO15N, Ra, Ba, Sr (WHOI)	
14		3500	PO15N, Ra, Ba, Sr (WHOI)	
15		3500	PO15N, Ra, Ba, Sr (WHOI)	
16		3500	PO15N, Ra, Ba, Sr (WHOI)	
17		3500	PO15N, Ra, Ba, Sr (WHOI)	
18		3500	PO15N, Ra, Ba, Sr (WHOI)	
19		5000	PO15N, Ra, Ba, Sr (WHOI)	
20		5000	PO15N, Ra, Ba, Sr (WHOI)	
21		5000	PO15N, Ra, Ba, Sr (WHOI)	
22		5000	PO15N, Ra, Ba, Sr (WHOI)	
23		5000	PO15N, Ra, Ba, Sr (WHOI)	
24		5000	PO15N, Ra, Ba, Sr (WHOI)	
25		5000	PO15N, Ra, Ba, Sr (WHOI)	
26		5000	PO15N, Ra, Ba, Sr (WHOI)	
27		5000	PO15N, Ra, Ba, Sr (WHOI)	
28		5000	PO15N, Ra, Ba, Sr (WHOI)	
29		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
30		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
31		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
32		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
33		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
34		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
35		Bottom	PO15N, Ra, Ba, Sr (WHOI)	
36		Bottom	PO15N, Ra, Ba, Sr (WHOI)	

* Niskin-X

Table 1.1.3 List of LVP (station K1)

LARGE VOLUME PUMP

Station K1

Cast #. 1

ship time (hr): 1.56

For	PO15N (WHOI)
Filter	GF/F
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.

pumping time : 1hrs.

Cast #. 2

ship time (hr): 1.56

For	PO15N (WHOI)
Filter	polycarbonate (0.8mm)
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.

pumping time : 1hrs.

Cast #. 3

ship time (hr): 8.51

For	PO15N (WHOI)
Filter	GF/F & polycarb.
#	Depth (m)
1	500 (G)
2	500 (G)
3	510 (p)
4	510 (p)
5	1000 (G)
6	1000 (G)
7	1010 (p)
8	1010 (p)

Another possibe cast is as follows:

pumping time : 8hrs.

Cast #. 4

ship time (hr): 5.07

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	30
2	80
3	110
4	150
5	230
6	400
7	600
8	1000

pumping time : 4hrs.

Cast #. 5

ship time (hr): 11.29

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	no sample
2	2000
3	2000
4	3000
5	3500
6	4000
7	4500
8	5000

pumping time : 8hrs.

Cast #. 6 (as same as cast #5)

ship time (hr): 5.07

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	30
2	80
3	110
4	150
5	230
6	400
7	600
8	1000

pumping time : 4hrs.

Cast #. 7

ship time (hr): 1.62

For	234Th / POC (Kawakami)
Filter	GF/F
#	Depth (m)
1	10
2	20
3	40
4	60
5	80
6	100
7	150
8	200

pumping time : 1hrs.

Table 1.1.3 List of LVP (station K2)

LARGE VOLUME PUMP

Station K2

Cast #. 1
ship time (hr): 1.56

SUSPENDED

For	PO15N (WHOI)
Filter	GF/F
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.
pumping time : 1hrs.

Cast #. 2
ship time (hr): 1.56

SUSPENDED

For	PO15N (WHOI)
Filter	polycarbonate (0.8mm)
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.
pumping time : 1hrs.

Cast #. 3
ship time (hr): 6.51

SUSPENDED

For	PO15N (WHOI)
Filter	GF/F & polycarb.
#	Depth (m)
1	500 (G)
2	500 (G)
3	500 (p)
4	500 (p)
5	1000 (G)
6	1000 (G)
7	1000 (p)
8	1000 (p)

Another possibe cast is as follows:
pumping time : 6 hrs.

Cast #. 4
ship time (hr): 5.07

SUSPENDED

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	50
2	100
3	200
4	300
5	400
6	500
7	700
8	1000

pumping time : 4hrs.

Cast #. 5
ship time (hr): 11.29

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	150
2	250
3	400
4	600
5	800
6	1000
7	2000
8	5000

pumping time : 8hrs.

Cast #. 6 (as same as cast #5)
ship time (hr): 5.07

SUSPENDED

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	50
2	100
3	200
4	300
5	400
6	500
7	700
8	1000

pumping time : 4hrs.

Cast #. 7
ship time (hr): 1.62

For	234Th / POC (Kawakami)
Filter	GF/F
#	Depth (m)
1	10
2	20
3	40
4	60
5	80
6	100
7	150
8	200

pumping time : 1hrs.

Table 1.1.3 List of LVP (station K2.5)

LARGE VOLUME PUMP

Station K2.5

Cast #. 1

ship time (hr): 5.07

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	30
2	100
3	200
4	300
5	400
6	500
7	700
8	1000

pumping time : 4hrs.

Cast #. 2

ship time (hr): 11.40

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	1500
2	2000
3	3000
4	3500
5	4000
6	4500
7	5000
8	5200

pumping time : 8hrs.

Table 1.1.3 List of LVP (station K3)

LARGE VOLUME PUMP

Station K3

Cast #. 1

ship time (hr): 1.56

For	PO15N (WHOI)
Filter	GF/F
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.
pumping time : 1hrs.

Cast #. 2

ship time (hr): 1.56

For	PO15N (WHOI)
Filter	polycarbonate (0.8mm)
#	Depth (m)
1	10
2	10
3	30
4	30
5	50
6	50
7	75
8	75

Depths decided based on chl-a profile.
pumping time : 1hrs.

[redacted]

Cast #. 3

ship time (hr): 6.51

SUSPENDED

For	PO15N (WHOI)
Filter	GF/F & polycarb.
#	Depth (m)
1	500 (G)
2	500 (G)
3	500 (p)
4	500 (p)
5	1000 (G)
6	1000 (G)
7	1000 (p)
8	1000 (p)

Another possibe cast is as follows:
pumping time : 6hrs.

Cast #. 4

ship time (hr): 5.07

SUSPENDED

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	50
2	100
3	200
4	300
5	400
6	500
7	700
8	1000

pumping time : 4hrs.

Cast #. 5

ship time (hr): 11.46

SUSPENDED

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	1500
2	2000
3	3000
4	3500
5	4000
6	4500
7	5000
8	bottom

pumping time : 8hrs.

Cast #. 6 (as same as cast #5)

ship time (hr): 5.07

SUSPENDED

For	Ra SEM, opal, metal and Th/Pa (WHOI/Kaz)
Filter	Versipor
#	Depth (m)
1	50
2	100
3	200
4	300
5	400
6	500
7	700
8	1000

pumping time : 4hrs.

Cast #. 7

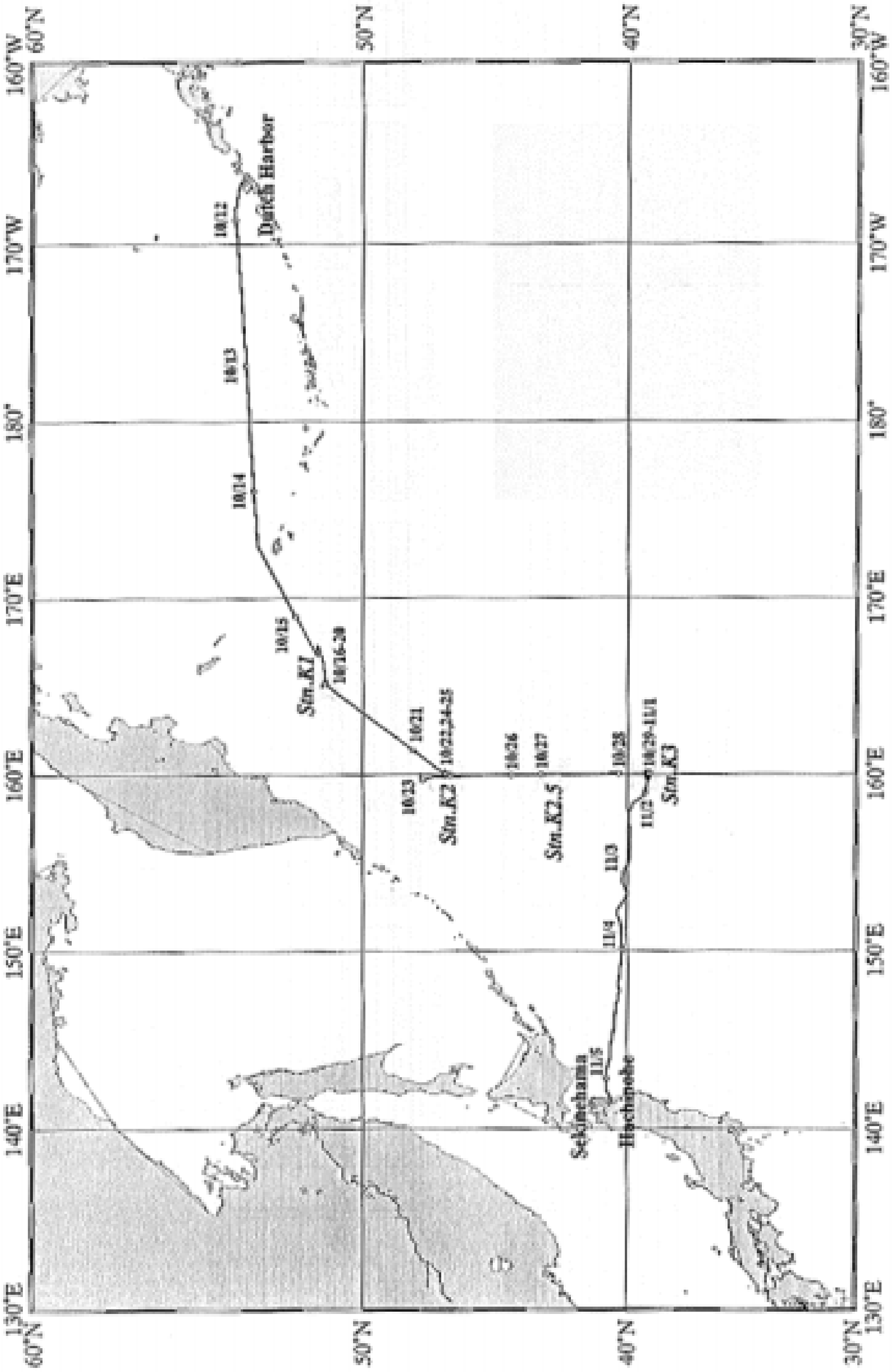
ship time (hr): 1.62

For	234Th / POC (Kawakami)
Filter	GF/F
#	Depth (m)
1	10
2	20
3	40
4	60
5	80
6	100
7	150
8	200

pumping time : 1hrs.

1.2 Track and log

Satoshi OKUMURA (GODI)
Wataru TOKUNAGA (GODI)



U.T.C.		S.M.T.		Position		Events
Date	Time	Date	Time	Lat.	Lon.	
10.11	17:05	10.11	09:05	53-51.10N	166-34.44W	Departure from Dutch Harbor
10.12	06:00	10.11	22:00	-	-	Time adjustment -2 hours (SMT=UTC-10h)
10.13	06:00	10.12	22:00	-	-	Time adjustment -2 hours (SMT=UTC-12h)
		10.13	-	-	-	Skipped (SMT=UTC+12h)
10:14	10:00	10.14	22:00	-	-	Time adjustment -1 hours (SMT=UTC+11h)
10.15	19:00	10.16	06:00	51-00N	165-00E	Arrival at Station K1
10.16	07:11	10.16	18:11	51-17.07N	165-13.55E	CTD cast (300m)
	09:03		20:03	51-16.83N	165-18.40E	CTD cast (2,000m)
	12:07		23:07	51-16.68N	165-13.89E	CTD cast (5,112m), Surface water sampling
	22:10	10.17	09:10	51-19.83N	165-12.40E	BGC mooring recovery
10.17	06:59	10.17	17:59	51-16.84N	165-14.07E	Large Volume Pump (LVP) cast (75m, 1 hour)
	09:26		20:26	51-16.39N	165-14.92E	CTD cast (500m)
	10:30		21:30	51-16.70N	165-15.25E	LVP cast (1,000m, 6 hours)
	19:22	10.18	06:22	51-17.95N	165-18.24E	PO mooring recovery
10.18	00:00	10.18	11:00	51-16.92N	165-13.96E	LVP cast (1,000m, 4 hours)
	05:52		16:52	51-16.74N	165-11.86E	Releaser test (4,000m)
	08:56		19:56	51-16.24N	165-11.73E	LVP cast (5,000m, 8 hours)
	20:29	10.19	07:29	51-11.19N	165-17.85E	PO mooring deployment
	-		-	51-18.064N	165-17.931E	PO mooring Fixed position
10.19	06:00	10.19	17:00	51-17.07N	165-14.07E	LVP cast (1,000m, 4.5 hours)
	11:49		22:49	51-15.82N	165-17.55E	CTD cast (5,222m)
	14:55	10.20	01:55	51-16.12N	165-16.36E	LVP cast (200m, 1 hour)
	17:22		04:22	51-17.24N	165-15.14E	Plankton net (300m)
	17:54		04:54	51-17.33N	165-15.03E	Plankton net (300m)
	18:27		05:27	51-17.38N	165-14.83E	LVP cast (75m, 1 hour)
	22:06		09:06	51-22.78N	165-00.05E	BGC mooring deployment
	-		-	51-19.935N	165-12.313E	BGC mooring Fixed position
	-		-	-	-	Site survey (1 hour)
10.20	07:30	10.20	18:30	-	-	Departure from Station K1
10.21	06:54	10.21	17:54	47-00N	160-00E	Arrival at Station K2
	07:31		18:31	46-57.11N	159-58.30E	CTD cast (300m)
	09:27		20:27	46-57.31N	159-58.54E	CTD cast (5,164m), Surface water sampling
	20:51	10.22	07:51	47-00.45N	159-58.03E	BGC mooring recovery
10.22	00:46	10.22	11:46	47-01.51N	160-01.80E	Releaser test (4,000m)
	04:05		15:05	47-00.67N	160-01.14E	CTD cast (5,150m)
	07:12		18:12	-	-	Departure from Station K2
10.23	-	10.23	-	48-00N	160-00E	(Avoiding low pressuer)
10.23	19:30	10.24	06:30	47-00N	160-00E	Arrival at Station K2
	22:33		09:33	46-51.99N	159-58.83E	Releaser test (4,000m)

U.T.C.		S.M.T.		Position		Events
Date	Time	Date	Time	Lat.	Lon.	
10.24	02:24	10.24	13:24	46-46.38N	160-01.72E	PO mooring deployment
	-		-	46-52.286N	159-59.035E	PO mooring Fixed position
	09:29		20:29	46-54.08N	159-54.65E	LVP cast (5,000m, 7 hours)
	23:30	10.25	10:30	46-54.62N	160-03.33E	BGC mooring deployment
	-		-	47-00.229N	159-58.421E	BGC mooring Fixed position
	-		-	-	-	Site survey (1 hour)
10.25	09:00	10.25	20:00	47-00.31N	159-54.32E	LVP cast (200m, 1 hour)
	11:15		22:15	48-00.51N	159-53.88E	CTD cast (5,169m)
	13:36	10.26	00:36	-	-	Departure from Station K2
10.26	04:36	10.26	15:36	43-30N	160-00E	Ariival at Station K2.5
	04:57		15:57	43-29.94N	160-01.29E	CTD cast (5,463m), Surface water sampling
	08:33		19:33	43-28.48N	160-01.73E	LVP cast (1,000m, 4 hours)
	14:09	10.27	01:09	43-27.84N	159-59.80E	CTD cast (2,000m)
	15:49		02:49	43-27.15N	159-59.40E	LVP cast (5,207m, 8 hours)
10.27	03:25	10.27	14:25	43-25.53N	160-01.17E	CTD cast (5,368m)
	06:36		17:36	-	-	Departure form Station K2.5
10.28	07:24	10.28	18:24	39-00N	160-00E	Arrival at Station K3
	-		-			Site survey (1 hour)
	08:55		19:55	39-10.59N	160-00.22E	CTD cast (300m)
	10:30		21:30	39-10.70N	160-00.17E	CTD cast (5,455m), Surface water sampling
	13:54	10.29	00:54	-	-	Site survey (6 hours)
	19:44		06:44	39-10.73N	160-00.30E	CTD cast (5,448m)
	23:45		10:45	39-09.59N	160-01.76E	LVP cast (75m, 1 hour)
10.29	02:28	10.29	13:28	39-09.54N	160-00.89E	LVP cast (75m, 1 hour)
	04:38		15:38	39-08.96N	160-01.61E	CTD cast (983m)
	-		-	-	-	Site survey (15 hours)
10.30	-	10.30	-	39-10N	160-00E	Drifting at Station K3
10.31	19:30	11.1	06:30	39-05.88N	160-00.13E	PO mooring deployment
	-		-	39-10.827N	159-55.815E	PO mooring Fixed position
11.1	04:31	11.1	15:31	39-05.80N	160-07.65E	BGC mooring deployment
	-		-	39-10.14N	160-01.01E	BGC mooring Fixed position
	11:49		22:49	39-08.29N	160-04.00E	CTD cast (5,448m)
	18:01	11.2	05:01	39-06.39N	159-59.92E	LVP cast (300m, 1 hour)
	20:18		07:18	-	-	Departure from Station K3
11.2	11:00	11.2	22:00	-	-	Time adjustment -1 hour (SMT=UTC+10h)
11.3	11:00	11.3	22:00	-	-	Time adjustment -1 hour (SMT=UTC+9h)
11.5	04:51	11.5	13:51	40-33.28N	141-30.01E	Arrival at Hachinohe
	08:43		17:43	-	-	Departure from Hachinohe

1.3 List of Participants

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2. North Pacific Time-series observational study

2.1 Recovery and Deployment of Mooring systems

Toru IDAI (JAMSTEC MIO)

Two types of mooring systems were designed and deployed: one for physical oceanography (PO mooring) and another for biogeochemistry (BGC mooring).

The PO mooring consists of a 64” syntactic top float with 3,000 lbs buoyancy, instrument, wire and nylon ropes, glass floats (Benthos 17” glass ball), dual releasers (Edgetech) and 4,660 lbs. sinker with mace plate. Autonomous CTD profiler, MMP (McLane Moored Profiler), is installed on the 4,500m wires for observation. It descends and ascends between 60m and 4,000m with taking vertical profiles of CTD and 3D current direction and velocity. ARGOS compact mooring locator and submersible recovery strobe are mounted on all of top floats. Before cruise, all wires and nylon ropes are pre-stretched by approximately 1.3 ton, which load corresponds to mooring tension and measured exact length using a laser equipment, which error is ± 1 mm.

The BGC mooring consists of a top float, instruments, mooring wire and rope, glass floats, dual releasers and sinker. The following time-series observational instruments are mounted approximately 40 ~ 50 m below sea surface.

- SID - Submersible Incubation Device with Ocean Optical Sensor
- WTS - Water Access Sampler
- RAS - Remote Access Sampler
- ZPS - Zoo Plankton Sampler
- Sediment Trap – 1,000 m, 2,000 m and 5,000 m

In addition, seven more Sediment traps including two small Sediment traps are installed at approximately 150 m, 250 m, 400 m, 500 m, 600 m, 800 m and 4,867 m at K-2.

Details for each instrument are described later (section 2.2). Serial numbers for instruments are as follows:

Table 2.1.1 Recovery serial numbers of instruments

Station and type of system Mooring system S / N	K-1 PO K1P010904	K-1 BGC K1B010905	K-2 BGC K2B010909
ARGOS	18839	18840	18838
ARGOS ID	18557	18558	18556
Strobe	233	236	235
MMP	ML11241-01	-	-
SID	-	ML11241-17	ML11241-16
OOS	-		DFLS-072
WTS	-	ML11241-14	ML11241-15
RAS	-	ML11241-11	ML11241-10
ZPS	-	ML11241-19	ML11241-21
Sediment Trap (1000m) (2000m) (5000m)	- - -	ML11241-22 ML11241-24 ML11241-25	ML11241-23 ML11241-26 ML11241-27
Releaser	027867 027809	027824 027864	027825 027868

Table 2.1.2 Deployment serial numbers of instruments

Station S / N	K-1 PO K1P021018	K-1 BGC K1B021020	K-2 PO K2P021024	K-2 BGC K2B021024	K-3 PO K3P021031	K-3 BGC K3B021101
ARGOS ID	52111 5357	52112 5374	18840 18558	18839 18557	18838 18556	18841 18570
Strobe	236	243	233	244	235	234
MMP	ML11241-03	-	ML11241-02	-	ML11241-06	-
SID	-	ML11241-13		ML11241-17	-	ML11241-16
OOS	-	DFLS-084		DFLS-085	-	DFLS-093
WTS	-	ML11241-13		ML11241-14	-	ML11241-15
RAS	-	ML11241-07		ML11241-12	-	ML11241-09
ZPS	-	ML11241-20		ML11241-19	-	ML11241-21
Traps (150m) (250m) (400m) (500m) (600m) (800m) (1000m) (2000m) (4867m) (5000m)	- - - - - - - - - - -	- - - - - - - ML11241-25 ML11241-22 - 10357-2	- - - - - - - - - - -	- 10558-2 11445.01 11445.02 11555.1021 11445.03 ML11241-26 ML11241-23 ML11241-27 1386 1388	- - - - - - - - - - -	- - - - - - - ML11241-24 10357-989 878
Releaser	027864 027824	027867 027809	028509 028533	027825 027868	027805 027815	28531 28532

2.1.1 Deployment

We planned to deployed PO and BGC mooring at two areas in the Western Subarctic Gyre. One of candidates is 51N / 165E, near where gigantic opal flux was observed before (Wong et al., 1997). Another is 47N / 160E, where is close to station KNOT and, however, structure of water mass is more stable than station KNOT. Before deployment, sea floor topography was surveyed with Sea Beam. In order to place the top of mooring systems in the surface euphotic layer, precise water depths for mooring positions was measured by an altimeter (Datasonics PSA900D) mounted on CTD / CWS. Mooring works took approximately 5 hours for PO mooring system and 7 hours for BGC mooring system. After sinker was dropped, we positioned the mooring systems by measuring the slant ranges between research vessel and the acoustic releaser. Each position of the moorings is finally determined as follows:

Table 2.1.1.1 Mooring positions for respective mooring systems

	K-1 PO K1P021018	K-1 BGC K1B021020	K-2 PO K2P021024	K-2 BGC K2B021024	K-3 PO K3P021031	K-3 BGC K3B021101
Date of Deploy	Oct.18th 2002	Oct. 20th 2002	Oct. 24th 2002	Oct. 24th 2002	Oct. 31st 2002	Nov. 1st 2002
Latitude	51° 18.06 N	51° 19.93 N	46° 52.29 N	47° 00.23 N	39° 10.83 N	39° 10.14 N
Longitude	165° 17.93 E	165° 12.31 E	159° 59.03 E	159° 58.42 E	159° 55.82 E	160° 01.01 E
Depth	5,140 m	5,132 m	5,121 m	5,206 m	5,450m	5,470m

Table 2.1.1.2 Deployment Record

K-1 PO Mooring **MOORING No.** K1P021018

PROJECT	Time Series	TIME	Oct. 18th 2002
AREA	North Pacific	RECORDER (D) :	Miki Yoshiike
POSITION	Station K-1	RECORDER (R) :	

TARGET	51°17'.91N 165°18'.05E	DEPTH	5,140.0 m		
PERIOD	1 year	NAVIGATION SYSTEM :			
LENGTH :	5,079.2 m	DEPTH of BUOY :	54 m	BUOYANCY :	1,360 kg

ACOUSTIC RELEASERS

TYPE	Edgetech	TYPE	Edgetech
S/N	027824	S/N	027864
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	RECEIVE F.	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	TRANSMIT F.	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344674	RELEASE C.	344421
ENABLE C.	(A) 361121 (B) 361144	ENABLE C.	(A) 357724 (B) 357741
DISABLE C.	361167	DISABLE C.	357762
BATTERY	1 year	BATTERY	1 year
RELEASE TEST	FINE	RELEASE TEST	FINE

DEPLOYMENT

DATE	Oct. 18th 2002	SHIP	MIRAI	CRUISE No.	MR02-K05		
WATHER	c	CONDITIONS	rough	DEPTH	5144 m	SHIP HEADING	<000>
DIR. And VEL. of WIND	<000> 2.1 m/s	START	6.5 Nmile	OVERSHOOT	450m		
POS. of START	51°11'.19N	165°17'.85E	BUOY	22:00			
POS. of DEP.	51°18'.20N	165°18'.06E	ANCHOR	02:11	DISAPPEAR	2:40	
POS. of MOORING	51°18'.064N	165°17'.931E	LANDING	:			

K-1 BGC Mooring MOORING No. **K1P021019**

PROJECT	Time Series	**TIME**	Oct. 19th 2002		
AREA	North Pacific	**RECORDER (D) :**	Miki Yoshiike		
POSITION	Station K-1	**RECORDER (R) :**			
TARGET	51°19'.96N 165°12'.23E	**DEPTH**	5,132.4 m		
PERIOD	1 year	**NAVIGATION SYSTEM :**			
LENGTH :	5,100.4 m	**DEPTH of BUOY :**	34.6 m	**BUOYANCY :**	1,360 kg

ACOUSTIC RELEASERS

TYPE	Edgetech	**TYPE**	Edgetech
S/N	027867	**S/N**	027809
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	**RECEIVE F.**	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	**TRANSMIT F.**	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344573	**RELEASE C.**	344535
ENABLE C.	(A) 360536 (B) 360553	**ENABLE C.**	(A) 360320 (B) 360345
DISABLE C.	360570	**DISABLE C.**	360366
BATTERY	1 year	**BATTERY**	1 year
RELEASE TEST	FINE	**RELEASE TEST**	FINE

DEPLOYMENT

DATE	Oct. 20th 2002	**SHIP**	MIRAI	**CRUISE No.**	MR02-K05		
WATHER	r	**CONDITIONS**	rough	**DEPTH**	5,141.0 m	**SHIP HEADING**	<110>
DIR. And VEL. of WIND	<120> 2.2 m/s	**START**	8.0 Nmile	**OVERSHOOT**	550m		
POS. of START	51°22'.78N	165°00'.05E	**BUOY**	22:40			
POS. of DEP.	51°19'.80N	165°12'.64E	**ANCHOR**	04:29	**DISAPPEAR**	5:02	
POS. of MOORING	51°19'.935N	165°12'.313E	**LANDING**	:			

K-2 PO Mooring MOORING No. **K2P021024**

PROJECT	Time Series	**TIME**	Oct. 24th 2002		
AREA	North Pacific	**RECORDER (D) :**	Miki Yoshiike		
POSITION	Station K-2	**RECORDER (R) :**			
TARGET	46°52'.24N 159°59'.06E	**DEPTH**	5,152.0 m		
PERIOD	1 year	**NAVIGATION SYSTEM :**			
LENGTH :	5,085.6 m	**DEPTH of BUOY :**	66.4 m	**BUOYANCY :**	1,360 kg

ACOUSTIC RELEASERS

TYPE	Edgetech	**TYPE**	Edgetech
S/N	028509	**S/N**	028533
RECEIVE F.	11.0 kHz	**RECEIVE F.**	11.0 kHz
TRANSMIT F.	12.0 kHz	**TRANSMIT F.**	12.0 kHz
RELEASE C.	335704	**RELEASE C.**	223307
ENABLE C.	377142	**ENABLE C.**	201054
DISABLE C.	377161	**DISABLE C.**	201077
BATTERY	2 year	**BATTERY**	2 year
RELEASE TEST	FINE	**RELEASE TEST**	FINE

DEPLOYMENT

DATE	Oct. 24th 2002	**SHIP**	MIRAI	**CRUISE No.**	MR02-K05		
WATHER	bc	**CONDITIONS**	smooth	**DEPTH**	5,159 m	**SHIP HEADING**	<340>
DIR. And VEL. of WIND	<350> 6.0 m/s	**START**	6.0 Nmile	**OVERSHOOT**	390m		
POS. of START	46°46'.38N	160°01'.72E	**BUOY**	02:26			
POS. of DEP.	46°52'.44N	159°58'.96E	**ANCHOR**	06:54	**DISAPPEAR**	7:22	
POS. of MOORING	46°52'.286N	159°59'.035E	**LANDING**	:			

K-2 BGC Mooring **MOORING No.** K2B021024

PROJECT	Time Series	**TIME**	Oct. 24th 2002
AREA	North Pacific	**RECORDER (D) :**	Miki Yoshiike
POSITION	Station K-2	**RECORDER (R) :**	

TARGET	47°00'.350N 159°58'.326E	**DEPTH**	5,206.2 **m**		
PERIOD	1 year	**NAVIGATION SYSTEM :**			
LENGTH :	5,166.6 **m**	**DEPTH of BUOY :**	39.6 **m**	**BUOYANCY :**	1,360 **kg**

ACOUSTIC RELEASERS

TYPE	Edgetech	**TYPE**	Edgetech
S/N	027825	**S/N**	027868
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	**RECEIVE F.**	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	**TRANSMIT F.**	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344176	**RELEASE C.**	335534
ENABLE C.	(A) 356736 (B) 356753	**ENABLE C.**	(A) 322710 (B) 322733
DISABLE C.	356770	**DISABLE C.**	322756
BATTERY	1 year	**BATTERY**	1 year
RELEASE TEST	FINE	**RELEASE TEST**	FINE

DEPLOYMENT

DATE	Oct. 24th 2002		**SHIP**	MIRAI		**CRUISE No.**	MR02-K05
WATHER	bc	**CONDITIONS** smooth	**DEPTH**	5,215 m		**SHIP HEADING**	<220>
DIR. And VEL. of WIND	<292> 3.1 **m/s**		**START**	7.5 Nmile		**OVERSHOOT**	450**m**
POS. of START	46°54'.62N	165°05'.36E	**BUOY**	23:55			
POS. of DEP.	47°00'.54N	159°58'.10E	**ANCHOR**	05:11		**DISAPPEAR**	6:01
POS. of MOORING	47°00'.226N	159°58'.421E			**LANDING**	:	

K-3 PO Mooring **MOORING No.** K3P021031

PROJECT	Time Series	**TIME**	Oct. 31st 2002
AREA	North Pacific	**RECORDER (D) :**	Miki Yoshiike
POSITION	Station K-3	**RECORDER (R) :**	

TARGET	39°10'.955N 159°55'.948E	**DEPTH**	5,450.0 **m**		
PERIOD	1 year	**NAVIGATION SYSTEM :**			
LENGTH :	5,383.9.2 **m**	**DEPTH of BUOY :**	66.1 **m**	**BUOYANCY :**	1,360 **kg**

ACOUSTIC RELEASERS

TYPE	Edgetech	**TYPE**	Edgetech
S/N	027805	**S/N**	027815
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	**RECEIVE F.**	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	**TRANSMIT F.**	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344611	**RELEASE C.**	344657
ENABLE C.	(A) 360631 (B) 360654	**ENABLE C.**	(A) 361035 (B) 361050
DISABLE C.	360677	**DISABLE C.**	361073
BATTERY	1 year	**BATTERY**	1 year
RELEASE TEST	FINE	**RELEASE TEST**	FINE

DEPLOYMENT

DATE	Oct. 31th 2002		**SHIP**	MIRAI		**CRUISE No.**	MR02-K05
WATHER	bc	**CONDITIONS** rough	**DEPTH**	5,492 m		**SHIP HEADING**	<330>
DIR. And VEL. of WIND	<337> 12.0 **m/s**		**START**	6.0 Nmile		**OVERSHOOT**	325**m**
POS. of START	39°05'.88N	160°00'.13E	**BUOY**	19:30			
POS. of DEP.	39°11'.11N	159°55'.83E	**ANCHOR**	00:19		**DISAPPEAR**	00:58
POS. of MOORING	39°10'.82N	159°55'.81E			**LANDING**	:	

K-3 BGC Mooring **MOORING No.** K3B021101

PROJECT	Time Series	**TIME**	Nov. 1st 2002
AREA	North Pacific	**RECORDER (D) :**	Miki Yoshiike
POSITION	Station K-3	**RECORDER (R) :**	
TARGET	39°10'.22N 160°01'.09E	**DEPTH**	5,470.0 m
PERIOD	1 year	**NAVIGATION SYSTEM :**	
LENGTH : 5,426.1 m	**DEPTH of BUOY :** 43.9 m	**BUOYANCY :**	1,360 kg

ACOUSTIC RELEASERS			
TYPE	Edgetech	**TYPE**	Edgetech
S/N	028531	**S/N**	028532
RECEIVE F.	11.0 kHz	**RECEIVE F.**	11.0 kHz
TRANSMIT F.	12.0 kHz	**TRANSMIT F.**	12.0 kHz
RELEASE C.	223065	**RELEASE C.**	223114
ENABLE C.	200405	**ENABLE C.**	200443
DISABLE C.	200426	**DISABLE C.**	200460
BATTERY	2 year	**BATTERY**	2 year
RELEASE TEST	FINE	**RELEASE TEST**	FINE

DEPLOYMENT					
DATE	Nov. 1st 2002	**SHIP**	MIRAI	**CRUISE No.**	MR02-K05
WATHER bc	**CONDITIONS** rough	**DEPTH**	5,473 m	**SHIP HEADING**	<320>
DIR. And VEL. of WIND	<045> 10.0 m/s	**START**	6.8 Nmile	**OVERSHOOT**	500m
POS. of START	39°05'.80N	160°07'.65E	**BUOY** 05:00		
POS. of DEP.	39°10'.40N	160°00'.82E	**ANCHOR** 10:24	**DISAPPEAR**	11:02
POS. of MOORING	39°10'.14N	160°01'.01E		**LANDING**	:

*Deployment Depth was given from Brigde when dropping the anchor.

Table 2.1.1.3 Deployment working time record

K-1 PO Mooring **MOORING NO.** K1P021018

		DEPLOYMENT **DATE :** Oct. 18th 2002 **START :** 21:50 **FINISH :** 2:11		**RECOVERY** **DATE :** **START :** **FINISH :**	
I T E M	**S/N etc.**	**T I M E**	**MEMO**	**T I M E**	**MEMO**
Syntactic Sphere ARGOS and Flasher	A: 236 F: 52111	22:00			
Bumper (60m)		22:00			
4500m Wire	[C]	22:00~00:33			
MMP	ML11241-03	22:42			
Bumper (4,580m)		0:33			
20m Wire	[#1/20]	0:33~0:38			
(6) 17" Glass Balls		0:38			
430m Wire	[#O]	00:38~01:02			
25m Wire	[#1/25]	01:02~01:04			
(28) 17" Glass Balls	10/1	1:45			
Edgetech Releasers	27824 27864	1:45			
20m Nylon	[#02]	01:45~02:11			
4,000lb Anchor		2:11			

ARGOS : Model 3807 ID 5373 Start Time 21:53
Flasher : Model 204-RS

K-1 BGC Mooring MOORING NO. K1B021019

		DEPLOYMENT		RECOVERY	
		DATE : Oct. 19th 2002 START : 22:00 FINISH : 4:29		DATE : START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:52112 F:243	22:40			
SID Ocean Optical Seneor	SID:11241-18 OOS:DFLS-084	22:40			
WTS RAS ZPS	ML11241-13 ML11241-07 ML11241-20	22:38 22:38 22:33			
500m 5/16" Wire	[Z]	22:23~23:05			
403m 5/16" Wire	[AA]	23:05~23:26			
50m 5/16" Wire Coated	[AO]	23:26~23:37			
Sediment Trap_1000m	ML11241-25	23:37			
500m 1/4" Wire	[O]	23:37~23:55			
440.1m 1/4" Wire	[R]	23:55~00:18			
50m 1/4" Wire Coated	[AL]	00:18~00:27			
Sediment Trap_2000m	ML11241-22	0:27			
500m 1/4" Wire	[#A]	00:27~00:41			
500m 1/4" Wire	[#B]	00:41~00:58			
20m 1/4" Wire	[#6/20]	00:58~00:59			
20m 1/4" Wire	[#7/20]	00:59~01:02			
(8) 17" Glass Balls		1:02			
500m 1/4" Wire	[#C]	01:02~01:14			
500m 1/4" Wire	[#D]	01:14~01:25			
500m 1/4" Wire	[#E]	01:25~01:41			
(4) 17" Glass Balls		1:41			
200m 1/4" Wire	[FF]	01:41~01:51			
50m 1/4" Wire Coated	[#FF]	01:51~01:58			
Sediment Trap_5000m	10357-2	1:58			
100m 1/4" Wire	[UU]	01:58~02:04			
50m 1/4" Wire	[ZZ]	02:04~02:11			
25m 1/4" Wire	[#3/25]	2:11			
25m 1/4" Wire	[#2/25]	02:11~02:12			
20m 1/4" Wire	[#5/20]	02:12~02:18			
5m 1/4" Wire	[adj]	2:18			
(36) 17" Glass Balls		02:18~03:46			
Dual Releases	27867 27809	3:46			
20m 3/4" Nylon	[#01]	03:46~04:29			
4,000lb Mace Anchor		4:29			

ARGOS : Model 3807 ID 5374 Start Time 22:34
Flasher : Model 204-RS
Rigo Depth Sensor on WTS : Model DP500 S/N DP1142 Start time Oct.19th 2002 10:00 Sample int. 2hours
Deployment : 02:30~04:25 Ship speed 2 kn't until Deploy Point

K2 PO Mooring MOORING NO. K2P021024

		DEPLOYMENT		RECOVERY	
		DATE : Oct. 24th 2002 START : 2:24 FINISH : 6:54		DATE : START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:18840 F:233	2:26			
Bumper (60m)		2:25			
4500m 1/4" JacNil Wire	[#D]	2:25~5:18			
MMP	ML11241-02	2:54			
Bumper (4,560m)		5:18			
10m 1/4" JacNil Wire		5:18~5:21			
(6) 17" Glass Balls		5:21			

430m 1/4" JacNil Wire	[#P]	5:21~5:37			
50m 1/4" JacNil Wire	[YY]	5:37~5:44			
(28) 17" Glass Balls		5:44~6:24			
Edgetech Releasers	28509 28533	6:24			
20m Nylon	[03]	6:25~6:54			
4,000lb Anchor		6:54			
ARGOS : Model 3807 ID 18558 Flasher : Model 204-RS		Start Time 02:19			

K-2 BGC Mooring MOORING NO. **K2B021024**

		DEPLOYMENT DATE : Oct. 24th 2002 START : 23:30 FINISH : 5:11		RECOVERY DATE : START : FINISH :	
I T E M	S/N etc.	T I M E	MEMO	T I M E	MEMO
Syntactic Sphere ARGOS and Flasher	A:18839 F:244	23:55			
SID Ocean Optical Seneor	SID:17 OOS:DFLS-085	23:54			
WTS RAS ZPS	ML11241-14 ML11241-12 ML11241-19	23:53			
50m 5/16" Wire	[CF]	23:53~23:55			
50m 5/16" Wire Coated	[BW]	23:55~00:06			
Sediment Trap_150m	10558-2	0:06			
43.4m 5/16" Wire	[CB]	0:06~00:15			
50m 5/16" Wire Coated	[BX]	00:15~00:20			
Sediment Trap_250m	11445.02	0:20			
93.4m 5/16" Wire	[BS]	00:20~00:27			
50m 5/16" Wire Coated	[BY]	00:27~00:35			
Sediment Trap_400m	11445.02	0:35			
43.4m 5/16" Wire	[CC]	00:35~00:39			
50m 5/16" Wire Coated	[BZ]	00:39~00:44			
Sediment Trap_500m	11555.1021	0:44			
43.4m 5/16" Wire	[CD]	00:44~00:48			
50m 5/16" Wire Coated	[BT]	00:48~00:54			
Sediment Trap_600m	11445.03	0:54			
143.4m 5/16" Wire	[BP]	00:54~01:02			
50m 5/16" Wire Coated	[BU]	01:02~01:08			
Sediment Trap_800m	ML11241-26	1:08			
143.4m 5/16" Wire	[BQ]	01:08~01:15			
50m 5/16" Wire Coated	[BV]	01:15~01:22			
Sediment Trap_1000m	ML11241-23	1:22			
16.3m 1/4" Wire	[adj]	1:22			
20m 1/4" Wire	[20/D]	1:23			
10m 1/4" Wire	[10/A]	01:23~01:25			
500m 1/4" Wire	[BD]	01:25~01:51			
(10) 17" Glass Balls		1:51			
389m 1/4" Wire	[BM]	01:51~02:05			
50m 1/4" Wire Coated	[CA]	02:05~02:11			
Sediment Trap_2000m	ML11241-27	2:11			
500m 1/4" Wire	[BE]	02:11~02:26			
500m 1/4" Wire	[BF]	02:26~02:46			
20m 1/4" Wire	[20/C]	02:46~02:49			
10m 1/4" Wire	[10/B]	02:49~02:50			
(10) 17" Glass Balls		2:50			
500m 1/4" Wire	[BG]	02:50~03:06			
500m 1/4" Wire	[BH]	03:06~03:25			
500m 1/4" Wire	[BI]	03:25~03:46			
(8) 17" Glass Balls		3:46			
200m 1/4" Wire	[BN]	03:46~03:57			
50m 1/4" Wire Coated	[#DD]	03:57~04:04			
Sediment Trap_4810.8m	1386	4:04			
50m 1/4" Wire Coated	[#EE]	04:12~04:23			
Sediment Trap_4867m	1388	4:12			

200m 1/4" Wire	[BO]	04:12~04:23			
20m 1/4" Wire	[20/A]	04:23~04:25			
20m 1/4" Wire	[20/B]	04:25~04:27			
(44) 17" Glass Balls		04:27~05:00			
Dual Releases	27825 27868	5:01			
20m 3/4" Nylon	[#04]	05:01~05:11			
4,666lb Mace Anchor		5:11			
ARGOS : Model 3807 ID 18557 Flasher : Model 204-RS Rigo Depth Sensor on WTS : Model DP500 S/N DP1157 Start time Oct.24th 2002 Sample int. 2hours					

K-3 PO Mooring MOORING NO. K3P021031

		DEPLOYMENT		RECOVERY	
		DATE : Oct. 31st 2002 START : 19:29 FINISH : 0:30		DATE : START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:18838 F:235	19:30			
Bumper (60m)		19:30			
4500m 1/4" JacNil Wire	[C]	19:30~22:37			
MMP	ML11241-06	20:38			
Bumper (4,560m)		22:37			
20m 1/4" JacNil Wire	[20/2]	22:37~22:41			
(6) 17" Glass Balls		22:41			
500m 1/4" JacNil Wire	[N]	22:41~22:57			
200m 1/4" JacNil Wire	[DD]	22:57~23:07			
50m 1/4" JacNil Wire	[XX]	23:07~23:09			
19.93m 1/4" JacNil Wire		23:09~23:12			
(32) 17" Glass Balls		23:12~00:14			
Edgetech Releasers	27805 27815	0:14			
20m Nylon	[#05]	00:14~00:30			
4,000lb Anchor		0:30			
ARGOS : Model 3807 ID 18556 Flasher : Model 204-RS					

K-3 BGC Mooring MOORING NO. K3B021101

		DEPLOYMENT		RECOVERY	
		DATE : Nov. 1st 2002 START : 4:31 FINISH : 10:24		DATE : START : FINISH :	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:18841 F:234	5:00			
SID Ocean Optical Seneor	SID:16 OOS:DFLS093	5:00			
WTS RAS ZPS	ML11241-15 ML11241-09 ML11241-21	05:00 04:58 04:58			
500m 5/16" Wire	[#K]	04:58~05:24			
403m 5/16" Wire	[#R]	05:24~05:43			
50m 5/16" Wire Coated	[#X]	05:43~05:51			
Sediment Trap_1000m	ML11241-24	5:51			
2.3m Trawler Chain	Adj	05:51~05:51			
500m 1/4" Wire	[#F]	05:51~06:11			
440.1m 1/4" Wire	[#M]	06:11~06:28			
50m 1/4" Wire Coated	[#BB]	06:28~06:36			
Sediment Trap_2000m	10357 elect989	6:36			
500m 1/4" Wire	[#G]	06:36~06:49			
500m 1/4" Wire	[#H]	06:50~07:07			
20m 1/4" Wire	[20/A]	07:07~07:07			
20m 1/4" Wire	[20/B]	07:07~07:12			
(8) 17" Glass Balls		7:12			
500m 1/4" Wire	[#I]	07:12~07:37			
500m 1/4" Wire	[#J]	07:37~07:56			

500m 1/4" Wire	[BK]	07:56~08:24			
(4) 17" Glass Balls		8:24			
200m 1/4" Wire	[#T]	08:24~08:35			
50m 1/4" Wire Coated	[#CC]	08:35~08:41			
Sediment Trap_5000m	elect 878	8:41			
200m 1/4" Wire	[GG]	08:41~08:48			
200m 1/4" Wire	[HH]	08:48~08:55			
100m 1/4" Wire	[QQ]	08:55~09:00			
50m 1/4" Wire	[WW]	09:00~09:05			
10m 1/4" Wire	[10/A]	09:05~09:05			
(36) 17" Glass Balls		09:06~10:06			
Dual Releases	28531 28532	10:06			
20m 3/4" Nylon	[#06]	10:06~10:24			
4,666lb Mace Anchor		10:24			
ARGOS : Model 3807 ID 18570 Flasher : Model 204-RS Depth Sensor on WTS S/N DP1158 Start Time Oct. 31st 2002 03:00					

Table 2.1.1.4 Mooring Systems

PO Mooring for MMP K-1											
Mooring ID	NEW				Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0	0	5079.2	54.0
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5079.2	55.0
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5078.2	55.2
5m 3/4" PC		92.3	1	92.3	5.0	86.6	86.6	6.3	-2905.4	5078.0	60.2
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2900.0	5073.0	60.5
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	6.7	-2893.1	5072.7	60.6
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	0.2	3.6	3.6	6.9	-2889.5	5072.6	60.9
Stopper (55m)		11.4	1	11.4	0.0	0.0	0.0	6.9	-2889.5	5072.3	60.9
4,500m 1/4" wire		1890.0	1	1890.0	4500.0	1395.0	1395.0	4506.9	-1494.5	5072.3	4560.9
MMP		154.3	1	154.3	0.0	0.0	0.0	4506.9	-1494.5	572.3	4560.9
Stopper (4550m)		11.4	1	11.4	0.0	0.0	0.0	4506.9	-1494.5	572.3	4560.9
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	0.2	3.6	3.6	4507.1	-1490.9	572.3	4561.1
Swivel		11.0	1	11.0	0.2	7.0	7.0	4507.3	-1483.9	572.1	4561.2
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	0.2	3.6	3.6	4507.5	-1480.3	572.0	4561.4
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	4527.5	-1474.1	571.8	4581.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4527.7	-1471.1	551.8	4581.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4531.7	-1690.8	551.6	4585.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4531.9	-1687.9	547.6	4585.8
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	4533.9	-1797.7	547.4	4587.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4534.1	-1794.8	545.4	4588.0
430m 1/4" wire		181.7	1	181.7	430.0	133.3	133.3	4964.1	-1661.5	545.2	5018.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4964.3	-1658.6	115.2	5018.2
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	4989.3	-1650.8	115.0	5043.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4989.5	-1647.9	90.0	5043.4
4.4m 3/8" TC		20.9	1	20.9	4.4	19.7	19.7	4993.9	-1628.2	89.8	5047.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4994.1	-1625.3	85.4	5048.0
16.3m 1/4" wire		6.8	1	6.8	16.3	5.1	5.1	5010.4	-1620.2	85.2	5064.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5010.5	-1617.3	68.9	5064.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5014.5	-1837.0	68.7	5068.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5014.7	-1834.0	64.7	5068.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5018.7	-2053.7	64.5	5072.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5018.9	-2050.8	60.5	5072.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5022.9	-2270.4	60.3	5076.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5023.1	-2267.5	56.3	5077.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5027.1	-2487.2	56.1	5081.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5027.3	-2484.3	52.1	5081.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5031.3	-2703.9	51.9	5085.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5031.5	-2701.0	47.9	5085.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5035.5	-2920.7	47.7	5089.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5035.7	-2917.8	43.7	5089.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5039.7	-3137.4	43.5	5093.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5039.9	-3134.5	39.5	5093.9
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5044.9	-3112.1	39.3	5098.9
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5045.1	-3107.5	34.3	5099.1
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5046.1	-2962.0	34.1	5100.1
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5047.1	-2957.5	33.1	5101.1
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5047.3	-2948.0	32.1	5101.3
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5047.6	-2942.1	31.9	5101.5
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5052.6	-2919.7	31.7	5106.5
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5052.8	-2915.0	26.7	5106.8
20m 1" Nylon		0.9	1	0.9	20.0	0.6	0.6	5072.8	-2914.4	26.4	5126.8
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5073.0	-2909.7	6.4	5127.0
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5078.0	-2887.4	6.2	5132.0
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5078.2	-2881.4	1.2	5132.2
4,666 lb Mace Anchor		4666.0	1	4666.0	1.0	4666.0	4666.0	5079.2	1784.6	1	5133.2

PS Mooring for Biogeochemical Sensors and Samples for K-1											
Mooring ID	Joint	In the Air			Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0.0	0	5100.4	34.6
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5100.4	35.6
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5099.4	35.9
5m 3/4" PC		92.2	1	92.2	5.0	88.2	88.2	6.3	-2903.8	5099.1	40.9
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2898.5	5094.1	41.1
SID		198.4	1	198.4	1.8	130.1	130.1	8.3	-2768.4	5093.9	42.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	8.5	-2764.1	5092.1	43.1
WTS		99.2	1	99.2	0.3	77.2	77.2	8.9	-2687.0	5091.9	43.5
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	1.0	33.8	33.8	9.9	-2653.2	5091.5	44.5
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	10.1	-2648.9	5090.5	44.7
RAS		325.0	1	325.0	1.1	125.0	125.0	11.2	-2523.9	5090.3	45.8
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	0.8	33.8	33.8	12.0	-2490.1	5089.2	46.6
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	12.2	-2485.8	5088.4	46.8
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	13.2	-2463.0	5088.2	47.8
ZPS		167.6	1	167.6	0.9	57.3	57.3	14.2	-2405.7	5087.2	48.8
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	15.2	-2382.8	5086.2	49.8
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.4	-2378.6	5085.2	50.0
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	15.6	-2371.6	5085.0	50.2
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.8	-2367.3	5084.8	50.4
500m 5/16" wire		344.4	1	344.4	499.3	234.5	234.5	515.1	-2132.8	5084.6	549.7
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	515.3	-2128.6	4585.3	549.9
403.6m 5/16" wire		278.0	1	278.0	402.3	189.3	189.3	917.6	-1939.3	4585.1	952.2
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	917.8	-1935.0	4182.8	952.4
50m 5/16" wire		34.4	1	34.4	50.0	23.5	23.5	967.8	-1911.6	4182.6	1002.4
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	968.0	-1906.8	4132.6	1002.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	969.0	-1893.3	4132.4	1003.6
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	970.5	-1816.1	4131.4	1005.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	971.5	-1802.6	4129.9	1006.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	971.6	-1801.7	4128.9	1006.2
6.3m 3/8"TC		22.6	1	22.6	6.3	21.3	21.3	977.9	-1780.4	4128.8	1012.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	978.1	-1777.5	4122.5	1012.7
500m 1/4" wire		211.6	1	211.6	499.6	155.0	155.0	1477.6	-1622.5	4122.3	1512.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1477.8	-1619.6	3622.8	1512.4
440.1m 1/4" wire		186.2	1	186.2	439.6	136.4	136.4	1917.4	-1483.2	3622.6	1952.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1917.6	-1480.2	3183.0	1952.2
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	1967.6	-1464.7	3182.8	2002.2
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	1967.8	-1461.6	3132.8	2002.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1968.8	-1448.1	3132.6	2003.4
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	1970.3	-1371.0	3131.6	2004.9
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1971.3	-1357.5	3130.1	2005.9
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	1971.4	-1356.5	3129.1	2006.0
4.4m 3/8"TC		9.5	1	9.5	4.4	19.8	19.8	1975.8	-1336.7	3129.0	2010.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1976.0	-1333.8	3124.6	2010.6
500m 1/4" wire		211.6	1	211.6	501.1	155.0	155.0	2477.0	-1178.8	3124.4	2511.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2477.2	-1175.9	2623.4	2511.8
500m 1/4" wire		211.6	1	211.6	500.9	155.0	155.0	2978.1	-1020.9	2623.2	3012.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2978.3	-1018.0	2122.3	3012.9
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	2998.3	-1011.8	2122.1	3032.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2998.5	-1008.8	2102.1	3033.1
20m 1/4" wire		12.2	1	12.2	20.0	6.2	6.2	3018.5	-1002.6	2101.9	3053.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3018.7	-999.7	2081.9	3053.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3022.7	-1219.4	2081.7	3057.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3022.9	-1216.5	2077.7	3057.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3026.9	-1436.1	2077.5	3061.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3027.1	-1433.2	2073.5	3061.7
500m 1/4" wire		211.6	1	211.6	501.1	155.0	155.0	3528.2	-1278.2	2073.3	3562.8

(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3528.4	-1275.3	1572.2	3563.0
500m 1/4" wire		211.6	1	211.6	500.7	155.0	155.0	4029.1	-1120.3	1572.0	4063.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4029.3	-1117.3	1071.3	4063.9
500m 1/4" wire		211.6	1	211.6	501.0	155.0	155.0	4530.3	-962.3	1071.1	4564.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4530.5	-959.4	570.1	4565.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4534.5	-1179.1	569.9	4569.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4534.7	-1176.2	565.9	4569.3
200m 1/4" wire		84.6	1	84.6	199.9	62.0	62.0	4734.6	-1114.2	565.7	4769.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4734.8	-1111.2	365.8	4769.4
50m 1/4" wire		21.0	1	21.0	50.2	15.5	15.5	4785.0	-1095.7	365.6	4819.6
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4785.2	-1092.6	315.4	4819.8
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4786.2	-1079.1	315.2	4820.8
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	4787.7	-1002.0	314.2	4822.3
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4788.7	-988.5	312.7	4823.3
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4788.8	-987.6	311.7	4823.4
3m 3/8"TC		19.8	1	19.8	3.0	13.5	13.5	4791.8	-974.1	311.6	4826.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4792.0	-971.1	308.6	4826.6
100m 1/4" wire		42.3	1	42.3	100.0	31.0	31.0	4892.0	-940.1	308.4	4926.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4892.2	-937.2	208.4	4926.8
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4942.2	-921.7	208.2	4976.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4942.3	-918.8	158.2	4977.0
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	4967.3	-911.0	158.0	5002.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4967.5	-908.1	133.0	5002.1
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	4992.5	-900.3	132.9	5027.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4992.7	-897.4	107.9	5027.3
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	5012.7	-891.2	107.7	5047.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5012.9	-888.3	87.7	5047.5
5m 1/4" wire		2.1	1	2.1	5.0	1.6	1.6	5017.9	-886.7	87.5	5052.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5018.1	-883.8	82.5	5052.7
5m 3/8" TC		19.0	1	19.0	5.0	22.4	22.4	5023.1	-861.4	82.3	5057.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5023.3	-858.4	77.3	5057.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5027.3	-1078.1	77.1	5061.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5027.5	-1075.2	73.1	5062.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5031.5	-1294.9	72.9	5066.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5031.7	-1291.9	68.9	5066.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5035.7	-1511.6	68.7	5070.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5035.9	-1508.7	64.7	5070.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5039.9	-1728.4	64.5	5074.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5040.1	-1725.4	60.5	5074.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5044.1	-1945.1	60.3	5078.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5044.3	-1942.2	56.3	5078.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5048.3	-2161.9	56.1	5082.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5048.5	-2158.9	52.1	5083.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5052.5	-2378.6	51.9	5087.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5052.7	-2375.7	47.9	5087.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5056.7	-2595.4	47.7	5091.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5056.9	-2592.4	43.7	5091.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5060.9	-2812.1	43.5	5095.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5061.1	-2809.2	39.5	5095.7
5m 1/2" TC		23.8	1	23.8	5.0	22.4	22.4	5066.1	-2786.8	39.3	5100.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5066.3	-2782.1	34.3	5100.9
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5067.3	-2636.6	34.1	5101.9
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5068.3	-2632.1	33.1	5102.9
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5068.5	-2622.7	32.1	5103.1
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5068.7	-2616.7	31.9	5103.3
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5073.7	-2594.4	31.7	5108.3
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5074.0	-2589.7	26.7	5108.6
20m 1" Nylon		0.9	1	0.9	20.0	0.6	0.6	5094.0	-2589.1	26.4	5128.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5094.2	-2584.4	6.4	5128.8
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5099.2	-2562.0	6.2	5133.8
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5099.4	-2556.1	1.2	5134.0
4,000 lb Mace Anchor		4000.0	1	4000.0	1.0	4000.0	4000.0	5100.4	1443.9	1	5135.0

PO Mooring for MMP K-2											
Mooring ID	NEW				Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0	0	5085.6	66.4
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5085.6	67.4
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5084.6	67.7
5m 3/4" PC		92.3	1	92.3	5.0	86.6	86.6	6.3	-2905.4	5084.3	72.7
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2900.0	5079.3	72.9
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	6.7	-2893.1	5079.1	73.1
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	6.9	-2889.5	5078.9	73.3
Stopper (35m)		11.4	1	11.4	0.0	0.0	0.0	6.9	-2889.5	5078.7	73.3
4,500m 1/4" wire		1890.0	1	1890.0	4500.0	1395.0	1395.0	4506.9	-1494.5	5078.7	4573.3
MMP		154.3	1	154.3	0.0	0.0	0.0	4506.9	-1494.5	578.7	4573.3
Stopper		11.4	1	11.4	0.5	0.0	0.0	4507.4	-1494.5	578.7	4573.8
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	4507.6	-1490.9	578.2	4574.0
Swivel		11.0	1	11.0	0.2	7.0	7.0	4507.8	-1483.9	578.0	4574.2
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	4508.0	-1480.3	577.8	4574.4
10m 1/4" wire		8.4	1	8.4	10.0	3.1	3.1	4518.0	-1477.2	577.6	4584.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4518.2	-1474.3	567.6	4584.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4522.2	-1693.9	567.4	4588.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4522.4	-1691.0	563.4	4588.8
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	4524.4	-1800.8	563.2	4590.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4524.6	-1797.9	561.2	4591.0
430m 1/4" wire		182.7	1	182.7	430.9	134.4	134.4	4955.5	-1663.5	561.0	5021.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4955.7	-1660.6	130.1	5022.1
50m 1/4" wire		21.2	1	21.2	50.0	15.6	15.6	5005.7	-1645.0	129.9	5072.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5005.9	-1642.0	80.0	5072.2
7.6m 3/8" TC		36.2	1	36.2	7.6	34.0	34.0	5013.5	-1608.0	79.8	5079.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5013.6	-1605.1	72.2	5080.0
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5017.6	-1824.8	72.0	5084.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5017.8	-1821.8	68.0	5084.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5021.8	-2041.5	67.8	5088.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5022.0	-2038.6	63.8	5088.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5026.0	-2258.3	63.6	5092.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5026.2	-2255.3	59.6	5092.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5030.2	-2475.0	59.4	5096.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5030.4	-2472.1	55.4	5096.8
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5034.4	-2691.8	55.2	5100.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5034.6	-2688.8	51.2	5101.0
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5038.6	-2908.5	51.0	5105.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5038.8	-2905.6	47.0	5105.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5042.8	-3125.3	46.8	5109.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5043.0	-3122.3	42.8	5109.4
5m 1/2" TC		23.8	1	23.8	6.2	22.4	22.4	5049.2	-3100.0	42.6	5115.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5049.4	-3095.3	36.4	5115.8
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5050.4	-2949.8	36.2	5116.8
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5051.4	-2945.3	35.2	5117.8
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5051.7	-2935.8	34.2	5118.0
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5051.9	-2929.9	34.0	5118.3
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5056.9	-2907.5	33.7	5123.3
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5057.1	-2902.8	28.7	5123.5
20m 1" Nylon		0.9	1	0.9	22.1	0.7	0.7	5079.2	-2902.2	28.5	5145.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5079.4	-2897.5	6.4	5145.8
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5084.4	-2875.1	6.2	5150.8
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5084.6	-2869.2	1.2	5151.0
4,666 lb Mace Anchor		4666.0	1	4666.0	1.0	4666.0	4666.0	5085.6	1796.8	1	5152.0

PS Mooring for Biogeochemical Sensors and Samples for K-2											
Mooring ID	Joint	In the Air			Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below

Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0.0	0	5166.6	39.6
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5166.6	40.6
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5165.6	40.8
5m 3/4" PC		92.2	1	92.2	5.0	88.2	88.2	6.3	-2903.8	5165.4	45.8
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2898.5	5160.4	46.1
SID		198.4	1	198.4	1.8	130.1	130.1	8.3	-2768.4	5160.1	47.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	8.5	-2764.1	5158.3	48.1
WTS		99.2	1	99.2	0.3	77.2	77.2	8.9	-2687.0	5158.1	48.4
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	1.0	33.8	33.8	9.9	-2653.2	5157.8	49.4
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	10.1	-2648.9	5156.8	49.7
RAS		325.0	1	325.0	1.1	125.0	125.0	11.2	-2523.9	5156.5	50.8
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	0.8	33.8	33.8	12.0	-2490.1	5155.4	51.6
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	12.2	-2485.8	5154.6	51.8
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	13.2	-2463.0	5154.4	52.8
ZPS		167.6	1	167.6	0.9	57.3	57.3	14.2	-2405.7	5153.4	53.7
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	15.2	-2382.8	5152.5	54.7
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.4	-2378.6	5151.5	54.9
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	15.6	-2371.6	5151.3	55.1
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.8	-2367.3	5151.1	55.3
50m 5/16" wire		34.9	1	34.9	50.5	23.8	23.8	66.3	-2343.6	5150.9	105.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	66.5	-2339.3	5100.3	106.1
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	116.6	-2315.8	5100.1	156.2
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	116.8	-2311.0	5050.0	156.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	117.8	-2297.5	5049.8	157.4
Sediment Trap 150m		167.6	1	167.6	1.5	77.2	77.2	119.4	-2220.3	5048.8	158.9
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	120.4	-2206.8	5047.3	159.9
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	120.4	-2205.9	5046.3	160.0
3.45 m 3/8"TC		16.4	1	16.4	3.5	15.4	15.4	123.9	-2190.4	5046.2	163.4
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	124.1	-2186.8	5042.8	163.6
43.4m 5/16" wire		30.0	1	30.0	43.5	20.4	20.4	167.5	-2166.4	5042.6	207.1
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	167.7	-2162.2	4999.1	207.3
50m 5/16" wire		34.5	1	34.5	50.1	23.5	23.5	217.8	-2138.6	4998.9	257.4
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	218.0	-2133.8	4948.8	257.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	219.0	-2120.3	4948.6	258.6
Sediment Trap 250m		167.6	1	167.6	1.5	77.2	77.2	220.5	-2043.1	4947.6	260.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	221.5	-2029.6	4946.1	261.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	221.6	-2028.7	4945.1	261.2
1.7 m 3/8"TC		8.1	1	8.1	1.7	7.6	7.6	223.3	-2021.1	4945.0	262.9
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	223.5	-2017.5	4943.3	263.1
93.4m 5/16" wire		64.4	1	64.4	93.4	43.9	43.9	316.9	-1973.6	4943.1	356.4
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	317.1	-1969.4	4849.8	356.7
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	367.2	-1945.8	4849.5	406.7
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	367.4	-1941.0	4799.5	407.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	368.4	-1927.5	4799.2	408.0
Sediment Trap 400m		167.6	1	167.6	1.5	77.2	77.2	369.9	-1850.3	4798.2	409.5
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	370.9	-1836.8	4796.7	410.5
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	371.0	-1835.9	4795.7	410.5
1.9 m 3/8"TC		9.0	1	9.0	1.9	8.5	8.5	372.9	-1827.4	4795.7	412.4
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	373.1	-1823.8	4793.8	412.6
43.4m 5/16" wire		30.0	1	30.0	43.5	20.4	20.4	416.5	-1803.4	4793.6	456.1
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	416.7	-1799.1	4750.1	456.3
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	466.8	-1775.6	4749.9	506.4
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	467.0	-1770.8	4699.8	506.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	468.0	-1757.3	4699.6	507.6
Sediment Trap 500m		167.6	1	167.6	1.5	77.2	77.2	469.5	-1680.1	4698.6	509.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	470.5	-1666.6	4697.1	510.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	470.6	-1665.7	4696.1	510.2
2.6 m 3/8"TC		12.4	1	12.4	2.6	11.6	11.6	473.2	-1654.1	4696.0	512.8
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	473.4	-1650.5	4693.4	513.0
43.4m 5/16" wire		30.0	1	30.0	43.5	20.4	20.4	516.8	-1630.0	4693.2	556.4

(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	517.1	-1625.8	4649.8	556.6
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	567.1	-1602.3	4649.6	606.7
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	567.4	-1597.4	4599.5	606.9
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	568.4	-1583.9	4599.3	607.9
Sediment Trap 600m		167.6	1	167.6	1.5	77.2	77.2	569.9	-1506.8	4598.3	609.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	570.9	-1493.3	4596.8	610.4
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	570.9	-1492.3	4595.8	610.5
1.9 m 3/8"TC		9.0	1	9.0	1.9	8.5	8.5	572.8	-1483.8	4595.7	612.4
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	573.0	-1480.2	4593.8	612.6
143.4m 5/16" wire		99.0	1	99.0	143.5	67.4	67.4	716.5	-1412.8	4593.6	756.1
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	716.7	-1408.6	4450.1	756.3
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	766.8	-1385.0	4449.9	806.3
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	767.0	-1380.2	4399.9	806.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	768.0	-1366.7	4399.6	807.6
Sediment Trap 800m		167.6	1	167.6	1.5	77.2	77.2	769.5	-1289.5	4398.6	809.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	770.5	-1276.0	4397.1	810.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	770.6	-1275.1	4396.1	810.1
2.2 m 3/8"TC		10.5	1	10.5	2.2	9.8	9.8	772.8	-1265.3	4396.1	812.3
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	773.0	-1261.7	4393.9	812.5
143.4m 5/16" wire		99.0	1	99.0	143.5	67.4	67.4	916.4	-1194.3	4393.7	956.0
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	916.6	-1190.0	4250.2	956.2
50m 5/16" wire		34.6	1	34.6	50.1	23.5	23.5	966.7	-1166.5	4250.0	1006.3
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	966.9	-1161.6	4199.9	1006.5
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	967.9	-1148.1	4199.7	1007.5
Sediment Trap 1000m		167.6	1	167.6	1.5	77.2	77.2	969.4	-1071.0	4198.7	1009.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	970.4	-1057.5	4197.2	1010.0
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	970.5	-1056.5	4196.2	1010.1
1.24 m 3/8"TC		5.9	1	5.9	1.2	5.5	5.5	971.7	-1051.0	4196.1	1011.3
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	971.9	-1047.4	4194.9	1011.5
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	972.1	-1040.4	4194.7	1011.7
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	972.3	-1036.8	4194.5	1011.9
16.3m 1/4" wire		6.8	1	6.8	16.3	5.1	5.1	988.6	-1031.8	4194.3	1028.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	988.8	-1028.8	4178.0	1028.4
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	1008.8	-1022.6	4177.8	1048.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1009.0	-1019.7	4157.8	1048.6
10m 1/4" wire		4.2	1	4.2	10.0	3.1	3.1	1019.0	-1016.6	4157.6	1058.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1019.2	-1013.7	4147.6	1058.8
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	1519.2	-858.7	4147.4	1558.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1519.4	-855.7	3647.4	1559.0
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	1523.4	-1075.4	3647.2	1563.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1523.6	-1072.5	3643.2	1563.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	1527.6	-1292.2	3643.0	1567.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1527.8	-1289.2	3639.0	1567.4
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	1529.8	-1399.1	3638.8	1569.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1530.0	-1396.2	3636.8	1569.6
385m 1/4" wire		161.7	1	161.7	385.0	119.4	119.4	1915.0	-1276.8	3636.6	1954.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1915.2	-1273.9	3251.6	1954.8
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	1965.2	-1258.4	3251.4	2004.8
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	1965.4	-1255.3	3201.4	2005.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1966.4	-1241.8	3201.2	2006.0
Sediment Trap 2000m		167.6	1	167.6	1.5	77.2	77.2	1967.9	-1164.6	3200.2	2007.5
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1968.9	-1151.1	3198.7	2008.5
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	1969.0	-1150.2	3197.7	2008.5
1.81m 3/8"TC		8.6	1	8.6	1.8	8.1	8.1	1970.8	-1142.1	3197.7	2010.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1971.0	-1139.2	3195.9	2010.5
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	2471.0	-984.2	3195.7	2510.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2471.2	-981.2	2695.7	2510.7
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	2971.2	-826.2	2695.5	3010.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2971.3	-823.3	2195.5	3010.9
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	2991.3	-817.1	2195.3	3030.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2991.5	-814.2	2175.3	3031.1
10m 1/4" wire		4.2	1	4.2	10.0	3.1	3.1	3001.5	-811.1	2175.1	3041.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3001.7	-808.1	2165.1	3041.3

17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3005.7	-1027.8	2164.9	3045.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3005.9	-1024.9	2160.9	3045.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3009.9	-1244.6	2160.7	3049.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3010.1	-1241.6	2156.7	3049.7
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	3012.1	-1351.5	2156.5	3051.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3012.3	-1348.5	2154.5	3051.9
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	3512.3	-1193.5	2154.3	3551.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3512.5	-1190.6	1654.3	3552.1
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	4012.5	-1035.6	1654.1	4052.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4012.7	-1032.7	1154.1	4052.3
500m 1/4" wire		210.0	1	210.0	500.0	155.0	155.0	4512.7	-877.7	1153.9	4552.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4512.9	-874.7	653.9	4552.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4516.9	-1094.4	653.7	4556.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4517.1	-1091.5	649.7	4556.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4521.1	-1311.2	649.5	4560.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4521.3	-1308.2	645.5	4560.9
200m 1/4" wire		84.0	1	84.0	200.0	62.0	62.0	4721.3	-1246.2	645.3	4760.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4721.5	-1243.3	445.3	4761.1
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4771.5	-1227.8	445.1	4811.1
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4771.7	-1224.7	395.1	4811.3
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4772.7	-1211.2	394.9	4812.3
Sediment Trap 4810.8m		167.6	1	167.6	1.5	77.2	77.2	4774.2	-1134.1	393.9	4813.8
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4775.2	-1120.6	392.4	4814.8
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4775.3	-1119.6	391.4	4814.8
2.32m 3/8"TC		11.0	1	11.0	2.3	10.4	10.4	4777.6	-1109.3	391.4	4817.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4777.8	-1106.3	389.0	4817.4
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4827.8	-1090.8	388.8	4867.4
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4828.0	-1087.7	338.8	4867.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4829.0	-1074.2	338.6	4868.6
Sediment Trap 4867m		167.6	1	167.6	1.5	77.2	77.2	4830.5	-997.1	337.6	4870.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4831.5	-983.6	336.1	4871.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4831.6	-982.6	335.1	4871.1
1.76m 3/8"TC		8.4	1	8.4	1.8	7.9	7.9	4833.3	-974.8	335.1	4872.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4833.5	-971.8	333.3	4873.1
200m 1/4" wire		84.0	1	84.0	200.0	62.0	62.0	5033.5	-909.8	333.1	5073.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5033.7	-906.9	133.1	5073.3
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	5053.7	-900.7	132.9	5093.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5053.9	-897.8	112.9	5093.5
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	5073.9	-891.6	112.7	5113.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5074.1	-888.6	92.7	5113.7
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5079.1	-866.3	92.5	5118.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5079.3	-863.3	87.5	5118.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5083.3	-1083.0	87.3	5122.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5083.5	-1080.1	83.3	5123.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5087.5	-1299.8	83.1	5127.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5087.7	-1296.8	79.1	5127.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5091.7	-1516.5	78.9	5131.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5091.9	-1513.6	74.9	5131.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5095.9	-1733.3	74.8	5135.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5096.1	-1730.3	70.8	5135.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5100.1	-1950.0	70.6	5139.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5100.3	-1947.1	66.6	5139.8
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5104.3	-2166.8	66.4	5143.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5104.5	-2163.8	62.4	5144.0
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5108.5	-2383.5	62.2	5148.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5108.7	-2380.6	58.2	5148.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5112.7	-2600.3	58.0	5152.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5112.9	-2597.3	54.0	5152.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5116.9	-2817.0	53.8	5156.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5117.0	-2814.1	49.8	5156.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5121.0	-3033.8	49.6	5160.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5121.2	-3030.8	45.6	5160.8
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5125.2	-3250.5	45.4	5164.8

(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5125.4	-3247.6	41.4	5165.0
5m 1/2" TC		23.8	1	23.8	5.0	22.4	22.4	5130.4	-3225.2	41.2	5170.0
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5130.7	-3220.5	36.2	5170.2
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5131.7	-3075.0	36.0	5171.2
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5132.7	-3070.5	35.0	5172.2
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5132.9	-3061.1	34.0	5172.4
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5133.1	-3055.1	33.8	5172.7
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5138.1	-3032.8	33.5	5177.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5138.3	-3028.1	28.5	5177.9
20m 1" Nylon		0.9	1	0.9	21.9	0.7	0.7	5160.2	-3027.4	28.3	5199.8
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5160.4	-3022.8	6.4	5200.0
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5165.4	-3000.4	6.2	5205.0
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5165.6	-2994.4	1.2	5205.2
4,000 lb Mace Anchor		4000.0	1	4000.0	1.0	4000.0	4000.0	5166.6	1005.6	1	5206.2

PO Mooring for MMP K-3											
Mooring ID	NEW				Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0	0	5383.9	66.1
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5383.9	67.1
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5382.9	67.3
5m 3/4" PC		92.3	1	92.3	5.0	86.6	86.6	6.3	-2905.4	5382.7	72.3
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2900.0	5377.7	72.6
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	6.7	-2893.1	5377.4	72.7
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	6.9	-2889.5	5377.3	73.0
Stopper (35m)		11.4	1	11.4	0.0	0.0	0.0	6.9	-2889.5	5377.0	73.0
4,500m 1/4" wire		1890.0	1	1890.0	4500.0	1395.0	1395.0	4506.9	-1494.5	5377.0	4573.0
MMP		154.3	1	154.3	0.0	0.0	0.0	4506.9	-1494.5	877.0	4573.0
Stopper		11.4	1	11.4	0.5	0.0	0.0	4507.4	-1494.5	877.0	4573.5
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	4507.6	-1490.9	876.5	4573.7
Swivel		11.0	1	11.0	0.2	7.0	7.0	4507.8	-1483.9	876.3	4573.8
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	3.6	1	3.6	0.2	3.6	3.6	4508.0	-1480.3	876.2	4574.0
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	4528.0	-1484.7	876.0	4594.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4528.2	-1481.7	856.0	4594.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4532.2	-1701.4	855.8	4598.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4532.4	-1698.5	851.8	4598.4
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	4534.4	-1808.3	851.6	4600.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4534.6	-1805.4	849.6	4600.6
500m 1/4" wire		209.8	1	209.8	499.5	154.9	154.9	5034.1	-1650.6	849.4	5100.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5034.3	-1647.6	349.8	5100.4
200m 1/4" wire		84.0	1	84.0	199.9	62.0	62.0	5234.2	-1585.6	349.6	5300.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5234.4	-1582.7	149.7	5300.5
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	5284.4	-1567.2	149.5	5350.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5284.6	-1564.3	99.5	5350.7
19.93m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	5304.6	-1558.1	99.3	5370.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5304.8	-1555.1	79.3	5370.9
2.86m 3/8" TC		13.6	1	13.6	2.9	12.8	12.8	5307.7	-1542.4	79.1	5373.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5307.9	-1555.1	76.3	5373.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5311.9	-1774.8	76.1	5377.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5312.1	-1771.9	72.1	5378.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5316.1	-1991.6	71.9	5382.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5316.3	-1988.6	67.9	5382.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5320.3	-2208.3	67.7	5386.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5320.5	-2205.4	63.7	5386.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5324.5	-2425.1	63.5	5390.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5324.7	-2422.1	59.5	5390.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5328.7	-2641.8	59.3	5394.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5328.8	-2638.9	55.3	5394.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5332.8	-2858.6	55.1	5398.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5333.0	-2855.6	51.1	5399.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5337.0	-3075.3	50.9	5403.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5337.2	-3072.4	46.9	5403.3

17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5341.2	-3075.3	46.7	5407.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5341.4	-3072.4	42.7	5407.5
5m 1/2" TC		23.8	1	23.8	6.2	22.4	22.4	5347.6	-3050.0	42.5	5413.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5347.9	-3045.3	36.3	5413.9
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5348.9	-2899.8	36.1	5414.9
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5349.9	-2895.4	35.1	5415.9
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5350.1	-2885.9	34.1	5416.1
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5350.3	-2879.9	33.9	5416.4
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5355.3	-2857.6	33.6	5421.4
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5355.5	-2852.9	28.6	5421.6
20m 1" Nylon		1.0	1	1.0	22.0	0.7	0.7	5377.5	-2852.2	28.4	5443.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5377.7	-2847.6	6.4	5443.8
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5382.7	-2825.2	6.2	5448.8
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5382.9	-2819.3	1.2	5449.0
4,666 lb Mace Anchor		4666.0	1	4666.0	1.0	4666.0	4666.0	5383.9	1846.7	1.0	5450.0

PS Mooring for Biogeochemical Sensors and Samples for K-3											
Mooring ID	Joint	In the Air			Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0.0	0	5426.1	43.9
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5426.1	44.9
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5425.1	45.1
5m 3/4" PC		92.2	1	92.2	5.0	88.2	88.2	6.3	-2903.8	5424.9	50.1
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2898.5	5419.9	50.4
SID		198.4	1	198.4	1.8	130.1	130.1	8.3	-2768.4	5419.6	52.2
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	8.5	-2764.1	5417.8	52.4
WTS		99.2	1	99.2	0.3	77.2	77.2	8.9	-2687.0	5417.6	52.7
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	1.0	33.8	33.8	9.9	-2653.2	5417.3	53.7
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	10.1	-2648.9	5416.3	54.0
RAS		325.0	1	325.0	1.1	125.0	125.0	11.2	-2523.9	5416.0	55.1
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	0.8	33.8	33.8	12.0	-2490.1	5414.9	55.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	12.2	-2485.8	5414.1	56.1
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	13.2	-2463.0	5413.9	57.1
ZPS		167.6	1	167.6	0.9	57.3	57.3	14.2	-2405.7	5412.9	58.0
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	15.2	-2382.8	5412.0	59.0
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.4	-2378.6	5411.0	59.3
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	15.6	-2371.6	5410.7	59.4
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.8	-2367.3	5410.6	59.6
500m 5/16" wire		345.4	1	345.4	500.6	235.3	235.3	516.4	-2132.1	5410.4	560.2
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	516.6	-2127.8	4909.8	560.5
403.6m 5/16" wire		278.4	1	278.4	403.5	189.6	189.6	920.1	-1938.2	4909.5	964.0
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	920.3	-1933.9	4506.0	964.2
50m 5/16" wire		34.6	1	34.6	50.1	23.6	23.6	970.4	-1910.4	4505.8	1014.3
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	970.6	-1905.5	4455.7	1014.5
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	971.6	-1892.0	4455.5	1015.5
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	973.2	-1814.9	4454.5	1017.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	974.2	-1801.4	4453.0	1018.0
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	974.2	-1800.4	4452.0	1018.1
1.31m 3/8"TC		6.2	1	6.2	1.3	5.9	5.9	975.5	-1794.6	4451.9	1019.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	975.7	-1791.6	4450.6	1019.6
500m 1/4" wire		210.8	1	210.8	502.0	155.6	155.6	1477.7	-1636.0	4450.4	1521.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1477.9	-1633.1	3948.4	1521.8
440.1m 1/4" wire		185.2	1	185.2	441.0	136.7	136.7	1918.9	-1496.4	3948.2	1962.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1919.1	-1493.4	3507.2	1963.0
50m 1/4" wire		21.1	1	21.1	50.2	15.6	15.6	1969.3	-1477.9	3507.0	2013.2
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	1969.5	-1474.8	3456.8	2013.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1970.5	-1461.3	3456.6	2014.4
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	1972.1	-1384.1	3455.6	2015.9
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1973.1	-1370.6	3454.1	2016.9
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	1973.1	-1369.7	3453.1	2017.0
2.43m 3/8"TC		11.6	1	11.6	2.4	10.9	10.9	1975.5	-1358.8	3453.0	2019.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1975.7	-1355.9	3450.6	2019.6
500m 1/4" wire		210.4	1	210.4	501.1	155.3	155.3	2476.8	-1200.6	3450.4	2520.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2477.0	-1197.6	2949.3	2520.9
500m 1/4" wire		210.4	1	210.4	501.0	155.3	155.3	2978.0	-1042.3	2949.1	3021.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2978.2	-1039.4	2448.2	3022.0
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	2998.2	-1033.2	2448.0	3042.0

(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2998.4	-1030.3	2428.0	3042.2
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	3018.4	-1024.1	2427.8	3062.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3018.5	-1021.1	2407.8	3062.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3022.5	-1240.8	2407.6	3066.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3022.7	-1237.9	2403.6	3066.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3026.7	-1457.6	2403.4	3070.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3026.9	-1454.6	2399.4	3070.8
500m 1/4" wire		210.4	1	210.4	500.9	155.3	155.3	3527.9	-1299.3	2399.2	3571.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3528.1	-1296.4	1898.3	3571.9
500m 1/4" wire		210.3	1	210.3	500.6	155.2	155.2	4028.7	-1141.2	1898.1	4072.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4028.9	-1138.3	1397.4	4072.7
500m 1/4" wire		210.3	1	210.3	500.6	155.2	155.2	4529.5	-983.1	1397.3	4573.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4529.7	-980.2	896.6	4573.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4533.7	-1199.9	896.4	4577.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4533.9	-1196.9	892.4	4577.8
200m 1/4" wire		84.2	1	84.2	200.4	62.1	62.1	4734.3	-1134.8	892.3	4778.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4734.5	-1131.9	691.8	4778.4
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4784.5	-1116.4	691.6	4828.4
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4784.7	-1113.3	641.6	4828.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4785.7	-1099.8	641.4	4829.6
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	4787.2	-1022.6	640.4	4831.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4788.2	-1009.1	638.9	4832.1
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4788.3	-1008.2	637.9	4832.1
2.47m 3/8"TC		11.8	1	11.8	2.5	11.1	11.1	4790.7	-997.1	637.9	4834.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4790.9	-994.2	635.4	4834.8
200m 1/4" wire		84.0	1	84.0	200.0	62.0	62.0	4991.0	-932.2	635.2	5034.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4991.2	-929.3	435.2	5035.0
200m 1/4" wire		84.0	1	84.0	200.1	62.0	62.0	5191.2	-867.2	435.0	5235.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5191.4	-864.3	234.9	5235.3
100m 1/4" wire		42.0	1	42.0	100.0	31.0	31.0	5291.4	-833.3	234.7	5335.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5291.6	-830.4	134.7	5335.5
50m 1/4" wire		21.0	1	21.0	50.1	15.5	15.5	5341.7	-814.9	134.5	5385.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5341.8	-811.9	84.5	5385.7
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5346.8	-789.6	84.3	5390.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5347.0	-786.6	79.3	5390.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5351.0	-1006.3	79.1	5394.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5351.2	-1003.4	75.1	5395.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5355.2	-1223.1	74.9	5399.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5355.4	-1220.1	70.9	5399.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5359.4	-1439.8	70.7	5403.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5359.6	-1436.9	66.7	5403.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5363.6	-1656.5	66.5	5407.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5363.8	-1653.6	62.5	5407.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5367.8	-1873.3	62.3	5411.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5368.0	-1870.4	58.3	5411.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5372.0	-2090.0	58.1	5415.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5372.2	-2087.1	54.1	5416.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5376.2	-2306.8	53.9	5420.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5376.4	-2303.9	49.9	5420.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5380.4	-2523.5	49.7	5424.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5380.6	-2520.6	45.7	5424.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5384.6	-2740.3	45.5	5428.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5384.8	-2737.4	41.5	5428.7
5m 1/2" TC		23.8	1	23.8	5.0	22.4	22.4	5389.8	-2715.0	41.3	5433.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5390.0	-2710.3	36.3	5433.9
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5391.0	-2564.8	36.1	5434.9
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5392.0	-2560.3	35.1	5435.9
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5392.2	-2550.8	34.1	5436.1
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5392.5	-2544.9	33.9	5436.3
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5397.5	-2522.5	33.7	5441.3
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5397.7	-2517.9	28.7	5441.5
20m 1" Nylon		1.0	1	1.0	22.0	0.7	0.7	5419.7	-2517.2	28.5	5463.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5419.9	-2512.5	6.4	5463.8
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5424.9	-2490.2	6.2	5468.8
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5425.1	-2484.2	1.2	5469.0
4,000 lb Mace Anchor		4000.0	1	4000.0	1.0	4000.0	4000.0	5426.1	1515.8	1	5470.0

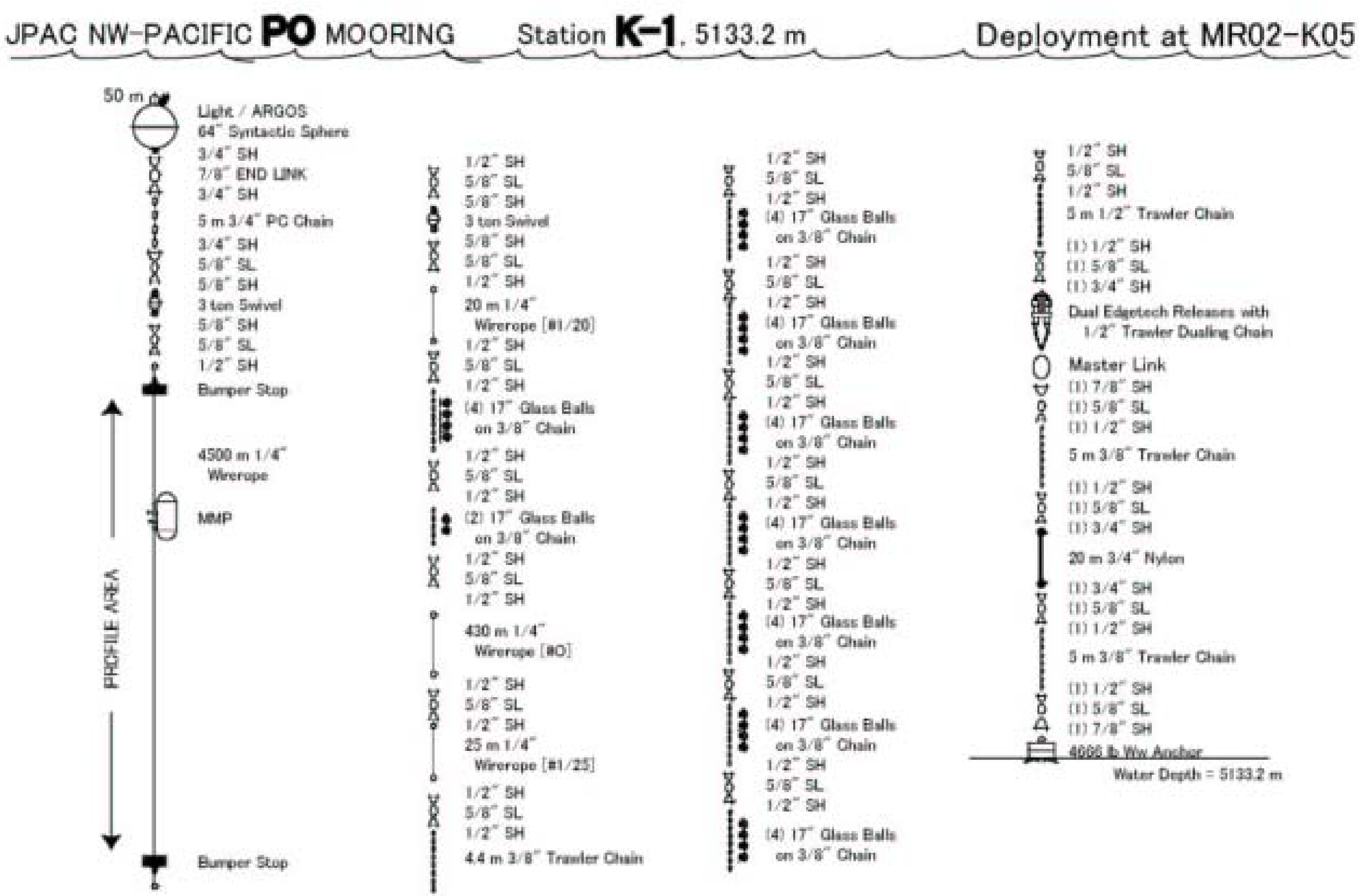
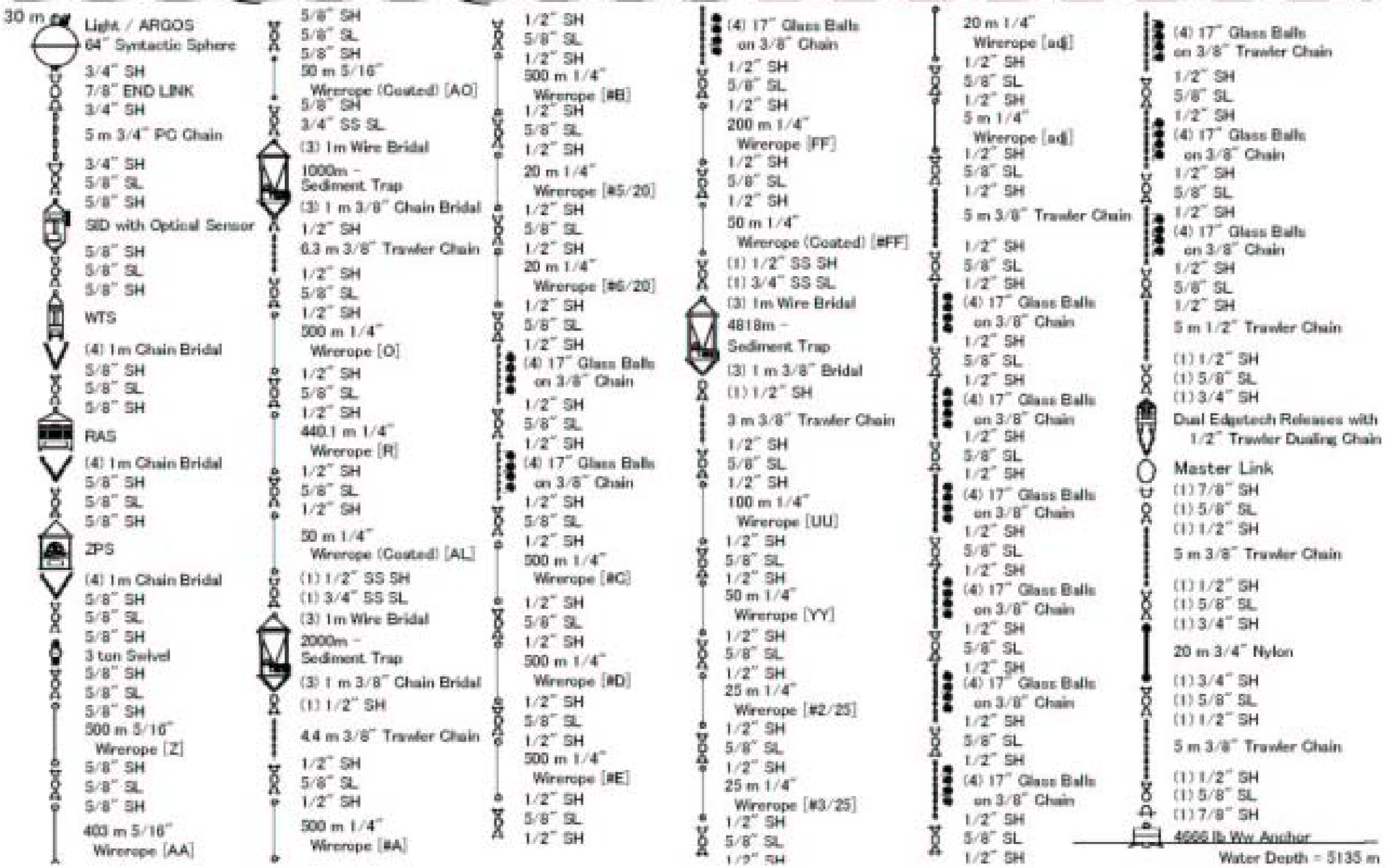
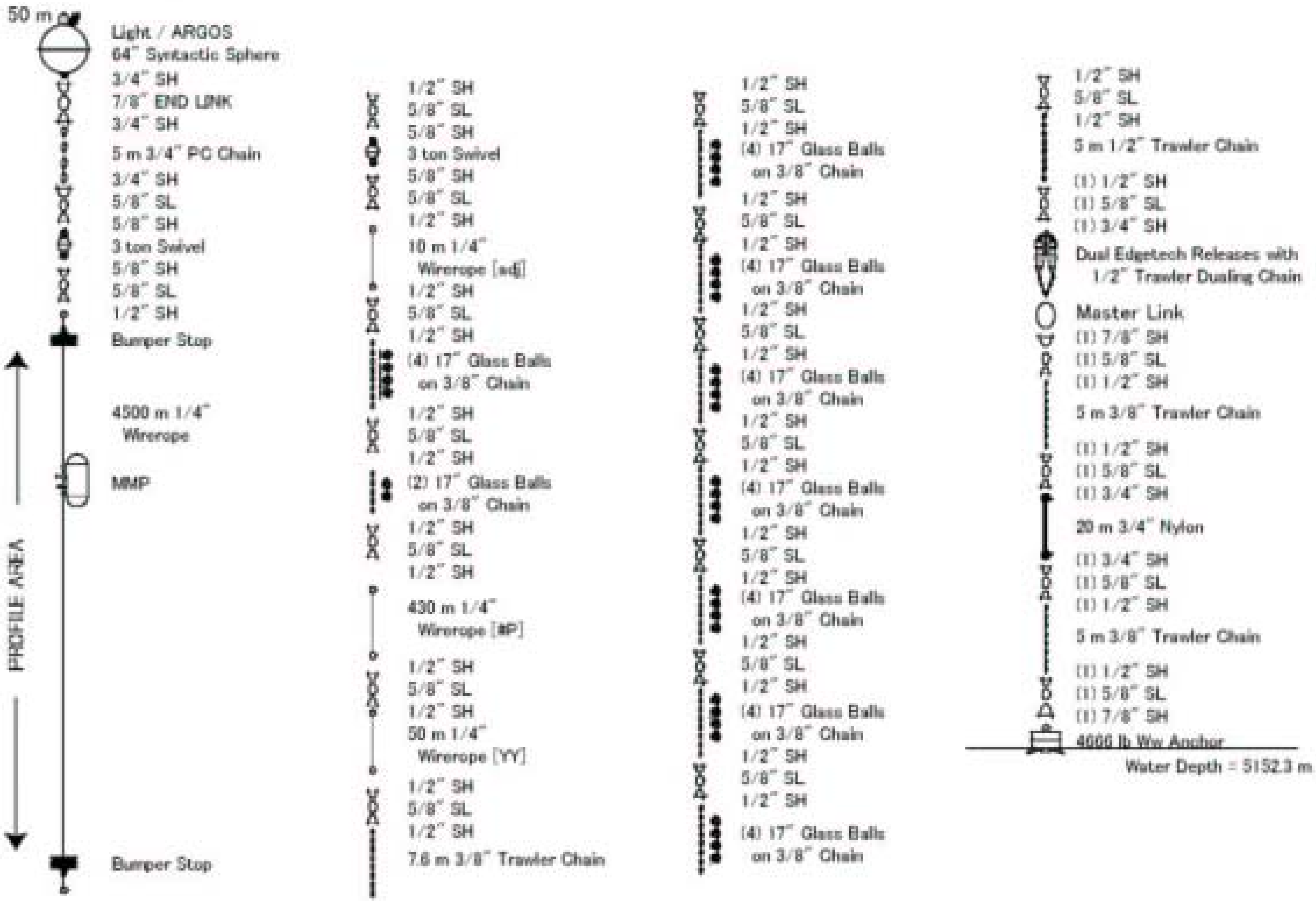


Fig 2.1.1.1 Mooring Figure

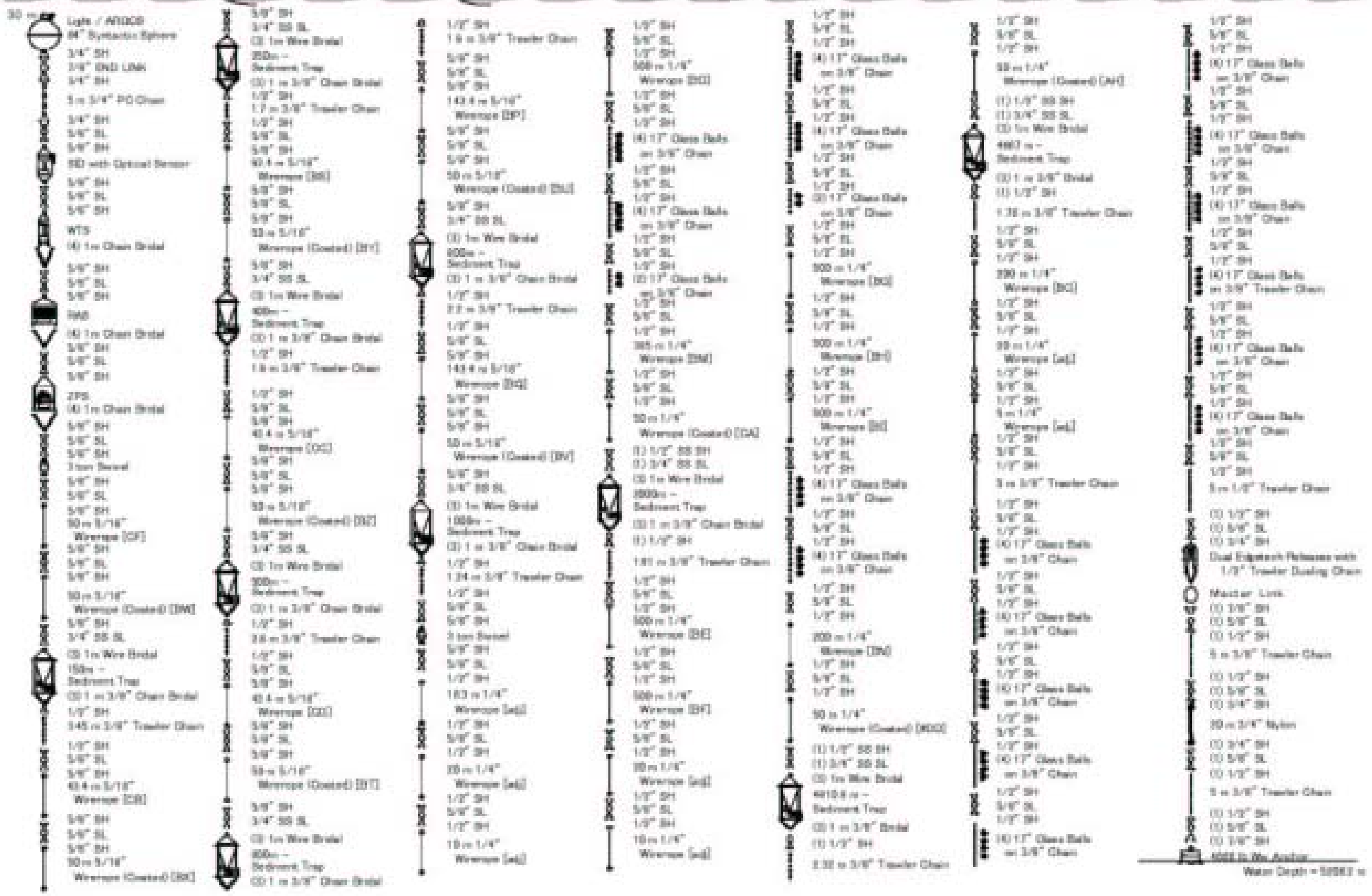
JPAC NW-PACIFIC **BGC** MOORING Station **K-1**, 5135 m Deployment at MR02-K05



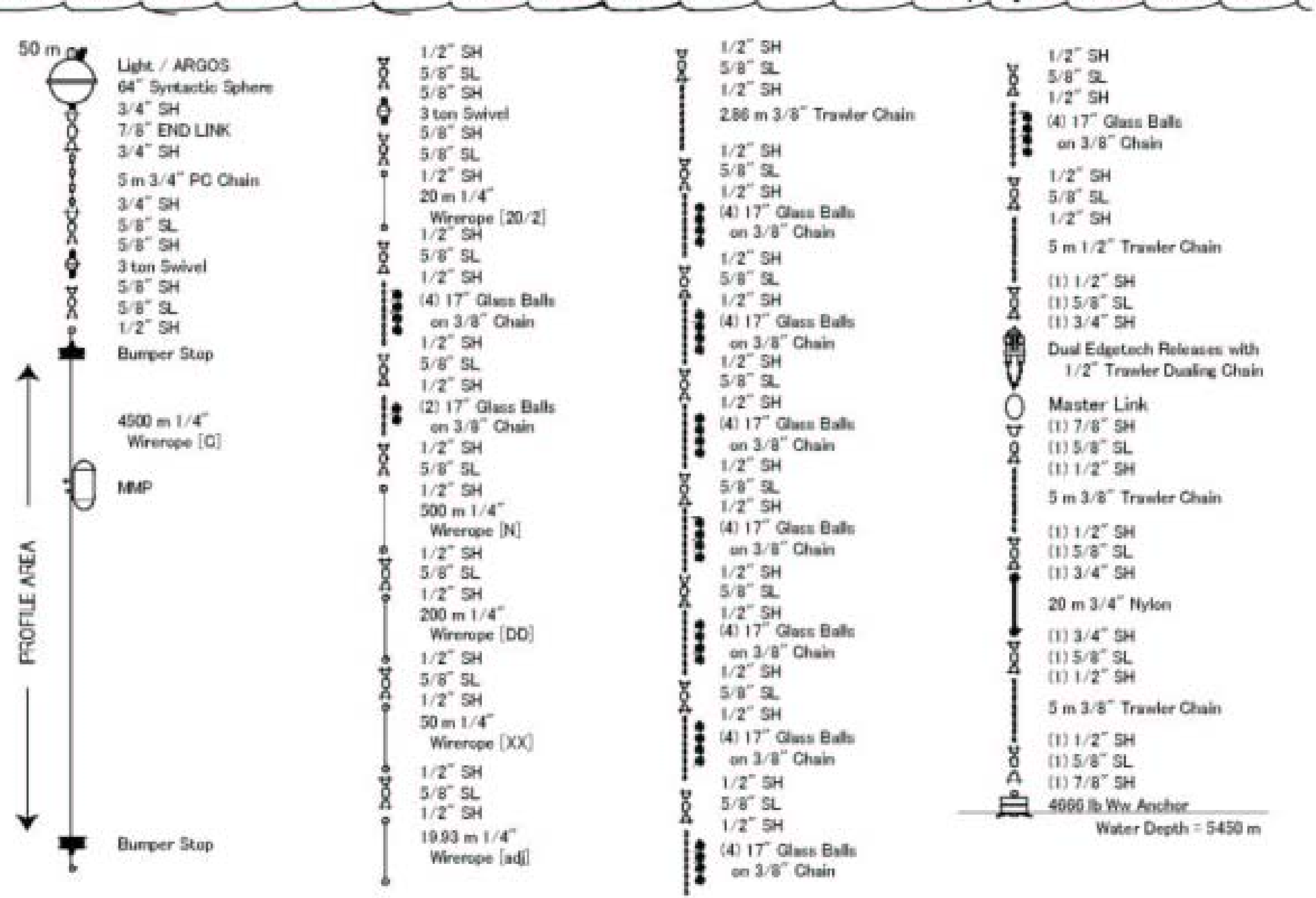
JPAC NW-PACIFIC PO MOORING Station K-2 5152.3 m Deployment at MR02-K05



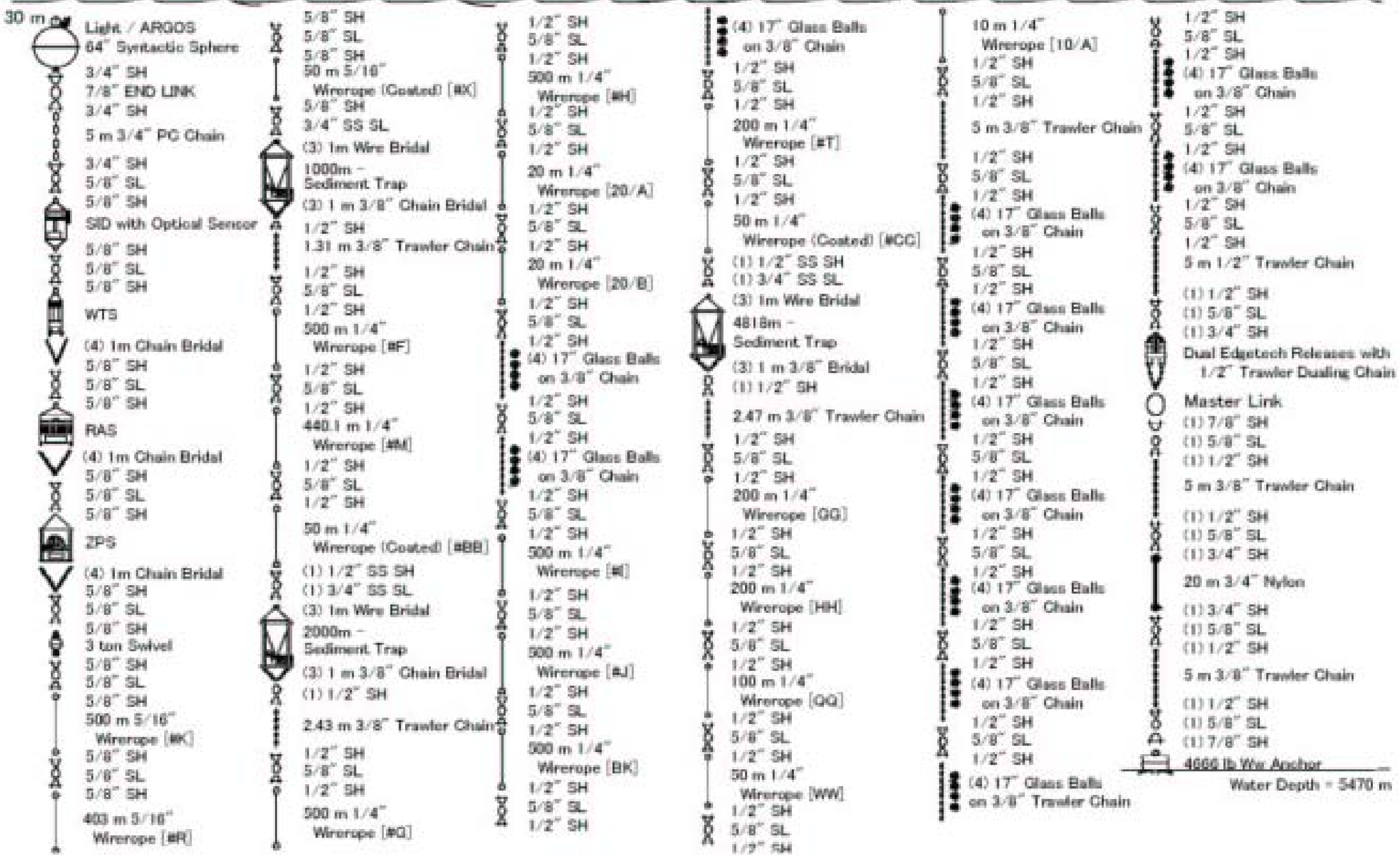
JPAC NW-PACIFIC BGC MOORING Station K-2, 5206.2m Deployment at MR02-K05



JPAC NW-PACIFIC **PO** MOORING Station **K-3**, 5450 m Deployment at MR02-K05



JPAC NW-PACIFIC **BGC** MOORING Station **K-3**, 5470 m Deployment at MR02-K05



2.1.2 Recovery

We recovered one PO mooring at K-1 and two BGC mooring at K-1 and K-2 that were deployed on Oct. 2001 (MR01-K04).

Table 2.1.2.1 Deployment and Recovery record

K-1 PO Mooring **MOORING No.** K1P010904

PROJECT	Time Series	TIME	Sep. 4th 2001
AREA	North Pacific	RECORDER (D) :	Miki Yoshiike
POSITION	Station K-1	RECORDER (R) :	Miki Yoshiike
DEPTH	5,140m	Planned Depth	5,130 m
PERIOD	1 year	NAVIGATION SYSTEM :	
LENGTH :	5,100.1 m	DEPTH of BUOY :	39.9 m BUOYANCY : 1,360 kg

ACOUSTIC RELEASERS			
TYPE	Edgetech	TYPE	Edgetech
S/N	027867	S/N	027809
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	RECEIVE F.	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	TRANSMIT F.	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344573	RELEASE C.	344535
ENABLE C.	(A) 360536 (B) 360553	ENABLE C.	(A) 360320 (B) 360345
DISABLE C.		DISABLE C.	360366
BATTERY	1 year	BATTERY	1 year
RELEASE TEST	OK	RELEASE TEST	OK

DEPLOYMENT					
DATE	Sep. 4th 2001	SHIP	MIRAI	CRUISE No.	MR01-K04
WATHER bc	CONDITIONS smooth	DEPTH	5,140 m	DEPTH of A.R.	5,106.9 m
DIR. And VEL. of WIND	<045> 5.0 m/s	SHIP'S HEAD	<020> 1.0 knot		
POS. of START	51°12'.00N	165°12'.06E		BUOY	19:21
POS. of DEP.	51°18'.18N	165°18'.34E		ANCHOR 00:39	DISAPPEAR 14:19
POS. of MOORING	51°17'.9597N	165°18'.2019E		LANDING	:

RECOVERY					
DATE	Oct. 18th 2002	SHIP	MIRAI	CRUISE No.	MR02-K05
WATHER o	CONDITIONS rough	DEPTH	5,141 m		
DIR. And VEL. of WIND	<290> 6.1 m/s				
SENDING Enable Command	1:27				
SENDING Release Command	6:32	FINISH of RELEASE			6:33
DISTANCE from A.R.		DISCOVERY Top Buoy			6:33
Recovery started at 51°17'.95N 165°18'.24E					

K-1 BGC Mooring **MOORING No.** K1B010905

PROJECT	Time Series	TIME	Sep. 4th 2001
AREA	North Pacific	RECORDER (D) :	Naoko Takahashi
POSITION	Station K-1	RECORDER (R) :	Miki Yoshiike
DEPTH	5,132.4m	Planned Depth	5,130 m
PERIOD	1 year	NAVIGATION SYSTEM :	
LENGTH :	5,098.9 m	DEPTH of BUOY :	33.5 m BUOYANCY : 1,360 kg

ACOUSTIC RELEASERS			
TYPE	Edgetech	TYPE	Edgetech
S/N	027824	S/N	027864
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	RECEIVE F.	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	TRANSMIT F.	(A) 12.0 (B) 11.0 kHz
RELEASE C.	344674	RELEASE C.	344421
ENABLE C.	(A) 361121 (B) 361144	ENABLE C.	(A) 357724 (B) 357741
DISABLE C.	361167	DISABLE C.	357762
BATTERY	1 year	BATTERY	1 year
RELEASE TEST	OK	RELEASE TEST	OK

DEPLOYMENT					
DATE	Sep. 5th 2001	**SHIP**	MIRAI	**CRUISE No.**	MR01-K04
WATHER o **CONDITIONS**	smooth	**DEPTH**	5,132.4 **m**	**DEPTH of A.R.**	5,099.3 **m**
DIR. And VEL. of WIND	<240> 9.6 **m/s**	**DIR. And VEL. Of Current**	<215> 0.3 **knot**		
POS. of START	51°23'.811N	165°23'.421E	**BUOY**	20:08	
POS. of DEP.	51°19'.82N	165°11'.85E	**ANCHOR**	01:53	**DISAPPEAR** 02:30
POS. of MOORING	51°19'.935N	165°12'.278E	**LANDING**	:	
RECOVERY					
DATE	Oct. 17th 2002	**SHIP**	MIRAI	**CRUISE No.**	MR02-K05
WATHER bc **CONDITIONS**	rough	**DEPTH**	5,141 **m**		
DIR. And VEL. of WIND	<000> 7.1 **m/s**				
SENDING Enable Command	5:55				
SENDING Release Command	7:38	**FINISH of RELEASE**	7:39		
DISTANCE from A.R.		**DISCOVERY Top Buoy**	7:39		
Recovery started at 51°19'.83N 165°12'.40E					

K-2 BGC Mooring **MOORING No.** **K2B010909**

PROJECT	Time Series	**TIME**	Sep. 9th 2001
AREA	North Pacific	**RECORDER (D) :**	Naoko Takahashi
POSITION	Station K-2	**RECORDER (R) :**	Miki Yoshiike
DEPTH	5,206.2m	**Planned Depth**	5,267 **m**
PERIOD	1 year	**NAVIGATION SYSTEM :**	
LENGTH :	5,170.1 **m**	**DEPTH of BUOY :** 36.1 **m**	**BUOYANCY :** 1,360 **kg**

ACOUSTIC RELEASERS

TYPE	Edgetech	**TYPE**	Edgetech
S/N	027868	**S/N**	027825
RECEIVE F.	(A) 11.0 (B) 9.0 kHz	**RECEIVE F.**	(A) 11.0 (B) 9.0 kHz
TRANSMIT F.	(A) 12.0 (B) 11.0 kHz	**TRANSMIT F.**	(A) 12.0 (B) 11.0 kHz
RELEASE C.	335534	**RELEASE C.**	344176
ENABLE C.	(A) 322710 (B) 322733	**ENABLE C.**	(A) 356736 (B) 356753
DISABLE C.	322756	**DISABLE C.**	356770
BATTERY	1 year	**BATTERY**	1 year
RELEASE TEST	OK	**RELEASE TEST**	OK

DEPLOYMENT					
DATE	Sep. 9th 2001	**SHIP**	MIRAI	**CRUISE No.**	MR01-K04
WATHER o **CONDITIONS**	smooth	**DEPTH**	5,206.2 **m**	**DEPTH of A.R.**	5,173.1 **m**
DIR. And VEL. of WIND	<223> 2.9 **m/s**	**DIR. And VEL. Of Current**	<050> 0.2 **knot**		
POS. of START	47°04'.680N	160°09'.114E	**BUOY**	21:33	
POS. of DEP.	47°00'.205N	159°57'.924E	**ANCHOR**	03:40	**DISAPPEAR** 04:15
POS. of MOORING	47°00'.324N	159°58'.246E	**LANDING**	:	
RECOVERY					
DATE	Oct. 21st 2002	**SHIP**	MIRAI	**CRUISE No.**	MR02-K05
WATHER bc **CONDITIONS**	rough	**DEPTH**	5,200 **m**		
DIR. And VEL. of WIND	<045> 5.6 **m/s**				
SENDING Enable Command	19:46				
SENDING Release Command	19:49	**FINISH of RELEASE**	19:49		
DISTANCE from A.R.		**DISCOVERY Top Buoy**	19:49		

Table 2.1.2.2 Deployment and Recovery working time record

K-1 PO Mooring MOORING NO. K1P010904

		DEPLOYMENT		RECOVERY	
		DATE : Sep. 4th 2001 START : 19:13 FINISH : 0:39		DATE : Oct. 17th 2002 START : 19:46 FINISH : 22:26	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:18839 F:233	19:21		20:11	
Bumper (40m)		19:21		20:16	
4500m Wire	[A]	19:21		21:56	
MMP	ML11241-01	19:44		21:56	
Bumper (4,540m)		22:09		21:56	
20m Wire	20/1	22:09		22:04	
(6) 17" Glass Balls		22:30		22:06	
430m Wire	[S]	22:31	Changed from 500m Wire	22:17	
25m Wire	25/2	22:47		22:18	
10m Wire	10/1	22:55		22:18	
5m Wire		22:55		22:18	
16.3m Wire	Adj	22:57		22:19	
(28) 17" Glass Balls		23:02		22:23	
Edgetech Releasers	27867 27809	0:33		22:26	
20m Nylon		0:34			
4,000lb Anchor		0:39			

ARGOS : Model 3807 ID 18557
Flasher : Model 204-RS
Recovery : 20m wire and 430m wire were tangled

K-1 BGC Mooring MOORING NO. K1B010905

		DEPLOYMENT		RECOVERY	
		DATE : Sep. 5th 2001 START : 20:04 FINISH : 1:54		DATE : Oct. 16th 2002 START : 22:10 FINISH : 1:45	
ITEM	S/N etc.	TIME	MEMO	TIME	MEMO
Syntactic Sphere ARGOS and Flasher	A:18840 F:236	20:08		22:45	
SID Ocean Optical Seneor	SID:17 OOS:	20:08		22:59	
WTS RAS ZPS	ML11241-14 ML11241-11 ML11241-19	20:08		23:07 23:12 23:12	
500m 5/16" Wire	[Y]	20:08		23:36	
403m 5/16" Wire	[W]	20:36		23:44	
50m 5/16" Wire Coated	[AN]	21:04		23:47	
Sediment Trap_1000m	ML11241-22	21:14	21:18 Deploy Trap again	23:53	
500m 1/4" Wire	[F]	21:18		0:11	
440.1m 1/4" Wire	[Q]	21:38		0:19	
50m 1/4" Wire Coated	[AJ]	21:55		0:21	
Sediment Trap_2000m	ML11241-24	22:03		0:26	
500m 1/4" Wire	[G]	22:03		0:38	
500m 1/4" Wire	[H]	22:16		0:45	
20m 1/4" Wire		22:33		0:46	
28.94m 1/4" Wire	Adj	22:35		0:47	
(8) 17" Glass Balls		22:42		0:50	
500m 1/4" Wire	[I]	22:42		0:59	
500m 1/4" Wire	[J]	22:58		1:05	
500m 1/4" Wire	[K]	23:16		1:12	
(4) 17" Glass Balls		23:40		1:14	
200m 1/4" Wire	[EE]	23:41		1:20	
50m 1/4" Wire Coated	[AK]	0:06		1:21	
Sediment Trap_5000m	ML11241-25	0:14		1:27	

100m 1/4" Wire	[VV]	0:14		1:33	
50m 1/4" Wire	[AB]	0:18		1:34	
25m 1/4" Wire	[25/3]	0:24		1:35	
20m 1/4" Wire	Adj	0:36		1:37	
25m 1/4" Wire	Adj	0:27		1:38	
5m 1/4" Wire		0:34		1:39	
(36) 17" Glass Balls		0:36		1:42	
Dual Releases	027824 027864	1:37		1:45	
20m 3/4" Nylon		1:52			
4,000lb Mace Anchor		1:54			

ARGOS : Model 3807 ID 18558
Flasher : Model 204-RS
DEPLOYMENT : 1,000m Trap has beed tried again because of quick release rope tangled to chain
RECOVERY : 5m and chain were tangled

K-2 BGC Mooring **MOORING NO.** K2B010909

		DEPLOYMENT		RECOVERY	
		DATE : Sep. 9th 2001 START : 21:33 FINISH : 3:40		DATE : Oct. 21st 2002 START : 20:51 FINISH : 0:11	
ITEM	**S/N etc.**	**TIME**	**MEMO**	**TIME**	**MEMO**
Syntactic Sphere ARGOS and Flasher	A:18838 F:235	21:33		21:07	
SID Ocean Optical Seneor	SID:16 OOS:DFLS-072	21:32		21:12	
WTS RAS ZPS	ML11241-15 ML11241-10 ML11241-21	21:32		21:16~21:18	
500m 5/16" Wire	[X]	21:32		21:42	
403m 5/16" Wire	[V]	21:54		21:53	
50m 5/16" Wire Coated	[AM]	22:15		21:55	
Sediment Trap_1000m	ML11241-23	22:23		22:02	
2.3m Trawler Chain	Adj	22:23		22:02	
500m 1/4" Wire	[A]	22:23		22:16	
440.1m 1/4" Wire	[P]	22:42		22:27	
50m 1/4" Wire Coated	[AH]	23:01		22:28	
Sediment Trap_2000m	ML11241-26	23:08		22:33	
500m 1/4" Wire	[B]	23:08		22:47	
500m 1/4" Wire	[C]	23:26		22:58	
50m 1/4" Wire	[AG]	23:50		22:58	
20m 1/4" Wire	[1/20]	23:54		22:59	
25m 1/4" Wire	[1/25]	23:55		23:03	
(8) 17" Glass Balls		0:00		23:06	
500m 1/4" Wire	[D]	0:01		23:19	
500m 1/4" Wire	[E]	0:18		23:30	
500m 1/4" Wire	[M]	0:38		23:41	
(4) 17" Glass Balls		1:02		23:43	
200m 1/4" Wire	[BB]	1:02		23:49	
50m 1/4" Wire Coated	[AI]	1:15		23:51	
Sediment Trap_5000m	ML11241-27	1:22		23:55	
200m 1/4" Wire	[CC]	1:23		0:03	
25m 1/4" Wire	[25/2]	1:34		0:03	
20m 1/4" Wire	[adj]	1:38		0:04	
5m 1/4" Wire	[adj]	1:41		0:06	
(36) 17" Glass Balls		1:42		0:08	
Dual Releases	27825 27868	3:21		0:11	
20m 3/4" Nylon	[#06]	3:36			
4,666lb Mace Anchor		3:40			

ARGOS : Model 3807 ID 18556
Flasher : Model 204-RS
Releaser S/N 27868 response was not clear at 1,000m test.
Recovery : One glass ball was broken.

Table 2.1.2.3 Detail of our mooring system.

PO Mooring for MMP K-1											
Mooring ID	NEW				Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0	0	5100.1	39.9
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5100.1	40.9
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5099.1	41.1
5m 3/4" PC		92.3	1	92.3	5.0	86.6	86.6	6.3	-2905.4	5098.9	46.1
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2900.0	5093.9	46.4
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	6.7	-2893.1	5093.6	46.5
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	3.6	0.2	0.2	10.3	-2892.8	5093.5	50.1
Stopper (35m)		11.4	1	11.4	0.0	0.0	0.0	10.3	-2892.8	5089.9	50.1
4,500m 1/4" wire		1890.0	1	1890.0	4500.0	1395.0	1395.0	4510.3	-1497.8	5089.9	4550.1
MMP		154.3	1	154.3	0.0	0.0	0.0	4510.3	-1497.8	589.9	4550.1
Stopper		11.4	1	11.4	0.5	0.0	0.0	4510.8	-1497.8	589.9	4550.6
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	3.6	0.2	0.2	4514.4	-1497.6	589.4	4554.2
Swivel		11.0	1	11.0	0.2	7.0	7.0	4514.5	-1490.7	585.8	4554.4
(1)1/2"SH, (1)5/8"SL, (1)5/8"SH	[B]	0.2	1	0.2	3.6	0.2	0.2	4518.1	-1490.4	585.6	4558.0
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	4538.1	-1484.2	582.0	4578.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4538.3	-1481.3	562.0	4578.2
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4542.3	-1701.0	561.8	4582.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4542.5	-1698.1	557.8	4582.4
17" glass balls on 3/8"TC		46.9	2	93.8	2.0	-54.9	-109.8	4544.5	-1807.9	557.6	4584.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4544.7	-1805.0	555.6	4584.6
430m 1/4" wire		181.7	1	181.7	429.4	133.3	133.3	4974.2	-1671.7	555.4	5014.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4974.4	-1668.8	126.0	5014.2
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	4999.4	-1661.0	125.8	5039.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4999.6	-1658.1	100.8	5039.4
10m 1/4" wire		4.2	1	4.2	10.0	3.1	3.1	5009.6	-1655.0	100.6	5049.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5009.8	-1652.1	90.6	5049.6
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5014.8	-1629.7	90.4	5054.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5015.0	-1626.7	85.4	5054.8
16.3m 1/4" wire		6.8	1	6.8	16.3	5.1	5.1	5031.3	-1621.7	85.2	5071.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5031.5	-1618.8	68.9	5071.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5035.5	-1838.4	68.7	5075.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5035.6	-1835.5	64.7	5075.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5039.6	-2055.2	64.5	5079.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5039.8	-2052.3	60.5	5079.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5043.8	-2271.9	60.3	5083.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5044.0	-2269.0	56.3	5083.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5048.0	-2488.7	56.1	5087.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5048.2	-2485.8	52.1	5088.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5052.2	-2705.4	51.9	5092.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5052.4	-2702.5	47.9	5092.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5056.4	-2922.2	47.7	5096.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5056.6	-2919.3	43.7	5096.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5060.6	-3138.9	43.5	5100.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5060.8	-3136.0	39.5	5100.7
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5065.8	-3113.6	39.3	5105.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5066.0	-3109.0	34.3	5105.9
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5067.0	-2963.4	34.1	5106.9
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5068.0	-2959.0	33.1	5107.9
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5068.3	-2949.5	32.1	5108.1
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5068.5	-2943.6	31.9	5108.3
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5073.5	-2921.2	31.7	5113.3
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5073.7	-2916.5	26.7	5113.6
20m 1" Nylon		0.9	1	0.9	20.0	0.6	0.6	5093.7	-2915.9	26.4	5133.6
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5093.9	-2911.2	6.4	5133.8
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5098.9	-2888.9	6.2	5138.8
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5099.1	-2882.9	1.2	5139.0
4,666 lb Mace Anchor		4666.0	1	4666.0	1.0	4666.0	4666.0	5100.1	1783.1	1	5140.0

PS Mooring for Biogeochemical Sensors and Samples for K-1											
Mooring ID	Joint	In the Air			Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0.0	0	5098.9	33.5
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5098.9	34.5
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5097.9	34.8
5m 3/4" PC		92.2	1	92.2	5.0	88.2	88.2	6.3	-2903.8	5097.6	39.8
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2898.5	5092.6	40.0
SID		198.4	1	198.4	1.8	130.1	130.1	8.3	-2768.4	5092.4	41.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	8.5	-2764.1	5090.5	42.1
WTS		99.2	1	99.2	0.3	77.2	77.2	8.9	-2687.0	5090.3	42.4
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	1.0	33.8	33.8	9.9	-2653.2	5090.0	43.4
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	10.1	-2648.9	5089.0	43.6
RAS		325.0	1	325.0	1.1	125.0	125.0	11.2	-2523.9	5088.8	44.8
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	0.8	33.8	33.8	12.0	-2490.1	5087.6	45.6
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	12.2	-2485.8	5086.8	45.8
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	13.2	-2463.0	5086.6	46.8
ZPS		167.6	1	167.6	0.9	57.3	57.3	14.2	-2405.7	5085.6	47.7
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	15.2	-2382.8	5084.7	48.7
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.4	-2378.6	5083.7	48.9
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	15.6	-2371.6	5083.5	49.1
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.8	-2367.3	5083.3	49.3
500m 5/16" wire		344.4	1	344.4	499.3	234.5	234.5	515.0	-2132.8	5083.1	548.6
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	515.2	-2128.6	4583.8	548.8
403.6m 5/16" wire		278.0	1	278.0	402.1	189.3	189.3	917.4	-1939.3	4583.6	950.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	917.6	-1935.0	4181.5	951.1
50m 5/16" wire		34.4	1	34.4	50.0	23.5	23.5	967.6	-1911.6	4181.3	1001.1
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	967.8	-1906.8	4131.3	1001.3
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	968.8	-1893.3	4131.1	1002.3
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	970.3	-1816.1	4130.1	1003.8
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	971.3	-1802.6	4128.6	1004.8
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	971.4	-1801.7	4127.6	1004.9
4.75m 3/8"TC		22.6	1	22.6	4.8	21.3	21.3	976.1	-1780.4	4127.5	1009.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	976.3	-1777.5	4122.8	1009.8
500m 1/4" wire		211.6	1	211.6	499.8	155.0	155.0	1476.1	-1622.5	4122.6	1509.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1476.3	-1619.6	3622.8	1509.8
440.1m 1/4" wire		186.2	1	186.2	439.6	136.4	136.4	1915.9	-1483.2	3622.6	1949.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1916.1	-1480.2	3183.0	1949.6
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	1966.1	-1464.7	3182.8	1999.6
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	1966.3	-1461.6	3132.8	1999.8
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1967.3	-1448.1	3132.6	2000.8
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	1968.8	-1371.0	3131.6	2002.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1969.8	-1357.5	3130.0	2003.4
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	1969.9	-1356.5	3129.0	2003.4
2m 3/8"TC		9.5	1	9.5	2.0	9.0	9.0	1971.9	-1347.5	3129.0	2005.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1972.1	-1344.6	3127.0	2005.6
500m 1/4" wire		211.6	1	211.6	499.8	155.0	155.0	2471.8	-1189.6	3126.8	2505.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2472.0	-1186.7	2627.0	2505.6
500m 1/4" wire		211.6	1	211.6	499.8	155.0	155.0	2971.8	-1031.7	2626.8	3005.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2972.0	-1028.8	2127.1	3005.5
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	2992.0	-1022.6	2126.9	3025.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2992.2	-1019.6	2106.9	3025.7
28.94m 1/4" wire		12.2	1	12.2	28.5	8.8	8.8	3020.7	-1010.8	2106.7	3054.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3020.9	-1007.9	2078.2	3054.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3024.9	-1227.6	2078.0	3058.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3025.1	-1224.6	2074.0	3058.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3029.1	-1444.3	2073.8	3062.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3029.3	-1441.4	2069.8	3062.8
500m 1/4" wire		211.6	1	211.6	499.9	155.0	155.0	3529.2	-1286.4	2069.6	3562.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3529.4	-1283.5	1569.7	3562.9
500m 1/4" wire		211.6	1	211.6	499.7	155.0	155.0	4029.0	-1128.5	1569.5	4062.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4029.2	-1125.5	1069.8	4062.8
500m 1/4" wire		211.6	1	211.6	499.6	155.0	155.0	4528.8	-970.5	1069.6	4562.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4529.0	-967.6	570.1	4562.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4533.0	-1187.3	569.9	4566.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4533.2	-1184.3	565.9	4566.7
200m 1/4" wire		84.6	1	84.6	199.9	62.0	62.0	4733.0	-1122.3	565.7	4766.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4733.2	-1119.4	365.8	4766.8
50m 1/4" wire		21.0	1	21.0	50.1	15.5	15.5	4783.3	-1103.9	365.6	4816.8

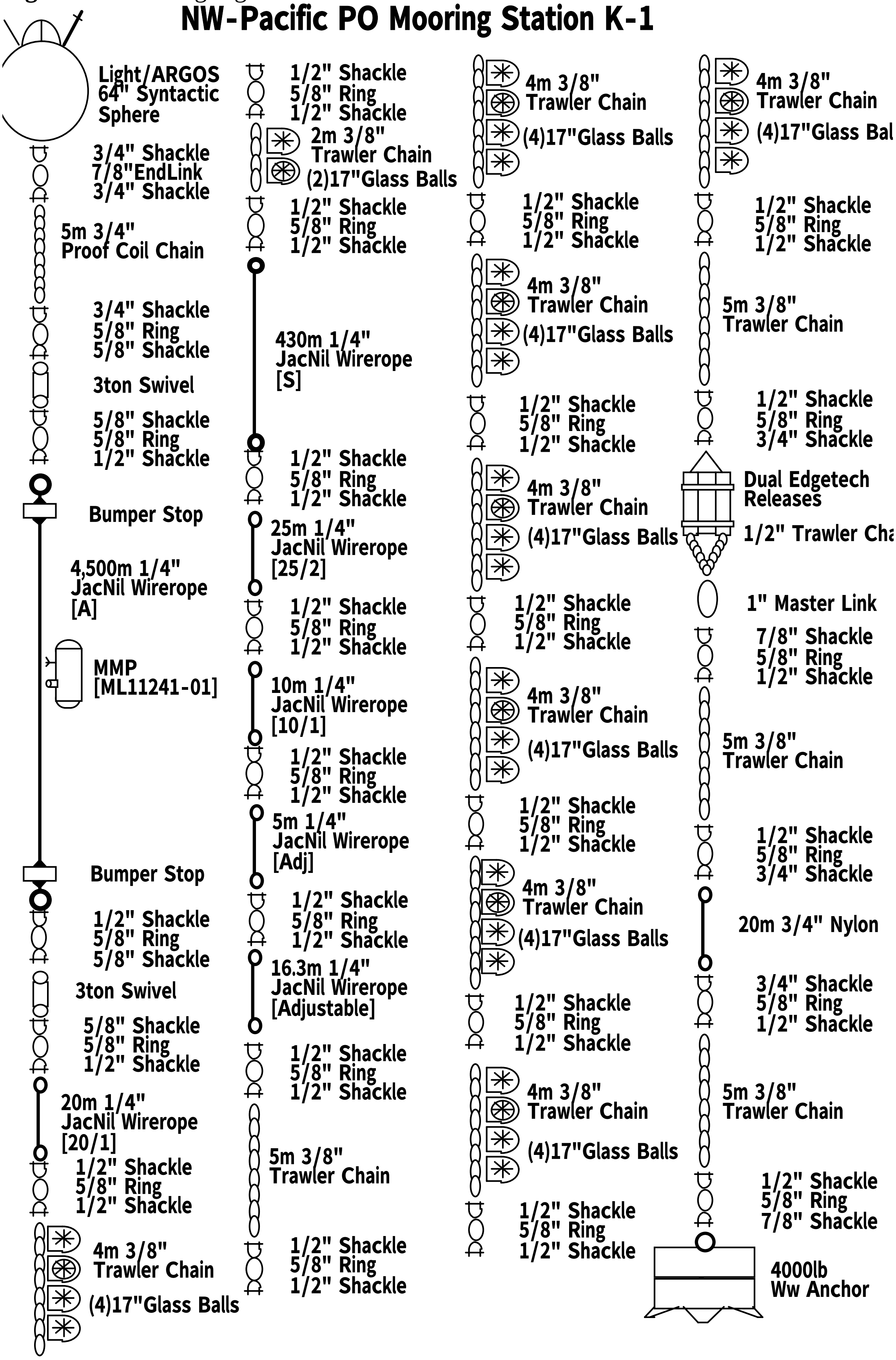
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4783.5	-1100.8	315.6	4817.1
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4784.5	-1087.3	315.3	4818.1
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	4786.0	-1010.2	314.3	4819.6
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4787.0	-996.7	312.8	4820.6
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4787.1	-995.7	311.8	4820.6
4.155m 3/8"TC		19.8	1	19.8	4.2	18.7	18.7	4791.2	-977.0	311.8	4824.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4791.4	-974.1	307.6	4825.0
100m 1/4" wire		42.3	1	42.3	100.0	31.0	31.0	4891.4	-943.1	307.4	4924.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4891.6	-940.2	207.5	4925.1
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4941.6	-924.7	207.3	4975.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4941.8	-921.7	157.2	4975.4
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	4966.8	-914.0	157.0	5000.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4967.0	-911.1	132.0	5000.5
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	4987.0	-904.9	131.9	5020.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4987.2	-901.9	111.9	5020.7
25m 1/4" wire		10.5	1	10.5	25.0	7.8	7.8	5012.2	-894.2	111.7	5045.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5012.4	-891.2	86.7	5045.9
5m 1/4" wire		2.1	1	2.1	5.0	1.6	1.6	5017.4	-889.7	86.5	5050.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5017.6	-886.8	81.5	5051.1
4m 3/8" TC		19.0	1	19.0	4.0	17.9	17.9	5021.6	-868.8	81.3	5055.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5021.8	-865.9	77.3	5055.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5025.8	-1085.6	77.1	5059.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5026.0	-1082.7	73.1	5059.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5030.0	-1302.3	72.9	5063.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5030.2	-1299.4	68.9	5063.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5034.2	-1519.1	68.7	5067.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5034.4	-1516.2	64.7	5067.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5038.4	-1735.8	64.5	5071.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5038.6	-1732.9	60.5	5072.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5042.6	-1952.6	60.3	5076.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5042.8	-1949.6	56.3	5076.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5046.8	-2169.3	56.1	5080.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5047.0	-2166.4	52.1	5080.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5051.0	-2386.1	51.9	5084.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5051.2	-2383.1	47.9	5084.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5055.2	-2602.8	47.7	5088.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5055.4	-2599.9	43.7	5088.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5059.4	-2819.6	43.5	5092.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5059.5	-2816.6	39.5	5093.1
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5064.5	-2794.3	39.3	5098.1
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5064.8	-2789.6	34.3	5098.3
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5065.8	-2644.1	34.1	5099.3
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5066.8	-2639.6	33.1	5100.3
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5067.0	-2630.1	32.1	5100.5
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5067.2	-2624.2	31.9	5100.7
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5072.2	-2601.8	31.7	5105.7
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5072.4	-2597.2	26.7	5106.0
20m 1" Nylon		0.9	1	0.9	20.0	0.6	0.6	5092.4	-2596.6	26.4	5126.0
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5092.6	-2591.9	6.4	5126.2
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5097.6	-2569.5	6.2	5131.2
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5097.9	-2563.6	1.2	5131.4
4,000 lb Mace Anchor		4000.0	1	4000.0	1.0	4000.0	4000.0	5098.9	1436.4	1	5132.4

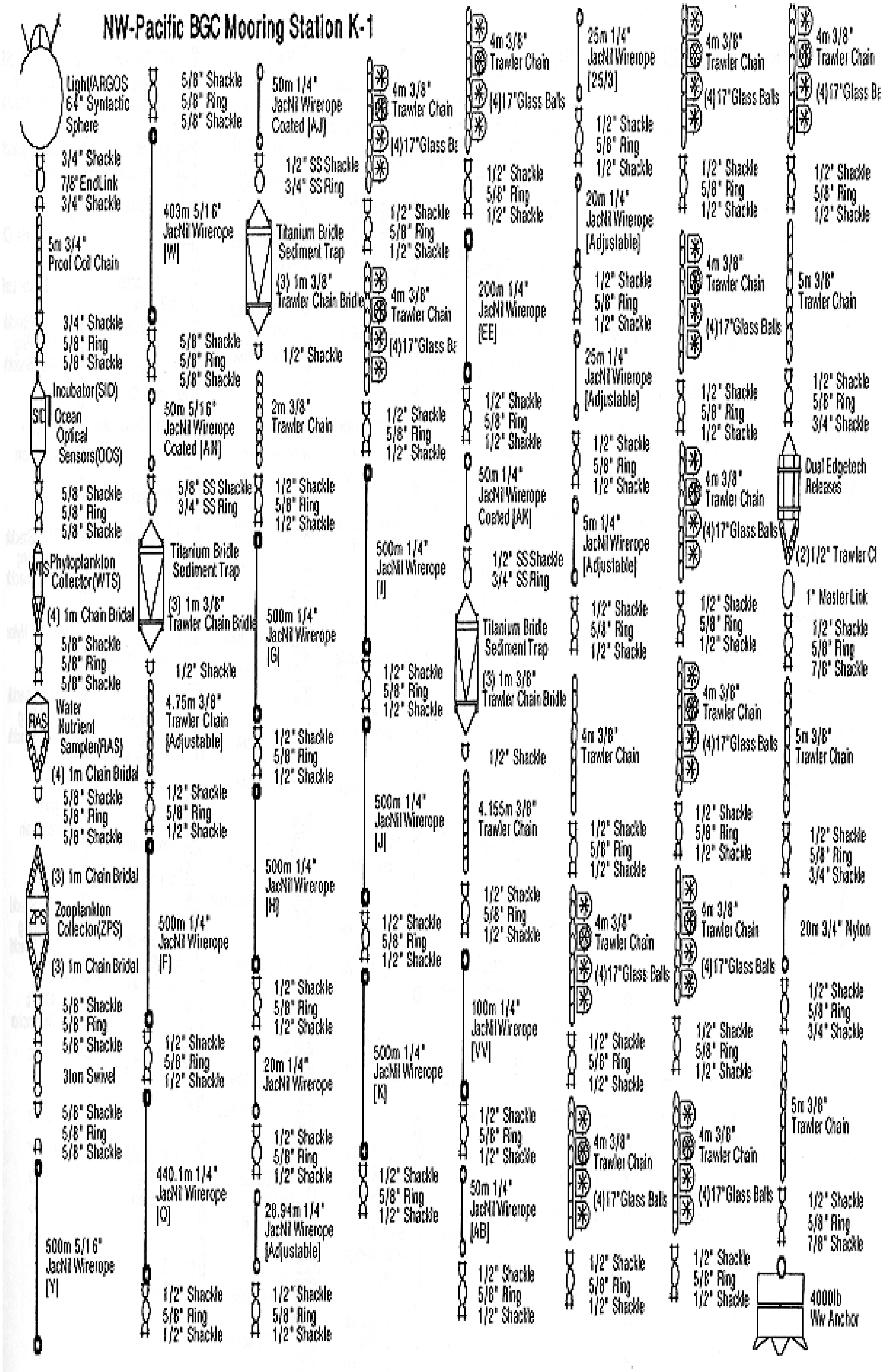
PS Mooring for Biogeochemical Sensors and Samples for K-1											
Mooring ID	Joint	In the Air			Water Depth						
			Item		Item	Item		Mooring	Mooring	Above	Below
Description		Weight	Quantitiy	Total	Length	Weight	Total	Length	Weight	Bottom	Surface
		(lb/ca)	(#)	(lbs)	(m)	(lbs)	(lbs)	(m)	(lbs)	(m)	(m)
Start of Mooring		0.0	0	0.0	0.0	0.0	0.0	0.0	0	5170.1	36.1
64"3000lb Syntactic sphere		2500.0	1	2500.0	1.0	-3000.0	-3000.0	1.0	-3000.0	5170.1	37.1
(2)3/4"SH, (1)7/8"End Link	[L]	8.0	1	8.0	0.3	8.0	8.0	1.3	-2992.0	5169.1	37.4
5m 3/4" PC		92.2	1	92.2	5.0	88.2	88.2	6.3	-2903.8	5168.8	42.4
(1)5/8"SH, (1)5/8"SL, (1)3/4"SH	[F]	5.3	1	5.3	0.2	5.3	5.3	6.5	-2898.5	5163.8	42.6
SID		198.4	1	198.4	1.8	130.1	130.1	8.3	-2768.4	5163.6	44.5
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	8.5	-2764.1	5161.7	44.7
WTS		99.2	1	99.2	0.3	77.2	77.2	8.9	-2687.0	5161.5	45.0
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	1.0	33.8	33.8	9.9	-2653.2	5161.2	46.0
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	10.1	-2648.9	5160.2	46.2
RAS		325.0	1	325.0	1.1	125.0	125.0	11.2	-2523.9	5160.0	47.4
(4)1m-Bridal,(4)5/8"SH,(8)1/2"SH,(2)5/8SL		33.8	1	33.8	0.8	33.8	33.8	12.0	-2490.1	5158.8	48.2

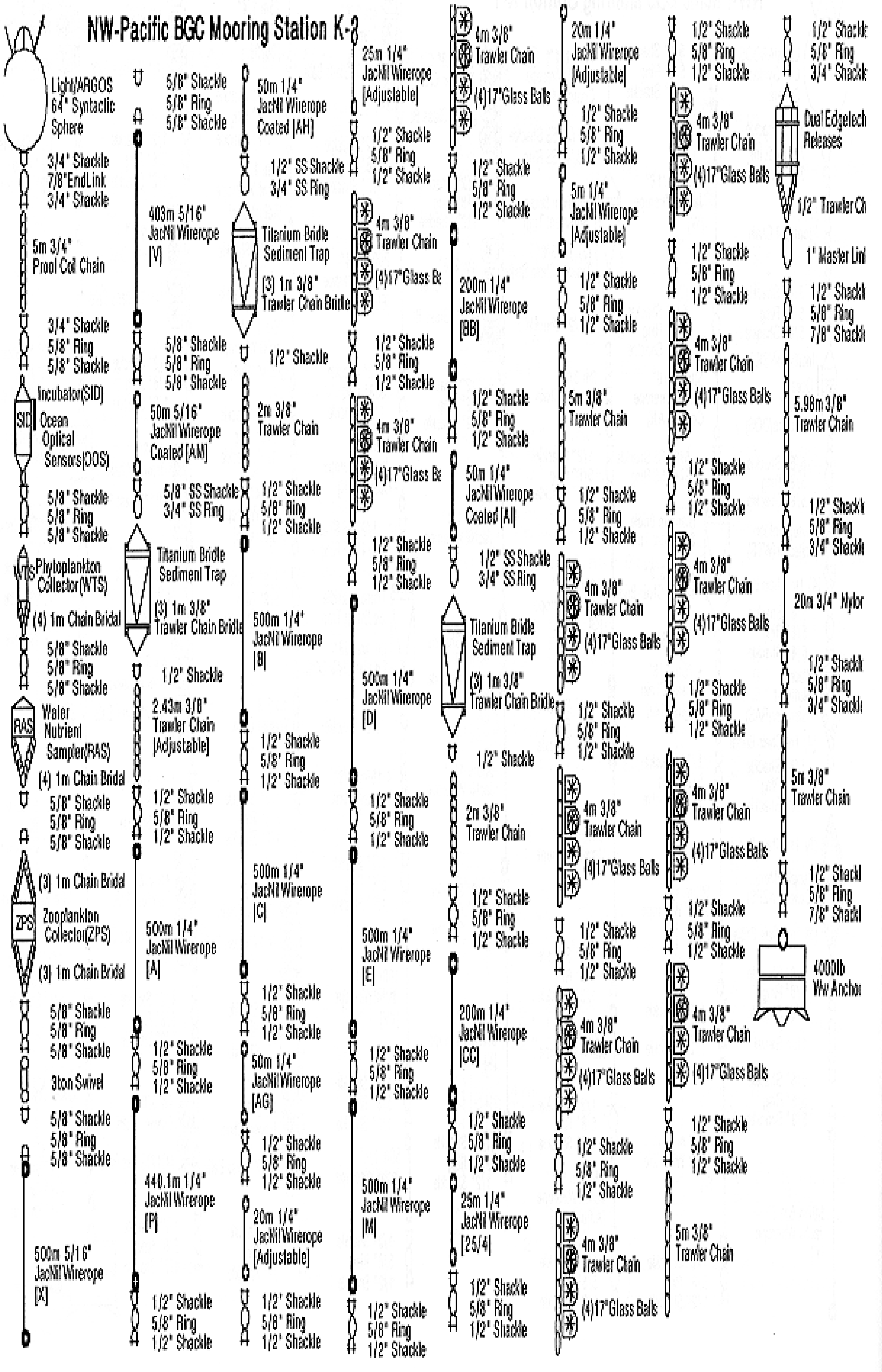
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	12.2	-2485.8	5158.0	48.4
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	13.2	-2463.0	5157.8	49.4
ZPS		167.6	1	167.6	0.9	57.3	57.3	14.2	-2405.7	5156.8	50.3
(3)1m-Bridal,(9)1/2"SH,(1)5/8SL		22.8	1	22.8	1.0	22.8	22.8	15.2	-2382.8	5155.9	51.3
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.4	-2378.6	5154.9	51.5
3ton Swivel		7.0	1	7.0	0.2	7.0	7.0	15.6	-2371.6	5154.7	51.7
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	15.8	-2367.3	5154.5	51.9
500m 5/16" wire		344.4	1	344.4	499.0	234.5	234.5	514.8	-2132.8	5154.3	550.9
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	515.0	-2128.6	4655.3	551.1
403.6m 5/16" wire		278.0	1	278.0	402.3	189.3	189.3	917.2	-1939.3	4655.1	953.4
(2)5/8"SH, (1)5/8"SL	[H]	4.3	1	4.3	0.2	4.3	4.3	917.5	-1935.0	4252.8	953.6
50m 5/16" wire		34.4	1	34.4	50.0	23.5	23.5	967.4	-1911.6	4252.6	1003.6
(1)5/8"SS SH, (1)3/4"SS SL	[I]	4.8	1	4.8	0.2	4.8	4.8	967.6	-1906.8	4202.6	1003.8
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	968.6	-1893.3	4202.4	1004.8
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	970.2	-1816.1	4201.4	1006.3
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	971.2	-1802.6	4199.9	1007.3
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	971.2	-1801.7	4198.9	1007.3
2.43m 3/8"TC		11.6	1	11.6	2.4	10.9	10.9	973.6	-1790.8	4198.9	1009.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	973.8	-1787.9	4196.4	1010.0
500m 1/4" wire		211.6	1	211.6	502.0	155.0	155.0	1475.8	-1632.9	4196.2	1511.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1476.0	-1629.9	3694.3	1512.1
440.1m 1/4" wire		186.2	1	186.2	439.9	136.4	136.4	1915.9	-1493.5	3694.1	1952.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1916.1	-1490.6	3254.2	1952.2
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	1966.1	-1475.1	3254.0	2002.2
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	1966.3	-1472.0	3204.0	2002.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1967.3	-1458.5	3203.8	2003.4
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	1968.8	-1381.4	3202.8	2005.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	1969.8	-1367.9	3201.2	2006.0
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	1969.9	-1366.9	3200.2	2006.0
2m 3/8"TC		9.5	1	9.5	2.0	9.0	9.0	1971.9	-1357.9	3200.2	2008.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	1972.1	-1355.0	3198.2	2008.2
500m 1/4" wire		211.6	1	211.6	499.6	155.0	155.0	2471.6	-1200.0	3198.0	2507.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2471.8	-1197.1	2698.4	2507.9
500m 1/4" wire		211.6	1	211.6	499.7	155.0	155.0	2971.5	-1042.1	2698.3	3007.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	2971.7	-1039.1	2198.6	3007.8
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	3021.7	-1023.6	2198.4	3057.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3021.9	-1020.7	2148.4	3058.0
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	3041.9	-1014.5	2148.2	3078.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3042.1	-1011.6	2128.2	3078.2
25m 1/4" wire		10.5	1	10.5	25.0	7.8	7.8	3067.1	-1003.8	2128.0	3103.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3067.3	-1000.9	2103.0	3103.4
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3071.3	-1220.6	2102.8	3107.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3071.5	-1217.6	2098.8	3107.6
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	3075.5	-1437.3	2098.6	3111.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3075.7	-1434.4	2094.6	3111.8
500m 1/4" wire		211.6	1	211.6	499.9	155.0	155.0	3575.6	-1279.4	2094.4	3611.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	3575.8	-1276.5	1594.5	3611.9
500m 1/4" wire		211.6	1	211.6	499.9	155.0	155.0	4075.6	-1121.5	1594.3	4111.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4075.8	-1118.5	1094.4	4112.0
500m 1/4" wire		211.6	1	211.6	499.6	155.0	155.0	4575.5	-963.5	1094.2	4611.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4575.7	-960.6	594.6	4611.8
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	4579.7	-1180.3	594.4	4615.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4579.9	-1177.3	590.4	4616.0
200m 1/4" wire		84.6	1	84.6	200.0	62.0	62.0	4779.9	-1115.3	590.2	4816.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4780.1	-1112.4	390.2	4816.2
50m 1/4" wire		21.0	1	21.0	50.0	15.5	15.5	4830.1	-1096.9	390.0	4866.2
(1)1/2"SS SH, (1)3/4"SS SL	[K]	3.1	1	3.1	0.2	3.1	3.1	4830.3	-1093.8	340.0	4866.4
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4831.3	-1080.3	339.8	4867.4
Sediment Trap		167.6	1	167.6	1.5	77.2	77.2	4832.8	-1003.2	338.8	4869.0
1m 3/8" TC Bridle		4.8	3	14.3	1.0	4.5	13.5	4833.8	-989.7	337.2	4870.0
(1)1/2"SH	[J]	0.9	1	0.9	0.1	0.9	0.9	4833.9	-988.7	336.2	4870.0
2m 3/8"TC		9.5	1	9.5	2.0	9.0	9.0	4835.9	-979.7	336.2	4872.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	4836.1	-976.8	334.2	4872.2
200m 1/4" wire		84.6	1	84.6	200.0	62.0	62.0	5036.0	-914.8	334.0	5072.2
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5036.2	-911.9	134.0	5072.4
25m 1/4" wire		10.6	1	10.6	25.0	7.8	7.8	5061.2	-904.1	133.8	5097.4
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5061.4	-901.2	108.8	5097.6
20m 1/4" wire		8.4	1	8.4	20.0	6.2	6.2	5081.4	-895.0	108.6	5117.6
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5081.6	-892.1	88.6	5117.8
5m 1/4" wire		2.1	1	2.1	5.0	1.6	1.6	5086.6	-890.5	88.4	5122.8
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5086.8	-887.6	83.4	5123.0
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5091.8	-865.2	83.2	5128.0
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5092.0	-862.3	78.2	5128.1

17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5096.0	-1081.9	78.1	5132.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5096.2	-1079.0	74.1	5132.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5100.2	-1298.7	73.9	5136.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5100.4	-1295.8	69.9	5136.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5104.4	-1515.4	69.7	5140.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5104.6	-1512.5	65.7	5140.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5108.6	-1732.2	65.5	5144.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5108.8	-1729.3	61.5	5144.9
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5112.8	-1948.9	61.3	5148.9
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5113.0	-1946.0	57.3	5149.1
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5117.0	-2165.7	57.1	5153.1
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5117.2	-2162.8	53.1	5153.3
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5121.2	-2382.4	52.9	5157.3
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5121.4	-2379.5	48.9	5157.5
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5125.4	-2599.2	48.7	5161.5
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5125.6	-2596.2	44.7	5161.7
17" glass balls on 3/8"TC		46.9	4	187.6	4.0	-54.9	-219.7	5129.6	-2815.9	44.5	5165.7
(2)1/2"SH, (1)5/8"SL	[A]	2.9	1	2.9	0.2	2.9	2.9	5129.8	-2813.0	40.5	5165.9
5.98m 3/8" TC		28.4	1	28.4	6.0	26.8	26.8	5135.7	-2786.2	40.3	5171.9
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5136.0	-2781.6	34.3	5172.1
Edgetech Release		77.2	2	154.3	1.0	72.8	145.5	5137.0	-2636.1	34.1	5173.1
1/2" Trawler Dualing Chain		4.8	1	4.8	1.0	4.5	4.5	5138.0	-2631.6	33.1	5174.1
(1)1-1/4" Master Link	[M]	9.5	1	9.5	0.2	9.5	9.5	5138.2	-2622.1	32.1	5174.3
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5138.4	-2616.2	31.9	5174.5
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5143.4	-2593.8	31.7	5179.5
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5143.6	-2589.1	26.7	5179.8
20m 1" Nylon		0.9	1	0.9	20.0	0.6	0.6	5163.6	-2588.5	26.4	5199.8
(1)1/2"SH, (1)5/8"SL, (1)3/4"SH	[C]	4.7	1	4.7	0.2	4.7	4.7	5163.8	-2583.9	6.4	5200.0
5m 3/8" TC		23.8	1	23.8	5.0	22.4	22.4	5168.8	-2561.5	6.2	5205.0
(1)1/2"SH, (1)5/8"SL, (1)7/8"SH	[D]	5.9	1	5.9	0.2	5.9	5.9	5169.1	-2555.6	1.2	5205.2
4,000 lb Mace Anchor		4000.0	1	4000.0	1.0	4000.0	4000.0	5170.1	1444.4	1	5206.2

Fig 2.1.2.1 Mooring Figure




NW-Pacific BGC Mooring Station K-1
Light(ARGOS
64" Syntactic Sphere
3/4" Shackle
7/8" EndLink
3/4" Shackle
5m 3/4" Proof Coil Chain
3/4" Shackle
5/8" Ring
5/8" Shackle
Incubator(SID)
Ocean Optical Sensors(OOS)
5/8" Shackle
5/8" Ring
5/8" Shackle
Phytoplankton Collector(WTS)
(4) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
Water Nutrient Sampler(RAS)
(4) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
(3) 1m Chain Bridal
Zooplankton Collector(ZPS)
(3) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
3ton Swivel
5/8" Shackle
5/8" Ring
5/8" Shackle
500m 5/16" JacNil Wirerope [Y]
5/8" Shackle
5/8" Ring
5/8" Shackle
403m 5/16" JacNil Wirerope [W]
5/8" Shackle
5/8" Ring
5/8" Shackle
50m 5/16" JacNil Wirerope Coated [AN]
5/8" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
4.75m 3/8" Trawler Chain [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [F]
1/2" Shackle
5/8" Ring
1/2" Shackle
440.1m 1/4" JacNil Wirerope [O]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope Coated [AJ]
1/2" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
2m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [G]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [H]
1/2" Shackle
5/8" Ring
1/2" Shackle
20m 1/4" JacNil Wirerope
1/2" Shackle
5/8" Ring
1/2" Shackle
28.94m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Ba
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Ba
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [I]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [J]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [K]
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
200m 1/4" JacNil Wirerope [EE]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope Coated [AK]
1/2" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
4.155m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
100m 1/4" JacNil Wirerope [VV]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope [AB]
1/2" Shackle
5/8" Ring
1/2" Shackle
25m 1/4" JacNil Wirerope [25/3]
1/2" Shackle
5/8" Ring
1/2" Shackle
20m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
25m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
5m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Ba
1/2" Shackle
5/8" Ring
1/2" Shackle
5m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
3/4" Shackle
Dual Edgetech Releases
(2)1/2" Trawler Ch
1" Master Link
1/2" Shackle
5/8" Ring
7/8" Shackle
5m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
3/4" Shackle
20m 3/4" Nylon
1/2" Shackle
5/8" Ring
3/4" Shackle
5m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
7/8" Shackle
4000lb Ww Anchor


NW-Pacific BGC Mooring Station K-2
Light/ARGOS 64" Syntactic Sphere
3/4" Shackle
7/8" EndLink
3/4" Shackle
5m 3/4" Proof Coil Chain
3/4" Shackle
5/8" Ring
5/8" Shackle
Incubator(SID)
SID
Ocean Optical Sensors(OOS)
5/8" Shackle
5/8" Ring
5/8" Shackle
WTS
Phytoplankton Collector(WTS)
(4) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
RAS
Water Nutrient Sampler(RAS)
(4) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
(3) 1m Chain Bridal
ZPS
Zooplankton Collector(ZPS)
(3) 1m Chain Bridal
5/8" Shackle
5/8" Ring
5/8" Shackle
3ton Swivel
5/8" Shackle
5/8" Ring
5/8" Shackle
500m 5/16" JacNil Wirerope [X]
5/8" Shackle
5/8" Ring
5/8" Shackle
403m 5/16" JacNil Wirerope [V]
5/8" Shackle
5/8" Ring
5/8" Shackle
50m 5/16" JacNil Wirerope Coated [AM]
5/8" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
2.43m 3/8" Trawler Chain [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [A]
1/2" Shackle
5/8" Ring
1/2" Shackle
440.1m 1/4" JacNil Wirerope [P]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope Coated [AH]
1/2" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
2m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [B]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [C]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope [AG]
1/2" Shackle
5/8" Ring
1/2" Shackle
20m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
25m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Ba
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Ba
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [D]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [E]
1/2" Shackle
5/8" Ring
1/2" Shackle
500m 1/4" JacNil Wirerope [M]
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
200m 1/4" JacNil Wirerope [BB]
1/2" Shackle
5/8" Ring
1/2" Shackle
50m 1/4" JacNil Wirerope Coated [AI]
1/2" SS Shackle
3/4" SS Ring
Titanium Bridle Sediment Trap
(3) 1m 3/8" Trawler Chain Bridle
1/2" Shackle
2m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
200m 1/4" JacNil Wirerope [CC]
1/2" Shackle
5/8" Ring
1/2" Shackle
25m 1/4" JacNil Wirerope [25/4]
1/2" Shackle
5/8" Ring
1/2" Shackle
20m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
5m 1/4" JacNil Wirerope [Adjustable]
1/2" Shackle
5/8" Ring
1/2" Shackle
5m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
4m 3/8" Trawler Chain
(4)17"Glass Balls
1/2" Shackle
5/8" Ring
1/2" Shackle
5m 3/8" Trawler Chain
1/2" Shackle
5/8" Ring
3/4" Shackle
Dual Edgetech Releases
1/2" Trawler Ch
1" Master Lin
1/2" Shackl
5/8" Ring
7/8" Shackl
5.98m 3/8" Trawler Chain
1/2" Shackl
5/8" Ring
3/4" Shackl
20m 3/4" Nylo
1/2" Shackl
5/8" Ring
3/4" Shackl
5m 3/8" Trawler Chain
1/2" Shackl
5/8" Ring
7/8" Shackl
4000lb Ww Ancho

2.2 Instruments

Toru IDAI (JAMSTEC MIO)

On mooring systems, the following instruments are installed.

2.2.1 ARGOS CML (Compact Mooring Locator)

The Compact Mooring Locator is a subsurface mooring locator based on SEIMAC's Smart Cat ARGOS PTT (Platform Terminal Transmitter) technology. Using CML, we can know when our mooring has come to the surface and its position. The CML employs a light sensor inside the acrylic dome. When the CML is mounted beyond the reach of sunlight, the light sensor electronics force the CML to a dormant state. In this mode, the light sensor checked optical condition every five minutes, to test for the presence of light. When the top buoy with the CML comes to the surface, the light sensor will respond to the presence of daylight by activating the main system electronics. Smart Cat transmissions will be initiated at this time, allowing us to locate our mooring. Depending on how to long the CML has been moored, it will transmit for up to 120 days on a 90 second repetition period. Battery life, however, is affected by how long the CML has been moored prior to activation. A longer pre-activation mooring will mean less activation life.

Principle specification is as follows:

(Specification)

Transmitter:	Smart Cat PTT
Operating Temp.:	+35 [deg] to –5 [deg]
Standby Current:	80 Amp.
Power Control.:	Ext. Magnetic Switch
Smart Cat Freq.:	401.650 MHz
Battery Supply:	7-Cell alkaline D-Cells
Ratings:	+10.5VDC nom., 10 Amp Hr
Hull:	6061-T6 Aluminum
Length:	22 inches
Diameter:	3.4 inches
Upper flange:	5.60 inches
Dome:	Acrylic
Buoyancy:	-2.5 (negative) approx.
Weight	12 pounds approx.

2.2.2 Submersible Recovery Strobe

The Benthos 204 - RS is fully self-contained 0.1 watt - second strobe intended to aid in the marking or recovery of oceanographic instruments, manned vehicles, remotely operated vehicles, buoys or structures. Due to the occulting (firing closely spaced bursts of light) nature of this design, it is much more visible than conventional marker strobes, particularly in poor sea conditions.

(Specification)

Power Level:	0.1 watt-second
Repetition Rate:	Adjustable from 2 bursts per second to 1 burst every 3 seconds.
Burst Length:	Adjustable from 1 to 5 flashes per burst. 100 ms between flashes

	nominal.
Battery Type:	C-cell alkaline batteries, (Eveready E-93 or equivalent).
Life:	Dependent on repetition rate and burst length. 150 hours with a one flash burst every 2 seconds.
Construction:	Awl-grip painted, Hard coat anodized 6061 T-6 aluminum housing.
Pressure Rating:	10,000 psi
Daylight-off:	User selected, standard
Pressure Switch:	Turns unit off below approximately 30 feet. Rotary, clockwise – ON, counter clockwise – OFF.
Weight in Air:	4 pounds
Weight in Water:	2 pounds
Outside Diameter:	1.7 inches nominal
Length:	21-1/2 inches nominal

2.2.3 MMP

The McLane Moored Profiler is an autonomous, profiling, instrument platform. The purpose is to make moored profiler technology available to, operable by, and useful to a broad cross-section of the oceanographic community. The platform and software are designed for ease of access, operation, and maintenance. The instrument includes both a CTD and an acoustic current meter. Side and top views of the MMP are shown in Fig. 2. The major components of the system are labeled in the figures. There include the controller, the buoyancy elements, the drive motor and guide wheels, the instruments suite, the internal frame, and the hydrodynamically faired external shell. The platform is designed to profile between pressure limits (or physical stops), powered along a conventional, plastic jacketed mooring cable by a traction drive. While profiling it samples the water column with a suite of instruments and stores the measurements for later retrieval. The shape accommodates a cylindrical housing that has sufficient length for batteries and electronics and a 6,000 m depth rating. Two glass spheres are used for buoyancy only. The mooring cable threads through faired retainers at the top and bottom of the vehicle. The retainers can be opened for launch and recovery and are strong enough to support the full weight, including trapped water, of the MMP on a horizontal cable, a normal situation during recovery. Sampling will be conducted each 5 days.

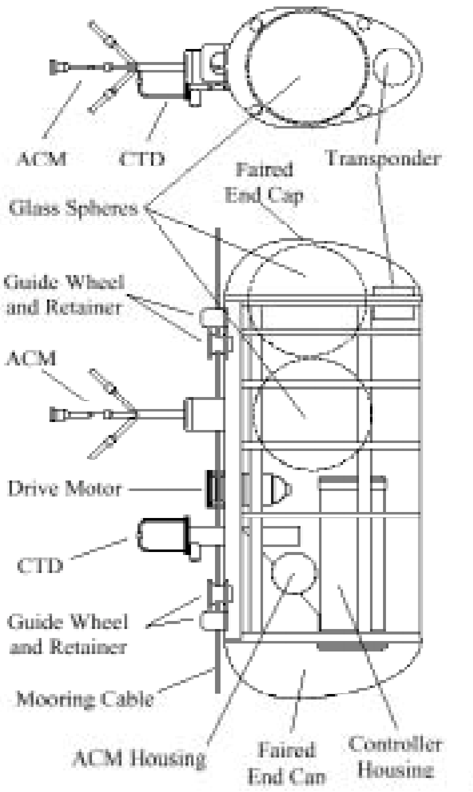


Fig. 2.2.3.1 Cut away side and top views of the MMP showing the major components of the system. The overall dimensions of the faired external shell are 124 cm * 51 cm* 34 cm

Table 2.2.3.1 Deployed MMP Setting Parameter

Station MMP S / N	K-1 PO ML11241-03	K-2 PO ML11241-02	K-3 PO ML11241-06
*1 Initialize Down	03:00:00 Oct.19th 2002	00:00:00 Oct.30th 2002	00:00:00 Oct.30th 2002
*2 Sampling Start	00:00:00 Nov.2nd 2002	00:00:00 Nov.2nd 2002	00:00:00 Nov.2nd 2002
*3 Profile Interval	9 hours	9 hours	9 hours
*4 Burst Interval	5 days	5 days	5 days
Burst (up and down)	twice	twice	twice
Shallow Depth [db]	60	60	60
Deep Depth [db]	4000	4000	4000
Shallow Error [db]	100	100	100
Deep Error [db]	100	100	100
Profile Time Limit	6 hours	6 hours	6 hours
Stop Check Interval	30 sec	30 sec	30 sec

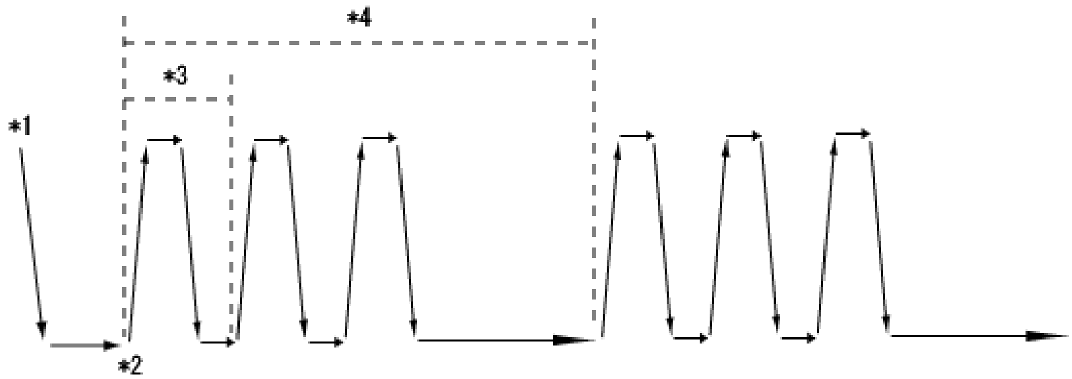


Table 2.2.3.2 Recovered MMP Setting Parameter

Station MMP S / N	K-1 PO ML11241-01	Shallow Depth [db]	40
*1 Initialize Down	06:00:00 Sep.5th 2001	Deep Depth [db]	4540
*2 Sampling Start	04:00:00 Sep.6nd 2001	Shallow Error [db]	100
*3 Profile Interval	18 hours	Deep Error [db]	100
*4 Burst Interval	10 days	Profile Time Limit	6 hours 45 minutes
Burst (up and down)	Three times	Stop Check Interval	30 sec

Table 2.2.3.3 Recovered MMP at K-1 Engineering Result

	Start			Stop			Distance [m]	Sampling Time	Hour
Profile	Date	Time	[dbar]	Date	Time	[dbar]			
0000000	09/05/01	6:01:01	1348.6	09/05/01	9:59:31	4541.4	3192.7	3:58:30	3
0000001	09/06/01	4:00:31	4517.7	09/06/01	10:37:01	50.1	4467.6	6:36:30	6
0000002	09/06/01	11:20:28	148.2	09/06/01	16:38:28	4541.6	4393.4	5:18:00	5
0000003	09/06/01	22:00:31	4535.1	09/07/01	4:45:01	72.0	4463.0	6:44:30	6
0000004	09/07/01	5:29:47	122.7	09/07/01	10:46:47	4542.4	4419.6	5:17:00	5

0000005	09/07/01	16:00:31	4537.3	09/07/01	22:45:01	70.5	4466.8	6:44:30	6
0000006	09/07/01	23:29:48	124.9	09/08/01	4:52:48	4541.4	4416.6	5:23:00	5
0000007	09/16/01	4:00:31	3073.0	09/16/01	8:33:31	50.3	3022.7	4:33:00	4
0000008	09/16/01	9:05:07	262.9	09/16/01	14:18:37	4540.3	4277.4	5:13:30	5
0000009	09/16/01	22:00:32	4493.2	09/17/01	4:41:02	49.8	4443.4	6:40:30	6
0000010	09/17/01	5:24:56	122.3	09/17/01	10:45:26	4540.5	4418.2	5:20:30	5
0000011	09/17/01	16:00:32	4530.2	09/17/01	22:30:02	48.5	4481.7	6:29:30	6
0000012	09/17/01	23:14:14	88.1	09/18/01	4:32:14	4542.7	4454.6	5:18:00	5
0000013	09/26/01	4:00:32	2576.7	09/26/01	7:55:02	49.8	2526.9	3:54:30	3
0000014	09/26/01	8:23:00	95.2	09/26/01	13:40:00	4540.2	4445.1	5:17:00	5
0000015	09/26/01	22:00:32	4530.0	09/27/01	4:20:32	50.5	4479.5	6:20:00	6
0000016	09/27/01	5:02:23	290.3	09/27/01	10:10:53	4543.6	4253.3	5:08:30	5
0000017	09/27/01	16:00:32	4504.1	09/27/01	22:21:32	48.5	4455.6	6:21:00	6
0000018	09/27/01	23:03:38	186.6	09/28/01	4:14:38	4546.7	4360.1	5:11:00	5
0000019	10/06/01	4:00:32	2578.9	10/06/01	7:54:02	49.6	2529.3	3:53:30	3
0000020	10/06/01	8:21:51	190.9	10/06/01	13:33:21	4540.5	4349.7	5:11:30	5
0000021	10/06/01	22:00:32	4481.1	10/07/01	4:10:02	49.6	4431.5	6:09:30	6
0000022	10/07/01	4:51:03	105.2	10/07/01	10:07:03	4542.1	4436.8	5:16:00	5
0000023	10/07/01	16:00:32	4506.7	10/07/01	22:12:02	50.0	4456.7	6:11:30	6
0000024	10/07/01	22:53:03	265.3	10/08/01	3:53:33	4542.3	4277.0	5:00:30	5
0000025	10/16/01	4:00:32	2750.2	10/16/01	8:09:02	49.8	2700.4	4:08:30	4
0000026	10/16/01	8:38:21	217.2	10/16/01	13:39:51	4545.4	4328.2	5:01:30	5
0000027	10/16/01	22:00:32	4461.2	10/17/01	4:02:32	49.2	4412.0	6:02:00	6
0000028	10/17/01	4:42:44	142.5	10/17/01	9:46:44	4541.6	4399.1	5:04:00	5
0000029	10/17/01	16:00:32	4525.4	10/17/01	21:54:02	49.4	4476.1	5:53:30	5
0000030	10/17/01	22:33:26	116.3	10/18/01	3:43:26	4543.2	4426.9	5:10:00	5
0000031	10/26/01	4:00:32	2740.0	10/26/01	8:12:32	49.3	2690.7	4:12:00	4
0000032	10/26/01	8:42:15	170.7	10/26/01	13:51:15	4544.6	4373.9	5:09:00	5
0000033	10/26/01	22:00:32	4325.9	10/27/01	3:57:02	48.2	4277.7	5:56:30	5
0000034	10/27/01	4:36:40	154.2	10/27/01	9:38:40	4543.2	4389.0	5:02:00	5
0000035	10/27/01	16:00:32	4523.4	10/27/01	21:59:02	48.9	4474.5	5:58:30	5
0000036	10/27/01	22:38:49	107.9	10/28/01	3:44:49	4540.2	4432.3	5:06:00	5
0000037	11/05/01	4:00:32	2661.3	11/05/01	8:38:04	55.9	2605.4	4:37:32	4
0000038	11/05/01	9:10:14	155.6	11/05/01	14:27:44	4545.6	4389.9	5:17:30	5
0000039	11/05/01	22:00:32	4173.4	11/06/01	3:51:02	51.1	4122.4	5:50:30	5
0000040	11/06/01	4:30:09	253.3	11/06/01	9:31:09	4547.4	4294.1	5:01:00	5
0000041	11/06/01	16:00:33	4501.5	11/06/01	21:54:03	50.5	4451.0	5:53:30	5
0000042	11/06/01	22:33:27	111.8	11/07/01	3:54:57	4544.8	4432.9	5:21:30	5
0000043	11/15/01	4:00:33	2690.8	11/15/01	8:19:33	51.8	2639.0	4:19:00	4
0000044	11/15/01	8:49:51	232.3	11/15/01	14:08:21	4544.2	4311.9	5:18:30	5
0000045	11/15/01	22:00:33	4252.7	11/16/01	3:51:03	50.1	4202.6	5:50:30	5
0000046	11/16/01	4:30:11	240.4	11/16/01	9:40:11	4541.9	4301.4	5:10:00	5
0000047	11/16/01	16:00:33	4474.4	11/16/01	22:09:03	49.1	4425.3	6:08:30	6
0000048	11/16/01	22:49:56	206.6	11/17/01	4:01:56	4540.2	4333.6	5:12:00	5
0000049	11/25/01	4:00:33	2642.3	11/25/01	8:09:33	48.6	2593.8	4:09:00	4
0000050	11/25/01	8:38:53	173.3	11/25/01	13:58:53	4542.8	4369.4	5:20:00	5
0000051	11/25/01	22:00:33	4496.0	11/26/01	4:12:03	48.1	4447.9	6:11:30	6
0000052	11/26/01	4:53:05	130.3	11/26/01	10:06:05	4546.5	4416.2	5:13:00	5
0000053	11/26/01	16:00:33	4530.7	11/26/01	22:05:33	48.0	4482.7	6:05:00	6
0000054	11/26/01	22:46:10	118.6	11/27/01	3:57:10	4544.2	4425.5	5:11:00	5
0000055	12/05/01	4:00:33	2665.9	12/05/01	8:22:03	49.0	2616.9	4:21:30	4
0000056	12/05/01	8:52:36	217.9	12/05/01	14:26:36	4540.0	4322.1	5:34:00	5
0000057	12/05/01	22:00:33	4347.5	12/06/01	4:36:33	116.8	4230.7	6:36:00	6
0000058	12/06/01	5:20:03	322.7	12/06/01	10:46:03	4543.7	4221.0	5:26:00	5
0000059	12/06/01	16:00:33	4401.9	12/06/01	22:45:03	129.8	4272.1	6:44:30	6
0000060	12/06/01	23:31:16	410.8	12/07/01	4:54:46	4544.1	4133.3	5:23:30	5
0000061	12/15/01	4:00:33	2661.9	12/15/01	9:33:09	114.0	2547.9	5:32:36	5
0000062	12/15/01	10:10:31	361.7	12/15/01	15:49:31	4541.6	4179.8	5:39:00	5
0000063	12/15/01	22:00:33	4457.5	12/16/01	4:45:03	180.9	4276.5	6:44:30	6
0000064	12/16/01	5:29:59	405.9	12/16/01	11:03:59	4541.7	4135.9	5:34:00	5
0000065	12/16/01	16:00:33	4456.3	12/16/01	22:45:03	196.2	4260.1	6:44:30	6
0000066	12/16/01	23:29:59	426.9	12/17/01	4:53:59	4545.6	4118.7	5:24:00	5
0000067	12/25/01	4:00:33	2715.6	12/25/01	9:27:33	48.9	2666.7	5:27:00	5
0000068	12/25/01	10:04:22	256.2	12/25/01	15:53:22	4545.7	4289.6	5:49:00	5
0000069	12/25/01	22:00:34	4480.1	12/26/01	4:44:34	255.6	4224.6	6:44:00	6
0000070	12/26/01	5:29:25	447.5	12/26/01	11:01:55	4543.9	4096.4	5:32:30	5
0000071	12/26/01	16:00:34	4505.4	12/26/01	22:44:34	239.3	4266.1	6:44:00	6
0000072	12/26/01	23:29:24	418.3	12/27/01	4:54:24	4540.9	4122.6	5:25:00	5

0000073	01/04/02	4:00:34	2752.8	01/04/02	10:13:40	121.3	2631.4	6:13:06	6
0000074	01/04/02	10:54:59	371.5	01/04/02	16:40:29	4542.7	4171.2	5:45:30	5
0000075	01/04/02	22:00:34	4453.4	01/05/02	4:44:34	395.8	4057.6	6:44:00	6
0000076	01/05/02	5:29:24	601.7	01/05/02	11:04:54	4541.1	3939.4	5:35:30	5
0000077	01/05/02	16:00:34	4460.0	01/05/02	22:44:34	422.6	4037.4	6:44:00	6
0000078	01/05/02	23:29:25	636.1	01/06/02	4:52:55	4541.7	3905.6	5:23:30	5
0000079	01/14/02	4:00:34	2800.1	01/14/02	9:51:06	49.0	2751.1	5:50:32	5
0000080	01/14/02	10:30:16	211.9	01/14/02	16:22:46	4543.1	4331.1	5:52:30	5
0000081	01/14/02	22:00:34	4488.1	01/15/02	4:44:34	520.6	3967.5	6:44:00	6
0000082	01/15/02	5:29:24	714.8	01/15/02	11:00:24	4541.4	3826.6	5:31:00	5
0000083	01/15/02	16:00:34	4496.0	01/15/02	22:44:34	478.3	4017.7	6:44:00	6
0000084	01/15/02	23:29:24	654.5	01/16/02	4:51:54	4540.0	3885.5	5:22:30	5
0000085	01/24/02	4:00:34	3151.3	01/24/02	9:42:14	749.2	2402.1	5:41:40	5
0000086	01/24/02	10:20:36	970.1	01/24/02	16:04:36	4542.4	3572.3	5:44:00	5
0000087	01/24/02	22:00:34	4438.8	01/25/02	5:43:44	608.1	3830.6	7:43:10	7
0000088	01/25/02	6:33:47	870.2	01/25/02	11:58:17	4542.5	3672.3	5:24:30	5
0000089	01/25/02	16:00:34	4512.7	01/25/02	22:45:04	567.0	3945.8	6:44:30	6
0000090	01/25/02	23:30:02	727.6	01/26/02	4:55:02	4540.9	3813.2	5:25:00	5
0000091	02/03/02	4:00:34	2767.1	02/03/02	9:28:04	54.2	2713.0	5:27:30	5
0000092	02/03/02	10:05:03	140.1	02/03/02	15:57:33	4543.6	4403.5	5:52:30	5
0000093	02/03/02	22:00:34	4524.1	02/04/02	4:45:04	398.8	4125.3	6:44:30	6
0000094	02/04/02	5:30:10	519.9	02/04/02	11:17:40	4541.5	4021.6	5:47:30	5
0000095	02/04/02	16:00:34	4523.5	02/04/02	22:45:04	300.6	4223.0	6:44:30	6
0000096	02/04/02	23:30:02	368.6	02/05/02	5:28:32	4511.2	4142.6	5:58:30	5
0000097	02/13/02	4:00:34	2873.0	02/13/02	11:13:44	138.1	2734.9	7:13:10	7
0000098	02/13/02	12:00:48	320.0	02/13/02	18:01:18	4540.7	4220.8	6:00:30	6
0000099	02/13/02	22:00:34	4520.1	02/14/02	4:45:04	417.5	4102.6	6:44:30	6
0000100	02/14/02	5:30:12	515.2	02/14/02	11:11:12	4540.3	4025.0	5:41:00	5
0000101	02/14/02	16:00:35	4526.3	02/14/02	22:44:35	375.6	4150.7	6:44:00	6
0000102	02/14/02	23:29:28	471.2	02/15/02	5:35:58	4540.3	4069.1	6:06:30	6
0000103	02/23/02	4:00:35	2802.8	02/23/02	10:05:15	281.2	2521.6	6:04:40	6
0000104	02/23/02	10:45:47	448.4	02/23/02	17:25:47	4541.3	4092.9	6:40:00	6
0000105	02/23/02	22:00:35	4519.9	02/24/02	4:44:35	510.0	4009.8	6:44:00	6
0000106	02/24/02	5:29:28	624.1	02/24/02	11:02:58	4535.1	3910.9	5:33:30	5
0000107	02/24/02	16:00:35	4531.3	02/24/02	22:44:35	433.9	4097.3	6:44:00	6
0000108	02/24/02	23:29:28	610.8	02/25/02	5:24:58	4540.7	3929.9	5:55:30	5
0000109	03/05/02	4:00:35	2872.0	03/05/02	10:43:05	134.0	2738.0	6:42:30	6
0000110	03/05/02	11:27:19	203.4	03/05/02	17:32:49	4456.7	4253.3	6:05:30	6
0000111	03/05/02	22:00:35	4428.4	03/06/02	4:45:05	642.7	3785.7	6:44:30	6
0000112	03/06/02	5:30:12	736.4	03/06/02	11:48:42	4539.3	3802.9	6:18:30	6
0000113	03/06/02	16:00:35	4529.0	03/06/02	22:45:05	545.1	3983.9	6:44:30	6
0000114	03/06/02	23:30:11	612.3	03/07/02	5:57:41	4541.7	3929.5	6:27:30	6
0000115	03/15/02	4:00:35	2762.9	03/15/02	11:02:45	149.5	2613.4	7:02:10	7
0000116	03/15/02	11:48:53	294.7	03/15/02	18:25:54	4491.5	4196.9	6:37:01	6
0000117	03/15/02	22:00:35	4444.2	03/16/02	4:45:05	874.1	3570.1	6:44:30	6
0000118	03/16/02	5:30:13	997.1	03/16/02	11:10:43	4540.4	3543.3	5:40:30	5
0000119	03/16/02	16:00:35	4521.9	03/16/02	23:40:15	818.0	3703.9	7:39:40	7
0000120	03/17/02	0:30:04	1067.1	03/17/02	6:56:04	4541.9	3474.8	6:26:00	6
0000121	03/25/02	4:00:35	2679.7	03/25/02	9:22:15	704.8	1974.9	5:21:40	5
0000122	03/25/02	9:58:44	870.3	03/25/02	16:27:47	4455.4	3585.1	6:29:03	6
0000123	03/25/02	22:00:35	4420.6	03/26/02	4:45:05	925.0	3495.6	6:44:30	6
0000124	03/26/02	5:30:13	1025.7	03/26/02	10:57:53	4158.1	3132.4	5:27:40	5
0000125	03/26/02	16:00:35	4132.5	03/26/02	22:45:05	651.5	3481.0	6:44:30	6
0000126	03/26/02	23:30:13	714.2	03/27/02	5:56:49	4505.6	3791.5	6:26:36	6
0000127	04/04/02	4:00:35	2946.5	04/04/02	9:33:15	899.6	2046.9	5:32:40	5
0000128	04/04/02	10:10:50	1074.9	04/04/02	16:12:20	4540.2	3465.3	6:01:30	6
0000129	04/04/02	22:00:36	4511.6	04/05/02	4:44:36	703.3	3808.3	6:44:00	6
0000130	04/05/02	5:29:30	818.3	04/05/02	11:08:00	4542.3	3724.0	5:38:30	5
0000131	04/05/02	16:00:36	4537.5	04/05/02	22:44:36	638.3	3899.2	6:44:00	6
0000132	04/05/02	23:29:30	685.7	04/06/02	4:55:30	4457.8	3772.1	5:26:00	5
0000133	04/14/02	4:00:36	2894.7	04/14/02	9:58:16	645.5	2249.2	5:57:40	5
0000134	04/14/02	10:38:10	811.8	04/14/02	16:44:40	4527.7	3716.0	6:06:30	6
0000135	04/14/02	22:00:36	4509.9	04/15/02	4:44:36	684.7	3825.2	6:44:00	6
0000136	04/15/02	5:29:30	751.8	04/15/02	11:13:00	4482.3	3730.5	5:43:30	5
0000137	04/15/02	16:00:36	4478.8	04/15/02	22:27:16	841.0	3637.8	6:26:40	6
0000138	04/15/02	23:10:01	857.3	04/16/02	5:06:11	4417.6	3560.4	5:56:10	5
0000139	04/24/02	4:00:36	2839.8	04/24/02	8:06:46	861.7	1978.1	4:06:10	4
0000140	04/24/02	8:35:55	869.9	04/24/02	14:02:05	4301.9	3432.1	5:26:10	5

0000141	04/24/02	22:00:36	4297.2	04/25/02	5:22:16	596.7	3700.5	7:21:40	7
0000142	04/25/02	6:10:21	619.1	04/25/02	12:02:01	4255.8	3636.7	5:51:40	5
0000143	04/25/02	16:00:36	4251.9	04/25/02	22:45:06	647.3	3604.7	6:44:30	6
0000144	04/25/02	23:30:15	723.4	04/26/02	5:53:55	4281.4	3558.0	6:23:40	6
0000145	05/04/02	4:00:36	2775.8	05/04/02	10:44:16	472.2	2303.6	6:43:40	6
0000146	05/04/02	11:28:40	610.4	05/04/02	17:30:20	4028.3	3417.9	6:01:40	6
0000147	05/04/02	22:00:36	4010.5	05/05/02	4:45:06	690.6	3319.9	6:44:30	6
0000148	05/05/02	5:30:07	716.7	05/05/02	10:35:47	3962.0	3245.4	5:05:40	5
0000149	05/05/02	16:00:36	3958.4	05/05/02	23:47:16	471.7	3486.7	7:46:40	7
0000150	05/06/02	0:37:39	503.3	05/06/02	6:45:49	4120.6	3617.3	6:08:10	6
0000151	05/14/02	4:00:36	2589.7	05/14/02	10:25:46	397.6	2192.1	6:25:10	6
0000152	05/14/02	11:08:23	469.9	05/14/02	16:55:33	3969.8	3499.8	5:47:10	5
0000153	05/14/02	22:00:37	3966.0	05/15/02	4:59:17	768.0	3198.0	6:58:40	6
0000154	05/15/02	5:45:10	790.1	05/15/02	11:14:20	3890.1	3100.0	5:29:10	5
0000155	05/15/02	16:00:36	3886.6	05/15/02	22:45:06	904.3	2982.3	6:44:30	6
0000156	05/15/02	23:30:16	921.4	05/16/02	5:25:56	3868.8	2947.4	5:55:40	5
0000157	05/24/02	4:00:37	2843.8	05/24/02	10:13:47	810.9	2032.9	6:13:10	6
0000158	05/24/02	10:55:19	910.9	05/24/02	17:38:00	4002.5	3091.6	6:42:41	6
0000159	05/24/02	22:00:37	3997.8	05/25/02	4:44:37	1047.6	2950.2	6:44:00	6
0000160	05/25/02	5:29:41	1060.5	05/25/02	11:17:51	3970.4	2909.9	5:48:10	5
0000161	05/25/02	16:00:37	3968.5	05/25/02	23:30:17	879.4	3089.1	7:29:40	7
0000162	05/26/02	0:19:12	893.2	05/26/02	6:23:22	3961.7	3068.5	6:04:10	6
0000163	06/03/02	4:00:37	3452.1	06/03/02	10:28:17	909.3	2542.9	6:27:40	6
0000164	06/03/02	11:11:14	920.5	06/03/02	17:10:54	3967.4	3047.0	5:59:40	5
0000165	06/03/02	22:00:37	3964.9	06/04/02	4:44:38	1065.9	2899.1	6:44:01	6
0000166	06/04/02	5:29:42	1107.9	06/04/02	12:11:22	4107.1	2999.3	6:41:40	6
0000167	06/04/02	16:00:37	4103.0	06/04/02	22:44:37	1250.9	2852.1	6:44:00	6
0000168	06/04/02	23:29:40	1277.2	06/05/02	5:48:50	4037.9	2760.7	6:19:10	6
0000169	06/13/02	4:00:37	2639.5	06/13/02	10:27:17	647.4	1992.1	6:26:40	6
0000170	06/13/02	11:10:06	699.7	06/13/02	18:14:16	4046.2	3346.5	7:04:10	7
0000171	06/13/02	22:00:37	4039.9	06/14/02	4:45:07	1172.5	2867.4	6:44:30	6
0000172	06/14/02	5:30:18	1212.6	06/14/02	12:35:28	4207.4	2994.7	7:05:10	7
0000173	06/14/02	16:00:37	4169.5	06/14/02	22:45:07	1371.2	2798.3	6:44:30	6
0000174	06/14/02	23:30:18	1408.8	06/15/02	5:24:28	3991.9	2583.1	5:54:10	5
0000175	06/23/02	4:00:37	3873.1	06/23/02	10:45:07	1037.3	2835.8	6:44:30	6
0000176	06/23/02	11:30:18	1058.2	06/23/02	17:32:58	3956.1	2897.8	6:02:40	6
0000177	06/23/02	22:00:37	3952.3	06/24/02	4:45:07	1113.3	2839.0	6:44:30	6
0000178	06/24/02	5:30:18	1119.1	06/24/02	11:03:59	3959.5	2840.3	5:33:41	5
0000179	06/24/02	16:00:37	3956.1	06/24/02	22:45:07	1082.2	2873.9	6:44:30	6
0000180	06/24/02	23:30:18	1091.7	06/25/02	4:59:58	3787.3	2695.6	5:29:40	5
0000181	07/03/02	4:00:37	3700.9	07/03/02	10:45:07	1041.7	2659.2	6:44:30	6
0000182	07/03/02	11:30:18	1054.6	07/03/02	17:39:28	3875.8	2821.2	6:09:10	6
0000183	07/03/02	22:00:37	3873.0	07/04/02	4:45:07	1192.3	2680.7	6:44:30	6
0000184	07/04/02	5:30:18	1196.8	07/04/02	11:02:28	3794.7	2597.9	5:32:10	5
0000185	07/04/02	16:00:38	3791.9	07/04/02	22:44:38	1221.3	2570.6	6:44:00	6
0000186	07/04/02	23:29:35	1228.5	07/05/02	4:33:37	3616.3	2387.8	5:04:02	5
Total							679015.4		1022

2.2.4 Submersible Incubation Device (SID)

Hiroaki SAKO (JAMSTC MIO)

(1) Instruments over view

The time series–submersible incubation device (TS-SID) is a mooring incubation system for conducting multiple *in situ* measurements of primary production. Each incubations involves a cleaning cycle, procurement of a 400 ml sample at depth with simultaneous introduction of an appropriate radioactive tracer and preservation of 47 filtered samples obtained after *in situ* incubations. Particulate samples are preserved in an array of filter - preservation units that contain a chemical fixative.

Between incubations, the incubation chamber (IC) and sample inlet is cleaned by introduction of an acid solution (1 M sulfuric acid) from the acid as IC is filled with water from the environment and allowed to soak. Prior the next incubation, the acidified water is flushed from the system. The biofouling control collar mechanically coupled to the IC floating piston physically removes light-occluding particulate material that may collect on the outer surfaces of the IC.

In order to know the optical condition and abundance of phytoplankton at the depth, BLOOM sensor (consisted of a spectral radiometer which measures photosynthetically active radiation (PAR), and a fluorometer) are installed on the frame of SID. These sensors are usually covered with shutter for preventing itself from biofouling.

(2) Result of recovery

SID samples were not collected at each station from the last mooring. It was caused by that the IC did not move smoothly by the high friction between IC glass and piston. For that reason, the battery voltage was decreased so quickly and SID stopped soon after deployment. Furthermore, the internal computer which deployed at K1 was broken. As a result, the deployment data (incubation period, filtration volume, etc.) was not acquired and could not calculate the primary production. BLOOM's data will be analyzed with cooperation of Prof. Tommy Dickey (University of California Santa Barbara).

(3) Deployment

In order for SID to move through the year, the following conversion were conducted;

1. the new IC glass which surface was more smoothly for reducing the friction
2. the long axis for the floating piston for avoiding sticking the end plate of the piston to IC.
3. the small pomp head for reducing the pressure in the filtration.
4. the big capacities battery which voltage is lower than last year (old: 32V, New: 28V).

Radioactive tracer solution prepared to add 1 mCi of $NaH^{14}CO_3$, 0.2 ml of 260 mM solution of NaOH, and 0.88 grams of NaCl in 400 ml distilled water. 400 Ci was injected in each SID.

Sampling filter was Whatman GF / F glass-fiber filter (diameter: 47 mm, pore size: 0.7 m). Fixative was 0.1 M sulfuric acid.

It was scheduled that incubation will start at 19:00 (UTC), which is 8:00 in the morning (LST) on November 1, 2002. The interval of incubation was 8 days. Incubation period is 12 hours centering midday (Table .2.2.8.3)

PAR was measured every 2 hours during the daytime, and fluorescence was measured every 2 hours through the whole day by BLOOM sensor.

2.2.5 Water Transfer System – Phytoplankton sampler (WTS-PPS)

Hiroaki SAKO (JAMSTEC MIO)

(1) Instruments over view

The water transfer system – phytoplankton sampler (WTS-PPS) collects *in situ* suspended particulate matter especially phytoplankton in an aquatic environment. A dual multi-port valve directs the water through 24 x 47-millimeter filters for a time-series operation. The positive displacement pump is placed downstream from the filters to prevent sample contamination. Samples are preserved in an array of filter-preservation units that each contains a chemical fixative.

Before taking sample, seawater is flushed through the valve and tube. This becomes clear out any particle and living things in the sampling way. The flow rate is controlled in order to prevent the sample from being crushed onto the filter. The computer records the instantaneous flow rate and total volume at a constant interval of time for each filter.

(2) Result of recovery

24 filter samples were collected at each station from the last mooring. Sampling times, filtration volume and filtration time was shown in table. Samples were filtrated 500 ml seawater through the year. Filtration time at K2 was shorter than it at K2 at the whole samples. It seemed that the suspended particles at K2 were less than at K1. However, 14 filtration times at K2 were indicated the shortest time (300 sec.). It is necessary to compare with the results of microscope analysis. Filter samples were took from the filter-preservation units and preserved in the Petri dish individually. These samples will be analyzed phytoplankton species especially coccolithophores using electron microscope by Dr. Xu (JAMSTEC MIO).

Table 2.2.5.1 Pumping results of WTS-PPS during last deployments.

Sampling number	Sampling Time	K1		K2	
		Filtration volume (ml)	Filtration time (sec.)	Filtration volume (ml)	Filtration time (sec.)
1	2001/9/30 19:00	500	576	500	301
2	2001/10/16 19:00	500	586	501	301
3	2001/11/1 19:00	500	542	500	301
4	2001/11/17 19:00	500	563	500	301
5	2001/12/3 19:00	500	523	500	301
6	2001/12/19 19:00	500	506	500	301
7	2002/1/4 19:00	500	490	500	301
8	2002/1/20 19:00	500	489	500	301
9	2002/2/5 19:00	500	506	500	310
10	2002/2/21 19:00	500	518	500	301
11	2002/3/9 19:00	500	485	500	319

12	2002/3/25 19:00	500	533	500	326
13	2002/4/10 19:00	500	543	500	336
14	2002/4/26 19:00	500	464	500	301
15	2002/5/12 19:00	500	461	500	301
16	2002/5/28 19:00	500	463	500	301
17	2002/6/13 19:00	500	456	500	311
18	2002/6/29 19:00	500	467	500	305
19	2002/7/15 19:00	500	450	500	326
20	2002/7/31 19:00	500	447	500	305
21	2002/8/16 19:00	500	432	500	301
22	2002/9/1 19:00	500	440	500	351
23	2002/9/17 19:00	500	445	500	327
24	2002/10/3 19:00	500	445	500	301

(3) Deployment

Sampling filter was Millipore HA filter (diameter: 47 mm, pore size: 0.45 m). Fixative was 0.5 % Utermöhl’s solution in 70 % (v/v) seawater. Utermöhl’s is a neutral solution and have similar composition of Lugol’s.

Sampling will start at 19:00 (UTC, Local time is 8:00 in the morning) on November 1, 2002. The Interval of each sampling is 16 days (Table 2.2.8.3). Filtration volume, pumping flow rate and flushing volume are 700 ml, 100 ml/min. and 100 ml, respectively. Filtration volume changed from 500 to 700 ml to collect more suspended particles.

2.2.6 Remote access sampler (RAS)

Kazuhiro HAYASHI (JAMSTEC MIO)

(1) Instruments

The remote access sampler (RAS) system was developed by McLane research laboratories, Inc., which has characteristic of time series water sampler to be able to collect under non-contamination condition. RAS has 49 acrylic sample containers (acryl tube) where contain 500ml Teflon coating aluminum sample bags. One of bags is filled with acid, use to wash sampling injector. Therefore, this instrument can collect 48samples. The acrylic container is filled with distilled water; this water was pumping out is done water collecting.

(2) Recovery

RAS were deployed by MR01-K04 cruise at the station K1 and K2. Each sample bags include about 52.5mg $HgCl_2$ as poison. After water sampling, sample will become 105ppm $HgCl_2$ (Kattner 1999). Table 2.2.6.1 shows sampling schedule. RAS was collection on 95 samples in 96 bags. Only one sample lost, it was expected that it be because vent tube separated from acryl tube. Vent tube works for adjusting pressure between acryl tube and seawater.

We were collected each sample bags about 450-480ml by RAS.

RAS's sample was analyzed on the ship for dissolved inorganic carbon (DIC), dissolved nutrients, total alkalinity (TALK) and salinity. First of all, DIC was measured. Sample was introduced to DIC measurement system by adding N2 gas. DIC system has 16ml pipette. And also, the pipette has needed to be rinsed with same volume water before measurement. Therefore water sample of about 60ml was used for the measurement of DIC.

After DIC measurement, samples were distributed by plastic syringe. Especially, Nutrients sample was filtered by 0.45 µm Millipore® HA for removing influence from diatom and organic matter.

The results of RAS sample ,measurements for DIC, TALK and nutrients were compared with discrete hydrocast data. These results were close to the chemical values of water at the 30~40 m water depths. However, salinity could not measure, because the value of salinity was affected by $HgCl_2$. We will measure salinity by another method. After measurement, we took 20ml to plastic tube as an archive, and the remains (less than 100ml) were sent to Woods Hole Oceanographic Institution for nitrogen isotope analysis.

(3) Deployment

We deployed RAS at the station K1, K2 and K3. RAS had a little improvement from last year. New instruments have filter holder, between sample valve and bag, and sample bag has also long (~50cm) tube in order to avoid contamination of decomposition of the particles on filter. Each filter holders have 47mm 0.45µm Millipore HA washed by ultra pure water. For this deployment, we used poison of , not only HCl, but also $HgCl_2$ for trace metal analysis. 3ml ultra pure grade HCl. will make the pH of 480 ml water sample approximately 2. Therefore, we will collect 24 time-series samples. Table 2.2.8.3 shows sampling schedule.

Reference

Kattner, G., 1999. Storage of dissolved in organic nutrients in sea water: poisoning with mercuric chloride. *Mar. chem*. **67**. 61-66.

Table 2.2.6.1 Sampling summary about RAS

RAS at the station K1

ID	Date	DIC	Nutrients	TALK	Salinity	ID	Date	DIC	Nutrients	TALK	Salinity
1	1.Oct / 2001	O	O	O	O	25	3.Apr / 2002	O	O	O	O
2	9.Oct / 2001	O	O	O	O	26	3.Apr / 2002	O	O	O	O
3	17.Oct / 2001	O	O	O	O	27	11.Apr / 2002	Not collected			
4	25.Oct / 2001	O	O	O	O	28	19.Apr / 2002	O	O	O	O
5	2.Nov / 2001	O	O	O	O	29	27.Apr / 2002	O	O	O	O
6	2.Nov / 2001	O	O	O	O	30	5.May / 2002	O	O	O	O
7	10.Nov / 2001	O	O	O	O	31	13.May / 2002	O	O	O	O
8	18.Nov / 2001	O	O	O	O	32	21.May / 2002	O	O	O	O
9	26.Nov / 2001	O	O	O	O	33	29.May / 2002	O	O	O	O
10	4.Dec / 2001	O	O	O	O	34	6.Jun / 2002	O	O	O	O
11	12.Dec / 2001	O	O	O	O	35	14.Jun / 2002	O	O	O	O
12	20.Dec / 2001	O	O	O	O	36	22.Jun / 2002	O	O	O	O
13	28.Dec / 2001	O	O	O	O	37	30.Jun / 2002	O	O	O	O
14	5.Jan / 2002	O	O	O	O	38	8.Jul / 2002	O	O	O	O
15	13.Jan / 2002	O	O	O	O	39	16.Jul / 2002	O	O	O	O
16	21.Jan / 2002	O	O	O	O	40	24.Jul / 2002	O	O	O	O
17	29.Jan / 2002	O	O	O	O	41	1.Aug / 2002	O	O	O	O
18	6.Feb / 2002	O	O	O	O	42	9.Aug / 2002	O	O	O	O
19	14.Feb / 2002	O	O	O	O	43	17.Aug / 2002	O	O	O	O
20	22.Feb / 2002	O	O	O	O	44	25.Aug / 2002	O	O	O	O
21	2.Mar / 2002	O	O	O	O	45	2.Sep / 2002	O	O	O	O
22	10.Mar / 2002	O	O	O	O	46	10.Sep / 2002	O	O	O	O
23	18.Mar / 2002	O	O	O	O	47	18.Sep / 2002	O	O	O	O
24	26.Mar / 2002	O	O	O	O	48	26.Sep / 2002	O	O	O	O

RAS at the station K2

ID	Date	DIC	Nutrients	TALK	Salinity	ID	Date	DIC	Nutrients	TALK	Salinity
1	1.Oct / 2001	O	O	O	O	25	3.Apr / 2002	O	O	O	O
2	9.Oct / 2001	O	O	O	O	26	3.Apr / 2002	O	O	O	O
3	17.Oct / 2001	O	O	O	O	27	11.Apr / 2002	O	O	O	O
4	25.Oct / 2001	O	O	O	O	28	19.Apr / 2002	O	O	O	O
5	2.Nov / 2001	O	O	O	O	29	27.Apr / 2002	O	O	O	O
6	2.Nov / 2001	O	O	O	O	30	5.May / 2002	O	O	O	O
7	10.Nov / 2001	O	O	O	O	31	13.May / 2002	O	O	O	O
8	18.Nov / 2001	O	O	O	O	32	21.May / 2002	O	O	O	O
9	26.Nov / 2001	O	O	O	O	33	29.May / 2002	O	O	O	O
10	4.Dec / 2001	O	O	O	O	34	6.Jun / 2002	O	O	O	O
11	12.Dec / 2001	O	O	O	O	35	14.Jun / 2002	O	O	O	O
12	20.Dec / 2001	O	O	O	O	36	22.Jun / 2002	O	O	O	O
13	28.Dec / 2001	O	O	O	O	37	30.Jun / 2002	O	O	O	O
14	5.Jan / 2002	O	O	O	O	38	8.Jul / 2002	O	O	O	O
15	13.Jan / 2002	O	O	O	O	39	16.Jul / 2002	O	O	O	O
16	21.Jan / 2002	O	O	O	O	40	24.Jul / 2002	O	O	O	O
17	29.Jan / 2002	O	O	O	O	41	1.Aug / 2002	O	O	O	O
18	6.Feb / 2002	O	O	O	O	42	9.Aug / 2002	O	O	O	O
19	14.Feb / 2002	O	O	O	O	43	17.Aug / 2002	O	O	O	O
20	22.Feb / 2002	O	O	O	O	44	25.Aug / 2002	O	O	O	O
21	2.Mar / 2002	O	O	O	O	45	2.Sep / 2002	O	O	O	O
22	10.Mar / 2002	O	O	O	O	46	10.Sep / 2002	O	O	O	O
23	18.Mar / 2002	O	O	O	O	47	18.Sep / 2002	O	O	O	O
24	26.Mar / 2002	O	O	O	O	48	26.Sep / 2002	O	O	O	O

2.2.7 Zooplankton Sampler (ZPS)

Hiroaki SAKO (JAMSTEC MIO)

(1) Instrument over view

Zooplankton Sampler (ZPS) collects zooplankton samples in time-series. A sample is collected using a positive displacement pump that generates negative pressure. Zooplanktons are unaware of being drawn towards the sampler until they are well inside and can not escape. Prefilter covers the mouth of the sample intake path to avoid invasion of large creatures. They are transported onto a 3.5 x 6 cm frame of a special roll of Nitex mesh (100 m mesh). The Zooplankton community retained on a frame is sandwiched by another piece of Nitex mesh for protection and immediately moved to the fixative bath for storage until recovery of the sampler. A new frame of mesh is positioned automatically to be ready for the next sampling cycle. This procedure can be repeated up to 50 times for each roll of Nitex mesh as instructed by the micro-controller. Before taking sample and every 4 days, seawater is flushed opposite direction. This becomes clear out any particle and living things in the sampling way.

(2) Result of recovery

Sampling times, filtration volume and filtration time was shown in table. 43 and 50 samples were collected from station K1 and K2 from the last mooring, respectively. Samples were collected from 1st October2001 to 17th August 2002 at station K1 and through the whole year at station K2. The operation at K1 stooped halfway through the year caused by low battery. These samples were washed out from the sample roll of mesh and kept in the sample bottle with 7% glutaraldehyde /seawater. These samples will be analyzed zooplankton species using microscope.

In the samples, the zooplankton was seemed to be a little. It was consider that the prefilter mesh size was too small. In last deployment, the prefilers mesh size was about 2-3mm. In these areas, dominant species of zooplankton was supposed to be the large copepod (2mm<). Besides, the ZPS had two horizontal disks which made a hydrodaynamically modeled space. It was known that these disks were useful at the near bottom sampling at coastal area, but these were became interruption at the mid and near surface layer sampling at open ocean.

Table 2.2.7.1 Pumping results of ZPS during last deployments.

Sampling number	Sampling Time	K1		K2	
		Filtration volume (l)	Filtration time (sec.)	Filtration volume (ml)	Filtration time (sec.)
1	2001/10/01 13:00	102.60	330	102.63	329
2	2001/10/09 13:00	102.61	330	102.63	329
3	2001/10/17 13:00	102.59	330	102.62	329
4	2001/10/25 13:00	102.58	330	102.62	329
5	2001/11/02 13:00	102.59	330	102.61	329
6	2001/11/10 13:00	102.44	329	102.61	329
7	2001/11/18 13:00	102.42	329	102.49	328

8	2001/11/26 13:00	102.41	329	102.48	328
9	2001/12/04 13:00	102.38	329	102.48	328
10	2001/12/12 13:00	102.37	329	102.48	328
11	2001/12/20 13:00	102.37	329	102.47	328
12	2001/12/28 13:00	102.37	329	102.47	327
13	2002/01/05 13:00	102.36	329	102.46	327
14	2002/01/13 13:00	102.23	328	102.33	326
15	2002/01/21 13:00	102.22	328	102.33	326
16	2002/01/29 13:00	102.22	328	102.39	328
17	2002/02/06 13:00	102.22	328	102.38	328
18	2002/02/14 13:00	102.21	328	102.37	328
19	2002/02/22 13:00	102.20	328	102.36	328
20	2002/03/02 13:00	102.19	328	102.22	327
21	2002/03/10 13:00	102.19	328	102.34	328
22	2002/03/18 13:00	102.05	327	102.20	327
23	2002/03/26 13:00	102.05	327	102.19	327
24	2002/04/03 13:00	102.04	327	102.19	327
25	2002/04/11 13:00	102.04	327	102.19	327
26	2002/04/19 13:00	102.04	327	102.18	327
27	2002/04/23 13:00	102.03	327	102.17	327
28	2002/04/27 13:00	102.03	327	102.16	327
29	2002/05/01 13:00	102.03	327	102.16	327
30	2002/05/05 13:00	102.03	327	102.15	327
31	2002/05/13 13:00	101.89	326	102.15	327
32	2002/05/21 13:00	102.02	327	102.01	326
33	2002/05/29 13:00	101.88	326	102.01	326
34	2002/06/06 13:00	101.89	326	102.00	326
35	2002/06/14 13:00	101.89	326	102.00	326
36	2002/06/22 13:00	101.87	326	102.00	326
37	2002/06/30 13:00	101.86	326	102.00	326
38	2002/07/08 13:00	101.86	326	101.99	326
39	2002/07/16 13:00	101.86	326	101.99	326
40	2002/07/24 13:00	101.85	325	101.99	326
41	2002/08/01 13:00	101.84	325	101.99	326
42	2002/08/17 13:00	101.84	325	101.98	326
43	2002/08/17 13:00	101.90	327	101.98	326
44	2002/08/25 13:00	-	-	101.85	325
45	2002/09/02 13:00	-	-	101.84	325
46	2002/09/10 13:00	-	-	101.84	325
47	2002/09/18 13:00	-	-	101.84	325
48	2002/09/26 13:00	-	-	101.84	325
49	2002/10/04 13:00	-	-	101.84	325
50	2002/10/12 13:00	-	-	101.84	325

(3) Deployment

ZPS had made two improvements for raising the sampling efficiency as follows:

1. To remove the lower horizontal disks.
2. To Exchange the prefilter (old mesh size: 3mm, New: 8mm).

Sampling will start at 13:00 (UTC: it is 2:00 in the midnight in local time) on November 1, 2002. The Interval of each sampling is essentially 8 days, and 4 days in spring bloom season (from April 7, 2003 to June 18, 2003; Table 2.2.8.3). Filtration volume is 90 liters and pumping flow rate is 15 liters / min. Filtration volume changed from 100 l and pumping flow rate was changed from 20 liters / min in order to keep the battery through the mooring.

2.2.8 Sediment Trap

Makio HONDA (JAMSTEC, MIO)

During this cruise, we recovered 6 sediment traps and deployed 16 sediment traps successfully.

(1) Recovery

In September 2001, three sediment traps were installed on the BGC mooring systems at station K1 and K2, respectively. Thanks to big efforts by MIO / JPAC mooring team and R/V MIRAI ship crews, 6 sediment traps (McLane Mark 78G-13) were recovered. However the rotation of collecting cups for all sediment traps stopped on the way resulting that approximately 60 % of samples planned to collect (78: 13 x 6) were obtained (Table 2.2.8.1).

We found that the voltage of battery for all traps were less that 10 V and quite lower than 21 V which was the minimum voltage needed for the rotation of collecting cups. These sediment traps have tilt and direction sensors. Based on the later investigation, it could be suspected that power of battery was unexpectedly consumed for the measurement of tilt and direction. Therefore we decided to disconnect these sensors from the main system when we redeployed these sediment traps.

After the measurement of pH on board, collecting cups with samples were stored under 4 degree-C in refrigerator and transferred to MIO laboratory on land.

In MIO laboratory, samples were sieved and samples less than 1 mm were divided to 10 aliquots with using McLane sample spritter. Sequentially, three aliquots were filtered with 47 mm Nucleopore filter (pore size: 0.45 m) and samples on filters were dried under 60 degree-C for 24 hours and, consequently, weighed in order to calculated total mass flux. Table 2.2.8.1 shows time schedule, pH measured after recovery, characteristics and total mass fluxes of sediment trap samples obtained.

Fig. 2.2.8.1 shows total mass fluxes for respective sediment traps.

Total mass flux at 5000 m at stations K1 and K2 were approximately 50 mg m^{-2} day^{-1} and 100 mg m^{-2} day^{-1}, respectively, and decreased toward winter. This tendency was similar to that observed previously at station 50N (50N, 165E, Honda, 2001) although total mass flux was smaller than that at 50N. Total mass flux at 1000 m and 2000 m for both stations were quite small compared to the previous report (Honda, 2001). In addition, most of sample collected in the cups consisted of foraminifera. It is doubtful that this small flux was a real flux and its main composition was foraminifera. We found a lot of “fish scales “ in collecting cups (Table 2.2.8.1). There is much possibility that materials fell into the collecting cone, especially organic materials, were grazed by fishes. In future, with using valid samples, concentrations of organic carbon, inorganic carbon, Si, Ca, trace elements, and natural radio nuclides will be measured.

(2) Deployment)

During this cruise, we add one more station (station K3) and deployed the BGC mooring system at stations K1, K2 and K3, respectively. While BGC mooring systems at station K1 and K3 have three sediment traps at 1000m, 2000m and 5000 m, BGC mooring system at station K2 has 10 sediment traps between 150 m and 5000 m in order to study the export flux in the twilight zone. We decided to call this BGC mooring system at station K2 "MEX" (for Mesopelagc layer's EXport flux study). In order to avoid the clog, various kind of sediment traps were used and these time schedules were different for respective sediment traps. Table 2.2.8.2 and 2.2.8.3 show sediment traps used for respective moorings and time schedule for sample collection, respectively. Before deployment, all of collecting cups were filled with seawater based 5 % buffered formalin with 20 mg NaCl. In addition, saturated $SrCl_4$ solution was add to several cups (see Table 2.2.8.2) in order to preserve "Acantharia".

Table 2.2.8.1 Sediment trap sample memo

Station K1 1000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	S	7.45	FISH SCALE / add formalin pH8.6
2	2001.10.29	S	7.64	FISH SCALE
3	2001.11.26	S	7.51	FISH SCALE
4	2001.12.24	S	7.52	FISH SCALE
5	2002.1.21	S	7.51	
6	2002.2.18	S	7.57	
7	2002.3.18	M	7.57	
8	2002.4.15	M	7.56	H2S smell, slow filteration
9	2002.5.13	M	7.58	
10	2002.6.10	L	7.60	
11	2002.7.8	L	7.60	stop rotating and recovery with open mouth
12	2002.8.5		8.15	no sample
13	2002.9.2		8.67	no sample

Station K2 1000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	S	7.59	fish scale, foraminifera
2	2001.10.29	S	7.18	foramnifera
3	2001.11.26	S	7.37	foramnifera
4	2001.12.24	S	7.53	foramnifera, fish scale
5	2002.1.21	S	7.56	foramnifera, fish scale
6	2002.2.18	S	7.48	
7	2002.3.18	L	8.06	Open hole, fish scale, foraminifera
8	2002.4.15		8.58	no sample
9	2002.5.13			no sample
10	2002.6.10			no sample
11	2002.7.8			no sample
12	2002.8.5			no sample
13	2002.9.2			no sample

Station K1 2000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	L	7.82	H2S smell, slow filteration
2	2001.10.29	M	7.53	FISH SCALE
3	2001.11.26	M	7.64	
4	2001.12.24		7.80	
5	2002.1.21		7.51	
6	2002.2.18	L	7.36	shrimp, fish scale
7	2002.3.18	L (fish scale, sh	8.03	stop rotating and recovery with open mouth
8	2002.4.15		8.65	no sample
9	2002.5.13			no sample
10	2002.6.10			no sample
11	2002.7.8			no sample
12	2002.8.5			no sample
13	2002.9.2			no sample

Station K2 2000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	M	7.80	foram. Fish scale, slow filteration
2	2001.10.29	M	7.54	fish scale
3	2001.11.26	M	7.40	fish scale
4	2001.12.24	M	7.47	fish scale
5	2002.1.21	M	7.50	foramnifera, fish scale
6	2002.2.18	M	7.46	fish scale
7	2002.3.18	M	7.47	
8	2002.4.15		8.10	Open hole
9	2002.5.13		8.59	no sample
10	2002.6.10			no sample
11	2002.7.8			no sample
12	2002.8.5			no sample
13	2002.9.2			no sample

Station K1 5000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	L	8.49	pteropod, foram.
2	2001.10.29	L	8.33	pteropod, foram.
3	2001.11.26	L	8.34	pteropod, foram.
4	2001.12.24	L	8.52	jelly fish
5	2002.1.21	L	8.64	break filter
6	2002.2.18	L	8.50	stop rotating and recovery with open mouth
7	2002.3.18	scarce	8.33	no sample
8	2002.4.15			no sample
9	2002.5.13			no sample
10	2002.6.10			no sample
11	2002.7.8			no sample
12	2002.8.5			no sample
13	2002.9.2			no sample

Station K2 5000m

S/N	open day	collected volum	pH	memo
1	2001.10.1	LL	7.55	diatom, foram.,
2	2001.10.29	LL	7.49	H2S smell, slow filteration
3	2001.11.26	LL	7.84	
4	2001.12.24	LL	7.81	
5	2002.1.21	M	7.87	
6	2002.2.18	little	8.11	Open hole
7	2002.3.18	S	7.99	Open hole
8	2002.4.15			no sample
9	2002.5.13			no sample
10	2002.6.10			no sample
11	2002.7.8			no sample
12	2002.8.5			no sample
13	2002.9.2			no sample

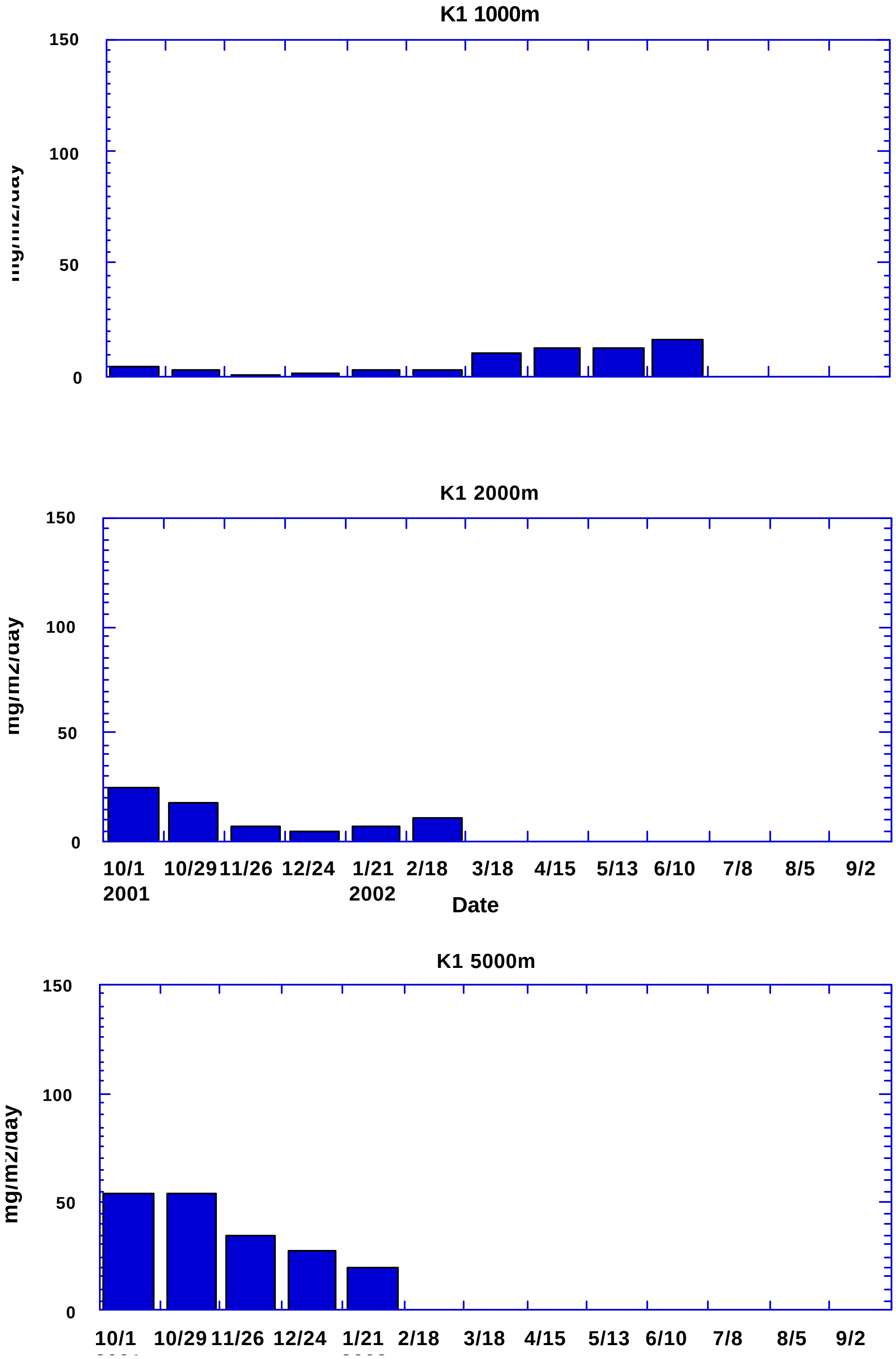


Fig. 2.2.8.1 Total Mass Flux (station K1)

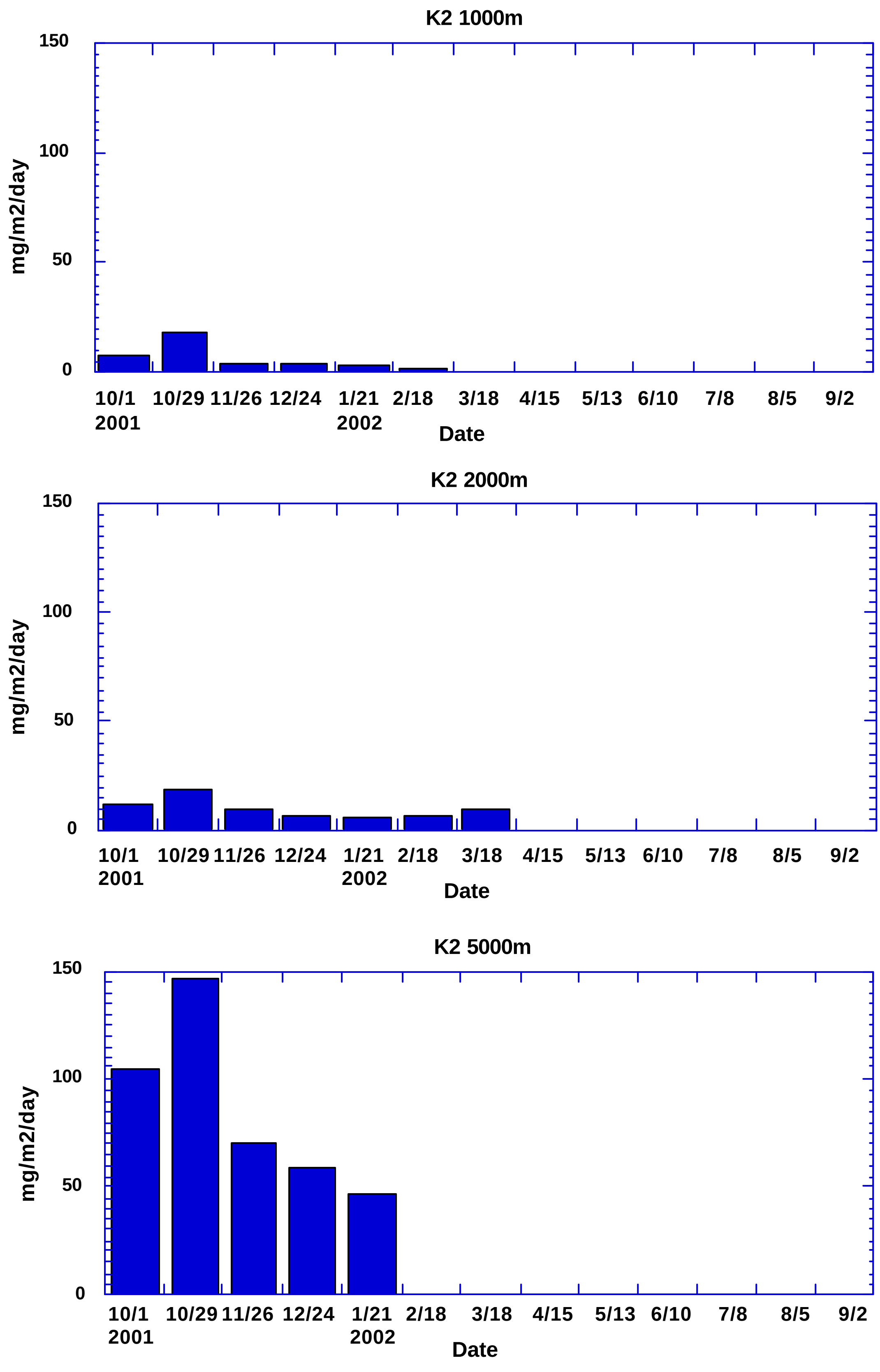


Fig. 2.2.8.1 Total Mass Flux (station K2)

Table 2.2.8.2 Sediment traps installed at each depth on respective BGC mooring systems
Numbers and "D" in parenthesis are sampling interval. (28D) means that sampring period is 28 day.

Depth(m)	K1	S/N	Depth(m)	K2-MEX	S/N	Depth(m)	K3	S/N
150			150	MK78G-21 (w. D, T) (4D)	10558-2/elec.6854	150		
250			250	MK78H-21 (14D)	11445.01/elec.5509	250		
400			400	MK78H-21 (14D)	11445.02/elec.5510	400		
500			500	SA7-21 (convert MK7G-21) (14D)	11555/elec.102	500		
600			600	MK78H-21 (w. D,T,C) (4D)	11445.03/elec.8307	600		
800			800	MK78-13 (28D)	11241-26elec./3081	800		
1000	MK78-13 (28D)	ML11241-25	1000	MK78-13 (28D)	11241-23/elec.3102	1000	MK78-13 (28D)	ML11241-24
2000	MK78-13 (28D)	ML11241-22	2000	MK78-13 (28D)	11241-27/elec.3099	2000	MK7G-21 (4D)	10357-989
4950			4950	SA7--21 (supllied by McLane) (14D)	/elec.1386	4950		
5000	MK78G-21 (w. D, T) (14D)	10357-2	5000	MK7G-21 (14D)	/elec. 1388	5000	MK7G-21 (4D)	878
quantity	3		quantity	10		quantity	3	

150m SrCl $_4$ in bottle #9, 12, 15
250m SrCl $_4$ in bottle #3, 9, 12, 15
500m SrCl $_4$ in bottle #3, 6, 9, 12, 15, 18, 21
4950m SrCl $_4$ in bottle #1, 9, 12, 15, 18, 21

2.2.8.3 Sampling schedule

		A: ST (13 cups)		B: ST (21 cups)		C: ST (MEX shallow)		SID		WTS-PPS		ZPS		RAS		MMP
Samp		13		21		21		40(sample)+7(blank)		24		50		24		K1, K2, K3
Int.		28		14		4		8		16		8		16		5
	1	2002.11.2 0:00	1	2002.11.2 0:00	1	2003.3.22 0:00	1	2002.11.1 19:00	1	2002.11.1 19:00	1	2002.11.2 13:00	1	2002.11.2 1:00	1	2002.11.2 0:00
	2	2002.11.30 0:00	2	2002.11.16 0:00	2	2003.3.26 0:00	2	2002.11.9 19:00	2	2002.11.17 19:00	2	2002.11.10 13:00	2	2002.11.18 1:00	2	2002.11.7 0:00
	3	2002.12.28 0:00	3	2002.11.30 0:00	3	2003.3.30 0:00	3	2002.11.17 19:00	3	2002.12.3 19:00	3	2002.11.18 13:00	3	2002.12.4 1:00	3	2002.11.12 0:00
	4	2003.1.25 0:00	4	2002.12.14 0:00	4	2003.4.3 0:00	4	2002.11.25 19:00	4	2002.12.19 19:00	4	2002.11.26 13:00	4	2002.12.20 1:00	4	2002.11.17 0:00
	5	2003.2.22 0:00	5	2002.12.28 0:00	5	2003.4.7 0:00	5	2002.12.3 19:00	5	2003.1.4 19:00	5	2002.12.4 13:00	5	2003.1.5 1:00	5	2002.11.22 0:00
	6	2003.3.22 0:00	6	2003.1.11 0:00	6	2003.4.11 0:00	6	2002.12.11 19:00	6	2003.1.20 19:00	6	2002.12.12 13:00	6	2003.1.21 1:00	6	2002.11.27 0:00
	7	2003.4.5 0:00	7	2003.1.25 0:00	7	2003.4.15 0:00	7	2002.12.19 19:00	7	2003.2.5 19:00	7	2002.12.20 13:00	7	2003.2.6 1:00	7	2002.12.2 0:00
	8	2003.4.19 0:00	8	2003.2.8 0:00	8	2003.4.19 0:00	8	2002.12.27 19:00	8	2003.2.21 19:00	8	2002.12.28 13:00	8	2003.2.22 1:00	8	2002.12.7 0:00
	9	2003.5.3 0:00	9	2003.2.22 0:00	9	2003.4.23 0:00	9	2003.1.4 19:00	9	2003.3.9 19:00	9	2003.1.5 13:00	9	2003.3.10 1:00	9	2002.12.12 0:00
	10	2003.5.17 0:00	10	2003.3.8 0:00	10	2003.4.27 0:00	10	2003.1.12 19:00	10	2003.3.25 19:00	10	2003.1.13 13:00	10	2003.3.26 1:00	10	2002.12.17 0:00
	11	2003.6.14 0:00	11	2003.3.22 0:00	11	2003.5.1 0:00	11	2003.1.20 19:00	11	2003.4.2 19:00	11	2003.1.21 13:00	11	2003.4.3 1:00	11	2002.12.22 0:00
	12	2003.7.12 0:00	12	2003.4.5 0:00	12	2003.5.5 0:00	12	2003.1.28 19:00	12	2003.4.10 19:00	12	2003.1.29 13:00	12	2003.4.11 1:00	12	2002.12.27 0:00
	13	2003.8.9 0:00	13	2003.4.19 0:00	13	2003.5.9 0:00	13	2003.2.5 19:00	13	2003.4.18 19:00	13	2003.2.6 13:00	13	2003.4.19 1:00	13	2003.1.1 0:00
		2003.9.6 0:00	14	2003.5.3 0:00	14	2003.5.13 0:00	14	2003.2.13 19:00	14	2003.4.26 19:00	14	2003.2.14 13:00	14	2003.4.27 1:00	14	2003.1.6 0:00
			15	2003.5.17 0:00	15	2003.5.17 0:00	15	2003.2.21 19:00	15	2003.5.4 19:00	15	2003.2.22 13:00	15	2003.5.5 1:00	15	2003.1.11 0:00
			16	2003.5.31 0:00	16	2003.5.21 0:00	16	2003.3.1 19:00	16	2003.5.12 19:00	16	2003.3.2 13:00	16	2003.5.13 1:00	16	2003.1.16 0:00
			17	2003.6.14 0:00	17	2003.5.25 0:00	17	2003.3.9 19:00	17	2003.5.20 19:00	17	2003.3.10 13:00	17	2003.5.21 1:00	17	2003.1.21 0:00
			18	2003.6.28 0:00	18	2003.5.29 0:00	18	2003.3.17 19:00	18	2003.5.28 19:00	18	2003.3.18 13:00	18	2003.5.29 1:00	18	2003.1.26 0:00
			19	2003.7.12 0:00	19	2003.6.2 0:00	19	2003.3.25 19:00	19	2003.6.13 19:00	19	2003.3.26 13:00	19	2003.6.14 1:00	19	2003.1.31 0:00
			20	2003.7.26 0:00	20	2003.6.6 0:00	20	2003.4.2 19:00	20	2003.6.29 19:00	20	2003.4.3 13:00	20	2003.6.30 1:00	20	2003.2.5 0:00
			21	2003.8.9 0:00	21	2003.6.10 0:00	21	2003.4.10 19:00	21	2003.7.15 19:00	21	2003.4.7 13:00	21	2003.7.16 1:00	21	2003.2.10 0:00
				2003.8.23 0:00		2003.6.14 0:00	22	2003.4.18 19:00	22	2003.7.31 19:00	22	2003.4.11 13:00	22	2003.8.1 1:00	22	2003.2.15 0:00
							23	2003.4.26 19:00	23	2003.8.16 19:00	23	2003.4.15 13:00	23	2003.8.17 1:00	23	2003.2.20 0:00
							24	2003.5.4 19:00	24	2003.9.1 19:00	24	2003.4.19 13:00	24	2003.9.2 1:00	24	2003.2.25 0:00
							25	2003.5.12 19:00			25	2003.4.23 13:00			25	2003.3.2 0:00
							26	2003.5.20 19:00			26	2003.4.27 13:00			26	2003.3.7 0:00
							27	2003.5.28 19:00			27	2003.5.1 13:00			27	2003.3.12 0:00
							28	2003.6.5 19:00			28	2003.5.5 13:00			28	2003.3.17 0:00
							29	2003.6.13 19:00			29	2003.5.9 13:00			29	2003.3.22 0:00
							30	2003.6.21 19:00			30	2003.5.13 13:00			30	2003.3.27 0:00
							31	2003.6.29 19:00			31	2003.5.17 13:00			31	2003.4.1 0:00
							32	2003.7.7 19:00			32	2003.5.21 13:00			32	2003.4.6 0:00
							33	2003.7.15 19:00			33	2003.5.25 13:00			33	2003.4.11 0:00
							34	2003.7.23 19:00			34	2003.5.29 13:00			34	2003.4.16 0:00
							35	2003.7.31 19:00			35	2003.6.2 13:00			35	2003.4.21 0:00
							36	2003.8.8 19:00			36	2003.6.6 13:00			36	2003.4.26 0:00
							37	2003.8.16 19:00			37	2003.6.10 13:00		MMP (continued)	37	2003.5.1 0:00
							38	2003.8.24 19:00			38	2003.6.14 13:00	51	2003.7.10 0:00	38	2003.5.6 0:00
							39	2003.9.1 19:00			39	2003.6.18 13:00	52	2003.7.15 0:00	39	2003.5.11 0:00
							40	2003.9.9 19:00			40	2003.6.22 13:00	53	2003.7.20 0:00	40	2003.5.16 0:00
											41	2003.6.30 13:00	54	2003.7.25 0:00	41	2003.5.21 0:00
								blank			42	2003.7.8 13:00	55	2003.7.30 0:00	42	2003.5.26 0:00
											43	2003.7.16 13:00	56	2003.8.4 0:00	43	2003.5.31 0:00
											44	2003.7.24 13:00	57	2003.8.9 0:00	44	2003.6.5 0:00
											45	2003.8.1 13:00	58	2003.8.14 0:00	45	2003.6.10 0:00
											46	2003.8.9 13:00	59	2003.8.19 0:00	46	2003.6.15 0:00
											47	2003.8.17 13:00	60	2003.8.24 0:00	47	2003.6.20 0:00
		NEXT CRUISE: 3 Sept. 2003 Lv. Vancouver, 11 Sept. Ar. station									48	2003.8.25 13:00	61	2003.8.29 0:00	48	2003.6.25 0:00
		Solar noon time		ca. 1:00 (UCT)							49	2003.9.2 13:00	62	2003.9.3 0:00	49	2003.6.30 0:00
		Mid night:		ca. 13:00 (UCT)		(in August of the northwestern North Pacific)					50	2003.9.10 13:00	63	2003.9.8 0:00	50	2003.7.5 0:00

2.2.9 Large Volume Pump (LVP)

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Large Volume Pump (LVP) was developed by McLane research laboratory, Inc. LVP is designed for large volume, *in situ* collection of particles and maximum volume 25,000L for 4L/min pump head with 30Ahr alkalinity battery. LVP can be deployed to a depth of 5,500m in water temperature from 0~50^{o}C.

LVP was attached on Piston corer wire (17mm o.d.). We have 8 instruments, and can deploy 8 layers for one cast. LVP have 14 deployments and each instruments works about 48 hours.

We expected to deployment depth from wire length, and deployed LVP. However, we didn't know real depth at the LVP at last year. So, in this time, two of them attached depth sensor (Sea bird SBE39). We can estimate almost depth of each LVP.

Table 2.2.9.1 shows sampling detail and estimate deployment depth.

Table 2.2.9.1 LVPsampling summary

	Station K1							Station K2		Station K2.5		Station K3		
Cast ID	#1 ^{15}N	#2 ^{15}N	#3 Barite	#4 Ba,Th,Pa	#5 Ba,Th,Pa	#6 Th-234	#7 ^{15}N	#8 Ba,Th,Pa	#9 Th-234	#10 Ba,Th,Pa	#11 Ba,Th,Pa	#12 ^{15}N	#13 ^{15}N	#14 Th-234
	Pumping volume /L													
LVP1	185	555	171		151	179	131	516	197	219	1240	198	212	206
LVP2	214	2857	431	1268	475	186	195		198	533	1264	200	211	205
LVP3	182	6659	482	1228	501			972	185	566	1207	193	206	200
LVP4	186	2681	524	1494	544	207	138	1014	204	609	1225	203	212	208
LVP5	195	2975	709	1361	601	202	215	1038	203	634	1269	203	213	210
LVP6	175	3236	626	1173	618	183	204	991	185	609	1038	182	194	195
LVP7	184	2076	617	1087	637	186	210	942	191	633	904	188	203	196
LVP8	192	3234	711	1168	799	208	218	885	202	694	1018	199	208	377
	Piston wire length /m													
LVP1	10	500	30	1500	30	10	10	150	10	30	1500	10	10	20
LVP2	9	499	80	2000	80	20	9	250	20	100	2000	9	9	35
LVP3	30	510	110	1999	110	40	30	400	40	200	3000	30	30	50
LVP4	29	509	150	3000	150	60	29	600	60	300	3500	29	29	70
LVP5	50	1000	230	3500	230	80	50	800	80	400	4000	50	50	90
LVP6	49	999	400	4000	400	100	49	1000	100	500	4500	49	49	110
LVP7	75	1010	600	4500	600	150	75	2000	150	700	5000	75	75	160
LVP8	74	1009	1000	5000	1000	200	74	5000	200	1000	5200	74	74	210
	Read value from depth sensor /m (Depth sensor doesn't work station K2.5 for low battery)													
LVP4	27.5	514.2	146.8	3029.8	144.5	56.7	27.6	602.1	58			27.9	26.9	67.3
STD.	0.7	0.7	0.2	34.8	1.5	0.8	0.7	1.6	0.8			0.8	0.8	3.1
LVP8	70.49	1014.7	1001.5	5067.3	993.3	195	68.4	5081.3	179.8			69.6	69.5	205
STD.	0.7	1	0.3	49.3	5.2	0.8	0.8	3.7	0.8			0.9	0.8	3.5
	Estimated deployment depth /m (LVP 1 to 3 were normalized by LVP 4's depth sensor value, the other were normalized by LVP 8.)													
LVP1	9	505	29	1515	29	9	10	151	10			10	9	19
LVP2	9	504	78	2020	77	19	9	251	19			9	8	34
LVP3	28	515	108	2019	106	38	29	401	39			29	28	48
LVP4	28	514	147	3030	145	57	28	602	58			28	27	67
LVP5	48	1006	230	3547	228	78	46	813	72			47	47	88
LVP6	47	1005	401	4054	397	98	45	1016	90			46	46	107
LVP7	71	1016	601	4561	596	146	69	2033	135			71	70	156
LVP8	70	1015	1002	5067	993	195	68	5081	180			70	70	205

2.3 ^{228}Ra, ^{226}Ra, Ba, Sr

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1. Seawater

^{228}Ra/^{226}Ra:

Radium isotopes have been widely used to trace water masses (van der Loeff *et al*., 1995). ^{228}Ra (half-life of 5.8 y) and ^{226}Ra (half-life of 1600 y) have the same geochemical behavior. Both radium isotopes are supplied to the ocean by deep-sea and continental-shelf sediments. A water mass in contact with the shelf is therefore enriched with Ra. The ^{228}Ra/^{226}Ra ratio of the water mass then decreases with increasing distance from the shelf, as a result of dilution and radioactive decay. ^{226}Ra can be used as a conservative tracer whereas the distribution of ^{228}Ra allows to estimate the transit time of the water masse since it lost contact with the shelf. If originating from the continental shelf (*i.e*. Sea of Okhotsk), intermediate waters from the north-west Pacific should be enriched in ^{228}Ra. Such a signature will be investigated in this study.

Methods: Seawater samples were collected using Niskin bottles (Table 2.3.1). Samples were then passed through a cartridge filled with MnO_2 fiber that retains radium isotopes. Once back in the lab, the fiber will be ashed in an oven and then measured for its gamma activity. Well-type, germanium detectors placed in the underground laboratory of Modane in the French Alps will be used. This equipment is protected from cosmic radiations by 1700m rock. A very low background is therefore achieved, allowing the measurement of very low activities (Reyss *et al*., 1995).

Ba, Sr:

In order to better understand the impact of primary production on the Ba and Sr geochemical cycles, high resolution profiles of Ba and Sr concentrations in seawater will be established at K1, K2 and K3. These profiles will be compared to those determined from the particulate matter.

Methods: Seawater samples were collected from Niskin bottles (same depths as for trace metal analysis). Ba and Sr concentrations will be measured by ICP/MS.

2. Particulate matter

^{228}Ra/^{226}Ra in barite:

Barite crystals ($BaSO_4$) are known to constitute a major component of the suspended and particulate matter. These crystals are assumed to form in the upper water column within microenvironments that result from the decay of organic matter. Chemical analogue of barium, radium is incorporated in barite during its precipitation. The radium signature of the suspended and particulate matter can thus be used to investigate the fate of barite - and by inference of

particles- within the water column.
As the $^{228}Ra/^{226}Ra$ ratio in seawater displays a strong vertical gradient, the $^{228}Ra/^{226}Ra$ ratio in barite offers a unique opportunity to identify the depth of barite precipitation within the water column (Legeleux and Reyss, 1996). The $^{228}Ra/^{226}Ra$ ratio in barite (together with the $^{226}Ra/Ba$ ratio) provides also information on the lateral transport of old barite crystals and on how this process may affect the vertical transport of particles to deep-sea sediments.

Methods: Particulate samples were collected using Large Volume Pumps -McLane, 4 l min^{-1}- (Table 2.3.2). Once back in the lab, a non-destructive gamma analysis will be conducted on the versapor filters at the underground laboratory of Modane, France.

Ba, Sr :

Sr and Ba measurements will be performed in the particulate matter to investigate the behavior of the Sr/Ba ratio (indicative of that in barite) with increasing water depth. This will provide information on how barite dissolution that increases with water depth may affect the elemental composition of barite.
Following Ganeshram *et al.*(submitted), leaching experiments will be conducted to quantify the different Ba-carriers within the particulate matter (labile organic matter, barite, refractory organic matter, alumino-silicates).

Methods: The leaching process proposed by Ganeshram *et al.*(submitted) will be performed. Ba and Sr concentrations in the different leachates will be measured by ICP/MS.

3. Underway sampling

Underway samples were collected using the seawater supply available on Mirai. Seawater and particulate matter collected at 6m depth could then be continuously sampled from Alaska to Japan. Ba and Sr analysis (in addition to Th and Pa analysis) will be conducted in both seawater and particulate matter samples to investigate possible geographic variations in the concentration of these elements that may be associated with changes in phytoplankton communities. Underway sampling was also conducted at K1, K2, K2.5 and K3 to collect large volume samples from surface waters for radium measurement (seawater and particulate matter).

Methods: stainless steel filter holders for 293mm filters were used. Particulate matter was collected by Versapor, Millipore and Nuclepore filters (Table 2.3.3). The volume filtered was given by flowmeters. Seawater samples were collected after filtration.

References

Ganeshram R., François R., Commeau J. & Brown-Leger S., submitted. An experimental investigation of barite formation in seawater.

Legeleux F. & Reyss J.-L., 1996. Ra-228/ Ra-226 activity ratio in oceanic settling particles : Implications regarding the use of barium as a proxy for paleoproductivity reconstruction, *Deep-Sea Res. I* 43 (11-12), 1857-1863.

Reyss J.-L., Schmidt S., Legeleux F. & Bonte P., 1995. Large, low background well-type detectors for measurements of environmental radioactivity, *Nucl. Inst. and Meth. A* 357, 391-397.

Rutgers van der Loeff M., Key R., Scholten J., Bauchs D., Michel A., 1995. ^{228}Ra as a tracer for shelf water in the Arctic Ocean, *Deep-Sea Res. I* 42, 6, 1533-1553.

Table 2.3.1 : Hydrocasts (depth, m)

K1	30	80	120	230	500	1000	2000	3500	4800	Bottom
K2	110	250	3000	4800	Bottom					
K3	40	110	250	400	800	2000	3500	5000	Bottom	

Table 2.3.2 : Pump casts (depth, m)

K1	30	80	110	150	230	400	600	1000
K1	30	80	110	150	230	400	600	1000
K1	2000	2000	3000	3500	4000	4500	5000	
K2	150	250	400	600	800	1000	2000	5000
K2.5	30	100	200	300	400	500	700	1000
K2.5	1500	2000	3000	3500	4000	4500	5000	5200

Table 2.3.3 : Underway sampling

1	54°09.53N	169°22.30W	to	54°07.81N	170°12.27W	versapor
2	54°07.69N	170°15.04W	to	54°06.33N	170°40.75W	millipore
3	53°56.28N	175°04.17W	to	53°54.46N	175°48.95W	versapor
4	53°54.27N	175°56.58W	to	53°53.23N	176°36.60W	millipore
5	53°53.075N	176°44.77W	to	53°51.72N	177°19.36W	nuclepore
6	53°46.11N	179°31.12W	to	53°45.05N	179°50.79W	versapor
7	53°44.80N	179°46.37W	to	53°43.82N	179°19.66E	millipore
8	53°37.30N	176°34.42W	to	53°36.91N	176°16.54E	nuclepore
9	53°35.84N	175°36.94E	to	53°34.14N	175°06.49E	millipore
10	53°34.03N	175°34.02E	to	53°33.14N	174°32.71E	versapor
11	52°38.03N	170°09.63E	to	52°27.77N	169°35.67E	versapor
12	52°26.41N	169°31.71E	to	52°16.97N	169°01.79E	millipore
13	52°15.70N	168°57.98E	to	52°03.55N	168°20.55E	nuclepore
14	K1					versapor
15	K1					millipore
16	K1					nuclepore
17	K1					versapor
18	K1					versapor
19	K1					millipore
20	K1					versapor
21	48°55.38N	162°14.19E	to	48°43.09N	161°59.07E	versapor
22	48°43.09N	161°59.07E	to	48°13.86N	161°24.08E	millipore
23	47°57.99N	161°05.25E	to	47°22.28N	160°22.44E	versapor
24	47°20.87N	160°20.92E	to	46°57.51N	160°05.13E	millipore
25	K2					versapor
26	K2					versapor
27	K2					millipore
28	K2					versapor
29	K2					nuclepore
30	45°08.44N	159°59.01E	to	44°41.59N	159°58.63E	versapor
31	44°39.35N	159°58.60E	to	44°20.10N	159°58.77E	millipore
32	K2.5					versapor
33	K2.5					millipore
34	K2.5					versapor
35	K2.5					versapor
36	K2.5					versapor
37	41°15.30N	159°59.64E	to	41°01.48N	159°59.89E	versapor
38	41°14.74N	159°59.67E	to	41°00.36N	159°59.92E	millipore
39	40°19.51N	160°03.16E	to	40°06.65N	160°00.30E	versapor
40	40°18.99N	160°03.04E	to	40°06.65N	160°00.30E	millipore
41	39°33.81N	159°59.96E	to	39°17.23N	160°00.02E	versapor
42	39°33.81N	159°59.96E	to	39°26.21N	159°59.98E	millipore
43	K3					versapor
44	K3					versapor
45	K3					versapor
46	K3					millipore
47	K3					nuclepore
48	K3					versapor
49	K3					nuclepore
50	40°09.24N	154°20.20E	to	40°17.54N	152°30.92E	versapor

2.4 Nitrogen isotopes

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(1) Objectives

Determining the nitrogen concentrations and fluxes as well as the ^{15}N signatures of the various components of the present day nitrogen cycle of the NW Pacific (nitrate, suspended and sinking PN, etc.) will enable a reconstruction of the modern nitrogen systematics in this HNLC region. Furthermore, combining information on the nitrogen isotopic composition of chlorophyll and/or suspended particles (*i.e.*, of phytoplankton biomass) and sinking particulate N (export flux) will constrain the f-ratio integrated over the residence time of nitrate in the mixed layer. The f-ratio is the ratio of new (exportable) production to total (new + regenerated) production, and is an important measure for quantifying the potential of an oceanic region to sequester atmospheric CO_2. Finally, establishing the relationship of ^{15}N of diatom frustule-bound and chlorophyll N to the nitrogen cycle dynamics in the NW Pacific will improve our understanding of the applicability of $^{15}N_{(chlorophyll)}$ and $^{15}N_{(frustule\text{-}bound\ N)}$ as proxies for palaeoceanographic studies.

(2) Sampling and Analytical Methods

Water samples for $^{15}N_{(nitrate)}$ analyses were taken at stations K1, K2, K2.5, and K3 (see Table 2.4.1) as well as from the ship intake during underway sampling (see Table 2.4.2), and acidified (HCl) immediately to a pH of 2-3. These samples will be analyzed following the 'ammonia diffusion method' detailed in Sigman *et al.* (1997). Suspended PN was filtered onto precombusted 47 mm GF/F filters using pressurized 20 L soda cans at stations K1, K2 and K3 (for sample depths and volumes filtered see Table 2.4.1). The $^{15}N_{(PN)}$ analyses will be carried out at the Stable Isotope Facility at UC Davis following standard procedures. Particulate samples for $^{15}N_{(chlorophyll)}$ and $^{15}N_{(frustule\text{-}bound\ N)}$ analyses were collected by Large Volume Pumps onto 142 mm diameter filters (GF/F and 5 m polycarbonate membrane filters, respectively; see Table 2.4.3, and chapter 2.2 for further details), and during underway sampling using 293 mm diameter filters (see Table 2.4.2). All filters were frozen to –80 °C immediately upon recovery. The procedures for $^{15}N_{(chlorophyll)}$ and $^{15}N_{(frustule\text{-}bound\ N)}$ analyses will be based on the pioneering studies by Sachs *et al.* (1999) and Sigman *et al.* (1999), respectively.

(3) References

Sachs, J. P., D. J. Repeta, and R. Goericke, Nitrogen and carbon isotopic ratios of chlorophyll from marine phytoplankton, Geochimica et Cosmochimica Acta 63, 1431-1441, 1999.

Sigman, D. M., M. A. Altabet, R. Michener, D. C. McCorkle, B. Fry, and R. M. Holmes, Natural abundance-level measurement of the nitrogen isotopic composition of oceanic nitrate: an adaption of the ammonia diffusion method, Marine Chemistry 57, 227-242, 1997.

Sigman, D. M., M. A. Altabet, R. Francois, D. C. McCorkle, and J.-F. Gaillard, The isotopic composition of diatom-bound nitrogen in Southern Ocean sediments, Paleoceanography 14, 118-134, 1999.

Table 2.4.1

station	depth [m]	hydrocast	bottle	water sample	amount filtered [kg]
K 1	10	1	13	250 ml	
K 1	30	1	14	250 ml	7.00
K 1	50	1	15	250 ml	
K 1	75	1	16	250 ml	
K 1	100	1	17	250 ml	
K 1	125	1	18	250 ml	
K 1	150	1	19	250 ml	
K 1	200	1	20	250 ml	
K 1	250	1	21	250 ml	
K 1	300	1	22	250 ml	
K 1	400	1	23	250 ml	
K 1	500	1	24	250 ml	
K 1	600	1	25	250 ml	
K 1	800	1	26	250 ml	
K 1	1000	1	27	250 ml	
K 1	1500	1	28	250 ml	
K 1	2000	1	29	250 ml	
K 1	2500	1	30	250 ml	
K 1	3000	1	31	250 ml	
K 1	3500	1	32	250 ml	
K 1	4000	1	33	250 ml	
K 1	4500	1	34	250 ml	
K 1	5000	1	35	250 ml	
K 1	bottom	1	36	250 ml	
K 1	750	1	2	250 ml	
K 1	5	2	1	250 ml	9.60
K 1	10	2	2	250 ml	9.90
K 1	25	2	3	250 ml	10.02
K 1	50	2	4		10.40
K 1	75	2	5		10.81
K 1	100	2	6		6.55
K 1	125	2	7		10.71
K 1	150	2	8		10.43
K 1	175	2	9	250 ml	10.03
K 1	200	2	10		10.65
K 1	250	2	11		10.84
K 1	300	2	12		6.68
K 1	20	2	16	250 ml	
K 1	40	2	19	250 ml	
K 1	60	2	22	250 ml	
K 1	80	2	25	250 ml	
K 1	225	3	1	250 ml	11.67
K 1	275	3	2	250 ml	11.00
K 1	350	3	3	250 ml	
K 1	450	3	4	250 ml	
K 1	60	3	5	250 ml	11.57
K 1	700	3	6	250 ml	
K 1	900	3	7	250 ml	
K 1	1250	3	8	250 ml	
K 1	1000	3	9- 16		60.00
K 1	30	4	1	250 ml	21.30
K 1	80	4	7	250 ml	20.10
K 1	120	4	14	250 ml	19.00
K 1	230	4	21	250 ml	19.40
K 1	500	4	29	250 ml	18.10
K 1	2000	5	10-18		59.91
K 1	3500	5	19-27		58.51
K 1	4800	5	1-9	250 ml	56.37
K 1	5126	5	28-36	250 ml	57.31
K 1	ca. 7	ship intake		250 ml	20.00
K 2	500	1	1	250 ml	
K 2	750	1	2	250 ml	
K 2	1000	1	3	250 ml	10.78
K 2	1500	1	4	250 ml	
K 2	2000	1	5	250 ml	10.86
K 2	2500	1	6	250 ml	
K 2	3000	1	7	250 ml	10.98
K 2	3500	1	8	250 ml	
K 2	4000	1	9	250 ml	
K 2	4500	1	10	250 ml	10.03
K 2	5000	1	11	250 ml	10.75
K 2	bottom	1	12	250 ml	10.71
K 2	30	1	14	250 ml	
K 2	400	1	23	250 ml	
K 2	600	1	25	250 ml	
K 2	5	2	1	250 ml	10.38
K 2	10	2	2	250 ml	10.26
K 2	25	2	3	250 ml	9.14
K 2	50	2	4	250 ml	10.25
K 2	75	2	5	250 ml	10.34
K 2	100	2	6	250 ml	10.48
K 2	125	2	7	250 ml	10.56
K 2	150	2	8	250 ml	10.49
K 2	175	2	9	250 ml	10.30
K 2	200	2	10	250 ml	10.30
K 2	250	2	11	250 ml	10.23
K 2	300	2	12	250 ml	9.99
K 2	20	2	16	250 ml	
K 2	40	2	19	250 ml	
K 2	60	2	22	250 ml	
K 2	80	2	25	250 ml	
K 2	110	3	1	250 ml	40.44
K 2	250	3	8	250 ml	36.49
K 2	3000	3	15	250 ml	59.37
K 2	4800	3	22	250 ml	56.08
K 2	neph.lay.	3	30	250 ml	55.41
K 2	ca. 7	ship intake		250 ml	20.00
K 2.5	1500	1	4	250 ml	
K 2.5	2000	1	5	250 ml	
K 2.5	2500	1	6	250 ml	
K 2.5	3000	1	7	250 ml	
K 2.5	3500	1	8	250 ml	
K 2.5	4000	1	9	250 ml	
K 2.5	4500	1	10	250 ml	
K 2.5	5000	1	11	250 ml	
K 2.5	bottom	1	12	250 ml	
K 2.5	30	1	14	250 ml	
K 2.5	400	1	23	250 ml	
K 2.5	500	1	24	250 ml	
K 2.5	600	1	25	250 ml	
K 2.5	800	1	26	250 ml	
K 2.5	1000	1	27	250 ml	
K 2.5	5	2	1	250 ml	
K 2.5	10	2	2	250 ml	
K 2.5	25	2	3	250 ml	
K 2.5	50	2	4	250 ml	
K 2.5	75	2	5	250 ml	
K 2.5	100	2	6	250 ml	
K 2.5	125	2	7	250 ml	
K 2.5	150	2	8	250 ml	
K 2.5	175	2	9	250 ml	
K 2.5	200	2	10	250 ml	
K 2.5	250	2	11	250 ml	
K 2.5	300	2	12	250 ml	
K 2.5	20	2	13	250 ml	
K 2.5	40	2	14	250 ml	
K 2.5	60	2	15	250 ml	
K 2.5	175	2	16	250 ml	
K 2.5	225	2	17	250 ml	
K 2.5	275	2	18	250 ml	
K 3	500	1	1	250 ml	10.69
K 3	750	1	2	250 ml	10.33
K 3	1000	1	3	250 ml	10.79
K 3	1500	1	4	250 ml	
K 3	2000	1	5	250 ml	
K 3	2500	1	6	250 ml	10.00
K 3	3000	1	7	250 ml	
K 3	3500	1	8	250 ml	
K 3	4000	1	9	250 ml	10.00
K 3	4500	1	10	250 ml	
K 3	5000	1	11	250 ml	
K 3	bottom	1	12	250 ml	10.00
K 3	30	1	14	250 ml	6.87
K 3	400	1	23	250 ml	
K 3	600	1	25	250 ml	
K 3	800	1	26	250 ml	
K 3	5	2	1	250 ml	10.02
K 3	10	2	2	250 ml	9.59
K 3	25	2	3	250 ml	9.69
K 3	50	2	4	250 ml	9.94
K 3	75	2	5	250 ml	9.69
K 3	100	2	6	250 ml	9.89
K 3	125	2	7	250 ml	9.81
K 3	150	2	8	250 ml	9.84
K 3	175	2	9	250 ml	9.75
K 3	200	2	10	250 ml	10.00
K 3	250	2	11	250 ml	10.08
K 3	300	2	12	250 ml	9.70
K 3	20	2	16	250 ml	
K 3	40	2	19	250 ml	
K 3	60	2	22	250 ml	
K 3	80	2	25	250 ml	
K 3	225	3	33	250 ml	8.24
K 3	60	3	34	250 ml	12.09
K 3	350	3	35	250 ml	12.06
K 3	450	3	36	250 ml	11.84
K 3	40	4	1		19.01
K 3	40 (repeat)	4	1		17.69
K 3	110	4	7		38.97
K 3	250	4	14		38.48
K 3	400	4	21		41.05
K 3	800	4	29		47.28
K 3	2000	5	1		60.51
K 3	3500	5	9		60.92
K 3	5000	5	19		56.52
K 3	neph.lay	5	29	250 ml	39.00
K 3	ca. 7	ship intake			

Table 2.4.2

station	filter type	lat / long start	lat / long end	volume filtered [L]
UW 1	5 µm polycarb.	54°09'N / 169°29'W	54°07'N / 170°06'W	252.46
	GF/F	54°09'N / 169°29'W	54°07'N / 170°06'W	223.32
UW 2	5 µm polycarb.	53°56'N / 174°51'W	53°54'N / 175°47'W	196.82
	GF/F	53°56'N / 174°51'W	53°54'N / 175°47'W	361.85
UW 3	5 µm polycarb.	53°46'N / 179°28'W	53°45'N / 179°58'E	135.88
	GF/F	53°46'N / 179°28'W	53°45'N / 179°58'E	250.57
UW 4	5 µm polycarb.	53°35'N / 175°15'E	53°34'N / 174°59'E	117.71
	GF/F	53°35'N / 175°15'E	53°34'N / 174°59'E	184.33
UW 5	5 µm polycarb.	52°39'N / 170°14'E	52°31'N / 169°46'E	157.83
	GF/F	52°39'N / 170°14'E	52°31'N / 169°46'E	166.92
UW 6 (K1)	5 µm polycarb.	51°16'N / 165°13'E	51°16'N / 165°13'E	181.68
	GF/F	51°16'N / 165°13'E	51°16'N / 165°13'E	601.44
UW 7	5 µm polycarb.	49°08'N / 162°30'E	48°45'N / 162°02'E	210.07
	GF/F	49°08'N / 162°30'E	48°36'N / 161°50'E	428.84
UW 8 (K2)	5 µm polycarb.	47°00'N / 159°58'E	46°55'N / 160°04'E	258.52
	GF/F	47°00'N / 159°58'E	46°56'N / 160°03'E	604.46
UW 9	5 µm polycarb.	45°23'N / 159°59'E	44°52'N / 159°59'E	218.39
	GF/F	45°23'N / 159°59'E	44°46'N / 159°59'E	367.90
UW 10 (K2.5)	5 µm polycarb.	43°30'N / 160°00'E	43°29'N / 160°01'E	391.75
	GF/F	43°30'N / 160°00'E	43°29'N / 160°01'E	648.37
UW 11	5 µm polycarb.	41°35'N / 159°59'E	41°19'N / 159°59'E	117.71
	GF/F	41°35'N / 159°59'E	41°16'N / 159°59'E	242.24
UW 12 (K3)	5 µm polycarb.	39°10'N / 160°00'E	39°10'N / 160°00'E	326.65
	GF/F	39°10'N / 160°00'E	39°10'N / 160°00'E	931.11

Table 2.4.3

	depth [m]	filter type	pumping time [min]	vol. pumped [L]		depth [m]	filter type	pumping time [min]	vol. pumped [L]
station K1, pump cast 1					**station K3, pump cast 1**				
P1	10	GF/F	60	184.71	P1	10	GF/F	60	197.58
P2	10	GF/F	60	213.85	P2	10	GF/F	60	199.85
P3	30	GF/F	60	182.44	P3	30	GF/F	60	193.04
P4	30	GF/F	60	185.84	P4	30	GF/F	60	202.88
P5	50	GF/F	60	195.31	P5	50	GF/F	60	202.88
P6	50	GF/F	60	174.49	P6	50	GF/F	60	182.44
P7	75	GF/F	60	184.33	P7	75	GF/F	60	187.74
P8	75	GF/F	60	191.52	P8	75	GF/F	60	198.71
station K1, pump cast 2					**station K3, pump cast 2**				
P1	500	5 µm polycarb.	360	1295.61	P1	10	5 µm polycarb.	60	212.34
P2	500	GF/F	360	1172.59	P2	10	5 µm polycarb.	60	210.82
P3	510	5 µm polycarb.	360	976.91	P3	30	5 µm polycarb.	60	205.53
P4	510	GF/F	360	1121.12	P4	30	5 µm polycarb.	60	211.96
P5	1000	5 µm polycarb.	360	1129.07	P5	50	5 µm polycarb.	60	212.72
P6	1000	GF/F	360	1071.91	P6	50	5 µm polycarb.	60	194.17
P7	1010	5 µm polycarb.	360	1049.20	P7	75	5 µm polycarb.	60	202.50
P8	1010	GF/F	360	1113.55	P8	75	5 µm polycarb.	60	207.80
station K1, pump cast 6									
P1	10	5 µm polycarb.	60	130.96					
P2	10	5 µm polycarb.	60	194.93					
P3	-	-	-	0.00					
P4	30	5 µm polycarb.	60	137.77					
P5	50	5 µm polycarb.	60	214.61					
P6	50	5 µm polycarb.	60	204.01					
P7	75	5 µm polycarb.	60	210.07					
P8	75	5 µm polycarb.	60	218.02					

2.5 ^{230}Th / ^{231}Pa

Kazuhiro HAYASHI (JAMSTEC MIO)
Roger FRANCOIS (WHOI)

(1) Objective

^{230}Th (Half life 75,400yr) and ^{231}Pa (half life 32,760yr) are produced in seawater from radioactive decay of ^{238} U and ^{235} U. Both nuclides are rapidly adsorbed on sinking particles (e.g. Fecal pellet) and removed from seawater. Therefore, these nuclides concentrations are considered proxy of biological pump. And also measurement of sediment trap sample, we can know trapping efficiency for the sediment trap. This study has two objects; one is to obtain information on the dissolved and particle concentration of ^{230}Th and ^{231}Pa in the northwest Pacific. Another one is to estimate trapping efficiency of sediment trap.

(2) Sampling

In this cruise we collected 2 types. One is particulate sample. These samples were collected by Large Volume Pump (McLane research laboratory, Inc) from water column and by filtering subsurface water (~5m) from underway sampling pump system at the Mirai Underway sampling room. LVP was using 142mm 0.8 m Verspor® filter, was amount of 38samples.

Underway sample was collected by same kind of 270mm filter at the LVP and filtered by it about ~1000L. After filteration, filters were moved to plastic tube and stored in room temperature. First of all, these filters will measure Ra. After measurement of filter, it will split between Barite chemistry.

Another one is dissolved sample. These samples were collected by the hydrocast and by underway water. The hydrocast samples (~20L) were immediately filtered gravitationally using 0.8µm Versopor filter from the Niskin bottles into 20L polyethylene cubitainers. Underway sample collected ~60L during underway filtering.

Dissolved samples weighed with a precision better than 2% on a computerized balance. The samples are acidified with 6M-HCl and spiked with ^{229} Th, ^{233}Pa and $FeCl_3$. After overnight for equilibration, the pH is adjusted to about ~8 by adding NH_4OH to precipitate $Fe(OH)_3$ that adsorbed dissolved and entrain particulate Th and Pa. After decantation, overlying water was removed. Therefore, each supernatant is separated by centrifuging in 50ml polypropylene centrifuge tubes and returned to the laboratory for chemical separation and analysis.

(3) Future works

Each sample will be separated by ion exchange, using a procedure that is modified by Fleer and Bacon (1991). ^{230} Th and ^{231}Pa are measurement by High Resolution Inductive Coupled Plasma Mass Spectrometry.

Reference

Fleer A. P. and Bacon M. P., (1991) Notes on some techniques of marine particle analysis used at WHOI. *In Marine Particles: Analysis and Characterization* (ed. D. C. Hurd and D. W. Spencer), pp223-226. Geophysical monograph 63, AGU.

2.6 Th-234 and export flux

Hajime KAWAKAMI (JAMSTEC MIO)

(1) Purpose of the study

The fluxes of POC were estimated from Particle-reactive radionuclide (^{234}Th) and their relationship with POC in the northwestern North Pacific Ocean.

(2) Sampling

Seawater sampling for ^{234}Th and POC: 3 stations (St. K1, K2 and K3) and 8 depths (10m, 20m, 40m, 60m, 80m, 100m, 150m and 200m) at each station.

Seawater samples (20–30 L) were taken from Hydrocast at each depth. The seawater samples were filtered with 47mm (for ^{234}Th) and 25mm (for POC) GF/F filter on board immediately after water sampling.

In situ filtering samples were taken from large volume pump sampler (LVP) at each depth. The filter samples (142mm GF/F filter) were divided for ^{234}Th and POC.

(3) Chemical analyses

Th was separated using anion exchange method on board; all dissolved samples. The particulate samples were separated in land-based laboratory. Separated samples of Th were absorbed on 25mm stainless steel disks electrically, and were measured by -ray counter.

The determinations of POC were used CHN analyzer.

(4) Preliminary result

The distributions of dissolved and particulate ^{234}Th will be determined as soon as possible after this cruise. This work will help further understanding of particle dynamics at the euphotic layer.

2.7 Plankton net

Hiroaki SAKO (JAMSTEC MIO)

Zooplankton puts out the vertical organic fluxes such as fecal pellets. To find the basically data of zooplankton species and to compare with the ZPS samples, plankton net sampling were carried out.

Samples were collected with a twin NORPAC net (mesh size; 100 and 300 m) towed vertically from the 300m depth to the surface at station K1 twice. The samples were fixed in 7% glutaraldehyde /seawater) immediately after capture except one 100 m< net samples. These samples will be analyzed zooplankton species using microscope.

One sample from 100 m net which did not add the fixative was distributed to Dr. Kienast (WHOI) for analyzing the diatoms ^{15}N.

3. General observation

3.1 Meteorological observations

3.1.1 Surface meteorological observation

Kunio YONEYAMA (JAMSTEC):Principal Investigator - Shore-side participant -
Satoshi OKUMURA (GODI)
Wataru TOKUNAGA (GODI)

(1) Objective

Surface meteorological parameters are obtained as a basic meteorological dataset. These parameters provide us the information about temporal variation of the meteorological condition surrounding the ship.

(2) Methods

The surface meteorological parameters were observed throughout MR02-K05 Leg2 cruise from the departure of Duath-Harbor on 11 October 2002 to the arrival of Sekinehama on 6 November 2002 .

This cruise, we used 2 systems for the surface meteorological observation.

1. Mirai meteorological observation system
2. Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

(3-1) Mirai meteorological observation system

Instruments of Mirai met system are listed in Table 3.1.1-1 and measured parameters are listed in Table 3.1.1-2. Data was collected and processed by KOAC-7800 weather data processor made by Koshin Denki, Japan. The data set has 6-second averaged every 6-second record and 10-minute averaged every 10-minute record.

Table 3.1.1-1: Instruments and their installation locations of Mirai met system

sensors	type	manufacturer	location(altitude from surface)
anemometer	KE-500	Koshin Denki, Japan	foremast (24m)
thermometer	FT	Koshin Denki, Japan	compass deck (21m) AT
	RFN1-0	Koshin Denki, Japan	4th deck (-1m, inlet –5m) SST
dewpoint meter	DW-1	Koshin Denki, Japan	compass deck (21m)
barometer	F-451	Yokogawa, Japan	captain deck (13m)
rain gauge	50202	R. M. Young, USA	compass deck (19m)
optical rain gauge	ORG-115DR	ScTi, USA	compass deck (19m)
radiometer (SW)	MS-801	Eiko Seiki, Japan	radar mast (28m)
radiometer (IR)	MS-202	Eiko Seiki, Japan	radar mast (28m)
wave height meter	MW-2	Tsurumi-seiki, Japan	bow (10m)

Table 3.1.1-2: Parameters of Mirai meteorological observation system

parmeters	units	remarks
1. latitude	degree	
2. longitude	degree	
3. ship's speed	knot	Mirai log,DS-30 Furuno
4. ship's heading	degree	Mirai gyro,TG-6000,Tokimec
5. relative wind speed	m/s	6sec/10min averaged
6. relative wind direction	degree	6sec/10min averaged
7. true wind speed	m/s	conducted by 3/4/5/6 6sec/10min averaged
8. true wind direction	degree	conducted by 3/4/5/6 6sec/10min averaged
9. barometric pressure	hPa	adjusted to sea surface level 6sec/10min averaged
10. air temperature (starboard side)	degC	6sec/10min averaged
11. air temperature (port side)	degC	6sec/10min averaged
12. dewpoint temperature (starboard side)	degC	6sec/10min averaged
13. dewpoint temperature (port side)	degC	6sec/10min averaged
14. relative humidity (starboard side)	%	conducted by 9/10/12 6sec/10min averaged
15. relative humidity (port side)	%	conducted by 9/11/13 6sec/10min averaged
16. sea surface temperature	degC	6sec/10min averaged
17. rain rate (optical rain gauge)	mm/hr	hourly accumulation
18. rain rate (capacitive rain gauge)	mm/hr	hourly accumulation
19. down welling shortwave radiation	W/m^2	6sec/10min averaged
20. down welling infra-red radiation	W/m^2	6sec/10min averaged
21. significant wave height	m	hourly
22. significant wave period	second	hourly

(3-2) Shipboard Oceanographic and Atmospheric Radiation (SOAR) system

SOAR system, designed by BNL (Brookhaven National Laboratory, USA), is consisted of 3 parts.

1. Portable Radiation Package (PRP) designed by BNL – short and long wave down welling radiation
2. Zeno meteorological system designed by BNL – wind, Tair/RH, pressure and rainfall measurement
3. Scientific Computer System (SCS) designed by NOAA (National Oceanographic and Atmospheric Administration, USA) – centralized data acquisition and logging of all data sets SCS recorded PRP data every 6.5 seconds, Zeno/met data every 10 seconds.

Instruments and their locations are listed in Table 3.1.1-3 and measured parameters are listed in Table 3.1.1-4

Table 3.1.1-3: Instrument installation locations of SOAR system

sensors	type	manufacturer	location(altitude from surface)
Zeno/Met			
anemometer	05106	R. M. Young, USA	foremast (25m)
T/RH	HMP45A	Vaisala, USA	foremast (24m)
		with 43408 Gill aspirated radiation shield (R. M. Young)	
barometer	61201	R. M. Young, USA	foremast (24m)
		with 61002 Gill pressure port (R. M. Young)	
rain gauge	50202	R. M. Young, USA	foremast (24m)
optical rain gauge	ORG-815DA	Optical Science Inc., USA	foremast (24m)
PRP			
radiometer (SW)	PSP	Eppley labs, USA	foremast (25m)
radiometer (IR)	PIR	Eppley labs, USA	foremast (25m)
fast rotating shadowband radiometer		Yankee Environmental Sys	foremast (25m)

Table 3.1.1-4: Parameters of SOAR System

parmeters	units	remarks
1. latitude	degree	
2. longitude	degree	
3. ship's speed	knot	Mirai log,DS-30 Furuno
4. ship's heading	degree	Mirai gyro,TG-6000,Tokimec
5. relative wind speed	m/s	
6. relative wind direction	degree	
7. true wind speed	m/s	conducted by 3/4/5/6
8. true wind direction	degree	conducted by 3/4/5/6
9. barometric pressure	hPa	
10. air temperature	degC	
11. relative humidity	%	
12. rain rate (optical rain gauge)	mm/hr	
13. precipitation (capacitive rain gauge)	mm	reset at 50mm
14. down welling shortwave radiation	W/m^2	
15. down welling infra-red radiation	W/m^2	
16. defused radiation	W/m^2	

(3) Preliminary results

Wind (converted to U, V component, from SOAR), Tair (from SOAR) / SST (from EPCS), RH (from SOAR) / precipitation (from SOAR), solar radiation (from SOAR), pressure (from SOAR) and hourly significant wave height observed during the cruise are shown in Figure 3.1.1-1, Figure 3.1.1-2, and Figure 3.1.1-3 respectively. In the figures, accumulated precipitation data from SOAR capacitive rain gauge was converted to the precipitation amount in every minute and obvious noises were eliminated but not calibrated. Other figures are showing uncorrected data.

(4) Data archives

These raw data will be submitted to the Data Management Office (DMO) in JAMSTEC just after the cruise and archived there.

(5) Remarks

1. Radiometers for the upwelling radiation measurement of Mirai meteorological observation system were not installed during this cruise.
2. Navigation data (Position, log, gyro etc.) was stopped, caused by network server trouble. As following term;
   1) Mirai meteorological observation system: 07:25 to 07:42 (UTC) Oct. 31, 2002/11/21
   2) SOAR: 06:43 to 07:42 (UTC) Oct. 31, 2002
3. SOAR PIRavg (and PIR Dome temp.) sometimes didn't output data (PIR Dome temp. was "-99.0"), from Oct. 11 to Oct. 22, 2002.

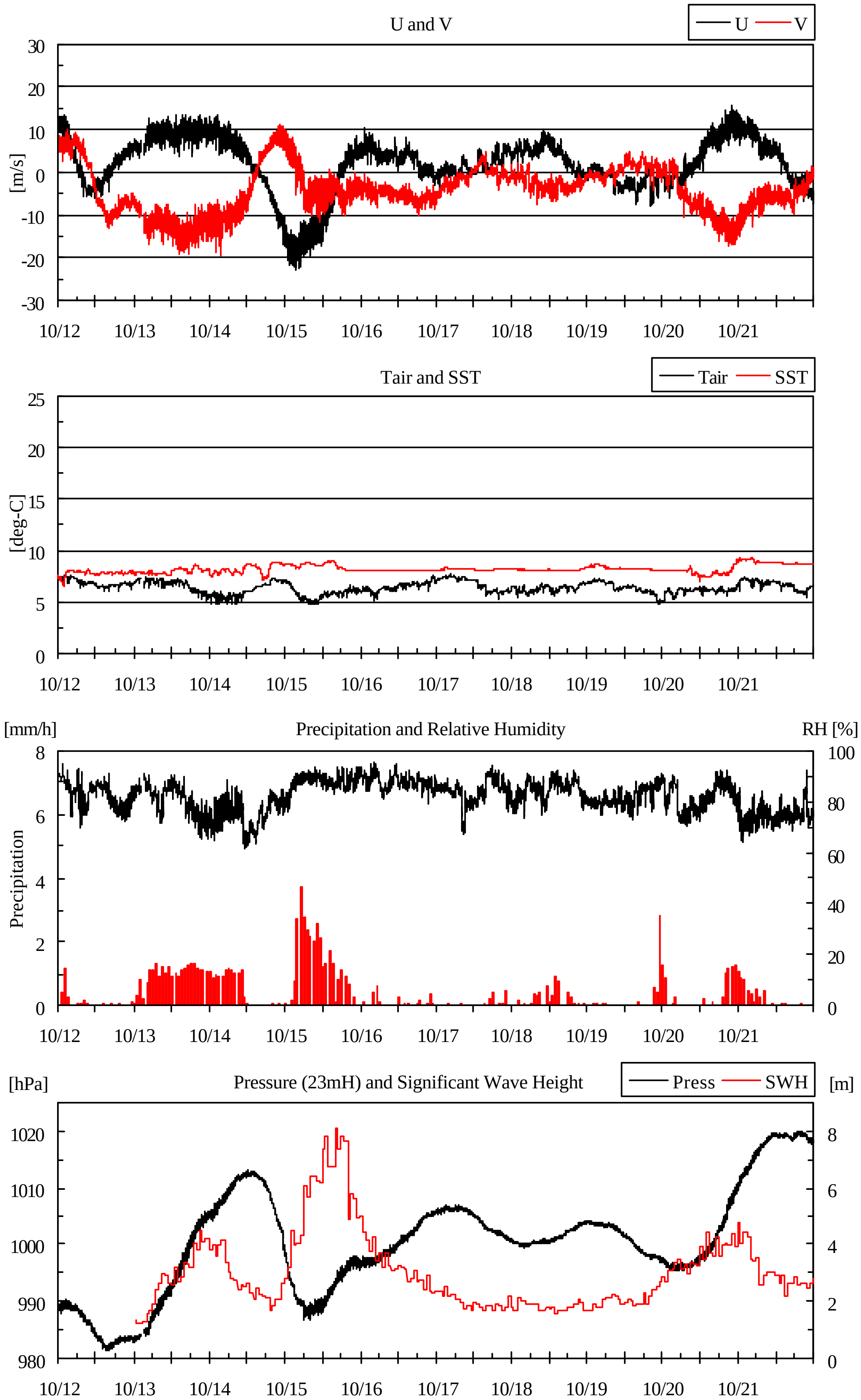
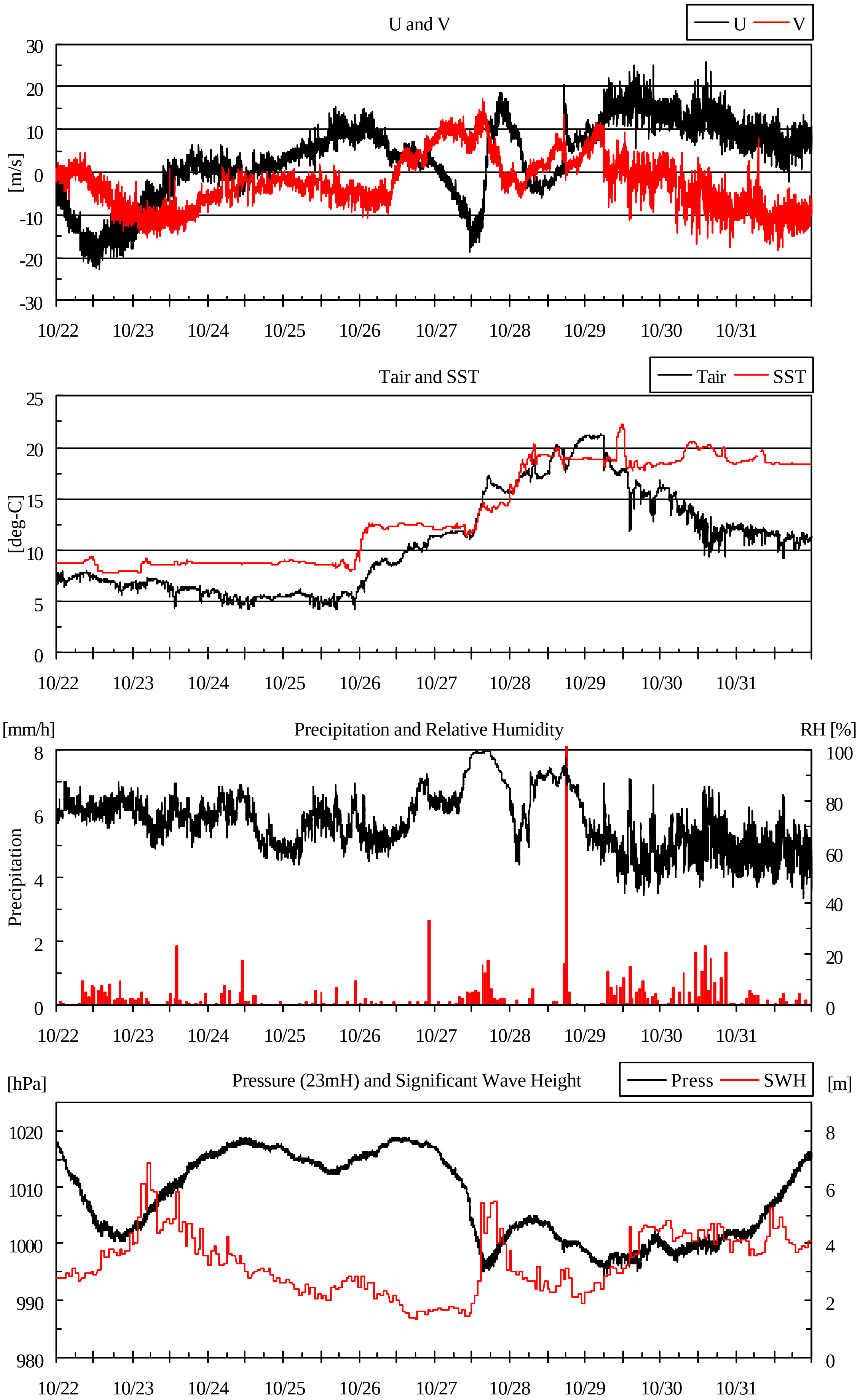

U and V
U
V
[m/s]
30
20
10
0
-10
-20
-30
10/12
10/13
10/14
10/15
10/16
10/17
10/18
10/19
10/20
10/21
Tair and SST
Tair
SST
[deg-C]
25
20
15
10
5
0
[mm/h]
Precipitation and Relative Humidity
RH [%]
Precipitation
8
6
4
2
100
80
60
40
20
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1020
1010
1000
990
980

Figure 3.1.1-1


U and V
U
V
[m/s]
30
20
10
0
-10
-20
-30
10/22
10/23
10/24
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10/26
10/27
10/28
10/29
10/30
10/31
Tair and SST
Tair
SST
[deg-C]
25
20
15
10
5
0
[mm/h]
Precipitation and Relative Humidity
RH [%]
Precipitation
8
6
4
2
0
100
80
60
40
20
0
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1020
1010
1000
990
980
8
6
4
2
0

Figure 3.1.1-2

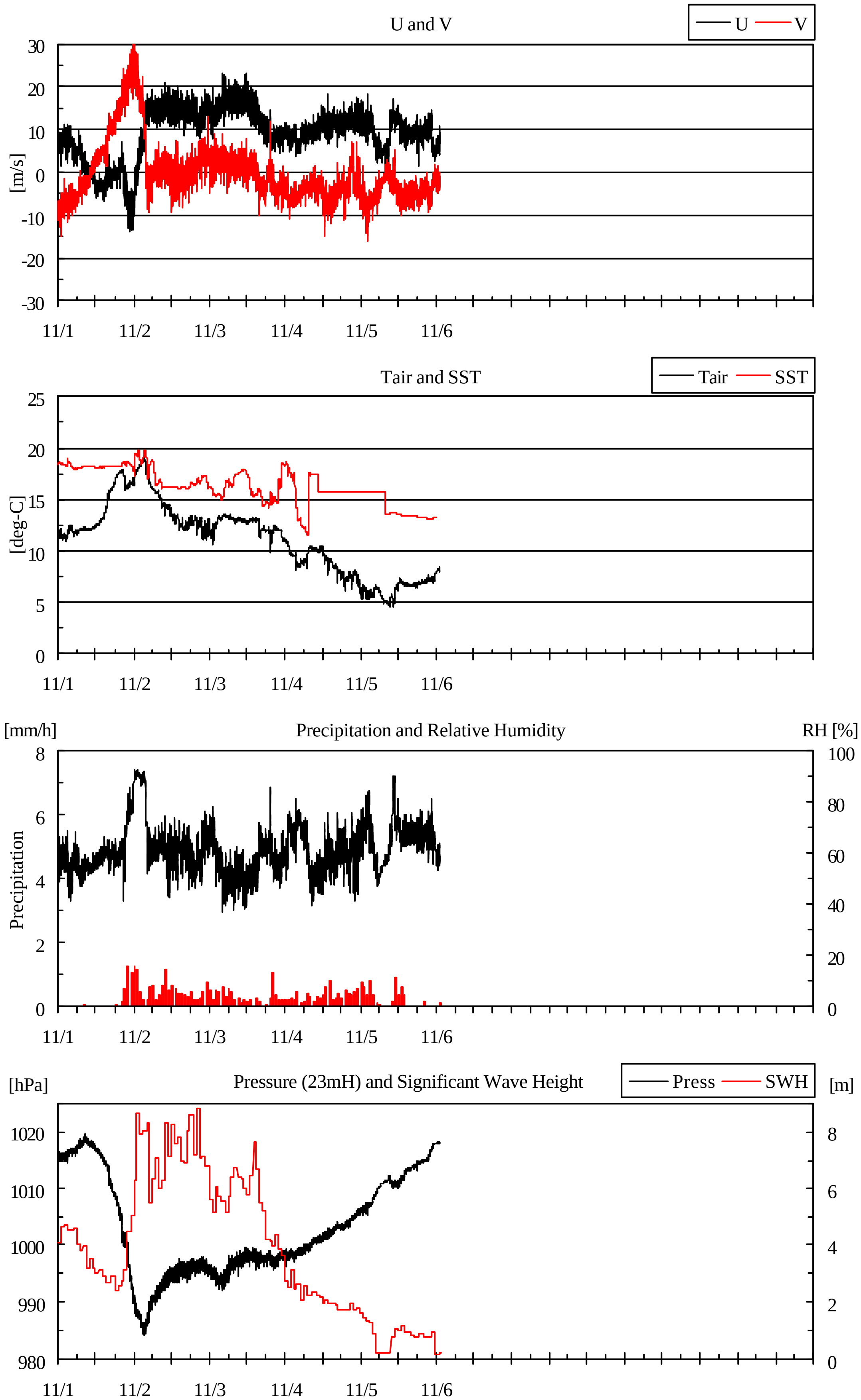

U and V
U
V
[m/s]
30
20
10
0
-10
-20
-30
11/1
11/2
11/3
11/4
11/5
11/6
Tair and SST
Tair
SST
[deg-C]
25
20
15
10
5
0
11/1
11/2
11/3
11/4
11/5
11/6
[mm/h]
Precipitation and Relative Humidity
RH [%]
Precipitation
8
6
4
2
0
100
80
60
40
20
0
11/1
11/2
11/3
11/4
11/5
11/6
[hPa]
Pressure (23mH) and Significant Wave Height
Press
SWH
[m]
1020
1010
1000
990
980
8
6
4
2
0
11/1
11/2
11/3
11/4
11/5
11/6

Figure 3.1.1-3

3.1.2 Ceilometer

Kunio YONEYAMA (JAMSTEC):Principal Investigator - Shore-side participant -
Satoshi OKUMURA (GODI)
Wataru TOKUNAGA (GODI)

(1) Objective

The information of the cloud base height and the liquid water amount around cloud base is important to understand the processes on the formation of the cloud. As one of the methods to measure them, the ceilometer observation was carried out.

(2) Methods

We measured cloud base height and backscatter profiles using CT-25K ceilometer (Vaisala, Finland) throughout MR02-K04 cruise from the departure of Sekinehama on 25th June to the arrival of Sekienehama on 21st August 2002.

Major parameters for the measurement configuration are as follows;

Laser source:	Indium Gallium Arsenide (InGaAs) Diode Laser
Transmitting wave length:	905 +/- 5 nm at 25 deg-C
Transmitting average power:	8.9 mW
Repetition rate:	5.57 kHz
Detector:	Silicon avalanche photodiode (APD)
Responsibility at 905 nm:	65 A/W
Measurement range:	0 – 7.5 km
Resolution:	50 ft in full range
Sampling rate:	60 sec.
Location:	Compass deck (18m above the sea level)

On the archived dataset, cloud base height and backscatter profile are recorded with the resolution of 30 m (100 ft).

(3) Preliminary results

The first (C1: blue) and second (C2: red) lowest cloud base height that the ceilometer detected during the cruise are plotted in Fig. 3.1.2-1 and Fig. 3.1.2-2. Sometimes the ceilometer records calculated vertical visibility and the height of detected highest signal instead of the cloud base heights. But they are not plotted in the figure.

(4) Data archives

These raw data will be submitted to the Data Management Office (DMO) in JAMSTEC just after the cruise and archived there.

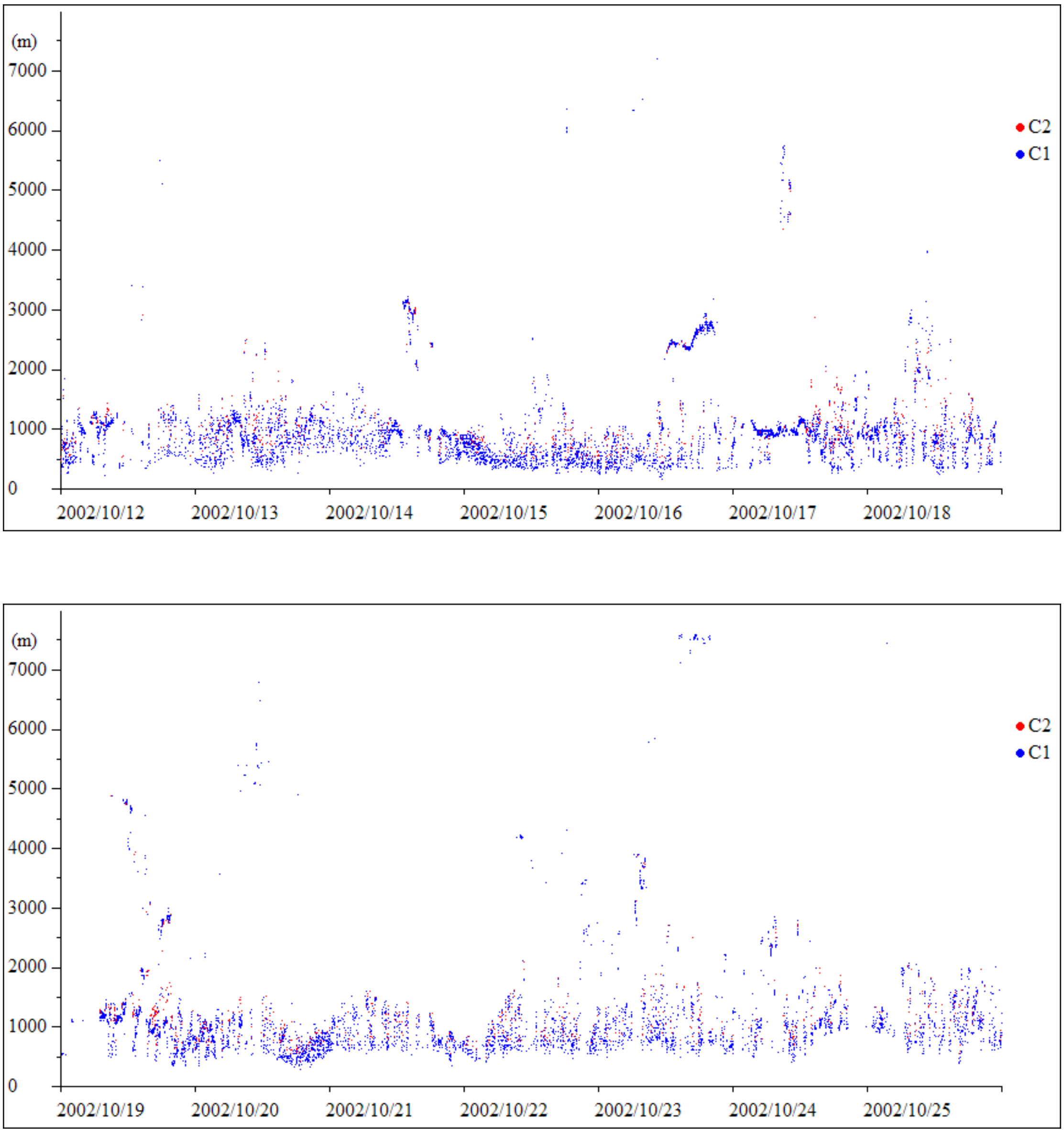
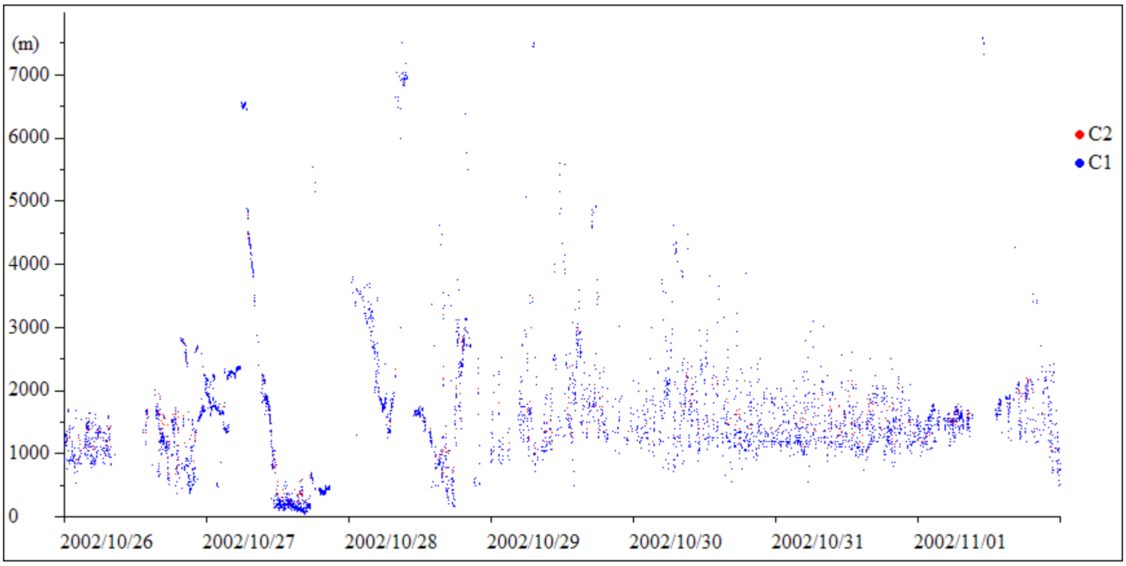

(m)
7000
6000
5000
4000
3000
2000
1000
0
2002/10/12
2002/10/13
2002/10/14
2002/10/15
2002/10/16
2002/10/17
2002/10/18
C2
C1
(m)
7000
6000
5000
4000
3000
2000
1000
0
2002/10/19
2002/10/20
2002/10/21
2002/10/22
2002/10/23
2002/10/24
2002/10/25
C2
C1

Fig. 3.1.2-1


(m)
7000
6000
5000
4000
3000
2000
1000
0
2002/10/26
2002/10/27
2002/10/28
2002/10/29
2002/10/30
2002/10/31
2002/11/01
C2
C1

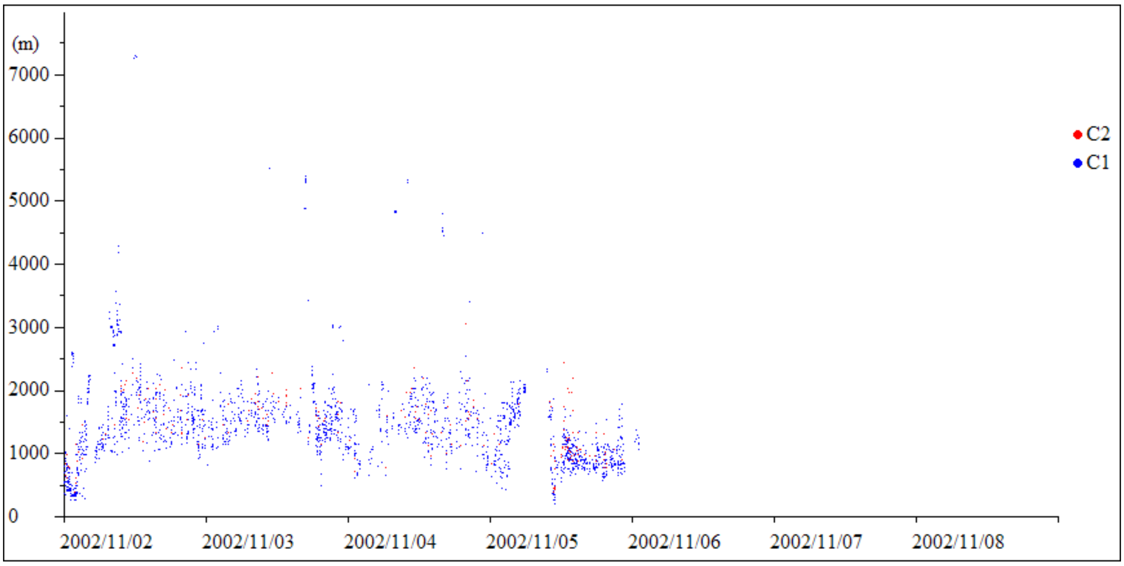

(m)
7000
6000
5000
4000
3000
2000
1000
0
2002/11/02
2002/11/03
2002/11/04
2002/11/05
2002/11/06
2002/11/07
2002/11/08
C2
C1

Fig. 3.1.2-2

3.2 Physical oceanographic observation

3.2.1 CTD cast and water sampling

Hiroshi MATSUNAGA (MWJ)：Operation Leader
Miki YOSHIIKE (MWJ)
Kenichi KATAYAMA (MWJ)
Tomohiko SUGIYAMA (MWJ)
Takaya OHMURA (MWJ)
Tomoko YOSHIDA (MWJ)

(1) Objective

Investigation of oceanic structure.

(2) Parameters

Temperature
Conductivity
Pressure
Dissolved Oxygen (here after D.O.) concentration
Fluorescence

(3) Instruments and Methods

CTD/Carousel Water Sampling System, which is a 36-position Carousel water sampler with Sea-Bird Electronics Inc. CTD (SBE9plus), was used during this cruise. 12-litter Niskin Bottles were used for sampling seawater. The sensors attached on the CTD were temperature, conductivity, pressure, D.O. and fluorometer, altimeter sensors. Salinity was calculated by measured values of pressure, conductivity and temperature. The CTD/CWS was deployed from starboard on working deck.

The CTD raw data were acquired on real time using the Seasave-Win32 (ver.5.25b) provided by Sea-Bird Electronics,Inc. and stored on the hard disk of the personal computer. Seawater was sampled during up-cast by sending fire commands from the personal computer. We sampled seawater to calibrate salinity data.

Total 18 casts of CTD measurements have been carried out. (See table 3.2.1-1)

The CTD raw data was processed using SBE Data Processing-Win32 (ver.5.25b) and SEASOFT (ver.4.249). SEASOFT (ver.4.249) was used only DERIVE and SPLIT. Data processing procedures and used utilities SBE Data Processing-Win32 and SEASOFT of were as follows:

DATCNV： Convert the binary raw data to output on physical units.
This utility selects the CTD data when bottles closed to output on another file.

SECTION: Remove the unnecessary data.

ALIGNCTD： ALIGNCTD aligns oxygen measurements in time relative to pressure.
D.O. sensor relative to pressure = 5.0 seconds

WILDEDIT： Obtain an accurate estimate of the true standard deviation of the data.

Std deviation for pass 1= 2
Std deviation for pass 2= 10
Scan per block= 48
Keep data within this distance of mean= 1000
Exclude Scan Marked Bad = Check

CELLTM： Remove conductivity cell thermal mass effects from measured conductivity.
Primary Alpha = 0.03, 1/beta = 7.0

FILTER： Filter the high frequency noise on the data
Filter A = 0.15sec
Variable to Filter: Pressure: Low Pass Filter A

LOOPEDIT： Mark scan with 'badflag', if the CTD velocity is less than 0 m/s.
Minimum Velocity Type = Fixed Minimum Velocity
Minimum CTD Velocity [m/sec] = 0.0
Exclude Scan Marked Bad = Check

BINAVG： Calculate the averaged data in every 1 m.

DERIVE： Calculate oceanographic parameters.

SPLIT： Splits the data made in CNV files into up-cast and down-cast files.

ROSSUM： Edits the data of water sampled to output a summary file.

Specifications of the sensors are listed below.

CTD: SBE911plus CTD system
Under water unit: SBE9plus (S/N 09P27443-0677, Sea-bird Electronics, Inc.)
Pressure sensor: Digiquartz pressure sensor (S/N 79511)
Calibrated Date: 02 Jul. 2002
Temperature sensors: SBE03-04/F (S/N 031464, Sea-bird Electronics, Inc.)
Calibrated Date: 07 Sep. 2002
Conductivity sensors: SBE04-04/0 (S/N 041203, Sea-bird Electronics, Inc.)
Calibrated Date: 06 Sep. 2002
D.O. sensor: SBE43 (S/N 430205, Sea-bird Electronics, Inc.)
Calibrated Date: 06 Sep. 2002
Altimeter: Datasonics PSA-900 (S/N 396, Datasonics, Inc.)
Fluorometer: (S/N 2148, Seapoint Sensors, Inc.)
Deck unit: SBE11plus (S/N 11P7030-0272, Sea-bird Electronics, Inc.).
Carousel water sampler: SBE32 (S/N 3227443-0391, Sea-bird Electronics, Inc.)
From Stn.K03
Clinometer： DUAL AXIS CLINOMETER Model SW 860
(S/N 083, SUNWEST TECHNOLOGIES, Inc.)
Calibrated Date: 16 Jan. 2002

(4) Results

Temperature, salinity, D.O. and Sigma-theta, Fluorescence profiles are shown in Fig.3.2.1-1 – Fig.3.2.1-9. Note that in these figures, the correction of salinity data by sampled water is not applied.

(5) Determination of depth

The depth of water measuring was enforced with the CTD cast (K03-03 cast) in the deployment point of BGC mooring of Stn.K03 by using the CTD system. The value used for the depth of water measuring was Depth value and Altimeter value, and made two addition value the depth of water value calculated by a CTD system. CTD was stopped in the point of 30m from 20m above the bottom of the sea by the Altimeter value, and data acquisition was done for 15 minutes. The Depth value and Altimeter value indicated on the screen of SEASAVE were read, and the depth of water value from the indication value was calculated to grasp the tendency of the depth of water value during the data acquisition for 15-minute. The Depth value and Altimeter value outputted from acquired Raw.data by the DATCNV process was added, and the depth of water value was calculated (In the Fig., Process value). The difference in average 11m occurred between the depth of water value calculated from the indication value in screen of SEASAVE (In the Fig., Indication value) as that result (See Fig.3.2.1-10). And, it was Depth value that the difference occurred, and it was proved that there was no difference in Altimeter value by the difference's occurring. As for other casts as well, it was investigated whether the same phenomenon occurred. The same cast was put together, too, and the difference occurred in 3 cast as that result. It was proved that it depended on depth with 3 cast as well in the size of the difference. But, a cause is with being not clear.

(6) Data archives

All raw and processed CTD data files were copied onto magnet-optical disk (MO). The data will be submitted to the Data Management Office (DMO), JAMSTEC, and will be opened to public via “R/V MIRAI Data Web Page” in JAMSTEC home page.

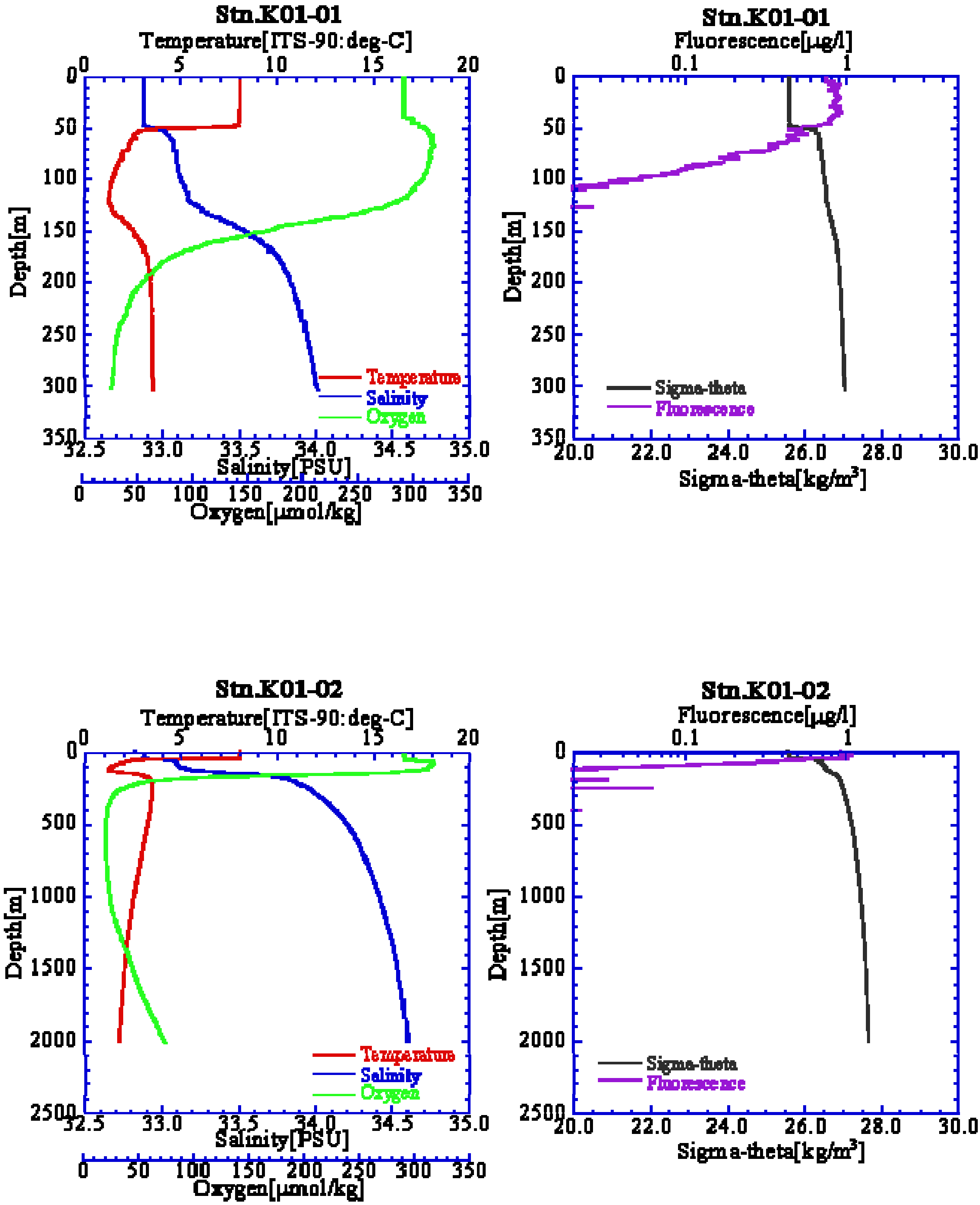

Stn.K01-01
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 50 100 150 200 250 300 350
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[μmol/kg]
Stn.K01-01
Fluorescence[μg/l]
0.1 1
Depth[m]
0 50 100 150 200 250 300 350
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]
Stn.K01-02
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 500 1000 1500 2000 2500
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[μmol/kg]
Stn.K01-02
Fluorescence[μg/l]
0.1 1
Depth[m]
0 500 1000 1500 2000 2500
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]

Fig.3.2.1-1

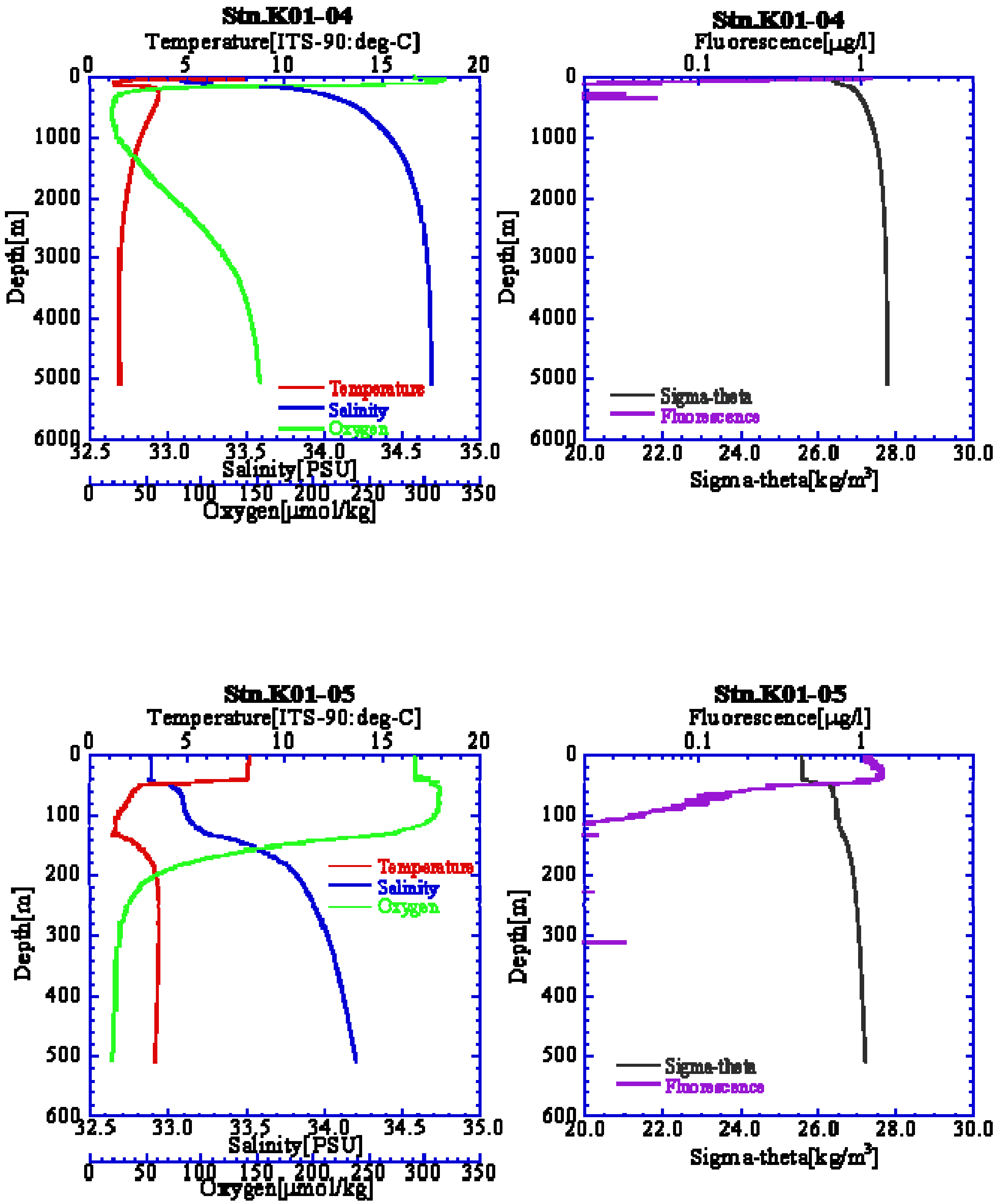

Stn.K01-04
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 1000 2000 3000 4000 5000 6000
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[µmol/kg]
Stn.K01-04
Fluorescence[µg/l]
0.1 1
Depth[m]
0 1000 2000 3000 4000 5000 6000
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]
Stn.K01-05
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 100 200 300 400 500 600
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[µmol/kg]
Stn.K01-05
Fluorescence[µg/l]
0.1 1
Depth[m]
0 100 200 300 400 500 600
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]

Fig.3.2.1-2

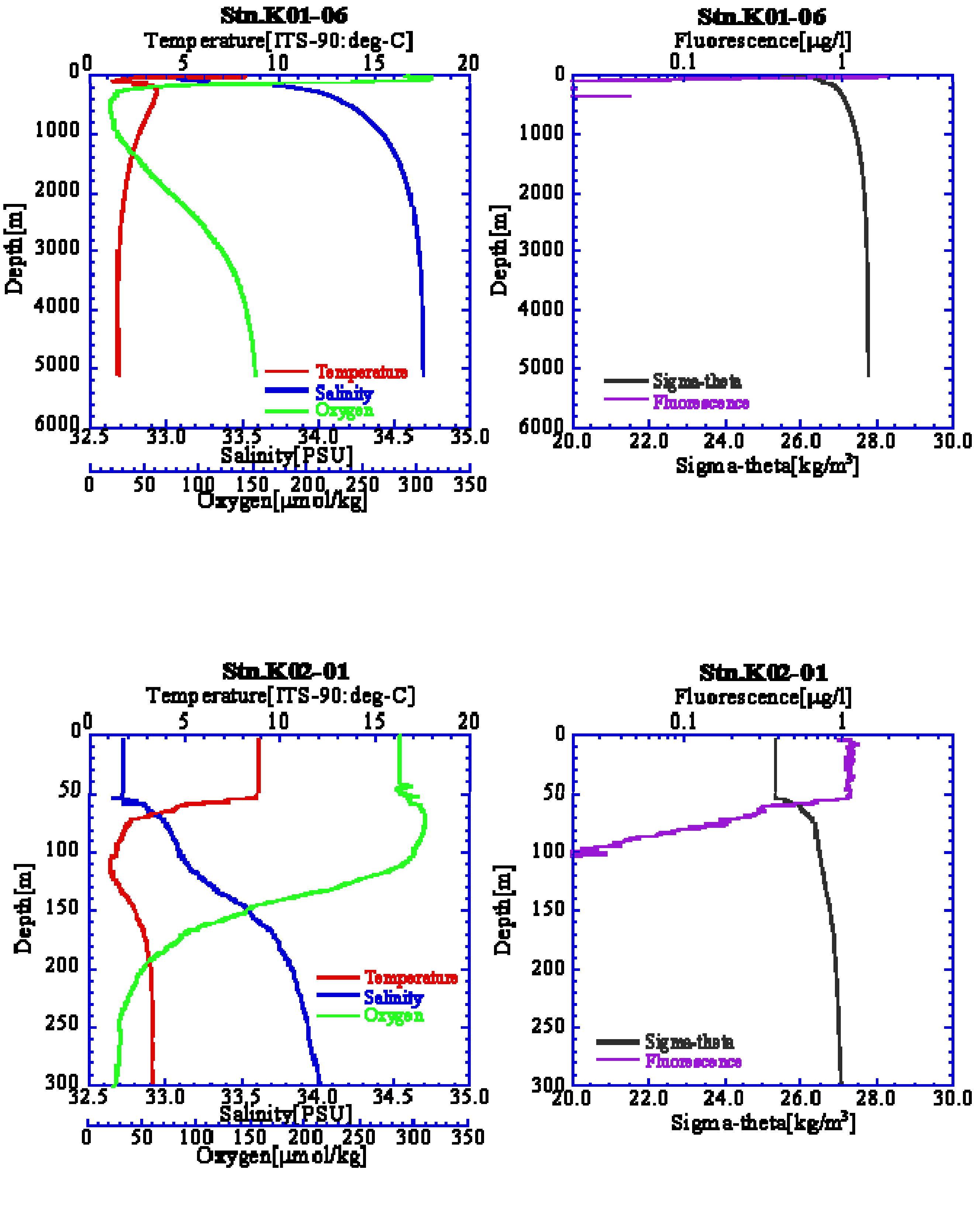

Stn.K01-06
Temperature[ITS-90:deg-C]
Depth[m]
Temperature
Salinity
Oxygen
Salinity[PSU]
Oxygen[μmol/kg]
Stn.K01-06
Fluorescence[μg/l]
Depth[m]
Sigma-theta
Fluorescence
Sigma-theta[kg/m3]
Stn.K02-01
Temperature[ITS-90:deg-C]
Depth[m]
Temperature
Salinity
Oxygen
Salinity[PSU]
Oxygen[μmol/kg]
Stn.K02-01
Fluorescence[μg/l]
Depth[m]
Sigma-theta
Fluorescence
Sigma-theta[kg/m3]

Fig.3.2.1-3

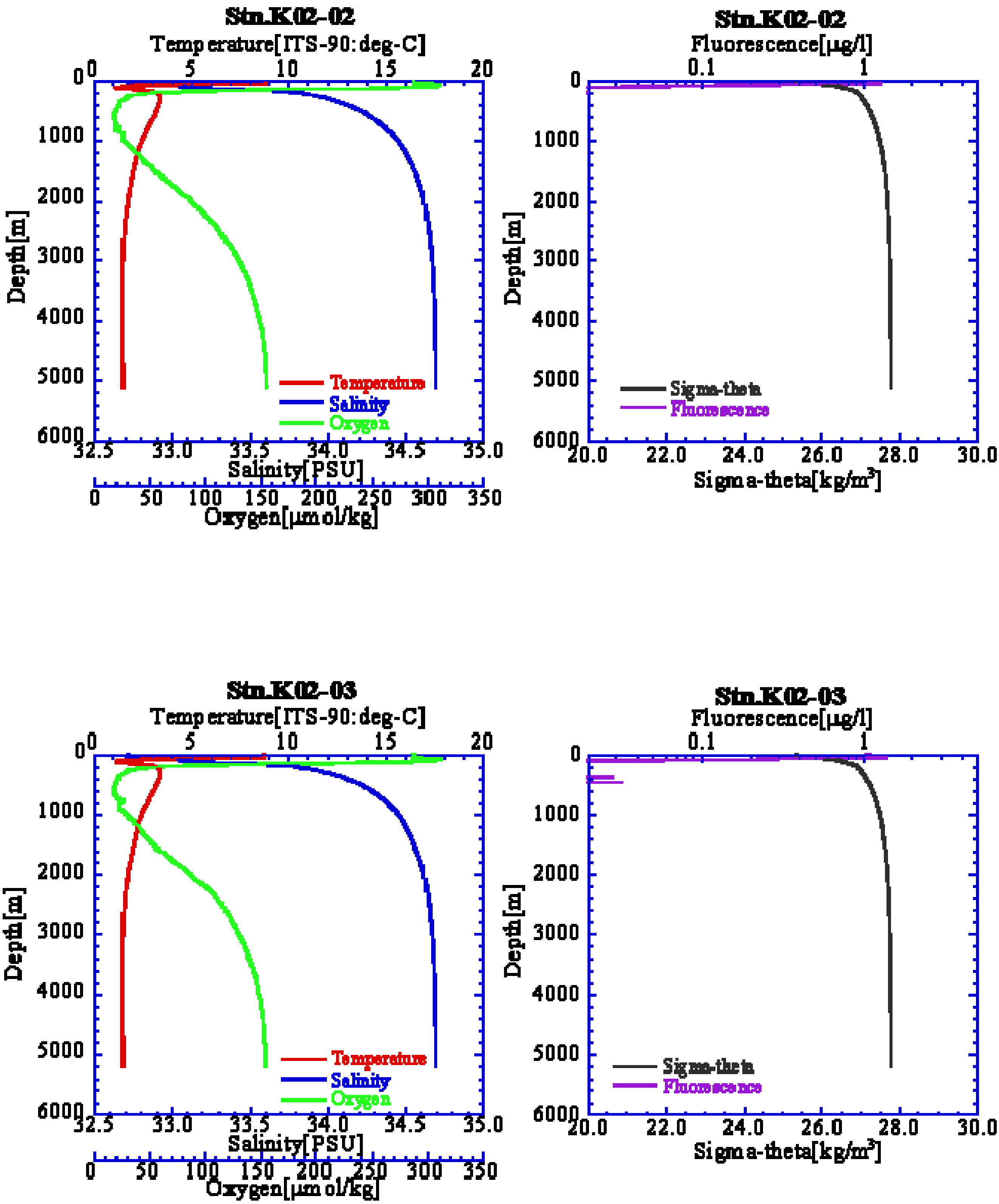

Stn.K02-02
Temperature[ITS-90:deg-C]
Depth[m]
Salinity[PSU]
Oxygen[μmol/kg]
Temperature
Salinity
Oxygen
Stn.K02-02
Fluorescence[μg/l]
Depth[m]
Sigma-theta[kg/m3]
Sigma-theta
Fluorescence
Stn.K02-03
Temperature[ITS-90:deg-C]
Depth[m]
Salinity[PSU]
Oxygen[μmol/kg]
Temperature
Salinity
Oxygen
Stn.K02-03
Fluorescence[μg/l]
Depth[m]
Sigma-theta[kg/m3]
Sigma-theta
Fluorescence

Fig.3.2.1-4

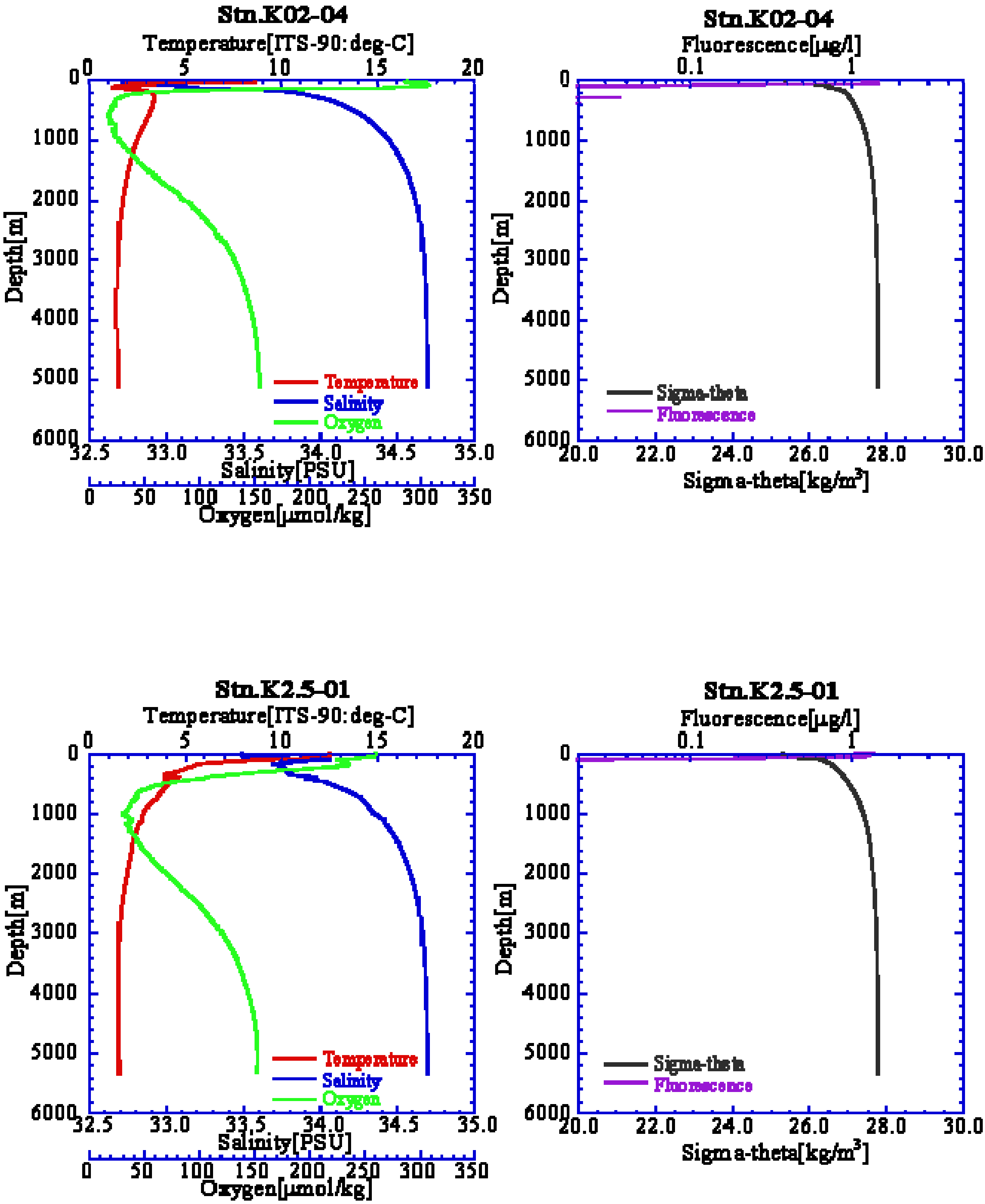

Stn.K02-04
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 1000 2000 3000 4000 5000 6000
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[µmol/kg]
Stn.K02-04
Fluorescence[µg/l]
0.1 1
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]
Stn.K2.5-01
Temperature[ITS-90:deg-C]
Stn.K2.5-01
Fluorescence[µg/l]

Fig.3.2.1-5

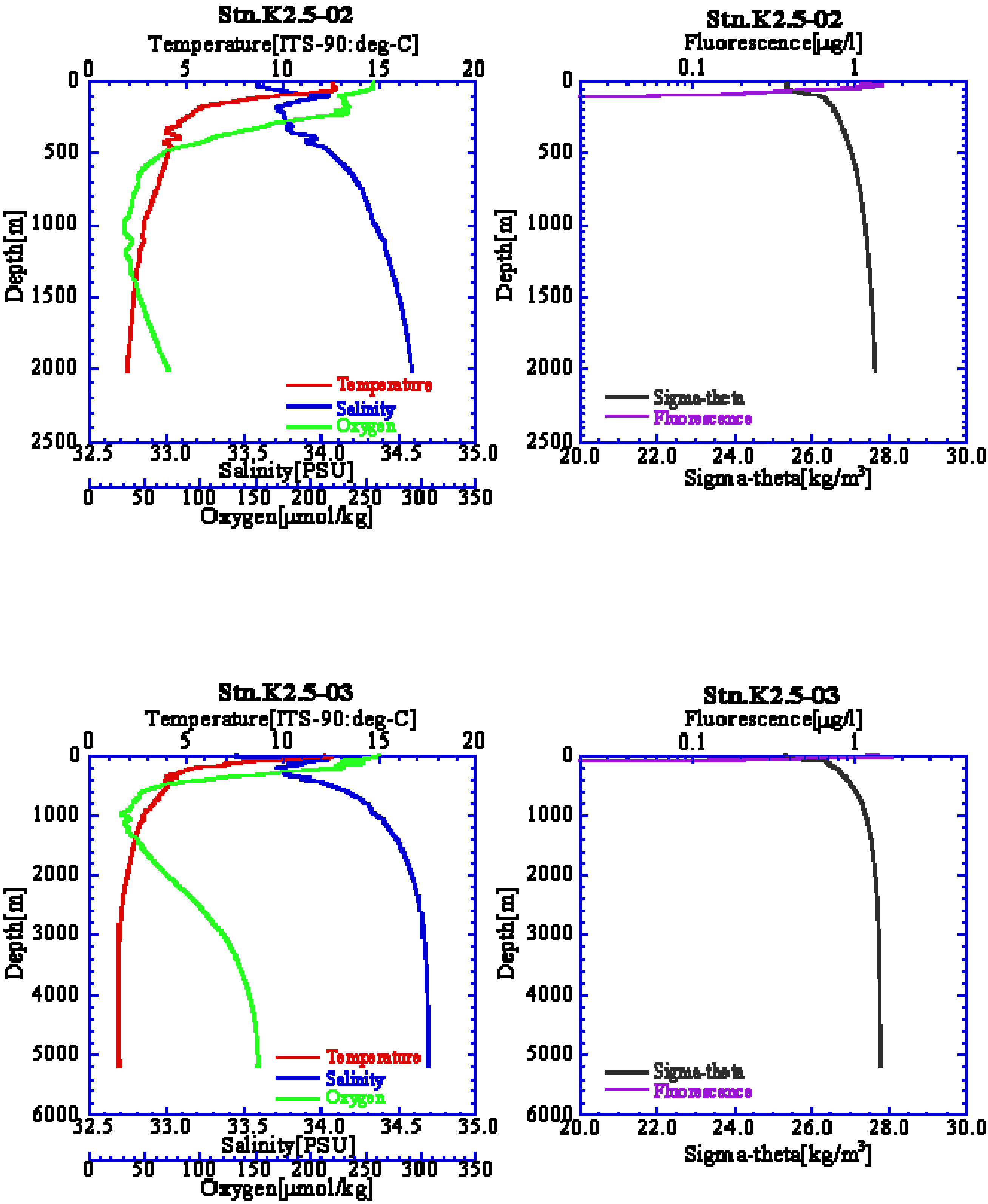

Stn.K2.5-02
Temperature[ITS-90:deg-C]
Salinity[PSU]
Oxygen[μmol/kg]
Depth[m]
Temperature
Salinity
Oxygen
Stn.K2.5-02
Fluorescence[μg/l]
Sigma-theta[kg/m³]
Depth[m]
Sigma-theta
Fluorescence
Stn.K2.5-03
Temperature[ITS-90:deg-C]
Salinity[PSU]
Oxygen[μmol/kg]
Depth[m]
Temperature
Salinity
Oxygen
Stn.K2.5-03
Fluorescence[μg/l]
Sigma-theta[kg/m³]
Depth[m]
Sigma-theta
Fluorescence

Fig.3.2.1-6

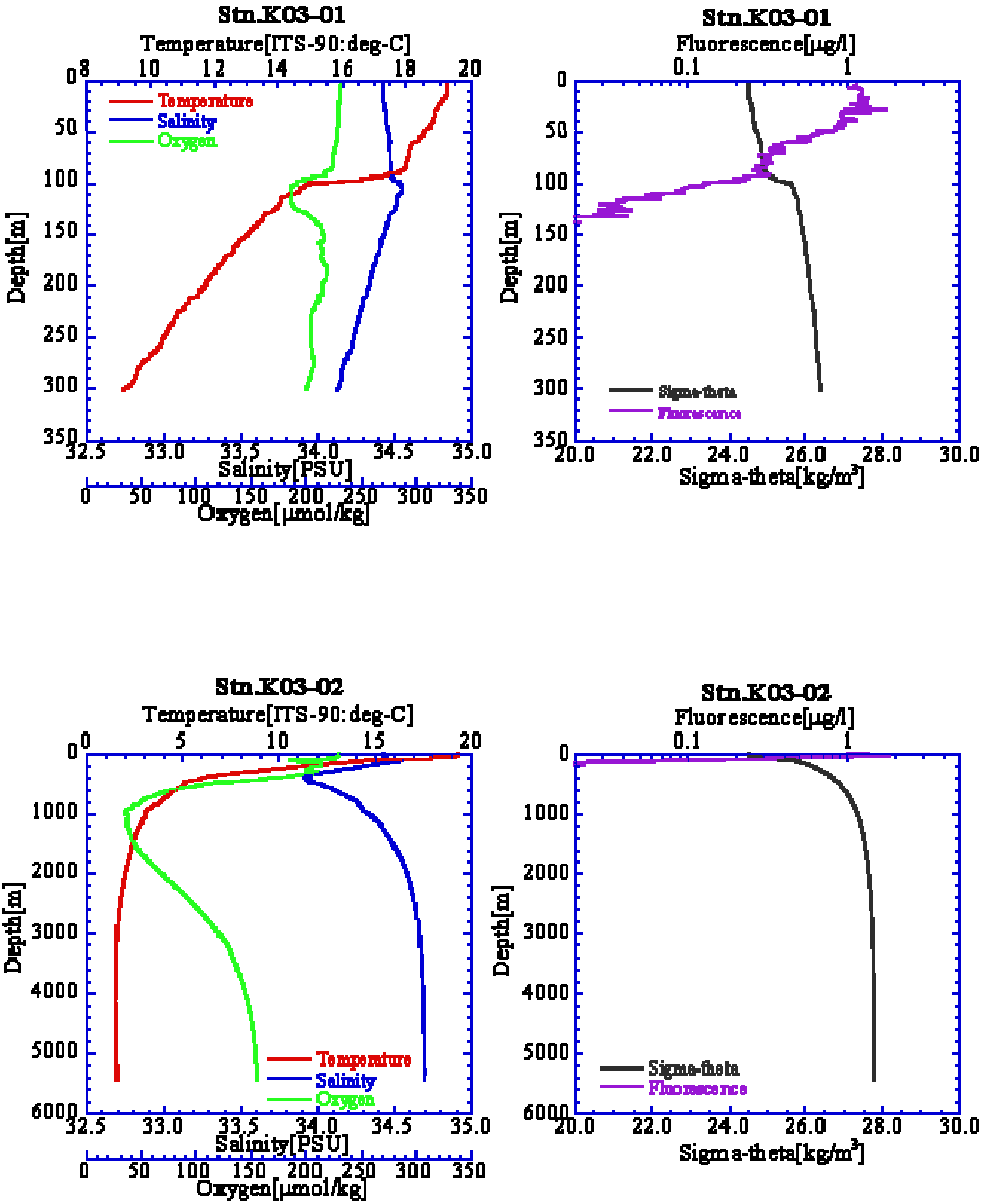

Stn.K03-01
Temperature[ITS-90:deg-C]
8 10 12 14 16 18 20
Temperature
Salinity
Oxygen
Depth[m]
0 50 100 150 200 250 300 350
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[μmol/kg]
Stn.K03-01
Fluorescence[μg/l]
0.1 1
Depth[m]
0 50 100 150 200 250 300 350
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]
Stn.K03-02
Temperature[ITS-90:deg-C]
0 5 10 15 20
Depth[m]
0 1000 2000 3000 4000 5000 6000
Temperature
Salinity
Oxygen
32.5 33.0 33.5 34.0 34.5 35.0
Salinity[PSU]
0 50 100 150 200 250 300 350
Oxygen[μmol/kg]
Stn.K03-02
Fluorescence[μg/l]
0.1 1
Depth[m]
0 1000 2000 3000 4000 5000 6000
Sigma-theta
Fluorescence
20.0 22.0 24.0 26.0 28.0 30.0
Sigma-theta[kg/m³]

Fig.3.2.1-7

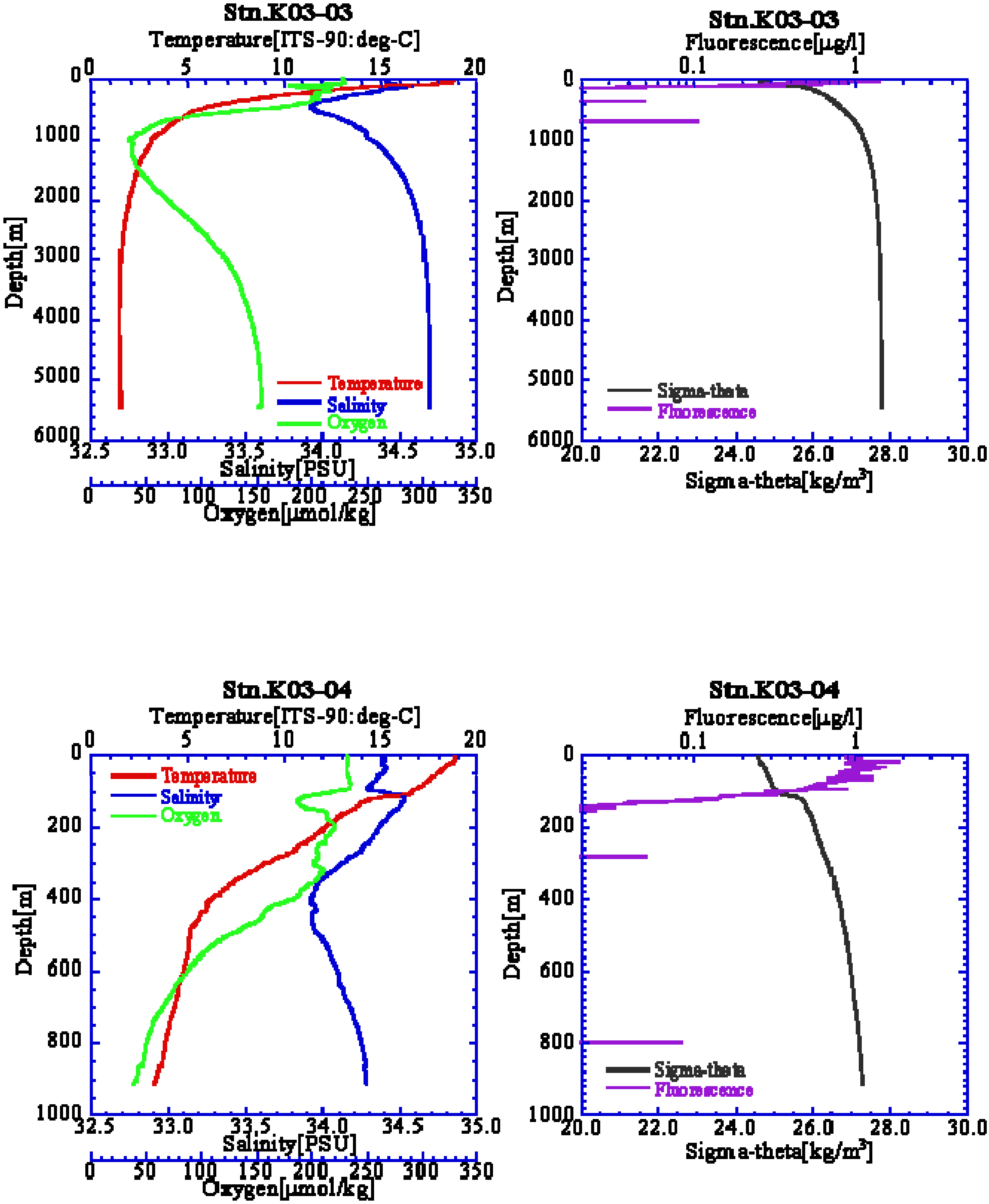

Stn.K03-03
Temperature[ITS-90:deg-C]
Depth[m]
Salinity[PSU]
Oxygen[µmol/kg]
Temperature
Salinity
Oxygen
Stn.K03-03
Fluorescence[µg/l]
Depth[m]
Sigma-theta[kg/m³]
Sigma-theta
Fluorescence
Stn.K03-04
Temperature[ITS-90:deg-C]
Depth[m]
Salinity[PSU]
Oxygen[µmol/kg]
Temperature
Salinity
Oxygen
Stn.K03-04
Fluorescence[µg/l]
Depth[m]
Sigma-theta[kg/m³]
Sigma-theta
Fluorescence

Fig.3.2.1-8

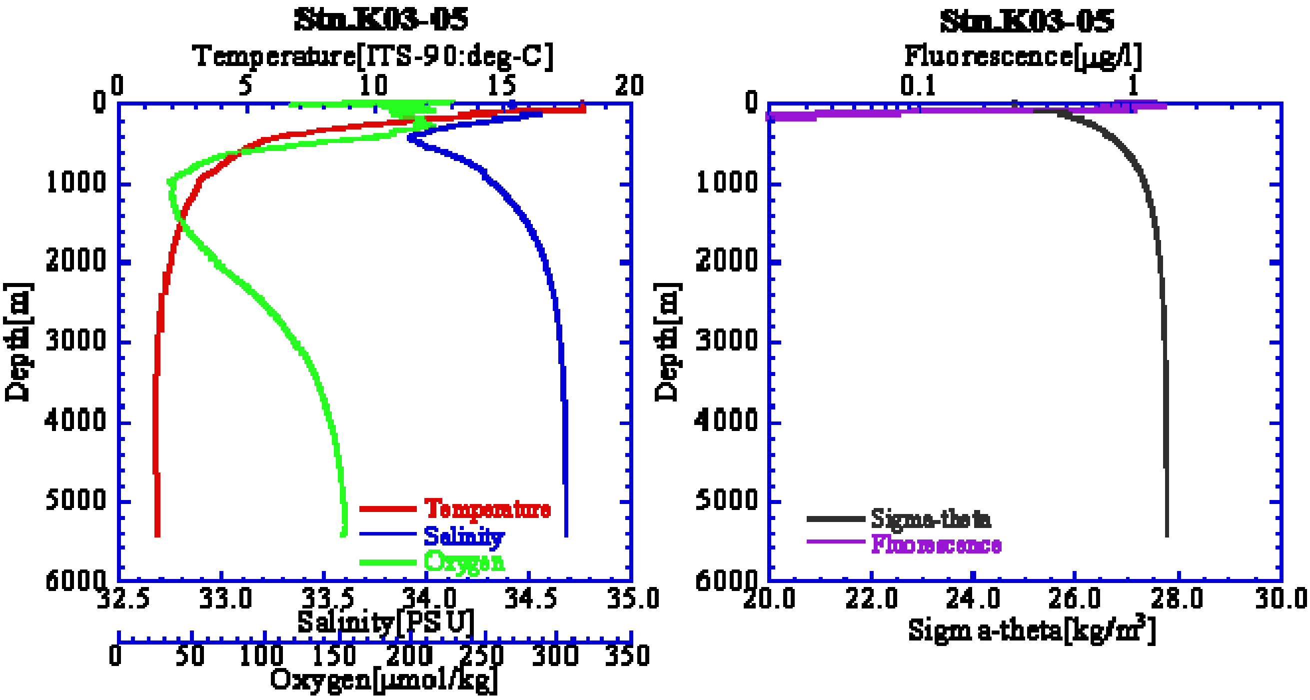

Stn.K03-05
Temperature[ITS-90:deg-C]
0
5
10
15
20
Depth[m]
0
1000
2000
3000
4000
5000
6000
32.5
33.0
33.5
34.0
34.5
35.0
Salinity[PSU]
0
50
100
150
200
250
300
350
Oxygen[μmol/kg]
Temperature
Salinity
Oxygen
Stn.K03-05
Fluorescence[μg/l]
0.1
1
Depth[m]
0
1000
2000
3000
4000
5000
6000
20.0
22.0
24.0
26.0
28.0
30.0
Sigma-theta[kg/m³]
Sigma-theta
Fluorescence

Fig.3.2.1-9

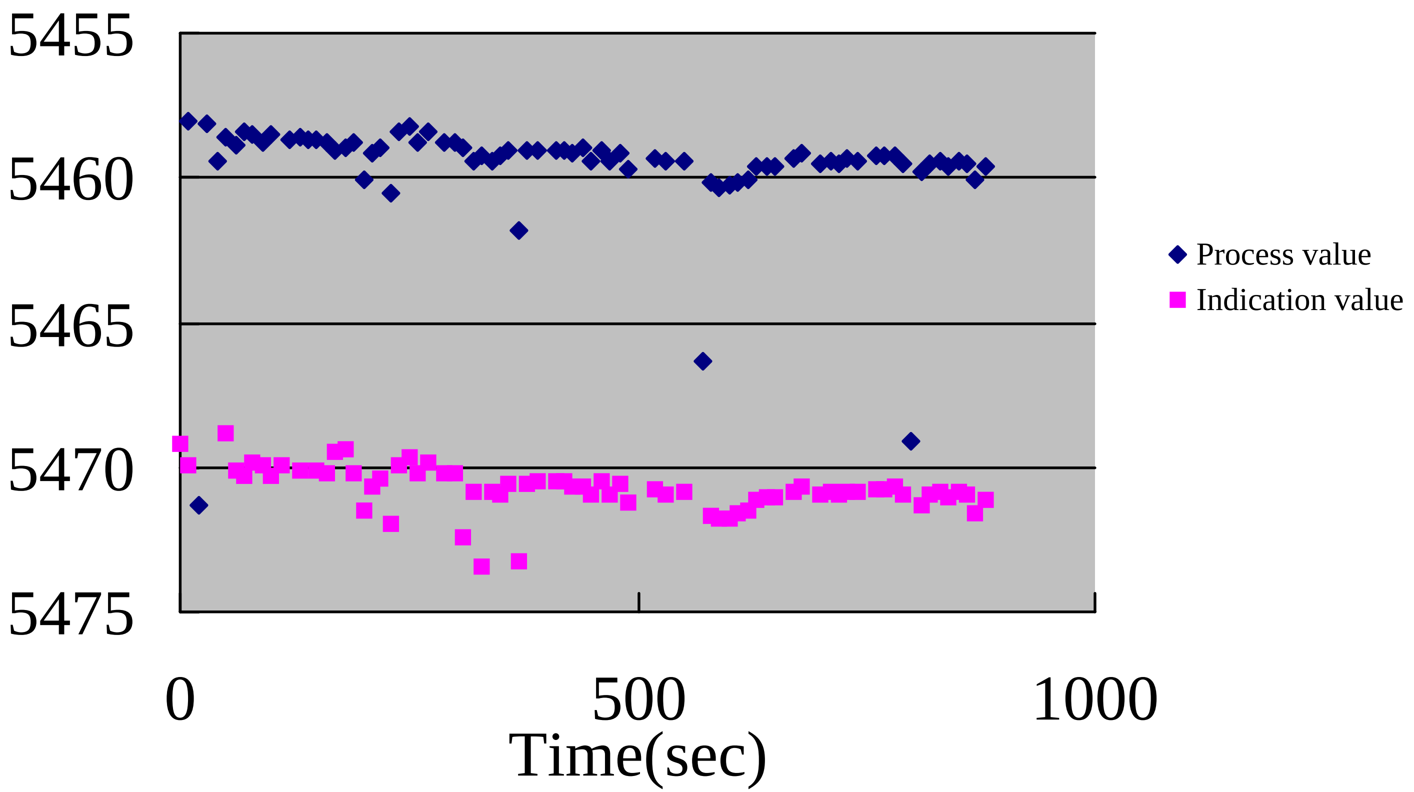

5455
5460
5465
5470
5475
0
500
1000
Time(sec)
Process value
Indication value

Fig. 3.2.1-10

Table 3.2.1-1 CTD Cast Table

Stn	Stn No.	Cast	Date(UTC) yy/mm/dd	Time(UTC) Start	Time(UTC) End	Start Position Latitude	Start Position Longitude	Raw data file name	Depth (MNB)	Altimeter	Max Depth	Max pressure	Remarks
K01	K01-01	Hydrocast#2	2002.10.16	7:16	7:55	51-17.10N	165-13.59E	K01m01.dat	5145.0	-	304.0	307.14	
	K01-02	Hydrocast#3	2002.10.16	9:08	10:53	51-16.95N	165-13.76E	K01m02.dat	5141.0	-	2006.5	2026.41	
	K01-03	Hydrocast#1	2002.10.16	11:50	11:52	51-16.94N	165-13.99E	K01m03.dat	5134.0	-	-	-	Deck unit trouble(fuse)
	K01-04	Hydrocast#1	2002.10.16	12:15	16:10	51-16.86N	165-13.86E	K01m04.dat	5137.0	41.8	5103.8	5192.53	
	K01-05	Hydrocast#4	2002.10.17	9:30	10:09	51-16.35N	165-14.75E	K01m05.dat	5139.0	-	503.8	508.84	
	K01-06	Hydrocast#5	2002.10.19	11:54	14:44	51-15.81N	165-17.54E	K01m06.dat	5138.0	7.0	5124.4	5232.86	
K02	K02-01	Hydrocast#2	2002.10.21	7:37	8:16	46-57.13N	159-58.30E	K02m01.dat	5190.0	-	302.0	304.94	
	K02-02	Hydrocast#1	2002.10.21	9:32	13:50	46-57.31N	159-58.52E	K02m02.dat	5192.0	46.7	5147.1	5239.14	
	K02-03	Hydrocast#3	2002.10.22	4:10	7:08	47-00.25N	160-01.70E	K02m03.dat	5227.0	17.0	5192.4	5299.96	
	K02-04	Hydrocast#5	2002.10.25	11:20	14:11	47-00.04N	159-53.87E	K02m04.dat	5181.0	43.8	5129.7	5237.71	
K2.5	K2.5-01	Hydrocast#1	2002.10.26	5:01	8:23	43-29.93N	160-00.23E	K25m01.dat	5363.0	40.0	5328.0	5439.26	
	K2.5-02	Hydrocast#2	2002.10.26	14:14	15:37	43-27.79N	159-59.78E	K25m02.dat	5434.0	-	2002.5	2029.17	
	K2.5-03	Hydrocast#3	2002.10.27	3:30	6:32	43-25.50N	160-01.21E	K25m03.dat	5456.0	-	-	-	
K03	K03-01	Hydrocast#2	2002.10.28	8:59	9:30	39-10.65N	160-00.25E	K03m01.dat	5464.0	-	299.7	302.20	
	K03-02	Hydrocast#1	2002.10.28	10:34	13:51	39-10.67N	160-00.35E	K03m02.dat	5465.0	49.8	5409.8	5521.91	
	K03-03	Hydrocast#5	2002.10.28	19:48	23:21	39-10.73N	160-00.31E	K03m03.dat	5474.0	11.9	5461.0	5562.00	Survey with Altimeter
	K03-04	Hydrocast#4	2002.10.29	4:53	5:46	39-08.94N	160-01.64E	K03m04.dat	5474.0	-	912.0	-	
	K03-05	Hydrocast#3	2002.11.1	11:55	15:34	39-08.27N	160-03.99E	K03m05.dat	5472.0	21.3	5431.9	5544.16	

3.2.2 Salinity Measurements.

Kenichi KATAYAMA (MWJ)

(1) Objectives

To calibrate salinity obtained by CTD

(2) Measured Parameters

Salinity of sampled water

(3) Method

Seawater samples were collected with 12-liter NiskinX bottle, and drawn into 250ml Phoenix brown glass bottles with screw caps. After rinsed three times with the sample water, the bottle was filled with sample water to the bottle shoulder. Its cap was also thoroughly rinsed. The bottle was stored more than 24 hours in the Autosal Room before starting the salinity measurement. The room temperature was set around 22 deg-C.

The salinity was measured with the laboratory salinometer (Autosal Model 8400B S/N 62827; Guildline Instruments Ltd.), attached with an Ocean Science International peristaltic-type sample intake pump. A double conductivity ratio was defined as median of 31 readings of the salinometer. Data collection started after 5 seconds and it took about 10 seconds to collect 31 readings by a personal computer.

The bath temperature of Autosal was set to 24 deg-C and standardized before and after sequence of measurement by IAPSO Standard Seawater (SSW) batch P142 (conductivity ratio was 0.99991, salinity was 34.997). We also used sub-standard seawater (SUB) which was deep-sea water filtered by Millipore filter (pore size of 0.45 μm). We measured both SSW and SUB every about 30 samples in order to check the drift of Autosal.

Table 3.2.2-1 Kind and number of samples

Kind and number of samples	**#**
Samples for CTD	112
Samples for EPCS	21
Reference material for Nutrient analysis	2
Sampled for RAS	95
Total	**230**

(4) Result

The average of the difference between CTD data and measured data was 0.0035 and the standard deviation was 0.0072.

The average of difference between CTD data and measured data below 1,000m was 0.0010 and the standard deviation was 0.0009.

The preliminary results are shown in Table-3.2.2-2.

To estimate the precision of this method, 12 replicate samples of the seawater were also measured. The average of difference between CTD data and measured data were 0.0012 and the standard deviation was 0.0012.

(5) Data archive

The data of salinity samples will be submitted to JAMSTEC Data Management Office (DMO).

Table 3.2.2-2 Salinity comparison between CTD and Autosal

Station	Niskin Bottle No.	Depth(m)	CTD Salinity	Autosal Salinity	Difference
K01M04	-	SURFACE	-	32.9061	-
	13	10.529	32.8914	32.8935	-0.0021
	14	29.318	32.8909	32.8935	-0.0026
	15	49.429	32.9562	33.0218	-0.0656
	16	73.646	33.0999	33.1023	-0.0024
	17	100.184	33.1444	33.1420	0.0024
	18	124.696	33.2713	33.2875	-0.0162
	19	148.431	33.6049	33.6271	-0.0222
	20	199.247	33.8439	33.8491	-0.0052
	21	249.779	33.9461	33.9405	0.0056
	22	299.269	34.0219	34.0186	0.0033
	23	399.045	34.1269	34.1266	0.0003
	24	498.055	34.199	34.1997	-0.0007
	25	598.944	34.2589	34.2599	-0.0010
	26	796.514	34.3502	34.3517	-0.0015
	27	997.67	34.4212	34.4224	-0.0012
	27	997.67	34.4212	34.4222	-0.0010
	28	1495.232	34.5417	34.5431	-0.0014
	29	1993.508	34.6033	34.6045	-0.0012
	30	2493.061	34.6405	34.6415	-0.0010
	31	2990.695	34.6614	34.6670	-0.0056
	31	2990.695	34.6614	34.6617	-0.0003
	32	3489.354	34.675	34.6760	-0.0010
	33	3987.447	34.6818	34.6829	-0.0011
	34	4486.299	34.6865	34.6879	-0.0014
	35	4984.217	34.689	34.6899	-0.0009
	35	4984.217	34.689	34.6908	-0.0018
	36	5084.633	34.69	34.6906	-0.0006
K02M02	-	SURFACE	-	32.7410	-
	13	10.064	32.7219	32.7235	-0.0016
	14	28.136	32.7218	32.7234	-0.0016
	15	48.319	32.7184	32.7239	-0.0055
	16	74.226	32.9972	33.0090	-0.0118
	17	99.933	33.0734	33.0797	-0.0063
	18	126.189	33.1753	33.1746	0.0007
	19	149.425	33.4862	33.4953	-0.0091
	20	198.893	33.7911	33.8108	-0.0197
	21	249.531	33.9243	33.9311	-0.0068
	22	300.211	33.9947	33.9997	-0.0050
	23	398.916	34.134	34.1383	-0.0043
	24	499.334	34.2288	34.2317	-0.0029

	25	599.177	34.2891	34.2920	-0.0029
	26	797.54	34.3872	34.3889	-0.0017
	27	997.053	34.4487	34.4507	-0.0020
	27	997.053	34.4487	34.4510	-0.0023
	28	1497.221	34.5595	34.5604	-0.0009
	29	1995.006	34.6227	34.6239	-0.0012
	30	2492.788	34.6524	34.6537	-0.0013
	31	2993.279	34.6696	34.6705	-0.0009
	31	2993.279	34.6696	34.6702	-0.0006
	32	3489.649	34.6798	34.6810	-0.0012
	33	3988.961	34.6859	34.6868	-0.0009
	34	4483.948	34.6894	34.6900	-0.0006
	35	4984.767	34.6908	34.6912	-0.0004
	35	4984.767	34.6908	34.6914	-0.0006
	36	5129.246	34.6914	34.6910	0.0004
K25M01	-	SURFACE	-	33.4114	-
	13	10.142	33.4059	33.4109	-0.0050
	14	30.663	33.4555	33.4714	-0.0159
	15	49.439	33.6678	33.6758	-0.0080
	16	74.792	33.7494	33.7562	-0.0068
	17	99.43	34.0309	34.0382	-0.0073
	18	125.241	33.9054	33.9094	-0.0040
	19	151.225	33.8174	33.8203	-0.0029
	20	200.231	33.7355	33.7394	-0.0039
	21	249.445	33.766	33.7692	-0.0032
	22	301.408	33.7772	33.7808	-0.0036
	23	400.509	33.941	33.9416	-0.0006
	24	500.714	34.0353	34.0376	-0.0023
	25	601.04	34.1291	34.1311	-0.0020
	26	802.654	34.2776	34.2787	-0.0011
	27	1000.217	34.3396	34.3429	-0.0033
	27	1000.217	34.3396	34.3415	-0.0019
	28	1500.579	34.499	34.5005	-0.0015
	29	2001.19	34.5883	34.5895	-0.0012
	30	2496.874	34.6358	34.6371	-0.0013
	31	3001.523	34.6603	34.6616	-0.0013
	31	3001.523	34.6603	34.6616	-0.0013
	32	3498.716	34.6745	34.6759	-0.0014
	33	4000.268	34.6826	34.6839	-0.0013
	34	4501.056	34.6879	34.6887	-0.0008
	35	5001.694	34.69	34.6908	-0.0008
	35	5001.694	34.69	34.6913	-0.0013
	36	5322.056	34.6905	34.6911	-0.0006
K03M02	-	SURFACE	-	34.4530	-

	13	10.57	34.4429	34.4449	-0.0020
	14	31.063	34.4394	34.4419	-0.0025
	15	50.476	34.4337	34.4281	0.0056
	16	75.03	34.4227	34.4310	-0.0083
	17	100.744	34.4965	34.5011	-0.0046
	18	125.685	34.5467	34.5474	-0.0007
	19	150.193	34.4795	34.4779	0.0016
	20	198.965	34.3308	34.3298	0.0010
	21	250.899	34.1692	34.1652	0.0040
	22	299.877	34.0512	34.0468	0.0044
	23	399.558	33.9309	NO SAMPLE	-
	24	498.209	33.9994	33.9988	0.0006
	25	599.208	34.091	34.0953	-0.0043
	26	800.091	34.2679	34.2655	0.0024
	27	1001.217	34.3349	34.3349	0.0000
	27	1001.217	34.3349	34.3350	-0.0001
	28	1502.513	34.4978	34.4982	-0.0004
	29	2001.372	34.5888	34.5886	0.0002
	30	2501.515	34.6335	34.6339	-0.0004
	31	3002.708	34.6601	34.6600	0.0001
	31	3002.708	34.6601	34.6601	0.0000
	32	3501.432	34.675	34.6750	0.0000
	33	4000.938	34.6836	34.6834	0.0002
	34	4500.91	34.6883	34.6883	0.0000
	35	4999.992	34.6913	34.6907	0.0006
	35	4999.992	34.6913	34.6908	0.0005
	36	5410.153	34.6925	34.6906	0.0019

3.2.3 Shipboard ADCP observation

Satoshi OKUMURA (GODI)
Wataru TOKUNAGA (GODI)

(1) Parameters

Current velocity of each depth cell [cm/s]
Echo intensity of each depth cell [dB]

(2) Methods

Upper ocean current measurements were made throughout MR02-K05 Leg2 cruise (from 11 October 2002 to 6 November 2002, from Dutch Harbor to Sekinehama) using the hull-mounted Acoustic Doppler Current Profiler (ADCP) system that is permanently installed on the R/V Mirai. The system consists of following components;

1) a 75 kHz Broadband (coded-pulse) profiler with 4-beam Doppler sonar operating at 78.5 KHz (RD Instruments, USA), mounted with beams pointing 30 degrees from the vertical and 45 degrees azimuth from the keel;
2) the Ship's main gyro compass (Tokimec, Japan), continuously providing ship's heading measurements to the ADCP;
3) a GPS navigation receiver (Leica MX9400) providing position fixes;
4) an IBM-compatible personal computer running data acquisition software (VmDas version 1.3 ; RD Instruments, USA).

The ADCP was configured for 16-m processing bin, a 8-m blanking interval. The sound speed is calculated from temperature at the transducer head. The transducer depth was 6.5 m; 40 velocity measurements were made at 16-m intervals starting 24.4m below the surface. Every 1 water-ping and 1 bottom-ping were recorded as raw ensemble data. Also, 60 seconds and 300 seconds average data were recorded as short-term average (STA) and long-term average (LTA) data.

Major parameters for the measurement (Direct Command) are listed in the appendix.

(3) Preliminary result

30 minutes running mean current vectors of the first bin are plotted along ship's track in Figure 3.2.3-1.

(4) Data archive

These data obtained during this cruise will be submitted to the JAMSTEC DMO (Data Management Office), and will be opened to the public via "R/V Mirai Data Web Page" in JAMSTEC home page.

Appendix (Direct Command)

BA = 020	Evaluation amplitude min (1-255)
BC = 220	Correlation magnitude min (0-255)
BE = 1000	Max error velocity (mm/s)
BP = 001	Bottom pings per ensemble
BX = 9999	Maximum depth (80-9999 dm)
EA = +00000	Heading alignment (1/100 deg)
ED = 00065	Transducer depth (0 - 65535 dm)
ES = 35	Salinity (0-40 PSU)
EX = 00000	Beam coordinate
EZ = 1020001	Sensor source (C; D; H; P; R; S; T)
	C(1): Sound velocity calculate using ED, ES, ET(temp.)
	D(0): Manual ED
	H(2): External synchro
	P(0), R(0): Manual EP, ER (0 degree)
	S(0): Manual ES
	T(1): Internal transducer sensor
TE = 00:00:02.00	Time per ensemble (hrs:min:sec)
TP = 00:02.00	Time per ping (min:sec)
WA = 255	False target threshold (Max) (0-255 counts)
WB = 1	Mode 1 bandwidth control (0=Wid, 1=Med, 2=Nar)
WC = 064	Low correlation threshold (0-255)
WE = 5000	Error velocity threshold (0-5000 mm/s)
WF = 0800	Blanking distance after transmit (cm)
WM = 1	Profiling mode (1-8)
WN = 040	Number of depth cells (1-128)
WP = 00001	Water per ensemble (0-16384)
WS = 1600	Depth cell size (cm)
WT = 0000	Transmit length (cm) [0 = Bin Length]
WV = 999	Ambiguity velocity (mm/s radial)

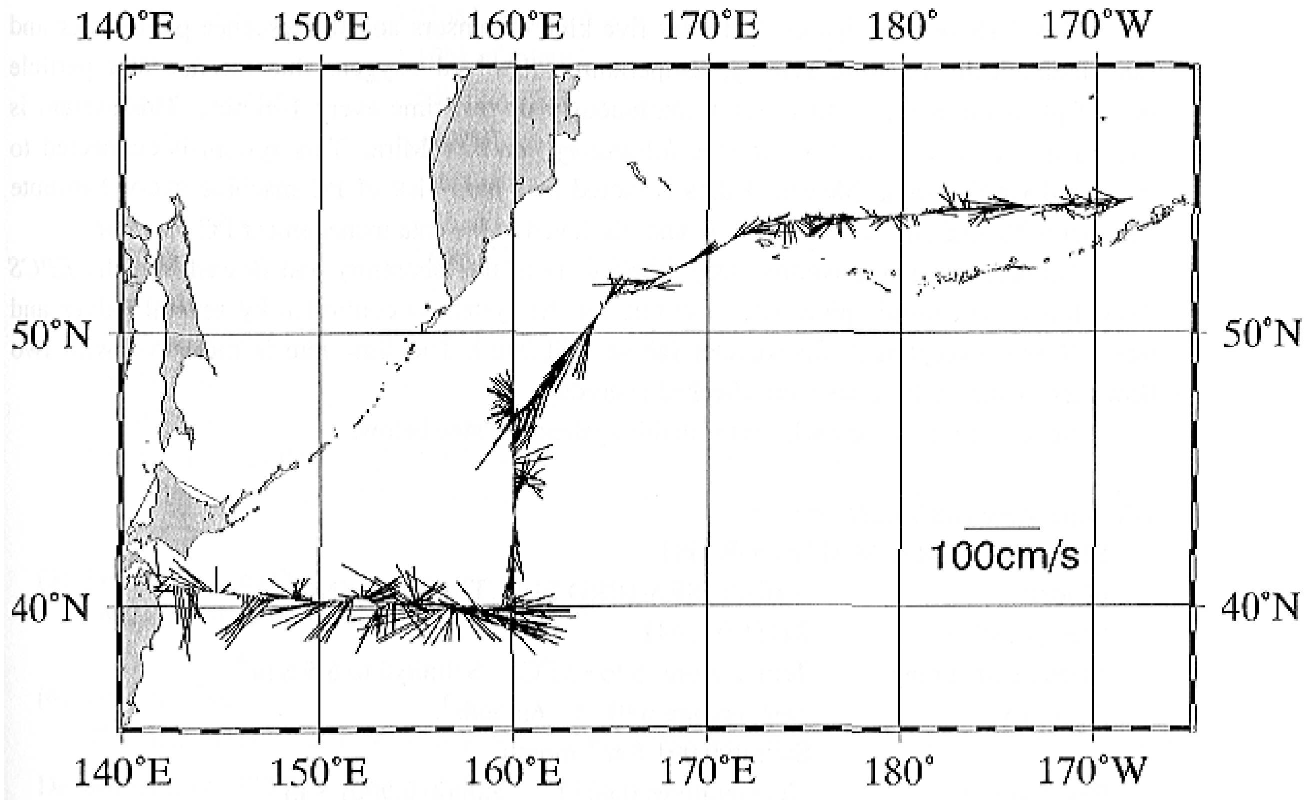


Figure 3.2.3-1 Every 30 minutes current vector plots (24.4m layer)

3.3 Sea surface water monitoring

Tomoko MIYASHITA (Marine Works Japan Ltd.)
Takayoshi SEIKE (Marine Works Japan Ltd.)

(1) Objective

In order to measure salinity, temperature, dissolved oxygen, and fluorescence of sea surface water.

(2) Methods

EPCS (Nippon Kaiyo co.,Ltd.) has five kind of sensors and fluorescence photometer and can automatically measure salinity, temperature, dissolved oxygen, fluorescence and particle size of plankton in sea surface water continuously on real time every 1-minute. This system is located in the "*sea surface monitoring laboratory*" on R/V Mirai. This system is connected to shipboard LAN-system. Measured data is stored in a hard disk of PC machine every 1-minute together with time and position of ship, and displayed in the data management PC machine.

Surface water was continuously pumped up to the laboratory and flowed into the *EPCS* through a vinyl-chloride pipe. The flow rate for the system is controlled by several valves and was 12L/min except with fluorometer (about 0.3L/min). The flow rate is measured with two flow meters and each values were checked everyday.

Specification of the each sensor in this system of listed below.

a) Temperature and Salinity sensor

SEACAT THERMOSALINOGRAPH

Model:	SBE-21, SEA-BIRD ELECTRONICS, INC.
Serial number:	2118859-2641
Measurement range:	Temperature -5 to +35℃, Salinity0 to 6.5 S m^{-1}
Accuracy:	Temperature 0.01 ℃ $6month^{-1}$, Salinity0.001 S m^{-1} $month^{-1}$
Resolution:	Temperatures 0.001℃, Salinity0.0001 S m^{-1}

b) Bottom of ship thermometer

Model:	SBE 3S, SEA-BIRD ELECTRONICS, INC.
Serial number:	032175
Measurement range:	-5 to +35℃
Resolution:	±0.001℃
Stability:	0.002 ℃ $year^{-1}$

c) Dissolved oxygen sensor

Model:	2127A, Orbisphere Laboratories Japan INC.
Serial number:	44733
Measurement range:	0 to 14 ppm
Accuracy:	±1% at 5 ℃ of correction range
Stability:	1% $month^{-1}$

d) Fluorometer

Model: 10-AU-005, TURNER DESIGNS
Serial number: 5562 FRXX
Detection limit: 5 ppt or less for chlorophyl a
Stability: 0.5% month^{-1} of full scale

e) Particle Size sensor

Model: P-05, Nippon Kaiyo LTD.
Serial number: P5024
Measurement range: 0.02681 mmt to 6.666 mm
Accuracy: ±10% of range
Reproducibility: ±5%
Stability: 5% week^{-1}

f) Flow meter

Model: EMARG2W, Aichi Watch Electronics LTD.
Serial number: 8672
Measurement range: 0 to 30 l min^{-1}
Accuracy: ±1%
Stability: ±1% day^{-1}

The monitoring Periods (UTC) during this cruise are listed below.

Leg.2 11-OCt.-’02 23:56 to 04-Nov.-’02 06:38

(3) Preliminary result

Acquired data were shown in the Fig 3.3-1～4.

(4) Date archive

The data were stored on a magnetic optical disk, which will be kept in Ocean Research Department, JAMSTEC.

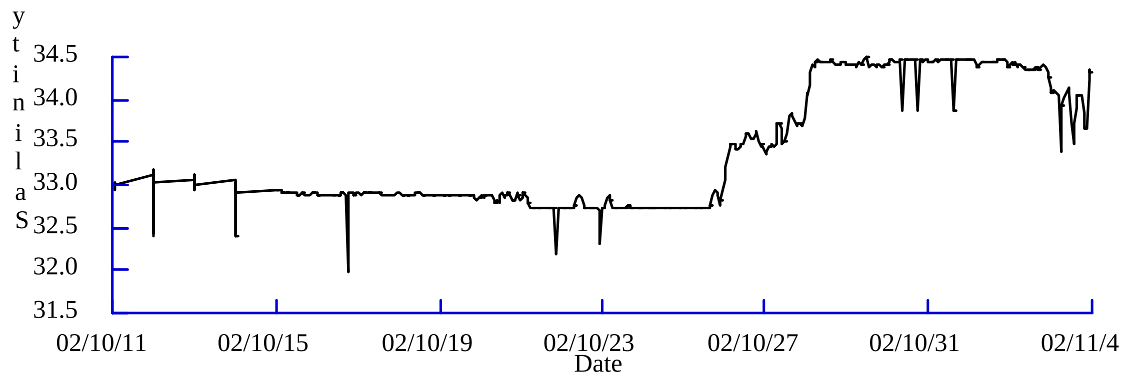


Fig.3.3-1：Temporal variation of the Salinity.

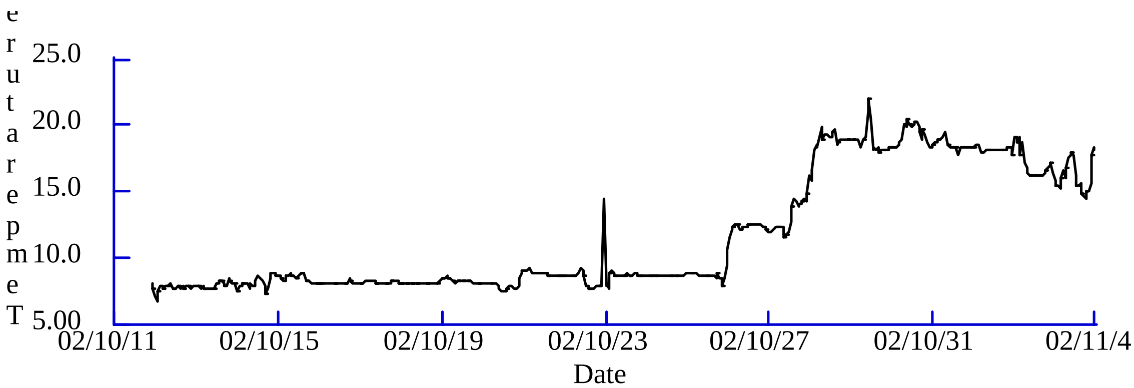


Fig. 3.3-2: Temporal variation of the Temperature.

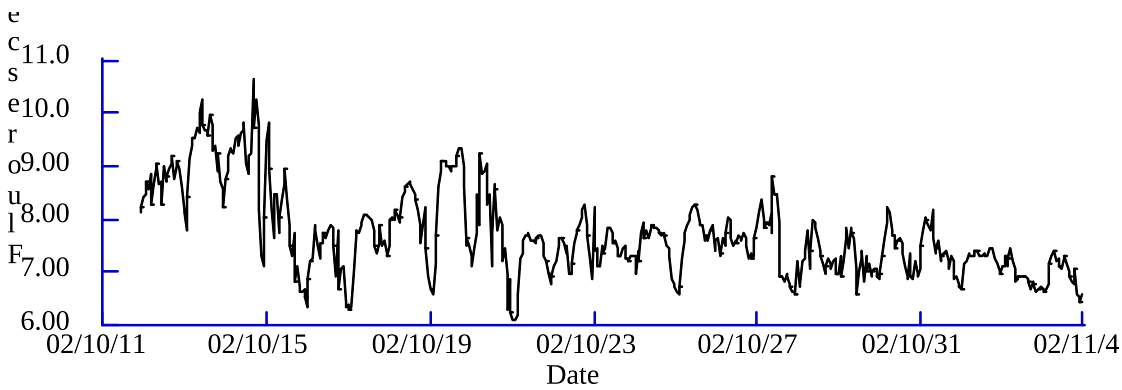


Fig. 3.3-3: Temporal variation of the Fluorescence.

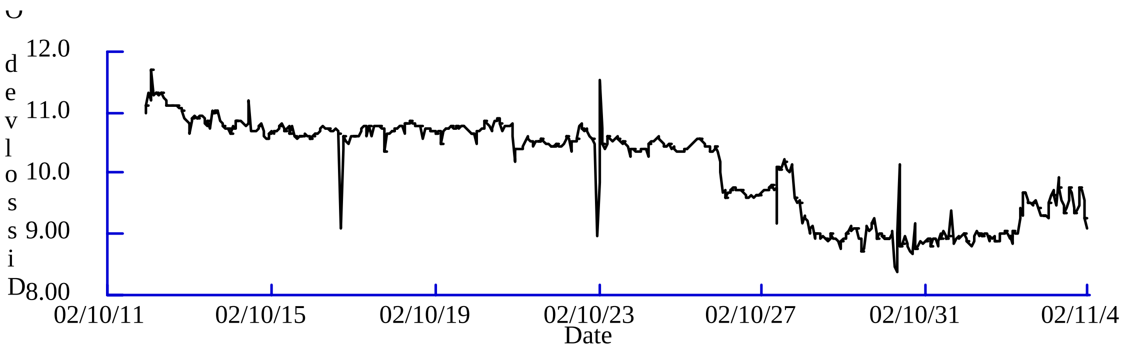


Fig. 3.3-4: Temporal variation of the Dissolved Oxygen.

3.4 Dissolved Oxygen

Tomoko SEIKE (MWJ)
Tomoko MIYASHITA (MWJ)

(1) Instruments:

Titrator; Metrohm Model 716 DMS Titrino/ 10ml of titration vessel
Detector; Pt Electrode/ 6.0401.100
Software; Data acquisition and endpoint evaluation/Metrohm, METRODATA/606013.000 and Tinet 2.4.

(2) Methods:

The 36 positions water samplers sampled seawater during CTD up cast. Bottle oxygen samples were taken in calibrated clear glass bottles (100ml) from the 12-liter Niskin water samplers. Water corresponded to three times of bottles was used to flush, and the temperature was measured by digital thermometer. Analysis followed the Winkler whole bottle method processed to the WHP Operations and Methods (Dickson, 1996), and used by Metrohm piston burette of 10ml with Pt electrode. Thiosulfate normality was determined on new reagents were made up. Replicate samples were taken on every cast; usually these were more than 10% of samples in each cast.

Results:

1) Reproducibility of Winkler titration data

A large number of replicate samples were taken during this cruise. Statistics on the replicates were given in Table 3.4-1.

Table 3.4-1 Statistics of replicates.

Number	Oxygen concentration mol/kg	
	Std.dev.	C.V. (%)
13	0.13	0.09

2) All D.O. data

All of D.O. data (113 samples include 13 replicates) were given in Table 3.4-2.

Table 3.4-2 All of D.O. data.

Niskin Number	Oxygen concentration mol/kg			
	K1	K2	K2.5	K3
Buckets	292.90	290.18	265.17	292.90
13	292.60	289.78	264.50	292.60
14	292.72	289.54	261.80	292.71
15	318.33	289.64	252.56	318.33
16	327.38	321.86	248.47	327.38
17	321.28	321.81	227.55	321.27

18	267.49	301.69	234.91	267.49
19	127.09	172.85	236.77	127.09
20	50.01	59.02	232.88	50.01
21	32.25	28.91	230.92	32.25
22	24.38	25.97	185.96	24.38
23	20.89	20.40	117.91	20.89
24	18.59	17.29	73.86	18.59
25	18.62	17.54	53.75	18.62
26	20.50	26.30	39.05	20.50
27	23.50	25.53	32.05	23.50
28	47.32	53.92	44.12	47.32
29	76.49	90.90	72.61	76.49
30	104.86	116.88	102.59	104.86
	-	117.11	-	-
31	125.59	135.96	125.56	125.59
32	141.33	147.77	141.51	141.33
	141.54	147.68	141.68	141.54
33	149.83	155.56	151.64	149.83
34	155.81	160.18	158.33	155.81
	155.78	159.67	158.65	155.78
35	158.49	161.97	160.46	158.49
36	159.67	162.27	159.96	159.67
	159.92	162.36	159.96	159.92

References:

Culberson, C.H. (1991) Dissolved Oxygen, in WHP Operations and Methods, Woods Hole., pp1-15

Culberson, C.H., G.Knapp, R.T.Williams and F.Zemlyak (1991) A comparison of methods for the determination of dissolved oxygen in sea water (WHPO 91-2), Woods Hole.

Dickson, A. (1996) Dissolved Oxygen, in WHP Operations and Methods, Woods Hole., pp1-13

Green, E.J. and D.E.Carritt (1966) An Improved Iodine Determination Flask for Whole-bottle Titrations, Analyst, 91, 207-208.

Horibe, Y., Y.Kodama and K.Shigehara (1972) Errors in sampling procedure for the determination of dissolved oxygen by Winkler method, J. Oceanogr. Soc, Jpn., 28, 203-206.

Murray, N., J.P.Riley and T.R.S.Wilson (1968) The solubility of oxygen in Winkler reagents used for determination of dissolved oxygen, Deep-Sea Res., 15, 237-238

S.Kitagawa and K.Taira (1993) Measurement of dissolved oxygen by an electrode method,Umi no Kagaku (in Japanese), 2, 15-18.

TOA Electronics Ltd. (1991) DO-25A Portable Dissolved Oxygen meter Operation Manual, Tokyo, 29

3.5 Nutrients

Junko HAMANAKA (MWJ)
Asako KUBO (MWJ)

(1) Objectives

Phytoplankton require nutrient elements for growth, chiefly nitrogen, phosphorus, and silicon. The data of nutrients in seawater is important for investigation of phytoplankton productivity.

(2) Measured parameters

・Nitrate
・Nitrite
・Silicic acid
・Phosphate
・Ammonia

(3) Methods

Seawater samples were transferred into 10 ml PMMA bottles. Sample bottles were rinsed three times before filling. The samples were analyzed as soon as possible. Nutrients were measured by a TRAACS 800 continuous flow analytical system (BRAN+LUEBBE). The following analytical methods were used.

Nitrate: Nitrate in the seawater was reduced to nitrite by reduction tube (Cd-Cu tube), and the nitrite reduced was determined by the nitrite method as shown below. The flow cell was a 3 cm length type.

Nitrite: Nitrite was determined by diazotizing with sulfanilamide by coupling with N-1-naphthyl-ethylendiamine (NED) to form a colored azo compound, and by being measured the absorbance of 550 nm using a 5 cm length flow cell in the system.

Silicic acid: Silicic acid was determined by complexing with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 630 nm using a 3 cm length flow cell in the system.

Phosphate: Phosphate was determined by complexing with molybdate, by reducing with ascorbic acid to form a colored complex, and by being measured the absorbance of 880 nm using a 5 cm length flow cell in the system.

Ammonia: Ammonia in seawater was mixed with an alkaline solution containing EDTA, ammonia as gas state was formed from seawater. The ammonia(gas) was absorbed in sulfuric acid solution by way of 0.5 m pore size membrane filter (ADVANTEC PTFE) at the dialyzer attached to analytical system. The ammonia absorbed in acid solution was determined by coupling with phenol and hypochlorite solution to from an indophenol blue compound. That compound produced is measured absorbance of 630 nm using a 3 cm length cell.

(4) Results

Precision of the analysis

Coefficient of variation (CV) of nitrate, nitrite, silicic acid, phosphate and ammonia analysis at each station were less than 0.15% (57 M), 0.30% (1.4 M), 0.21% (197 M), 0.17% (3.5 M), and 0.65% (6.0 M) respectively.

(5) Data Archive

These data are stored Ocean Research Department in JAMSTEC.

(6) Extra Sample

Seawater to be used for Reference Material (RM) production was collected from the depth of 2000 and 5000m at K2 station. This seawater was transferred into 20 litters plastic containers, which were rinsed three times in advance. These samples were kept in a freezer at the temperature of -20℃. Nutrients of these samples were measured by the same way as mentioned above. Results of analysis are shown Table 3.5-1.

Table 3.5-1. Results of nutrient and salinity analysis of the frozen sample

					n=1	n=1
Station K2 (47N, 160E)		NO_3	NO_2	SiO_2	PO_4	Salinity
Unfreezed at room temperature and dark place in 24 hour after freezing at	2000m	40.92	-0.01	168.47	2.86	34.6226
Unfreezed at 24℃water bass in 15 mimutes after freezing at -20℃	2000m	39.97	0.11	164.28	2.83	
Unfreezed at room temperature and dark place in 24 hour after freezing at	5000m	35.69	-0.01	147.60	2.45	34.6916
Unfreezed at 24℃water bass in 15 mimutes after freezing at -20℃	5000m	36.15	-0.01	148.66	2.47	

3.6. Partial Pressure of CO_2 (pCO_2) Measurement

Minoru KAMATA (MWJ)
Hideki YAMAMOTO (MWJ)

(1) Introduction

Since the global warming is becoming an issue world-widely, studies on the green house gas such as CO_2 are drawing high attention. Because the ocean plays an important roll in buffering the increase of atmospheric CO_2, studies on the exchange of CO_2 between the atmosphere and the sea becomes highly important. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Unfortunately, the concentrations of these individual species of CO_2 system in solution cannot be measured directly. There are, however, four parameters that could be measured; alkalinity, total dissolved inorganic carbon, pH and pCO_2. If two of these four are measured, the concentration of CO_2 system in the water could be estimated (DOE, 1994).

(2) Objective

The current investigation was carried out in order to verify carbon dioxide parameters in the Arctic Ocean and Bering Sea by continuously measuring the partial pressure of CO_2 in the atmosphere and surface seawater. The measurement was carried out in the research vessel MIRAI during this cruise.

Inventory information for the sampling

(3) Materials and Methods

Concentrations of CO_2 in the atmosphere and the sea surface were measured continuously during the cruise using an automated system with a non-dispersive infrared (IR) analyzer (BINOS^{TM}). The automated system ran on one and a half hour cycle during which standard gasses, ambient air sample and a headspace sample from the equilibrator were analyzed. During one cycle, standard gasses were measured once each, twice for ambient air sample and 7 times of the sample from the equilibrator. The concentrations of the standard gas used to calibrate the analyzer were 246.68, 297.82, 320.05 and 391.65 ppm.

The ambient air sample taken from the bow was introduced into the IR by passing through a mass flow controller which controlled the air flow rate at about 0.5L/min, a cooling unit, a perma-pure dryer (GL Sciences Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

A fixed volume of the ambient air taken from the bow was equilibrated with a stream of seawater that flowed at a rate of 5-8L/min in the equilibrator. The air passing the equilibrator was circulated with an air pump at 0.5-0.8L/min in a closed loop passing through two cooling units, a perma-pure dryer (GL Science Inc.) and a desiccant holder containing $Mg(ClO_4)_2$.

(4) Preliminary results

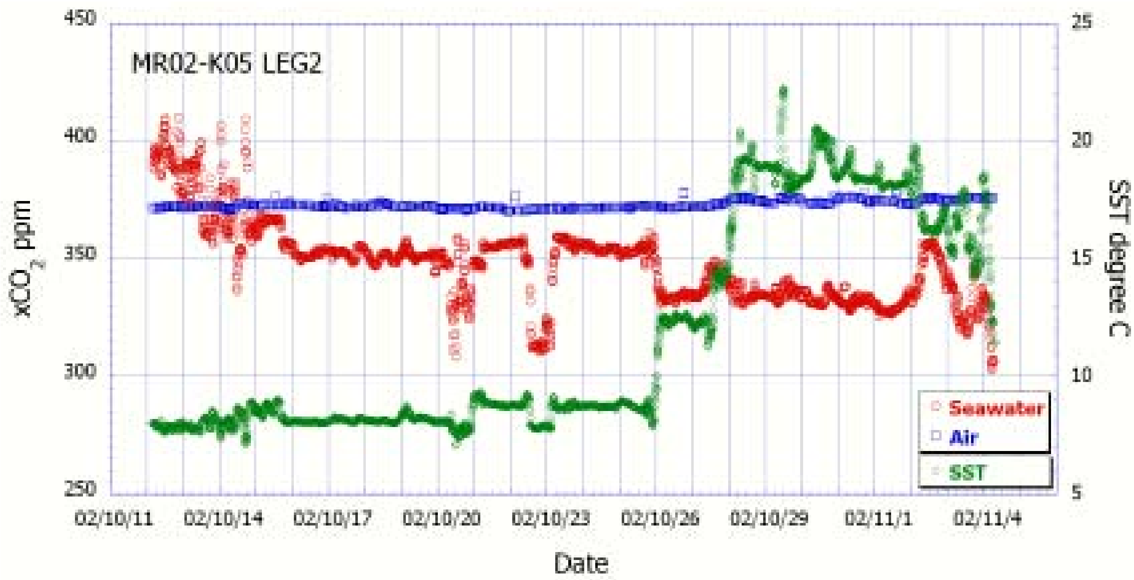
Figure 3.6-1. is showing the results of measuring the CO_2 concentration of ambient air sample and the CO_2 concentration of the seawater sample.

(5) Data Archive

All data was submitted to JAMSTEC Data Management Office (DMO) and is currently under its control.

Reference

DOE (1994), *Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water*; version 2, A. G. Dickson & C. Goyet, Eds., ORNS/CDIAC-74.



3.7. Total Dissolved Inorganic Carbon（TDIC）Measurement

Minoru KAMATA (MWJ)
Hideki YAMAMOTA (MWJ)

1. Introduction

Since the global warming is becoming an issue world-widely, studies on the green house gas such as CO_2 are drawing high attention. Because the ocean plays an important roll in buffering the increase of atmospheric CO_2, studies on the exchange of CO_2 between the atmosphere and the sea becomes highly important. When CO_2 dissolves in water, chemical reaction takes place and CO_2 alters its appearance into several species. Unfortunately, the concentrations of the individual species of CO_2 system in solution cannot be measured directly. There are, however, four parameters that could be measured; alkalinity, total dissolved inorganic carbon, pH and pCO_2. If two of these four are measured, the concentration of CO_2 system in the water could be estimated (DOE, 1994).

2. Objective

The current investigation was carried out in order to verify carbon dioxide parameters in the Northwestern Pacific by measuring TDIC with analytical instruments installed on the research vessel MIRAI during this cruise.

Inventory information

Table 3.7-1. is showing the site name, date and the position where the water column samples were collected.

Surface seawater was continuously collected from October 13th, 2002 to November 4th, 2002 during the cruise.

Table 3.7-1. Inventory information of the collected water column samples.

Station	Date mm/dd/yy	Longitude (°E)	Latitude (°N)
K1	10/16/02	165.231	51.281
K2	10/21/02	159.975	46.955
K2.5	10/26/02	160.003	43.498
K3	10/28/02	160.006	39.178

3.7.1. Water column TDIC

(1) Materials and Methods

1) Seawater sampling

Seawater from different depths was collected by 12L Niskin bottles at 4 stations. To collect the surface seawater, a plastic bucket was used. Seawater from different depths was sampled in a 250ml glass bottle, which was previously soaked in 5% non-phosphoric acid detergent (pH13) solution for at least 2 hours and was cleansed by fresh water and Milli-Q deionized water for 3 times each. A sampling tube was connected to the Niskin bottle when the sampling was carried out. The glass bottles were filled from the bottom, without rinsing, and were overflowed for 20 seconds with care not to leave any bubbles in the bottle. After collecting the samples on the deck, the glass bottles were removed to the lab to be analyzed. Prior to the analysis, 3ml of the sample (1% of the bottle volume) was removed from the glass bottle in order to make a headspace. The samples were then poisoned with 100 l of saturated solution of mercury chloride within one hour from the sampling point. After poisoning, the samples were sealed using grease (Apiezon M grease) and a stopper-clip. The samples were stored in a refrigerator in darkness at approximately 5°C until analyzed.

2) Seawater analysis

Using a coulometer (Carbon Dioxide Coulometer Model 5012, UIC Inc.) and an automated sampling system controlled by a computer, the concentration of TDIC was measured as the followings.

The sampling cycle set in the system was composed of 3 measuring factors; 70ml of standard CO_2 gas, 2ml of 10% (v/v) phosphoric acid solution and 6 seawater samples. The standard CO_2 gas was measured to confirm the constancy of the calibration factor during a run and phosphoric acid was measured for acid blank correction.

The calibration factor (slope) was calculated by measuring series of sodium carbonate solutions (0~2.5mM) and this calibration factor was applied to all of the data acquired throughout the cruise. By measuring Certified Reference Material (CRM) (Scripps Institution of Oceanography) every time the cell was filled with fresh anode and cathode solutions, the slope was calibrated with the counts of this outcome. The set of cell solutions was changed after approximately 60 seawater samples were measured.

The seawater samples were measured as the followings. From the glass bottle, approximately 28ml of seawater was measured in a receptacle and was mixed with 2ml of 10% (v/v) phosphoric acid. The carbon dioxide gas evolving from the chemical reaction was purged by nitrogen gas (carbon dioxide free) for 11 minutes at the flow rate of 130ml/min and was absorbed into an electrolyte solution. In the electrolyte solution, acids forming from the reaction between the solution and the absorbed carbon dioxide were titrated with hydrogen ions in the coulometer and the counts of the titration were stored in the computer.

3) Preliminary results

A duplicate seawater samples was collected from 5 different depths (500m - 4500m) on every station and the difference between each pair of analyses was plotted on a range control chart (see Figure 3.7.1-1.). The average of the absolute differences was 1.6. The standard deviation of the absolute differences was 1.5 mol/kg (n=20), which indicates that the analysis was accurate enough according to DOE (1994).

3.7.2. Sea surface TDIC

(1) Materials and Methods

Surface seawater was continuously collected by a pumping system from the depth of 4.5m. The TDIC of the introduced surface seawater was constantly measured by a coulometer that was set to analyze surface seawater specifically. The mechanism of the measurement was the same as described in *3.7.1.1 Seawater analysis*. The calibration factor (slope) was calculated by measuring series of sodium carbonate solutions (0~2.5mM) and this calibration factor was applied to all of the data acquired throughout the cruise. By measuring Reference Material (RM: Batch Q0208) (JAMSTEC) every time the cell was filled with fresh anode and cathode solutions, the slope was calibrated with the counts of this outcome. Concentration of TDIC of this RM had been decided for measuring with CRM（Batch 55）in MR02-K05 LEG1 cruise. The set of cell solutions was changed after samples were continuously measured for 3 days. However, the seawater measured in a receptacle was 24ml and the flow rate of nitrogen gas was 140ml/min.

(2) Preliminary results

The standard deviation of the absolute differences of duplicate measurements from the reference material created by JAMSTEC was 0.7 mol/kg (n=9), which indicates that the analysis was accurate enough according to DOE (1994).

3. Data Archive

All data was submitted to JAMSTEC Data Management Office (DMO) and is currently under its control.

4. Reference

DOE (1994), *Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water*; version 2, A. G. Dickson & C. Goyet, Eds., ORNS/CDIAC-74.

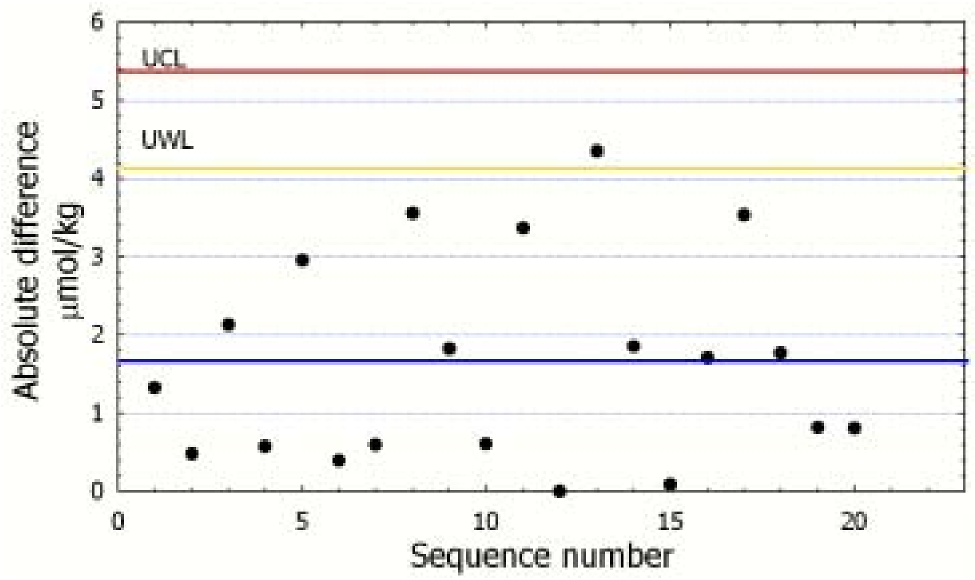


Fig. 3.7.1-1. Range control chart of absolute difference of seawater samples

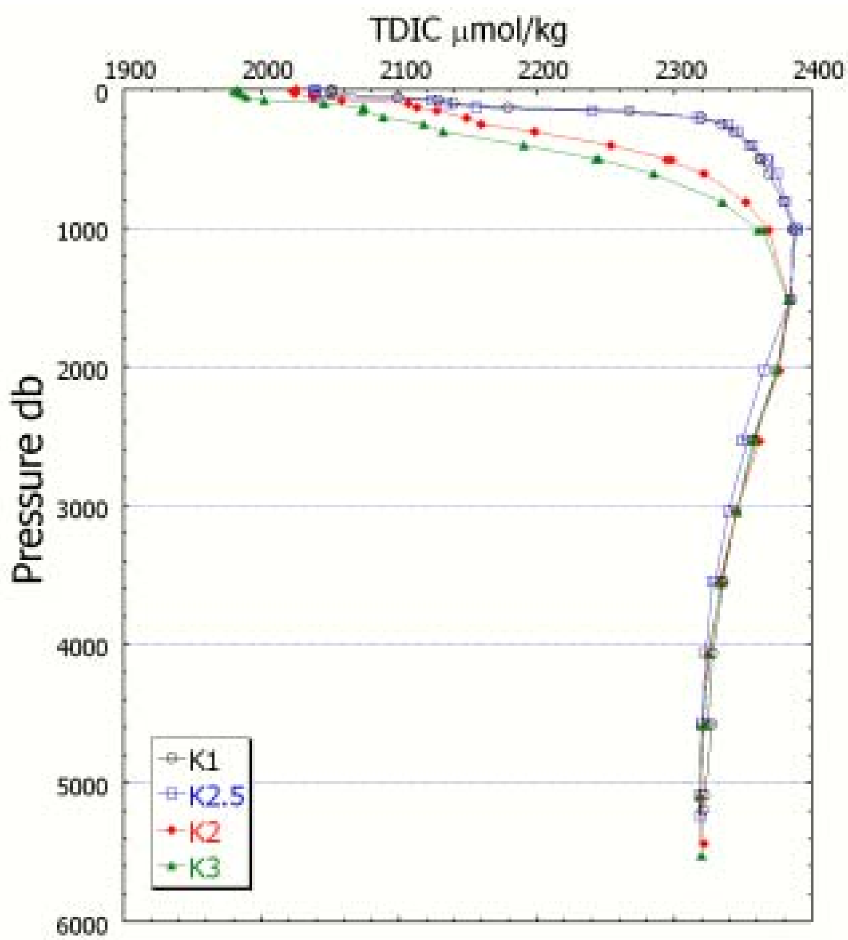


Fig. 3.7.1-2. Vertical profiles of TDIC on MR02-K05 LEG2 cruise.

3.8 Total alkalinity

Taeko OHAMAO (MWJ)

(1) Method and Instruments

As for the sample of the obtained seawater, capacity was flowed in the bottle made of the glass of 125ml by 12L Niskin TM bottle. Seawater was filled from the bottom of the sampling bottle, and the two double of the amounts were overflowed. The bottle was sealed with the screw top next, and stored in the refrigerator. The bottles were put in the water bath kept about 25℃ before the titration.

The method of total alkalinity measurement was that approx. 50ml of seawater was placed in a 100ml tall beaker with a Knudsen pipette, and titrated with a solution of 0.05M hydrochloric acid. The acid was made up in a solution of sodium chloride background (0.7M) to approx. the ionic strength of seawater. The titration carried out adding the acid to seawater past carbonic acid point with a set of electrodes used to measure electromotive force at 25 degree C. After titration, the data of titrated acid volume and electromotive force and seawater temperature pipetted were calculated to total alkalinity.

The titration system consisted of a titration manager (Radiometer, TIM900), an auto-burette (Radiometer, ABU901), a pH glass electrode (pHG201-7), a reference electrode (Radiometer, REF201), a thermometer (Radiometer, T201) and two computers, the one was installed burette operation software (Lab Soft, Tim Talk 9) and the another one was for calculated total alkalinity.

(2) Preliminary results

Preliminary data of total alkalinity were shown in Appendix.

The absolute differences of duplicate measurements were plotted sequentially to evaluate the precision of the measurement process. It was shown in Fig.3.8-1. The average and standard deviation, repeatability of measurements, were 2.0 and 2.0 µmol/kg. As for a lot of samples, the difference of the value of two samples was before and behind 1-2µmol/kg. But, the sample whose difference of two samples is 5µmol/kg or more existed, and influenced accuracy by these samples. However, we achieved the precision of recommended value or less (2µmol/kg) of DOE(1994).

We measured two kinds of control sample, SIO CRM batch 55 and JAMSTEC RM to evaluate the stability of the measurement process. Measurements values of CRM were plotted sequentially and shown in Fig.3.8-2. Measurements values of RM were corrected by CRM measurement values, plotted sequentially and shown in Fig.3.8-3. And Fig.3.8-4 shows the vertical distribution of Total Alkalinity from St.K1 to St.K3.

References

DOE (1994) Handbook of methods for the analysis of the various parameters of the carbon dioxide system in sea water; version 2, A.G. Dickson & C. Goyet, eds. ORNS/CDIAC-74.

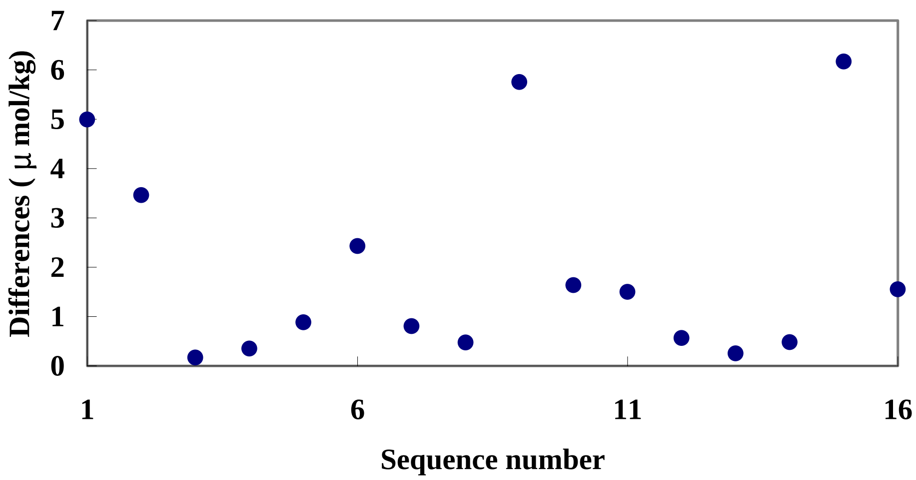


Fig.3.8-1 Differences of duplicate measurements

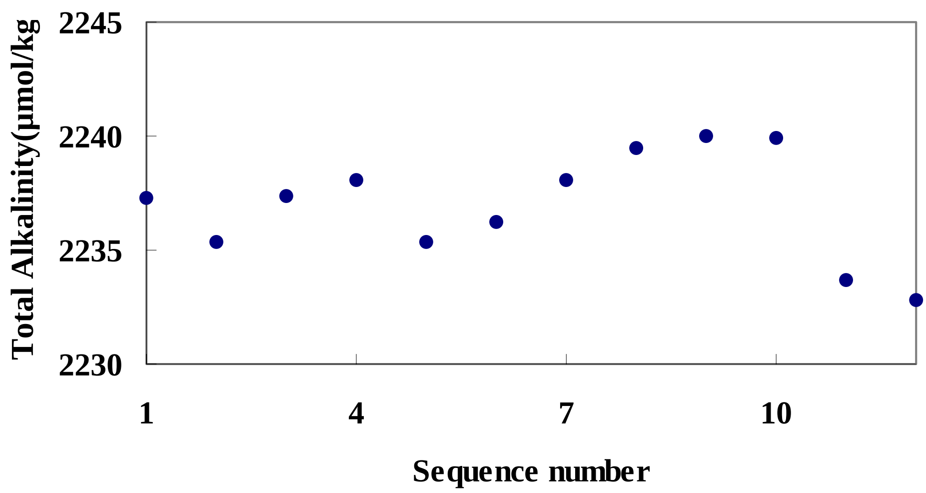


Fig.3.8-2 Measurement results

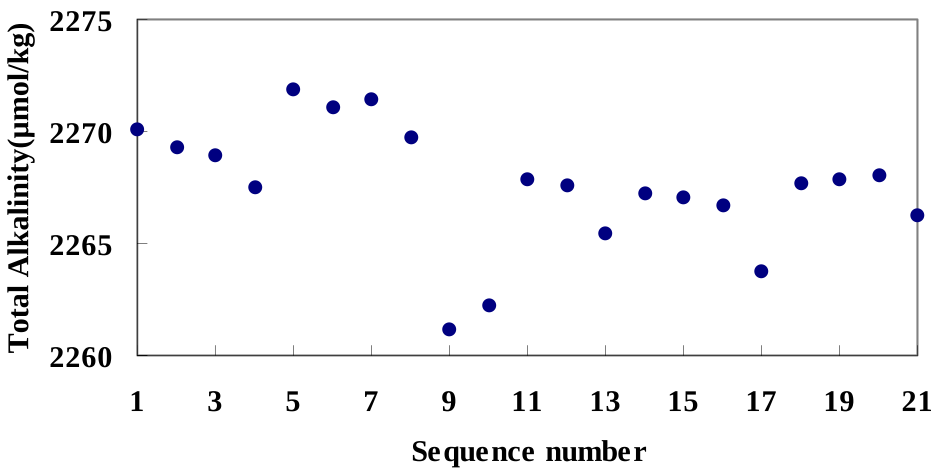


Fig.3.8-3　Measurement results of RM

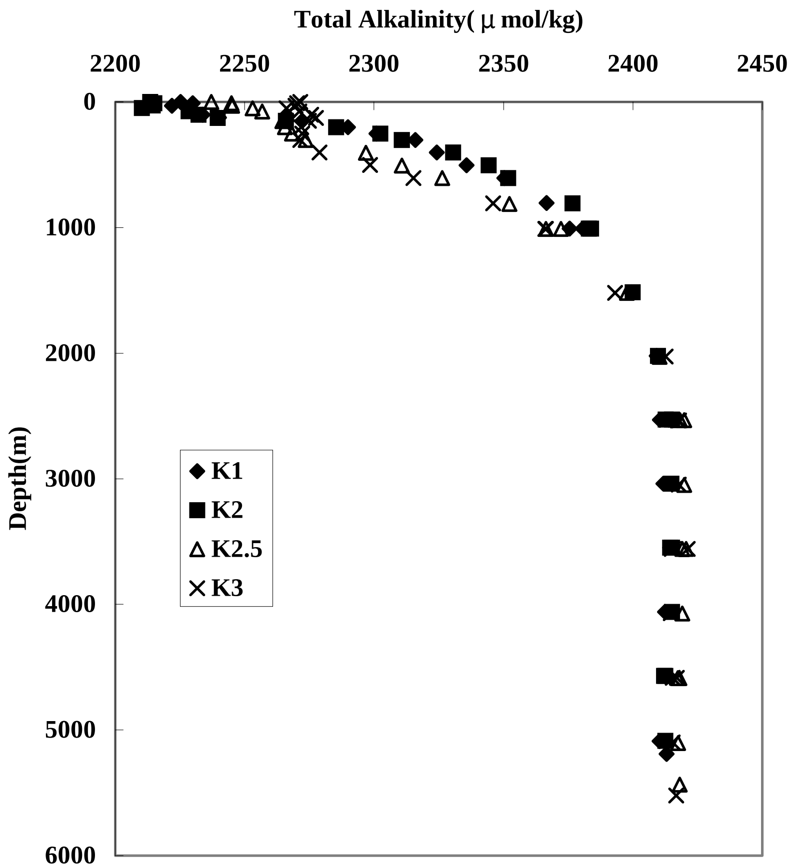


Fig.3.8-4　Vertical distribution of Total Alkalinity from St.K1 to St.K3.

3.9 Chlorophyll *a*

Hajime KAWAKAMI (JAMSTEC MIO)

(1) Sampling location

Seawater samples are collected from Station K1, K2, K2.5 and K3 in this cruise used 12 L Niskin sampling bottles with CTD-RMS. (Routine cast)

(2) Experimental procedure

The concentration of chlorophyll *a* in seawater samples is measured by fluorometric determination. The method used here utilizes the Turner fluorometer as suggested by Parsons et al. (1984).

Seawater samples (300 - 500 ml) are filtered through a glass fiber filter at 1/2 atmospheric pressure. Filters are used Whatman GF/F glass fiber filters (25 mm diameter). The filters are extracted by 7 ml of *N, N'* -dimethylformamide between overnight in a dark and cold (-20 °C) place. The extracts of the samples are measured the fluorescence by Turner fluorometer (10-AU-005, TURNER DESIGNS) with a 340-500 nm bound excitation filter and a >665 nm bound emission filer, before and after acidification. The acidification is carried out with 1 or 2 drops of 1 N HCl and the second measurement made 1 – 2 minutes after the acidification.

The amount of chlorophyll *a* is calculated from the following equation;

$$\mu g \text{ chlorophyll } a \text{ / L} = (fo - fa) / (F_{Ch} - F_{ph}) \; * \; v/V$$

where fo and fa are the fluorescence before and after the acidification, respectively, F_{Ch} and F_{ph} are the fluorescent factor of chlorophyll *a* and phaeophytine *a*, respectively, v is the volume of *N, N'* -dimethylformamide extract, and V is the volume of seawater.

The method is calibrated against a known concentration of chlorophyll *a* as determined by the spectrophotometric method (Porra et al., 1989).

A precision based on replicate measurements is usually less than 5%.

(3) Preliminary result

The preliminary results were shown in Table 3.9.1 and Fig. 3.9.1.

(4) References

Parsons Timothy R, Yoshiaki Maita and Carol M Lalli. 1984. "A manual of chemical and biological methods for seawater analysis" (Pergamon Press), pp. 101-112.

Porra R. J., W. A. Thompson and P. E. Kriedemann. 1989. Biochim. Biophys. Acta, 975, 384-394.

Table 3.9.1 The concentrations of Chlorophyll *a* (μg l^{-1}) at MR02-K05.

Depth (m)	St. K1	St. K2	St. K2.5	St. K3
0	0.449	0.514	0.732	0.610
10	0.545	0.578	0.727	0.644
30	0.519	0.564	0.696	0.634
50	0.279	0.547	0.279	0.568
75	0.142	0.155	0.146	0.430
100	0.034	0.038	0.023	0.152
125	0.021	0.018	0.009	0.074
150	0.013	0.011	0.014	0.038
200	0.015	0.015	-	0.010

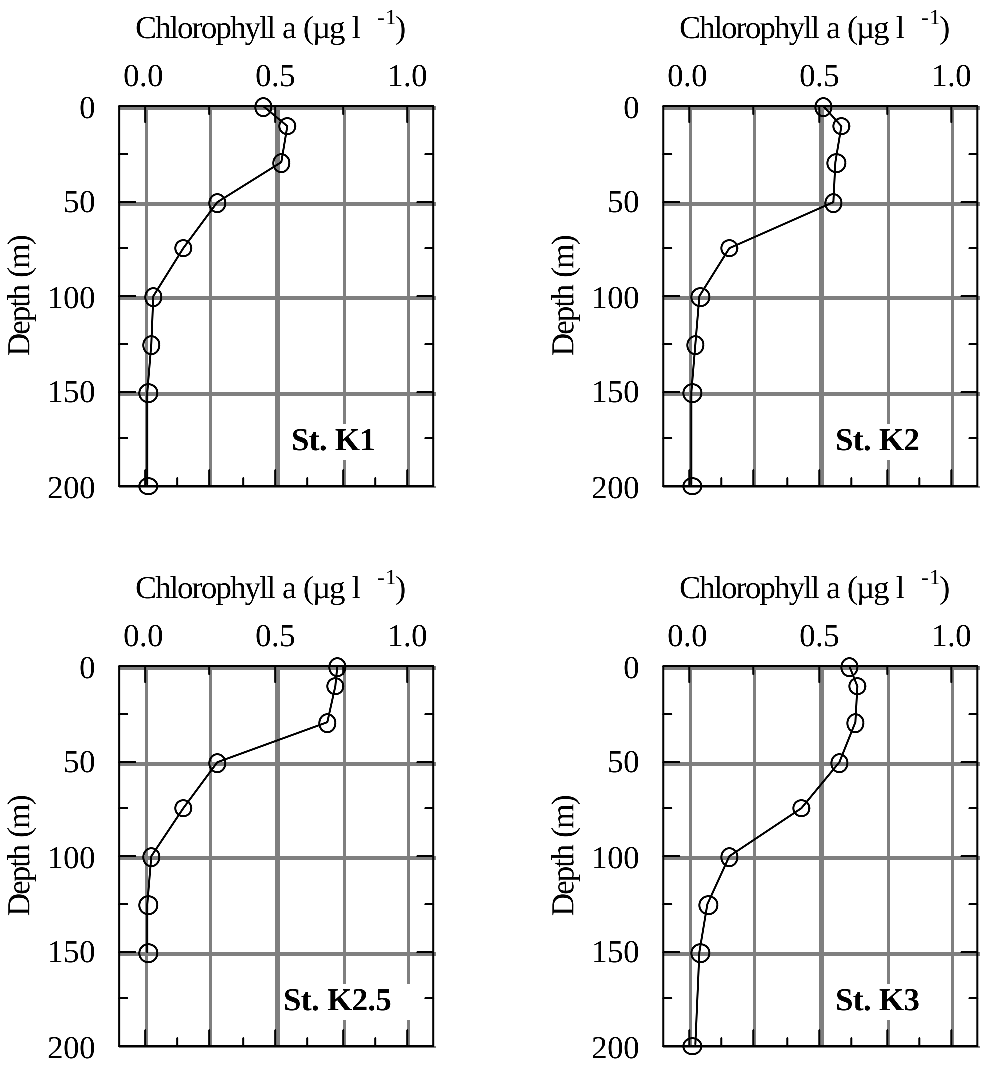


Figure 3.9.1 The vertical distributions of Chlorophyll *a* at MR02-K05.

4. Special observation

Time series observation on distribution and speciation of trace elements in the western subarctic North Pacific Ocean

Masako EZOE and Yoshiki SOHRIN
(Institute for Chemical Research, Kyoto University)

The distribution and speciation of trace elements in seawater are controlled by various physical, chemical and biological processes. Our object is to reveal the behavior of trace elements (Mn, Fe, Co, Ni, Cu, Zn, Zr, Nb, Cd, Hf, Ta, W, etc.) in seawater samples collected with a CTD carrousel sampler.

4.1 Distribution of trace bioelements in seawater

Martin *et al.* reported the distribution of iron and affirmed that iron deficiency is limiting phytoplankton growth in high-nutrient and low-chlorophyll (HNLC) areas such as the subarctic northeast Pacific and Antarctic Ocean[1,2]. Moreover, they suggested that oceanic iron fertilization aimed at the enhancement of phytoplankton production may turn out to be the most feasible method of stimulating the active removal of atmospheric CO_2. Concerning this hypothesis, many studies have been carried out and controversies have occurred[3,4]. The possibility of zinc limitation has also been reported. However, the data on the trace bioelements are very limited spatially and temporally. We have developed a novel simultaneous determination method for trace bioelements (Fe, Co, Ni, Cu, Zn, Cd, etc.)[5]. Our method is superior to previous methods in that many bioelements can be determined with a small volume of seawater (250 ml). We are going to measure the concentrations of the trace bioelements and to clarify their spatial and temporal variations in the western subarctic North Pacific Ocean.

(Method)

The seawater samples were collected by Niskin-X sampling bottles. Immediately after sampling, seawater (500 ml) was transferred to a pre-acid cleaned low-density polyethylene (LDPE) bottle using a silicon tubing and bell in order to avoid contamination with airborne particles. A portion of sample (250 ml) was filtered through an acid-cleaned Nuclepore filter (0.2 m pore size) using a closed filtration system in a clean room. The filtered and unfiltered seawater samples were acidified to pH 2 with hydrochloric acid and stored. It has been reported that most biogenic fractions and surface oxyhydroxides coatings in the unfiltered seawater dissolved during that storage at pH 2 [6].Thus, we will determine trace metal concentrations in ‘total dissolvable’ and ‘dissolved’ fractions using the unfiltered and filtered samples, respectively.

After brought back to our laboratory, the seawater sample will be adjusted to pH 4 with ammonium acetate buffer and passed through a column of 8-quinolinol immobilized fluoride containing metal alkoxide glass (MAF-8HQ). The trace bioelements collected on MAF-8HQ will be eluted with 25 ml of 0.5 M nitric acid containing 10^{-3} M hydrogen peroxide. The eluents will be analyzed with a ICP-mass spectrometer (ELAN DRC II, Perkin Elmer).

4.2 Distribution of second and third transition series elements in seawater

Our knowledge on the distribution of trace elements in the ocean has greatly advanced in recent years. This is due to the improvement of clean techniques and analytical methods. However, the data on second and third transition elements are still limited. We are investigating the marine chemistry of elements of groups 4, 5 and 6 (Zr, Nb, Hf, Ta and W) [7]. We will obtain the profiles of these elements in the western subarctic North Pacific Ocean on this cruise. The dissolved species of the elements are presumed to be $Zr(OH)_4$, $Nb(OH)_5$, $Hf(OH)_4$, $Ta(OH)_5$ and WO_4^{2-}. These elements are not thought to be essential to organism, and their distributions may not be significantly influenced by the active uptake of primary producers. The chemistry of the second and third transition series elements in the same group is very similar, because their ionic radii are close to each other owing to lanthanoid contraction. We expect that comparing the distribution and circulation of these elements will improve our knowledge on the chemical and physical process which fractionate the elements in the ocean.

(Method)

The method is basically the same as that for bioelements. The filtered and unfiltered seawater samples were acidified with hydrochloric acid and hydrofluoric acid and brought back to our laboratory. The trace elements collected on MAF-8HQ will be eluted with 25 ml of 0.5 M nitric acid containing 10^{-3} M oxalic acid. The eluents will be analyzed with a ICP-mass spectrometer (ELAN DRCⅡ, Perkin Elmer).

References

1. Martin, J.H. & Fitzwater, S.E. *Nature* **331**, 341-343 (1988).
2. Martin, J.H., Gordon, R.M. & Fitzwater, S.E. *Nature* **345**, 156-158 (1990).
3. de Baar, H.J.W. *Prog. Oceanog.* **33**, 123-386 (1994).
4. Martin, J.H., *et al. Nature* **371**, 123-129 (1994).
5. Sohrin , Y., *et al. Anal. Chim. Acta* **363**, 11-19 (1998).
6. Zhuang, G. & Duce, R.A., *J. Geophys. Res* **95**, 16207-16216 (1990).
7. Sohrin, Y., *et al., Geophys. Res. Lett* **25**, 999-1002 (1998).

5. Underway Geophysical observation

Satoshi OKUMURA (GODI)
Wataru TOKUNAGA (GODI)

5.1 Sea bottom topography (topography around mooring system's positions and position

(1) Objectives

To obtain the bathymetry data for the contribution of geophysical inve stigation.

(2) System configurations and performance

Frequency:	12 kHz
Transmit beam width:	2 degree
Transmit power:	20 kW
Transmit pulse length:	3 to 20 msec.
Depth range:	100 to 11,000 m
Beam spacing:	1 degree athwart ship
Swath width:	150 degree (max), 120 degree to 4,500 m 100 degree to 6,000 m, 90 degree to 11,000 m
Depth accuracy:	Within < 0.5% of depth or +/-1m, whichever is greater, over the entire swath (Nadir beam has greater accuracy; typically within < 0.2% of depth or +/-1m, whichever is greater)

(3) Methods

R/V Mirai has installed a Multi Narrow Beam Echo Sounding system (MNBES), SeaBeam 2112.004 (SeaBeam Inc., USA). We surveyed from Dutch-Harbor, USA on 11 October 2002 to Hachinohe, Japan on 5 November 2002. Additional survey performed around several sites (Stn. K1, K2 and K3) for determination of mooring positions.

To get accurate sound velocity of water column, we used temperature and salinity profiles from CTD (deep casts) data and calculated sound velocity by equation in Mackenzie (1981).

(4) Preliminary results

Figure 5.1-1, Figure 5.1-2 and Figure 5.1-3 show topography around Station K1, K2 and K3 respectively. Fixed mooring positions are also shown.

(5) Remarks

Navigation data (position, time, heading, ship speed, etc.) stopped from 07:25UTC to 07:42UTC 31 October 2002 because of network server trouble.

(6) Data archives

Bathymetry data obtained in this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be archived there.

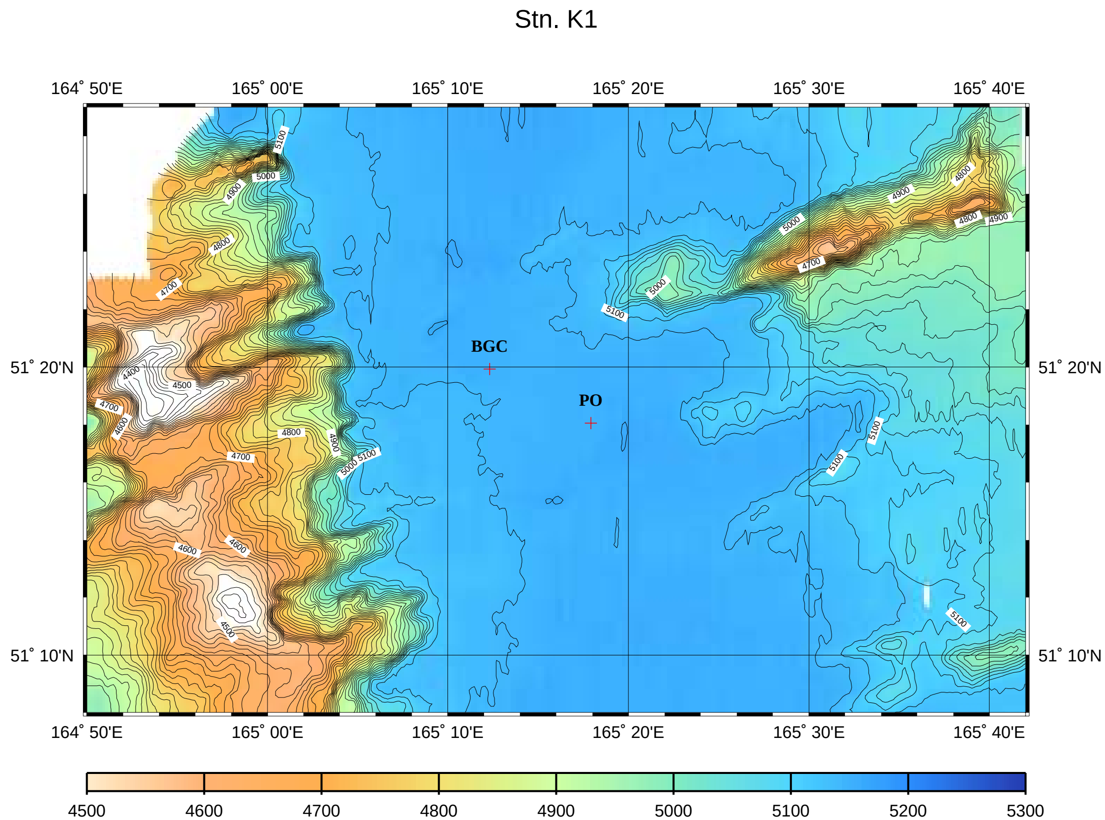


Figure 5.1-1 Station K1

Stn. K2

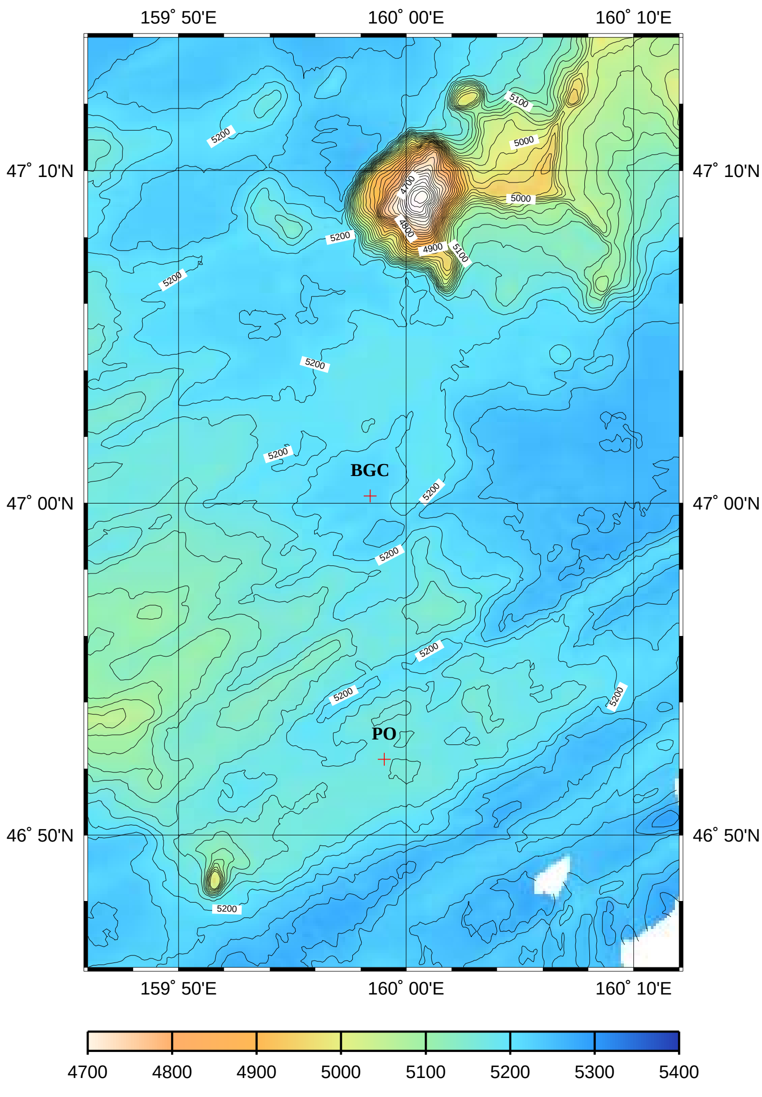


Figure 5.1-2 Station K2

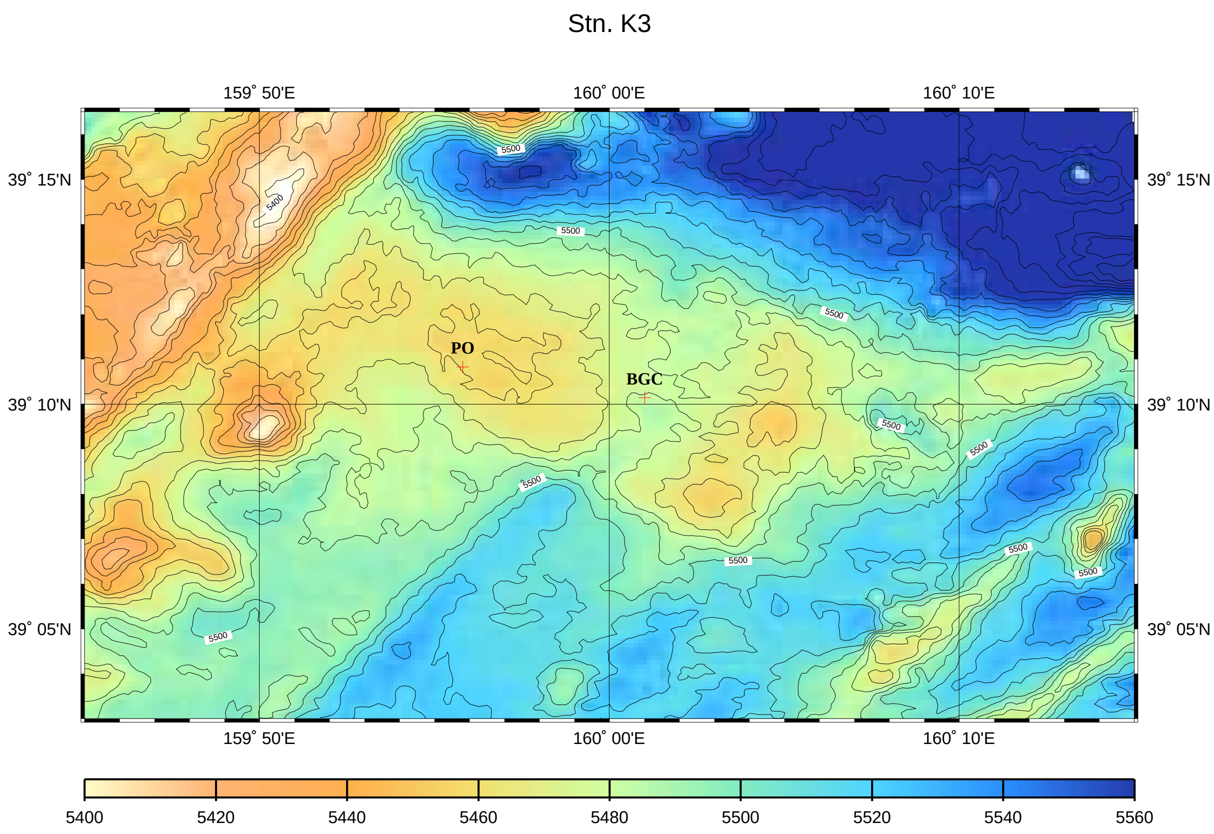


Figure 5.1-3 Station K3

5.2 Sea surface gravity

(1) Objectives

To obtain the continuous gravity data for contribution of geophysical investigation.

(2) Parameters

Gravity [mgal]

(3) Methods

We measured relative gravity values by LaCoste-Romberg (L&R) onboard gravity meter S-116 throughout MR02-K05 cruise from the departure of Sekinehama, Japan 24 August 2002 to arrival of Sehinehama, Japan on 6 November 2002.

To obtain absolute gravity value, we usually measure relative value by portable gravity meter (Scintrex gravity meter CG-3M) at comparable points, MIO gravity base, already known absolute gravity values. Moreover, measured values are corrected based on the bathymetry and ship movement. Consequently, the corrected gravity data should involve the information of crustal and upper mantle structures how they compensate the discrepancy from isostatic balance.

(4) Preliminary results

The absolute gravity values calculated in comparison with absolute values of reference point at Sekinehama Ports, to estimate mechanical drift of gravity meter during this cruise. Results as follows,

No	Date	UTC	Port	Absolute Gravity (mGal)	Sea Level (cm)	Draft (cm)	Gravity at sensor (mGal)*	L&R (mGal)
1	Aug/24	20:30	Sekinehama	980371.85	252.0	615	980372.66	12662.6
2	Sep/01	22:50	Dutch-Harbor	-	833.0	640	-	13819.2
3	Oct/10	20:00	Dutch-Harbor	-	322.0	629	-	13815.7
4	Nov/06	04:09	Sekinehama	980371.85	233.5	600	980372.60	12661.1

*: Gravity values at the sensor position of onboard gravity meter are calculated the follows;

Absolute Gravity + Sea Level*0.3086/100 + (Draft-530)/100*0.0431

Diff. L&R gravity	-1.5 mGal	(a)
Diff. Gravity at senor	-0.06 mGal	(b)
L&R drift (a-b)	-1.44 mgal	(c)
Cruise term	73.32 days	(d)
Drift rate (c/d)	<u>-0.02 mGal/day</u>	

(5) Remarks

Navigation data (position, time, heading, ship speed, etc.) stopped from 07:25UTC to 07:42UTC 31 October 2002, because of network server trouble.

(6) Data archives

Gravity data obtained in this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be archived there.

5.3 Surface three components magnetic field

(1) Objectives

In order to continuously obtain the geomagnetic field vectors on the sea surface, a three component magnetometer is very useful equipment. The magnetic force on the sea is affected by induction of magnetized body beneath the subbottom in addition to the earth dipole magnetic field. The magnetic measurement on the sea is, therefore, one of utilities for geophysical reconstruction of crustal structure and so on. The geomagnetic field can be divided into three components, i.e., two horizontal (x & y) and one vertical (z) moments. Three-component observation instead of total force includes much information of magnetic structure of magnetized bodies.

(2) Parameters

Three component magnetic force	[nT]
Ship's attitude (Pitch, Roll and Heading)	[1/100 deg]

(3) Methods

The sensor is a three axes fluxgate magnetometer on the top of foremast and sampling period is 8 Hz. The timing of sampling is controlled by the 1pps standard clock of GPS signal. Every one second data set which consists of 310 bytes; navigation information, 8 Hz three component of magnetic forces and Vertical Reference Unit (VRU) data were recorded in the external hard disk. The data set is simultaneously fed to the R/V Mirai network server through ethernet LAN system.

(4) Preliminary results

During MR02-K05 Leg2 cruise, the magnetic force is continuously measured from the departure of Dutch-Harbor, USA on 10 October 2002 to arrival at Sekinehama, Japan on 6 November 2002. Data obtained on the sea will be analyzed in near future. The procedure of quality control is mainly to eliminate the effect of ship's magnetized vector condition.

(5) Data archives

Navigation data (position, time, heading, ship speed, etc.) stopped from 07:25UTC to 07:42UTC 31 October 2002, because of network server trouble.

(6) Data archives

Magnetic force data obtained in this cruise will be submitted to the DMO (Data Management Office), JAMSTEC and will be archived there.

6. Ship's Handling

Masaharu AKAMINE (Master of R/V MIRAI) and
MIRAI Ship's Crew

6.1 Deployment

(1) Objectives

- **To deploy it surely and efficiently in the site of which the moorings is required**
- **To prevent damage of an observation equipment and a sensor**

Results are analyzed from the standpoint of ship's maneuvering to achieve two purposes that mentioned above, and it aims to make the results useful for observation work in the future.

(2) Observation parameters

- Ship's position, course, speed
- Directions of the wind and the current, velocities of the wind and the current
- Vectors of the wind and the current, the resultant force
- Working hours
- Position of sinker

(3) Methods

(3.1) Measurement of the actual ship-movement

Measurement of the ship-movement at engine stopped is executed by a set-drift which is measured before deploying the MMP/BGC moorings in order to make in advance a comparison between reality and expectation. A direction and a velocity of the ship-movement in the external force influence is measured by a radio navigation device " Sains" assembled by Sena Co., Ltd. Japan and a Doppler sonar "DS-30" assembled by FURUNO Electric Co., Ltd. Japan.

(3.2) Measurement of the wind and the current

The wind direction and speed is measured by KOAC-7800 weather data processor and sensors assembled by Koshin Denki.

The current direction and speed are continuously measured by a Doppler sonar "DS-30" installed at the bottom of the ship.

(3.3) Ship's speed

According to the results measured in past, and the instruction from the marine technician of WHOI, on the deploy of the MMP/BGC moorings, the ship's speed is set up so as to keep her speed on 1.0~ 2.0 knots at ship's through-the-water while the mooring lines are paid out, to keep her speed on about 1 knot at ship's through-the-water while the various instruments such as sensors, sediment traps, glass balls /releasers/sinker etc. are attached. In order to avoid their instrument accident and to maintain a safety of the works, an average speed through all the works around 1.5 knots at ship's through-the-water becomes one aim.

About the deployment of the BGC mooring, the ship's way is most stopped while instruments are attached in the top buoy at the stage of the start.

(3.4) Ship's course

The information of the ship's course is given beforehand from the marine technician of WHOI. This information is to make the ship proceed upwind. The final decision is done in consideration of the external force influence such as the wind-drift, the wave, the current, and the swell, making reference to the data of the set-drift carried out before the deploying operation of the MMP/BGC moorings.

It is important to lessen the angle between the ship's course and the wind direction in order to prevent the ship drifting to the lee. The ship shall be managed to make the mooring lines paid out from the stern, strait behind.

It is also necessary to consider the direction of the swell.

(3.5) Working hours for the deployment of the MMP/BGC moorings

The time that the ship needs in each work is investigated and recorded referring to past data.

(3.6) Tension of the wire cable and the nylon ropes

The tension of the cable/the ropes streamed astern may be checked with the tension meter with which the wind winch is equipped.

The speed of the ship and revolutions of the winch are adjusted so as not to hang a big stress in the cable/ropes actually paid out from her stern, checking the above-mentioned data and the cable/ropes tension measurement by skilled hands of marine technicians and chief officer at ship's stern.

(3.7) Decision of the anchored position

The position of the sinker arrived at the seabed is fixed by an acoustic transducer which is lowered over the stern, a radio navigation device, and the ship's radars are used to know the movement of the top buoy from dropping the sinker to disappearing it from the surface.

The acoustic transducer: Edgetech Inc. USA

The radio navigation device: "Sains" assembled by Sena Co., Ltd. Japan.

The ship's radar:

"JMA9000 X band" and "JMA 9000 S band " assembled by JRC Ltd.

"MM950 X & S band" assembled by Consilium Selesmar, Italy.

(4) Results

(4.1) Ship's speed

The results are shown in Fig.6.1-1 to 6.1-3.

The ship's speed is divided into two kinds of groups according to the result. One is the speed when having attached the sensor, the sediment traps, glass balls, and the releaser, etc. Another is the speed when paying out the mooring lines. On her through-the-water basis, the former was from 1.0 knot to 2.0 knots and the latter was approximately 1.0 knot. The numerical value is not greatly different from the past one and all are included in the standard of the speed for the deployment of the MMP/BGC moorings.

When the ship's head faced the wind and the stream or received the stream from the back, the ship's speed showed the tendency to become fast in each.

(4.2) Ship's course

The results are shown in Fig.6.1-4 to 6.1-6 and the following table.

	Gyro Co.	True Co.	Co. between the target point/the dropped point
K1-MMP	<000>	<000>	<000>
K1-BGC	<110>	<120>	<122>
K2-MMP	<345>	<340>	<341>
K2-BGC	<330>	<320>	<320>
K3-MMP	<330>	<330>	<329>
K3-BGC	<320>	<310>	<311>

As shown by the above-mentioned table, because there are few differences between the true Co. and the Co.-made-good which ran actually, the ship was completely handled so that the cable/ropes which has been paid out lead right aft.

To make the ship's handling easy, the angle between the ship's course and the wind
direction was made as small as possible so that the ship does not drift downwind steeply.

Fig.6.1-7 to 6.1-9 show the direction where the ship received the wind. It is a result in which having received the wind almost to the bow.

Fig.6.1-10 to 15 show the current influence. Firstly the direction and the speed of the current are shown by absolute value. Next, the speed of the current is divided into the direction of X (lateral force) and Y (longitudinal force). Because X moves the ship laterally, the amount of it influences the ship's control.

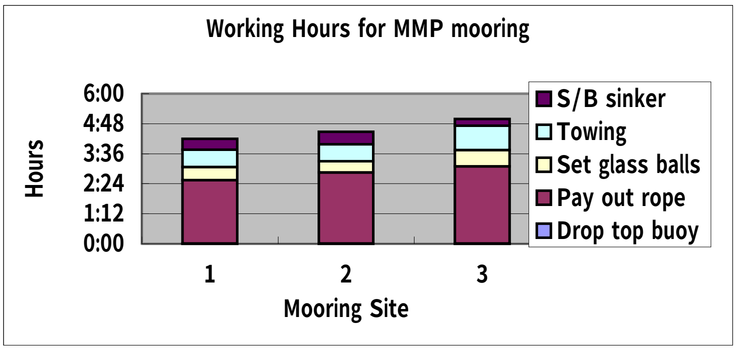
The current influence was a little, because the amount of it was not large though various lateral force of the current recorded. It was possible to adjust it by using the side-thrusters.

By the results of this time, about the course of the ship, a big difference is not recognized between the expectation and the actual results**.**

(4.3) Working hours

MMP mooing

The results are shown in Table 6.1-1, the following figure



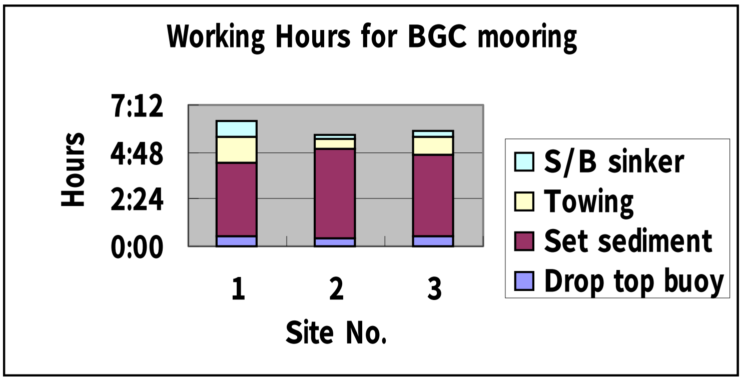
The times that the ship needs in each work show to be fixed nearly except the fact that the deeper depth is, the longer the work time is. By the way, each depth is 5133.4, 5152.3 and 5450 meters.

The average time spent in each work is as follows;

The time spent in setting top-buoy	1 minute
The time spent in paying out mooring lines with MMP	2 hour 49 minutes
The time spent in setting glass balls	32 minutes
The time spent for towing	47 minutes
The time spent in setting releaser and sinker	24 minutes
	Total 4 hour 33 minutes

BGC mooring

The results are shown in Table 6.1-2 and the following figure.



The total hours that the ship needs in the work is almost the same as each site except the fact that times spent in setting the sediment traps on the mooring at k2 is long, compared with others. Since the mooring at K2 has 7 units of the sediment traps extra.

The average time consumed in each work is as follows;

The time spent in setting top buoy and instrument	28 minutes
The time spent in paying out mooring lines with sediment traps (including the time spent in setting glass balls)	4 hours 10 minutes
The time spent on towing	54 minutes
The time spent in setting releasers and sinker	25 minutes
Total	5 hours 58 minutes

(4.4) Sinker's position

The difference between the position of **the sinker dropped** and the position of **the sinker reached the seabed** are shown in the following table.

Unit: meter

Mooring No.	Expectation	Actual	Fixed	A-E	A-F
02-K1 MMP	540	543	249	3	294
01-K1 MMP	600	611	444	11	167
02-K2 MMP	390	386	295	-4	91
01-K2 MMP	460	482	389	22	93
02-K3 MMP	325	333	519	8	-186
02-K1 BGC	550	553	451	3	102
01-K1 BGC	580	556	482	-24	74
02-K2 BGC	450	444	704	-6	-260
01-K2 BGC	550	574	463	24	111
02-K3 BGC	500	519	556	19	-37

The above-mentioned numerical value shows that the straight-line distance between the sinker dropped point and the target point/the fixed position.

"Expectation" means the distance from the target point directed by the technician of WHOI beforehand to the sinker dropping point. "Actual" means the distance between the position of **the sinker dropped** and the position of **the sinker reached the seabed**.

"Fix" means a fixed position that was obtained with the software of WHOI after the measurement of the transducer to decide the position. "A-E" means the expectation and the actual distance difference. "A-F" is the straight-line distance between the target point and the fixed position, namely the position of the sinker reached the seabed.

These numerical values are not included the about 80 meters of the distance between the bridge with which GPS was equipped and the ship's stern where the acoustic transducer was lowered to decide the position

In conclusion, the MMP/BGC moorings were anchored to the designated location by considerable accuracy. Fig. 6.1-4 to 6.1-6 were shown that the direction from the position of **the sinker dropped** to the position of **the sinker reached the seabed** was almost the same course line as the ship was finally towing in all cases.

(4.5) Required depth

The depth of water of the position in which the MMP/BGC moorings were actually moored with demanded depth of water is shown below.

Site No.	Actual	Demanded	Difference
K1-MMP	5133.4 m	5133.4 m	Nil
	(5142 m)	(5142 m)	(Nil)
K1-BGC	5135.0	5135.0	Nil
	(5141)	(5141)	(Nil)
K2-MMP	5152.3	5152.3	Nil
	(5158)	(5158)	(Nil)
K2-BGC	5206.2	5206.2	Nil
	(5215)	(5215)	(Nil)
K3-MMP	5450	5450	Nil
	(5457)	(5457)	(Nil)
K3-BGC	5470	5470	Nil
	(5477)	(5480)	(+3 m)

( ) : The depth of water was measured by a SEA-BEAM 2000 with depth accuracy within 0.5%.

An original depth is the one sounded by the CTD and the altimeter in details. It is able to guess that it is within error margin though there is a difference of 6 - 10 meters between the original depth and the depth measured by SEA-BEAM. Because the depth was checked again with SEA-BEAM by passing over the designated mooring location, it is convinced that the sinker was to be set to the demanded depth.

(4.6) Distance for Deployment MMP/BGC mooring

Results are shown in the following table (Unit: miles).

Mooring No.	Expectation	Actual	Tow	A-E	T/A
02-K1 MMP	6.79	7.02	1.84	0.23	0.26
01-K1 MMP	7.25	7.32	2.74	0.07	0.37
02-K2 MMP	6.21	6.46	1.45	0.25	0.22
01-K2 MMP	7.01	6.76	1.94	-0.25	0.29
02-K3 MMP	6.18	6.21	1.94	0.03	0.31
02-K1 BGC	8.3	8.3	3.34	0	0.40
01-K1 BGC	8.27	8.27	1.73	0	0.21
02-K2 BGC	7.74	7.77	0.99	0.03	0.13
01-K2 BGC	8.82	8.3	3.01	-0.52	0.36
02-K3 BGC	7.07	6.95	2.08	-0.12	0.30

"Expectation" and "Actual" are the distance from the starting point to the position of the dropped sinker. The distance of "Expectation" was given from the marine technician of WHOI. "Tow" is the distance to the position of the dropped sinker from the point where tow begins. "A-E" is the difference between

“Expectation” and “Actual”. “T/A” is the ratio of the distance for towing to the actual distance.The reason of the difference of “A-E” is the distance that the ship was drifted while the preparation for setting the top buoy and various instruments etc. because the ship has stopped the engine for avoiding the discharging current from CPP.

In case of the 02-K2 BGC, the towed distance was shorter than another because of the same way stream.

In the stage that the releaser was set to the stern, the distance to the site in which the sinker would be dropped was as follows;

Mooring No.	Distance to the position of the dropped sinker
K1-MMP	0.64 miles (56 minutes)
K1-BGC	0.67 miles (46 minutes)
K2-MMP	0.66 miles (30 minutes)
K2-BGC	0.28 miles (12 minutes)
K3-MMP	0.31 miles (16 minutes)
K3-BGC	0.40 miles (18 minutes)

After this, the distance to the dropped point was one by one informed with the communication device from the bridge to a team of technician and deck personnel. And the bridge counted down from 10 meters before the dropped point.

After the sinker was dropped, the ship did a U-turn and pursued it so as to make sure that the top buoy disappears from surface.

(6) Data archive

All data will be archived on board.

(7) Remarks

The following three points are important so that the deployment of the MMP/BGC moorings may succeed.

- The mooring system with accurate length must be prepared
- Accurate depth and detailed bottom of the sea geographical features must be obtained
- The ship must be maneuvered to lead her to the pinpoint accurately

The third matter is an important job on the person who handles the ship. To facilitate the ship’s handling, the person should be familiar with the external force influence such as the wind, the current, etc. Therefore a lot of analysis data of the wind and the current were published in this time.

Meanwhile, to avoid damaging the mooring system with the various instruments attached in top-to-bottom order, the job of a team technician and deck personnel who work on the deck is important. In order to give a fixed tension to the mooring cable/ropes, it is necessary to avoid a great speed adjustment. It is also required to adjust the speed to which the cable/ropes are paid out over the stern from the winch.

An expected purpose was achieved as shown in the result. Hereafter, the role of R/V”MIRAI” can be developed by acquiring such a valuable experience in the deployment of the MMP/BGC moorings.

Table 6.1-1 SUMMARY OF WORKING TIME FOR DEPLOYMENT MMP MOORING DURING MR02-K05

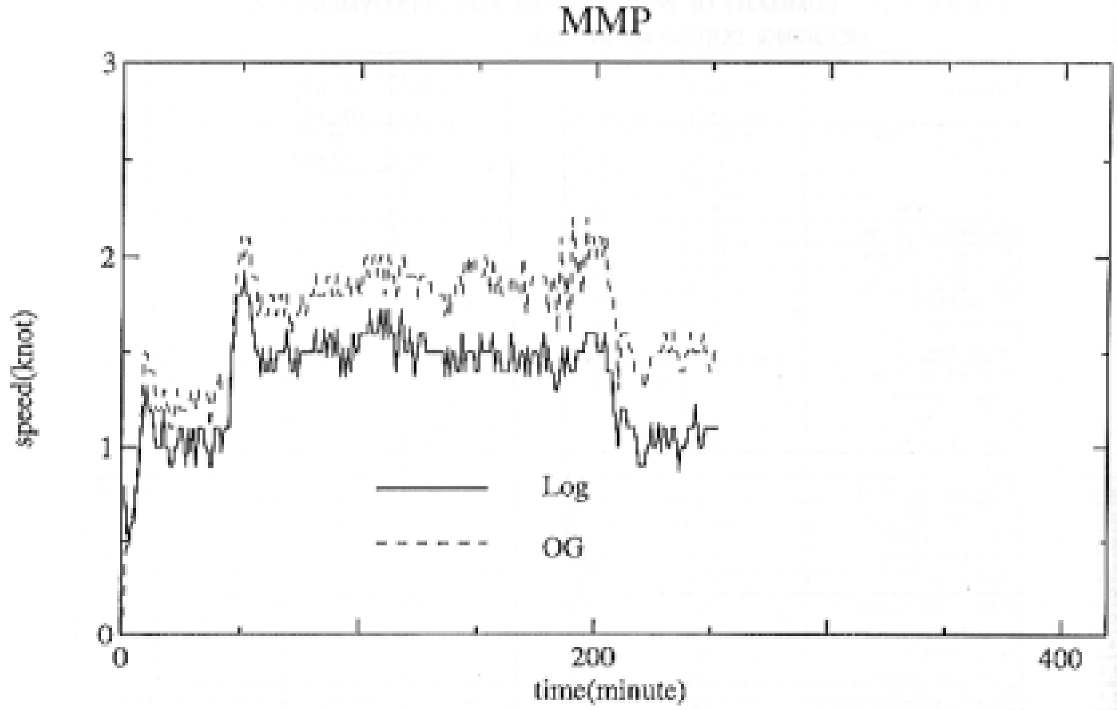
Mooring No.		K1	K2	K1	K2	K3	
Target point lat. Long.		51-17.91N 165-18.05E	47-52.24N 159-59.06E	51-17.91N 165-18.05E	47-52.24N 159-59.06E	39-10.955N 159-55.948E	
Works Date		5.Sep.01	9.Sep.01	19.Oct.02	24.Oct.02	1.Nov.02	
Depth (m)		5133.4	5152.3	5133.4	5152.3	5459.0	
Com'ced		8:00	8:13	8:59	13:24	6:30	
Buoy into sea		8:21	8:15	9:00	13:25	6:31	
Set MMP		8:44	8:44	9:41	13:54	7:37	
Set Bumper stop		11:09	11:04	11:32	16:15	9:36	
Set Glass balls		11:31	11:07	11:37	16:21	9:39	
Set Glass balls		12:01	11:35	12:03	16:42	10:15	
Set Releaser		13:34	12:31	12:45	17:23	11:13	
Let go sinker		13:40	12:43	13:11	17:53	11:29	Average
H	for top buoy	0:21	0:02	0:01	0:01	0:01	0:01
o	for wire rope	2:48	2:49	2:32	2:50	3:05	2:49
u	for glass balls	0:52	0:31	0:31	0:27	0:39	0:32
r	for towing	1:33	0:56	0:42	0:41	0:58	0:47
s	for S/B sinker	0:06	0:12	0:26	0:30	0:16	0:24
Total		5:40	4:30	4:12	4:29	4:59	4:33
Length of wirerope(m)		4500	4500	4500	4500	4500	4,500
Length of rope(m/h)		1,607	1,598	1,776	1,588	1,459	1,598
D	for buoy/rope (mile)	3.57	4.09	4.23	4.31	3.51	4.02
I	for glass balls (mile)	1.01	0.73	0.95	0.7	0.76	0.80
s	for towing (mile)	2.63	1.69	1.2	0.79	1.81	1.27
t	for sinker (mile)	0.11	0.25	0.64	0.66	0.13	0.48
Total (mile)		7.32	6.76	7.02	6.46	6.21	6.56
S	for buoy/rope (knot)	1.1	1.4	1.7	1.5	1.1	1.4
p	for glass balls (knot)	1.2	1.4	1.8	1.6	1.2	1.5
ee	for towing (knot)	1.7	1.8	1.7	1.2	1.9	1.6
d	for sinker (knot)	1.1	1.3	1.5	1.3	0.5	1.2
Average OG speed (knot)		1.3	1.5	1.7	1.4	1.2	1.4
Average Log speed (knot)		1.7	1.6	1.4	1.4	1.2	1.3

Table 6.1-2 SUMMARY OF WORKING TIME FOR DEPLOYMENT BGC MOORING DURING MR02-K05

Mooring No.		K1	K2	K1	K2	K3	
Location		51-19.95N 165-12.21E	47-00.35N 159-58.326E	51-19.960N 165-12.234E	47-00.350N 159-58.326E	39-1022N 160-01.09E	
Works	Date	6.Sep.01	9.Oct.01	20.Oct.02	25.Oct.02	1.Nov.02	
Depth (m)		5135	5206.2	5135	5206.2	5470	
		8:30	10:09	9:06	10:30	15:31	
Top buoy into sea		9:07	10:32	9:39	10:54	16:00	
Sediment(1) into sea		10:17	11:23	10:37	11:19	16:47	
Sediment(2) into sea		11:02	12:09	11:26	13:09	17:25	
Sediment(3) into sea		13:12	14:22	12:57	15:02	19:39	
Set Glass balls		13:43	14:48	13:22	15:31	20:10	
Set Releaser		14:35	16:20	14:42	15:59	21:06	
Let go sinker		14:53	16:40	15:28	16:11	21:24	Average
H	for top buoy/sensors	0:37	0:23	0:33	0:24	0:29	0:28
o	for sediments	4:36	4:16	3:43	4:37	4:10	4:10
u	for towing	0:52	1:32	1:20	0:28	0:56	0:54
r	for S/B sinker	0:18	0:20	0:46	0:12	0:18	0:25
Total		6:23	6:31	6:22	5:41	5:53	5:58
D	for top buoy (mile)	0	0	0.01	0.09	0.08	0.06
I	for sediments (mile)	6.54	5.29	5.01	6.69	4.79	5.50
s	for towing (mile)	1.29	2.56	2.72	0.71	1.68	1.70
t	for sinker (mile)	0.44	0.45	0.67	0.28	0.4	0.45
Total (mile)		8.27	8.30	8.41	7.77	6.95	7.71
S	for top buoy (knot)	0.0	0.0	0.0	0.2	0.2	0.1
p	for sediments (knot)	1.4	1.2	1.3	1.4	1.1	1.3
ee	for towing(knot)	1.5	1.7	2.0	1.5	1.8	1.9
d	for sinker (knot)	1.5	1.3	0.9	1.4	1.3	1.1
Average OG speed (knot)		1.3	1.3	1.3	1.4	1.2	1.3
Average LOG speed (knot)		1.4	1.7	1.3	1.3	1.2	1.3

Remak: About the mooring at K2, 7 units of the sediment trap are attached extra compared with others

Fig 6.1-1 Ship's Speed Stn k1 (Deployment)



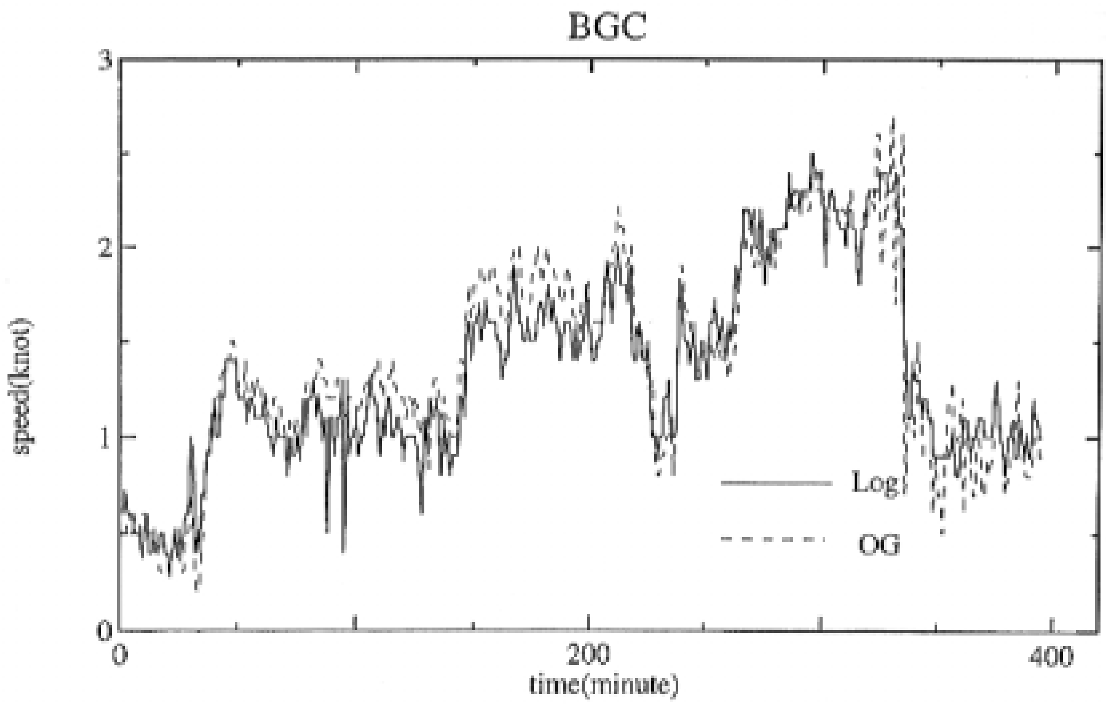
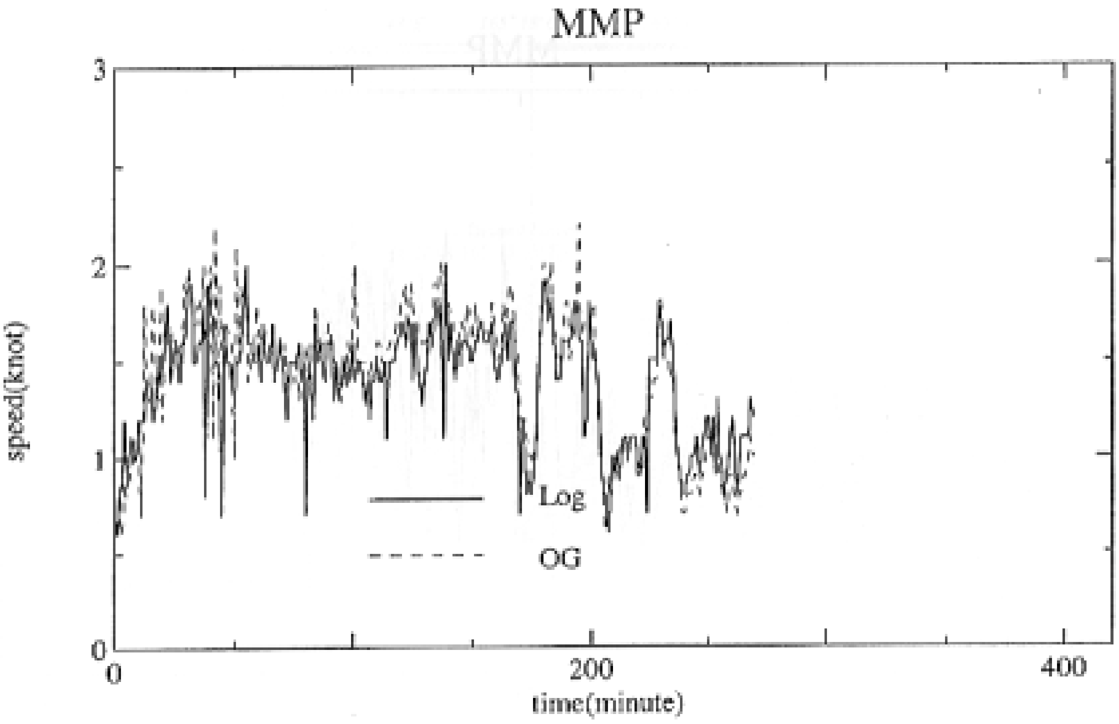


Fig 6.1-2 Ship’s Speed Stn k2 (Deployment)



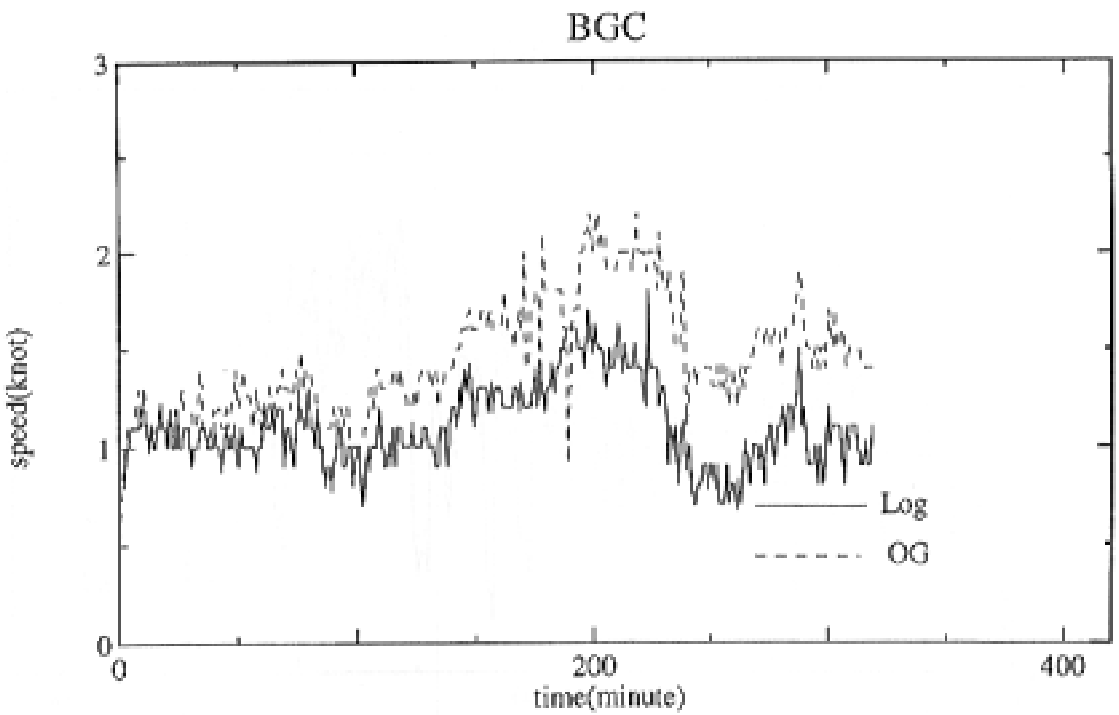
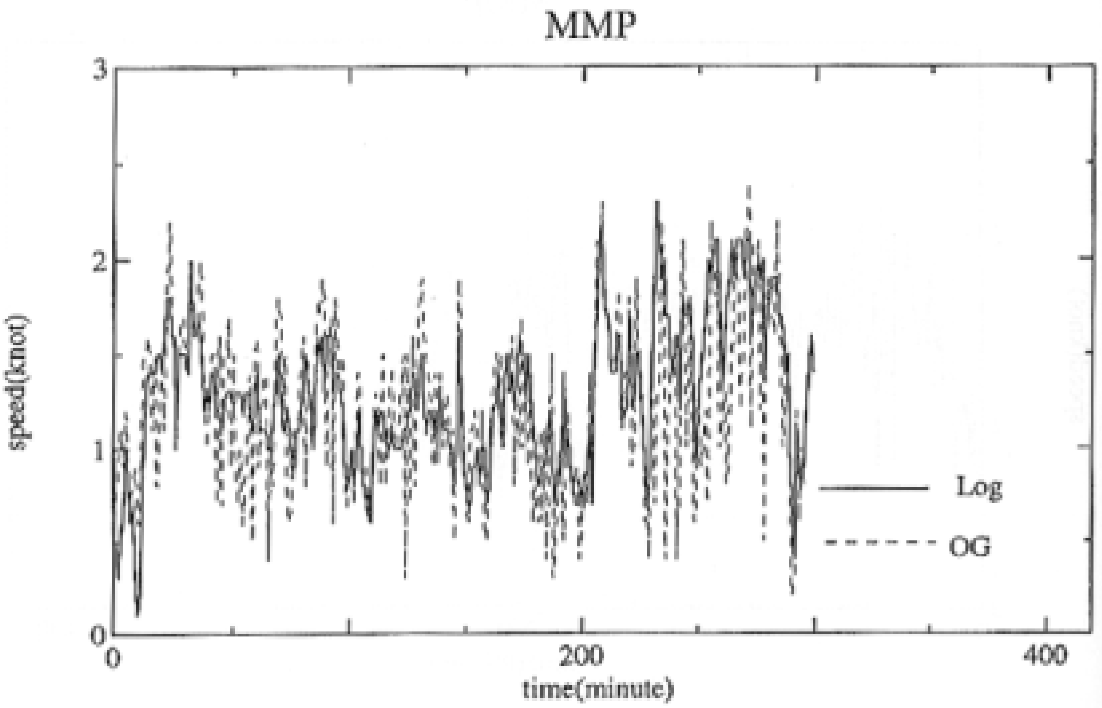


Fig 6.1-3 Ship’s Speed Stn k3 (Deployment)



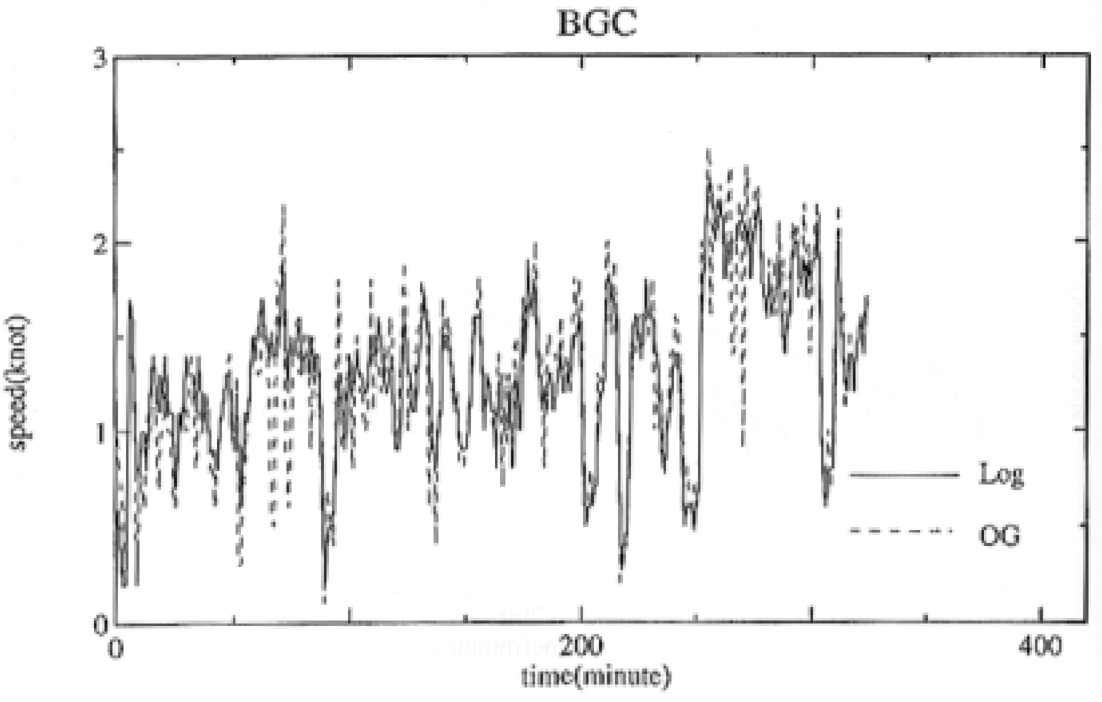
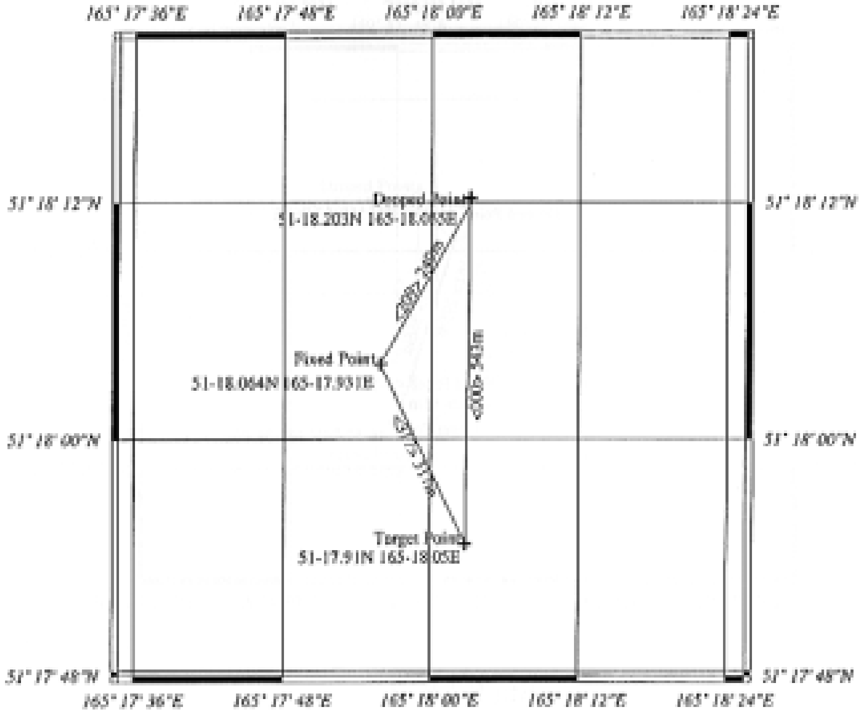


Fig 6.1-4 Mooring Point

Stn K1 MMP



Stn K1 BGC

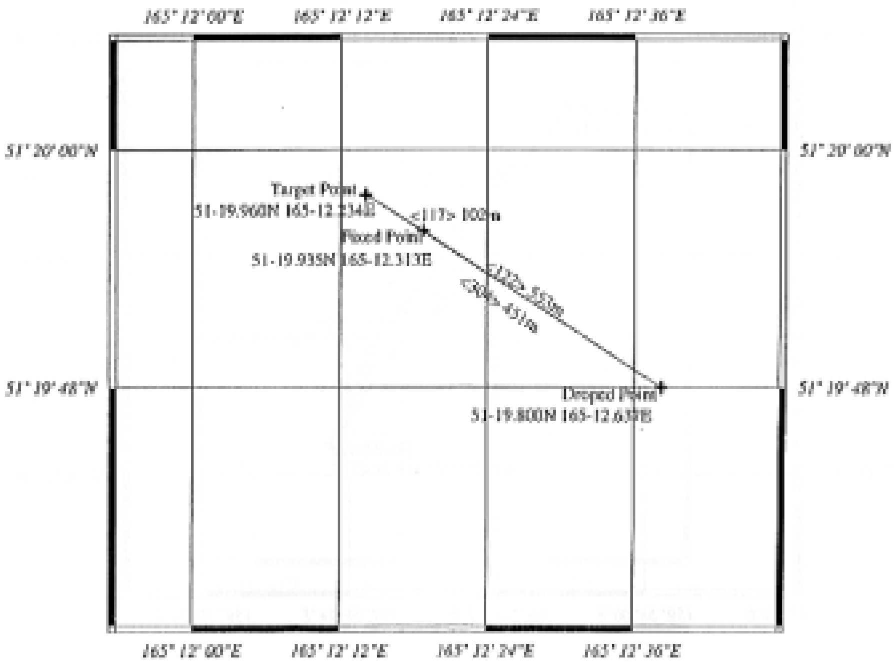
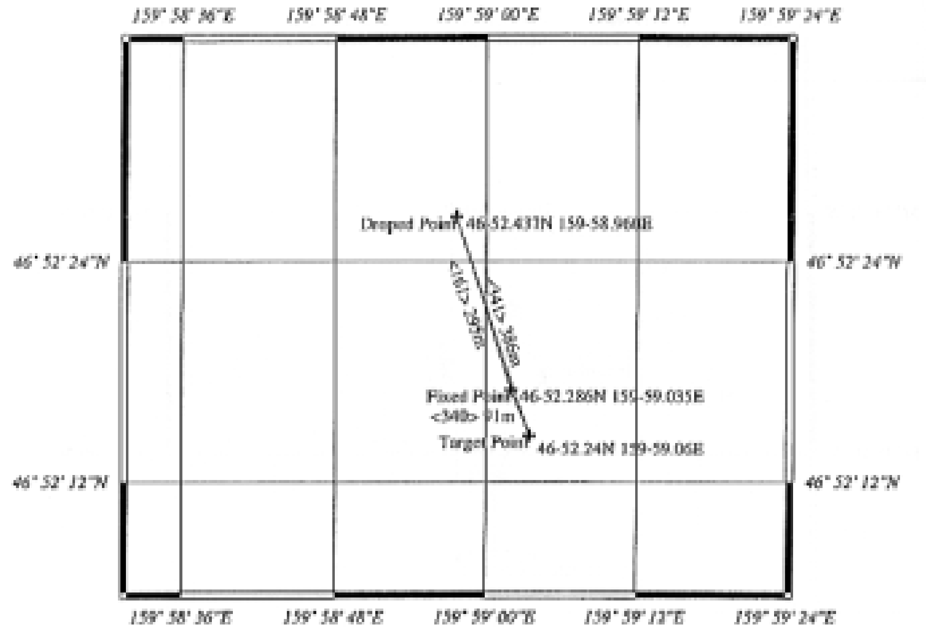


Fig 6.1-5 Mooring Point

Stn K2 MMP



Stn K2 BGC

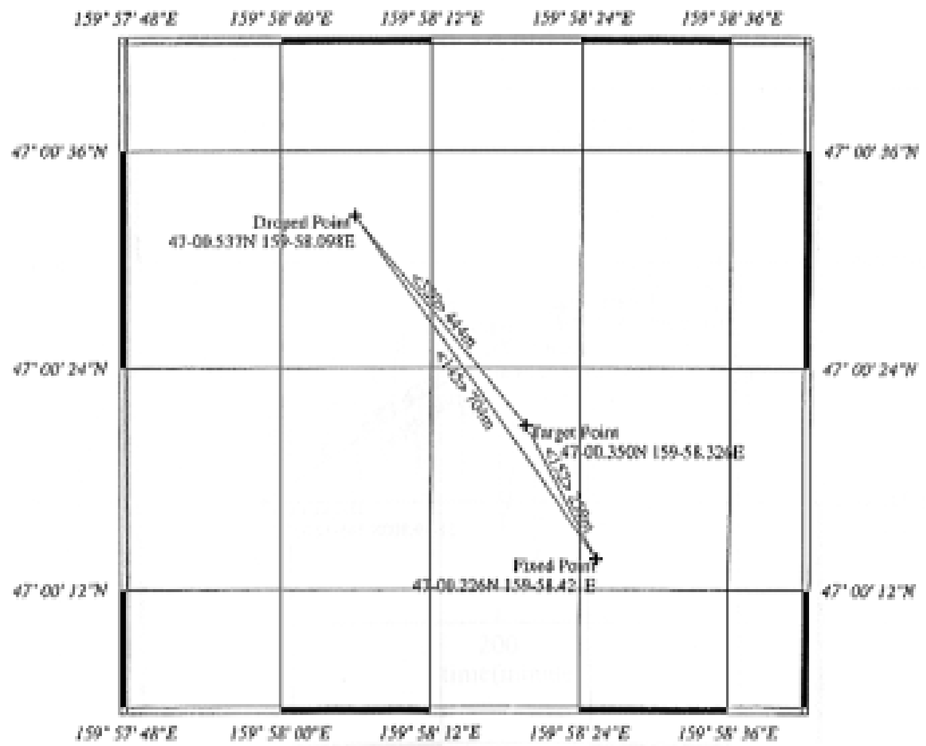
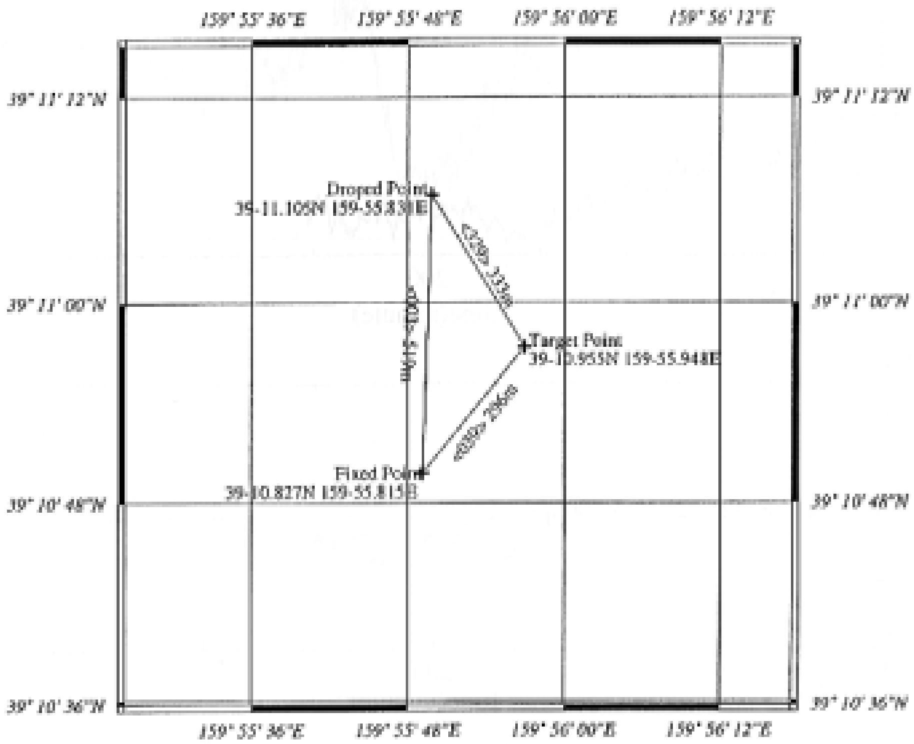


Fig 6.1-6 Mooring Point

K3-MMP



K3-BGC

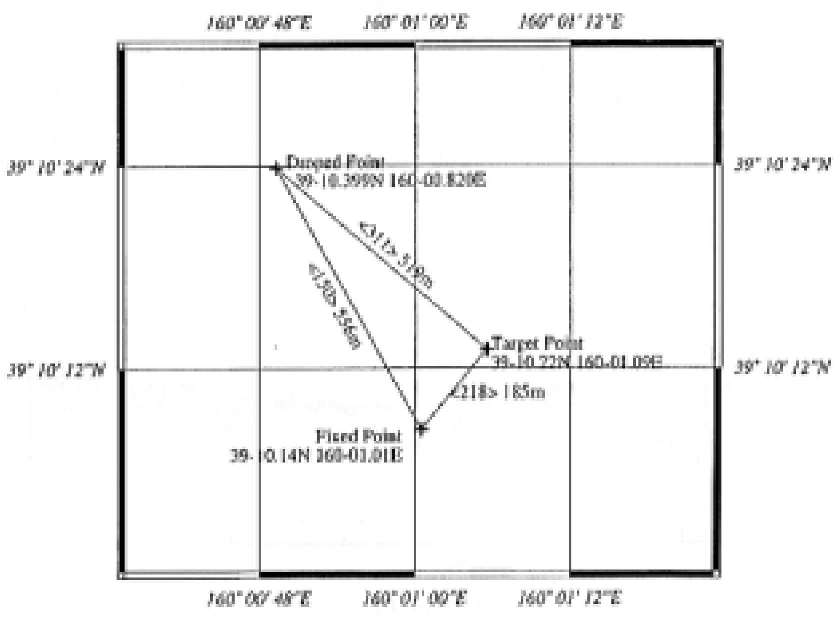


Fig 6.1-7 External force influence (relative wind) Stn k1 (Deployment)

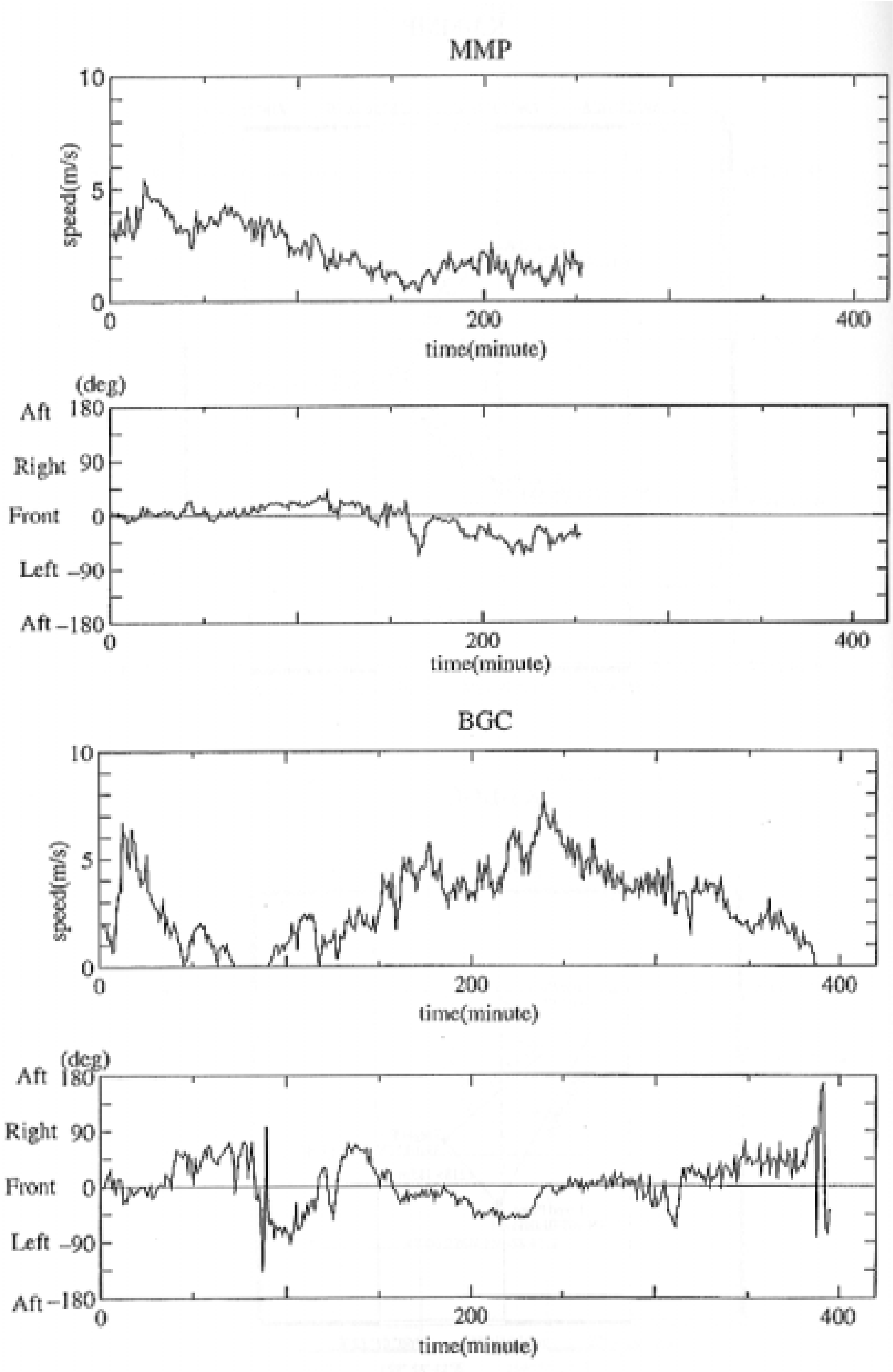


Fig 6.1-8 External force influence (relative wind) Stn k2 (Deployment)

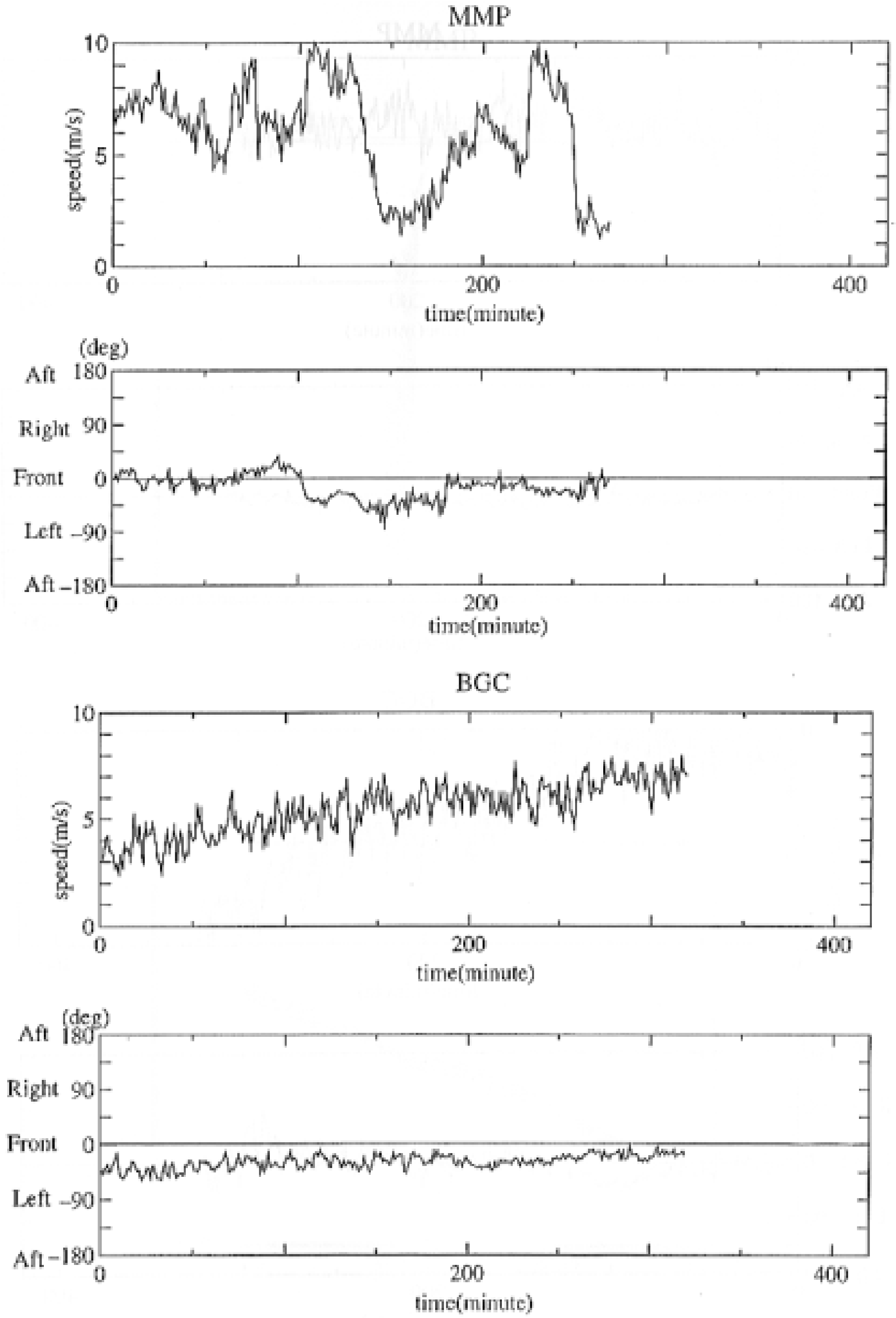


Fig 6.1-9 External force influence (relative wind) Stn k3 (Deployment)

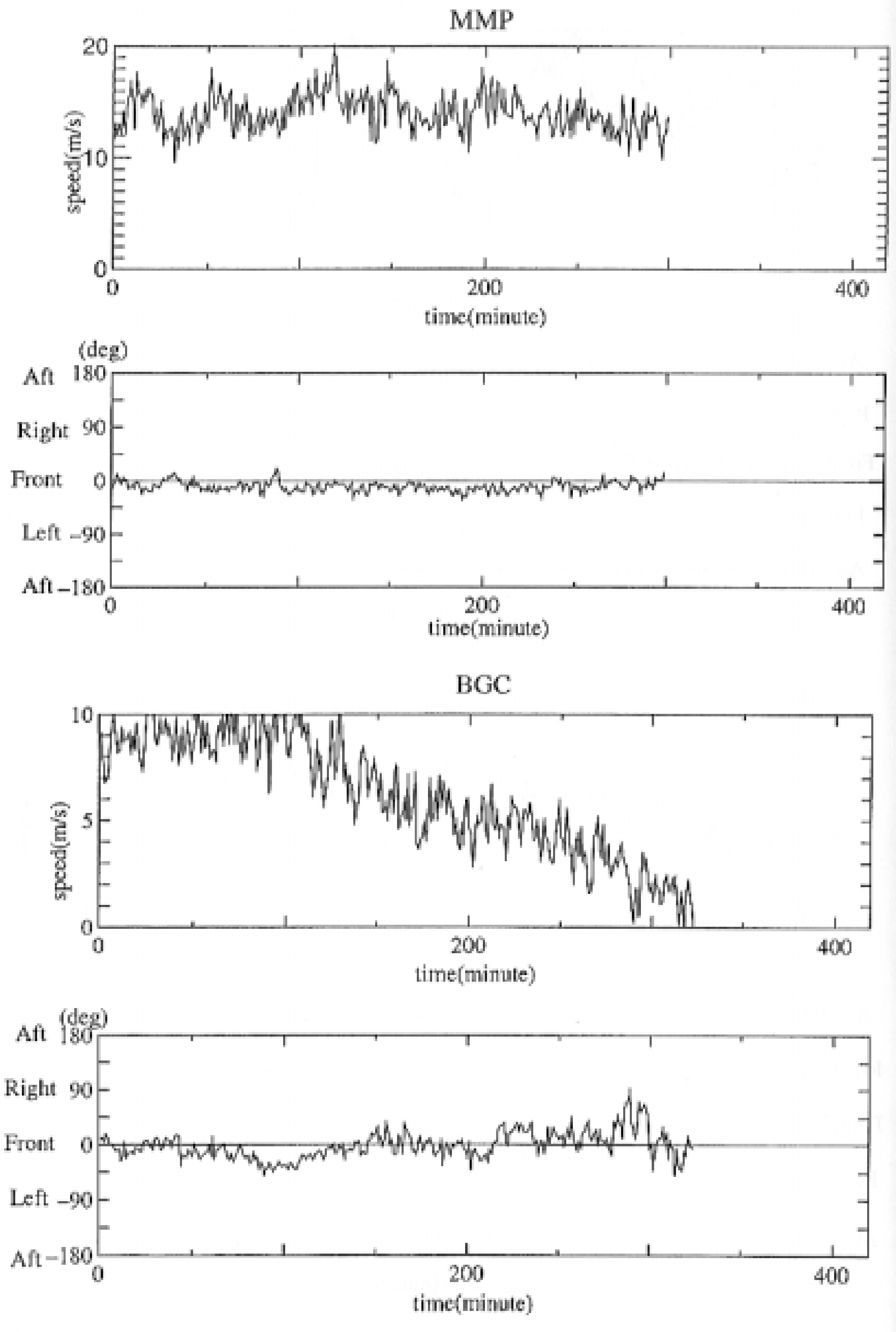
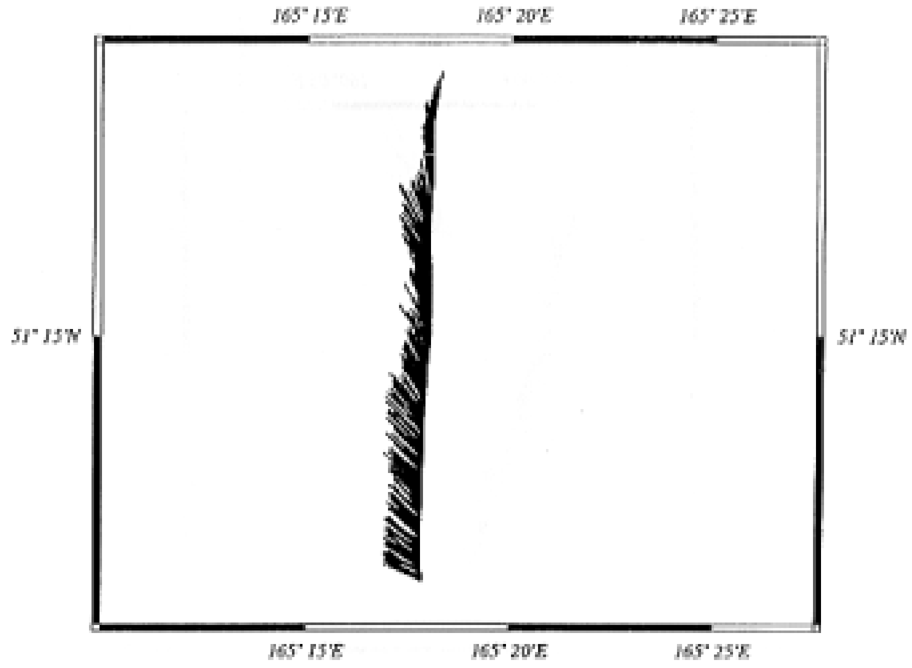


Fig 6.1-10 True current Stn k1 (Deployment)

MMP



BGC

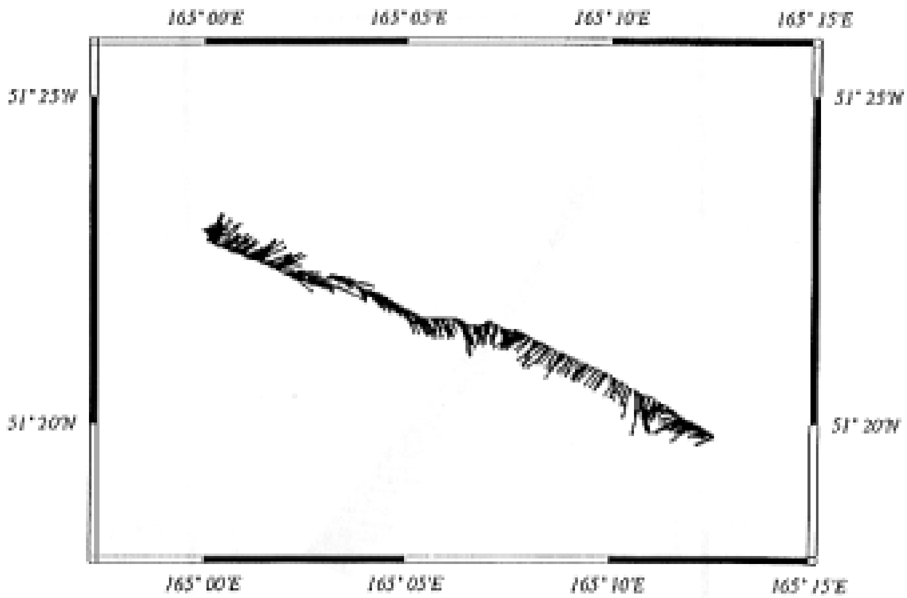
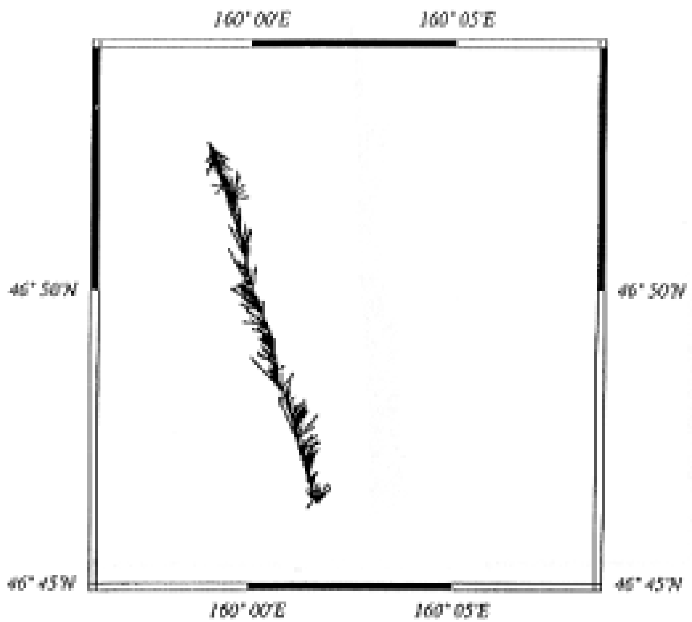


Fig 6.1-11 True current Stn k2 (Deployment)

MMP



BGC

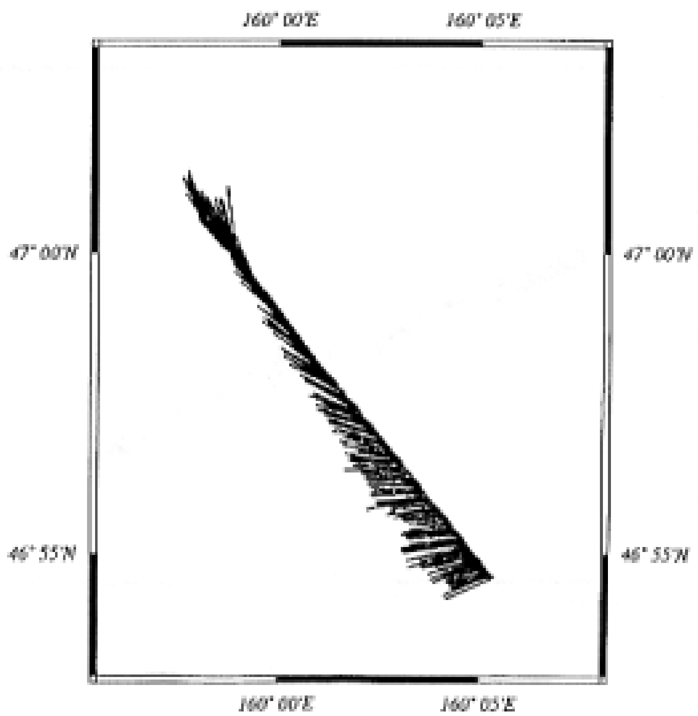


Fig 6.1-12 True current Stn k3 (Deployment)

MMP

BGC

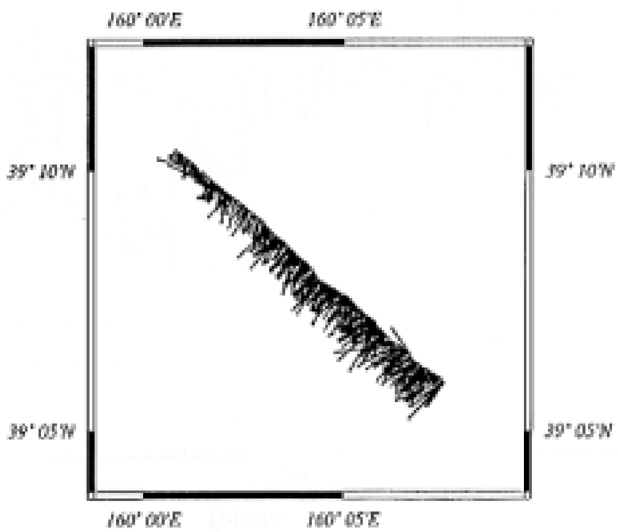
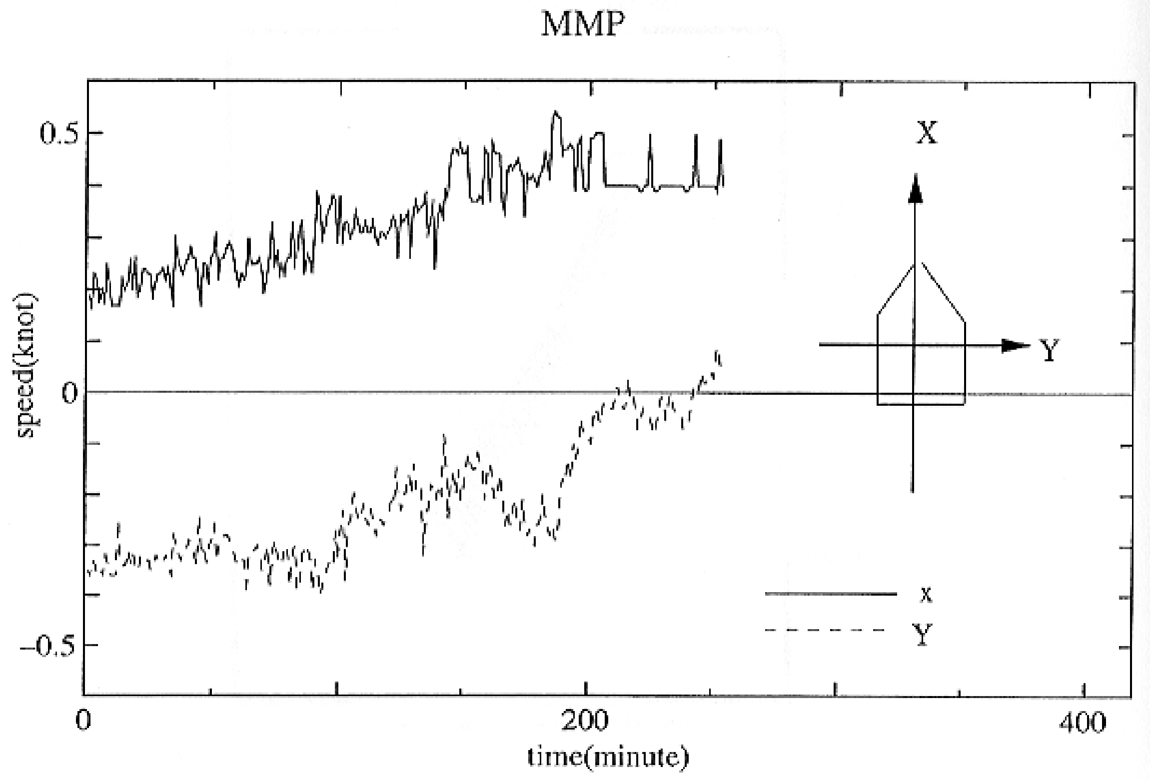


Fig 6.1-13 External force influence (current component) Stn k1 (Deployment)



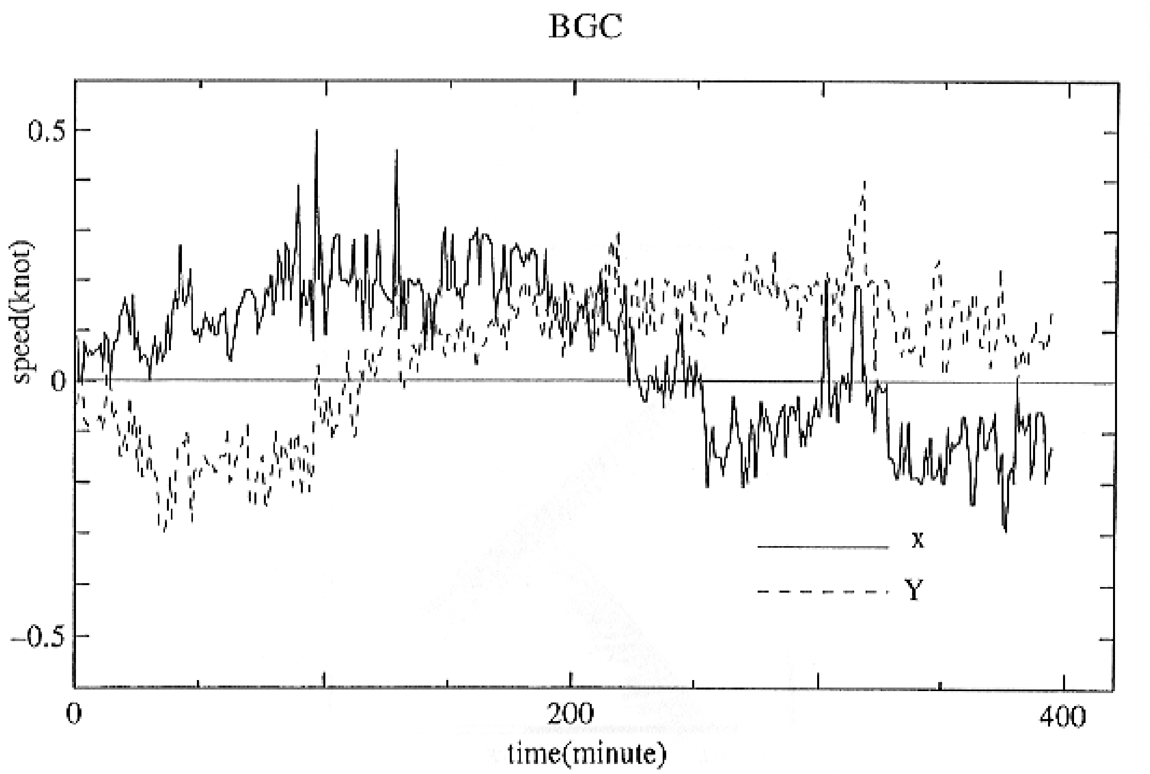
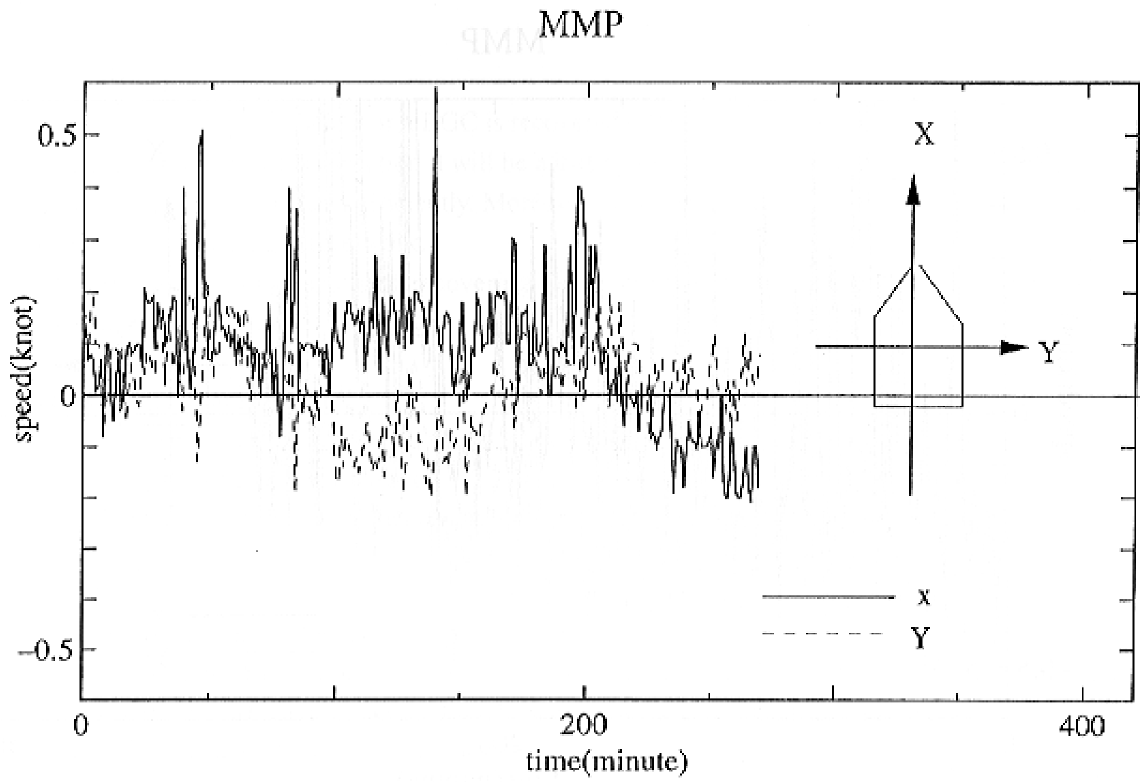


Fig 6.1-14 External force influence (current component) Stn k2 (Deployment)



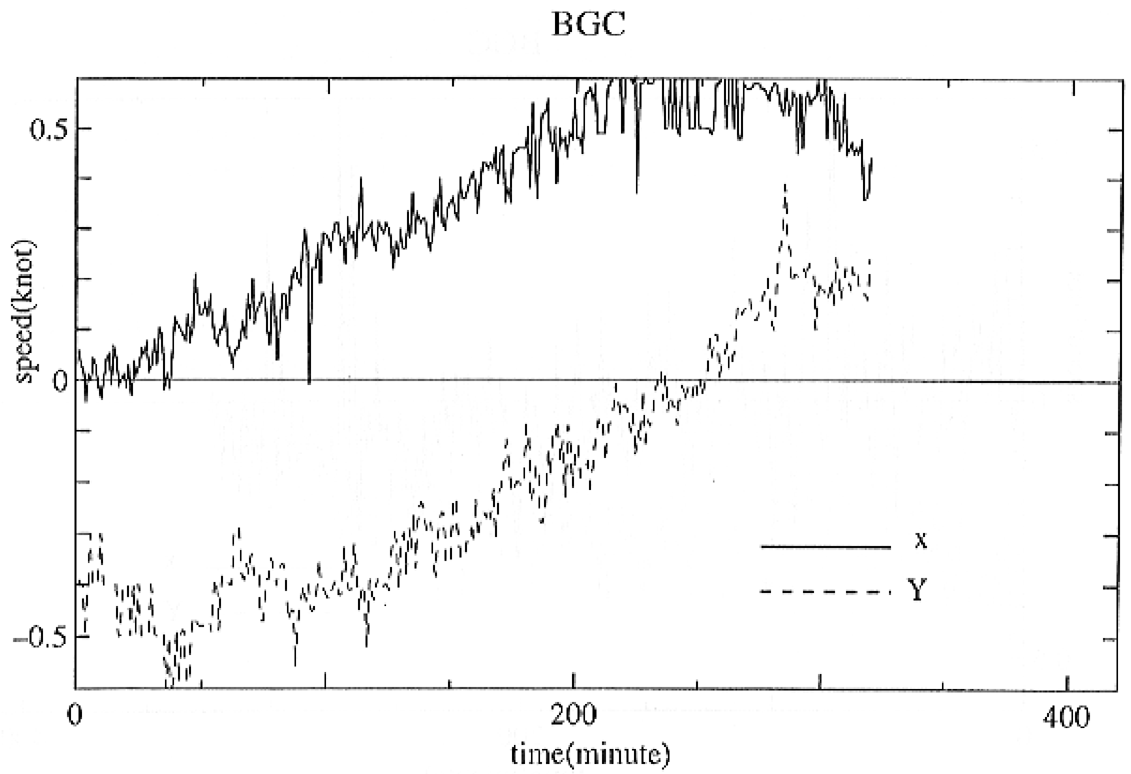
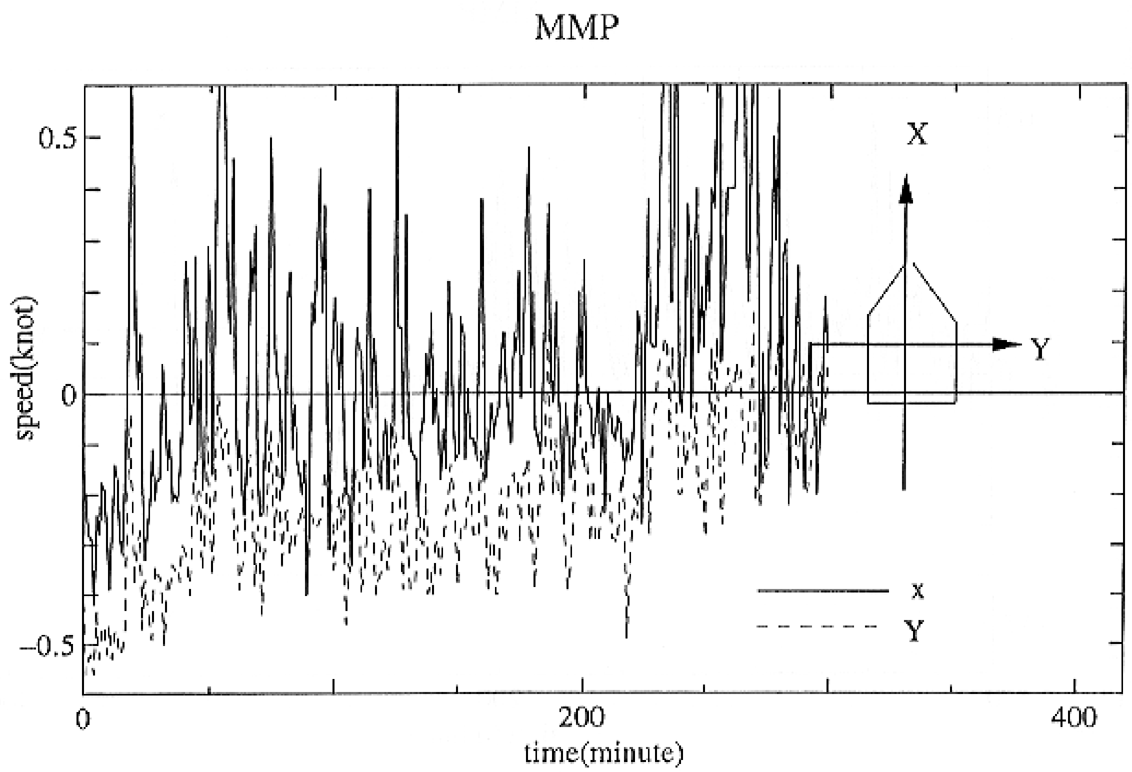
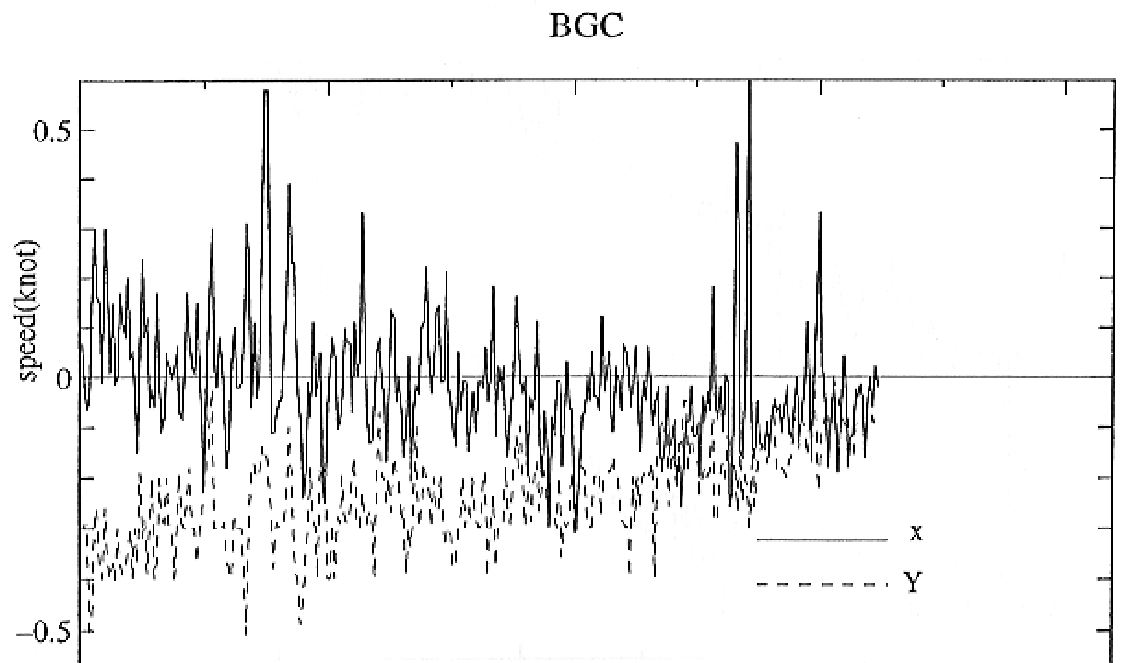


Fig 6.1-15 External force influence (current component) Stn k3 (Deployment)





6.2 Recovery

(1) Objectives

When a mooring of a MMP or a BGC is recovered, after separating it from the seabed, it is important to know in what direction it will be adrift by the wind, the current, and the swell, etc. in order to catch it safely, and efficiently. Moreover, it is greatly helpful to grasp actual working hours when performing future work.

It aims at recording results of recovering the mooring systems such as the MMP/BGC from the standpoint of the ship's handling.

(2) Observation parameters

- Movements of the MMP and the BGC moorings released from the seabed
- Ship's position, course, speed
- Directions of the wind/the current/the swell, velocities of the wind/the current

(3) Methods

(3.1) Measurement of the actual ship-movement

Measurement of the ship-movement at coming close to the top buoy and the glass balls is carried out in a radio navigation device assembled by Sena Co., Ltd. Japan.

(3.2) Measurement of the wind and the current

The wind direction and speed are measured by KOAC-7800 weather data processor and sensors assembled by Koshin Denki.

The current direction and speed are continuously measured by a Doppler sonar installed at the bottom of the ship. The Doppler sonar is assembled by FURUNO Electric Co., Ltd.

(3.3) Measurement of the releaser-movement in the sea

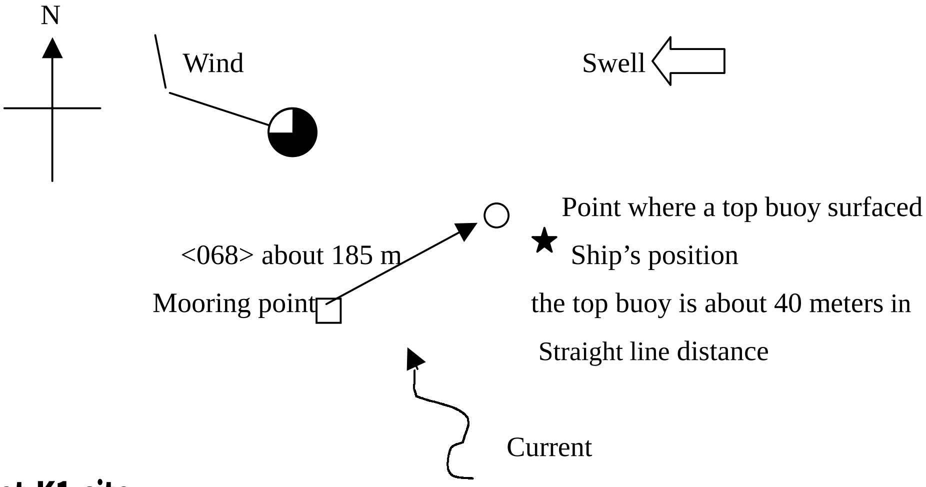
The releaser is operated with an acoustic transducer which is made by Edgeteh Inc. USA.

(4) Results

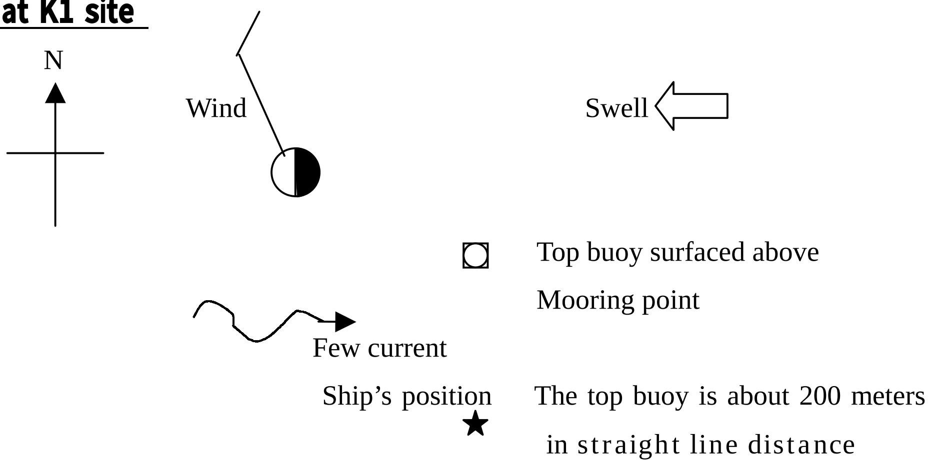
(4.1) Surfacing of the moorings

The results are shown in following figures and these are characterized as follows.

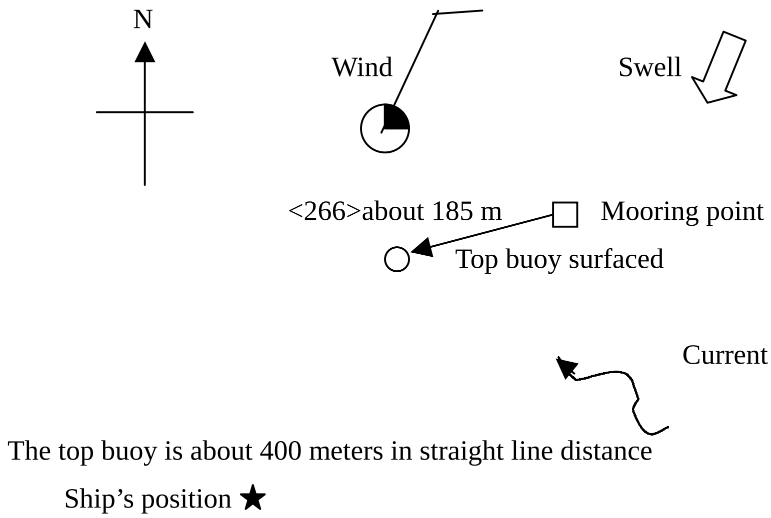
In case of MMP at K1 site



In case of BGC at K1 site



In case of BGC at K2 site



(a) The top buoy of the MMP/BGC moorings were released from the seabed by using the acoustic transducer on 11 and 12 kHz at the mooring deck of the ship’s stern.

(b) On the assumption that the mooring point was correct, a top buoy of each mooring has surfaced in the direction of the vector of the wind and the current. In case of K1 BGC, The top buoy has surfaced right above the mooring point because there was hardly a flow. The top buoy received the influence of the wind after it surfaced, and drifted.

(4.2) How to approach the top buoy/the glass balls

The results are illustrated in Fig.6.2-1 ~ Fig.6.2-3 and the following matters are pointed out.

(a) The ship was located downwind or downstream on a distance of 200 - 400 meters from the mooring point of the MMP/BGC moorings.

The “Enable” signal was sent from the stern of the ship by the transducer and the signal reception was confirmed. It is demanded to drift right above the mooed point when the signal reception is difficult. After the reception is confirmed, it is necessary to go away from the moored point by 400,500 meters because the point where the top buoy surfaces might shift by about 200 meters.

(b) When the ship approached buoys etc, the angle between the ship’s course and the wind direction was made as small as possible in order to lessen the external force influence of the wind. In addition the ship’s course was decided that she was located in the lee of buoys/glass balls.

(c) To prevent the ropes etc. from twining round the ship’s propeller, the clutch of the propeller in the recovery-side was discharged until the handling rope was connected to buoy etc. from the time that the ship approached buoys etc.

(d) In case of the MMP mooring, the work to catch the top buoy was carried out with the working boat after all of the system had surfaced. When the working boat was lowered, and the working boat was drawn up, the ship made the lee to make calm water, an ample berth for it.

(e) In case of the BGC mooring, the ship was handled to approach the top buoy most and the top buoy was caught from the upper deck of the ship by a hook and a long pole because the working boat was not able to use due to rough sea. Because delicate measuring instruments were installed under the top buoy, it was prohibited to push the buoy strongly, and to hit it the discharging current from CPP and propeller of the side-thruster.

It is prohibited to throw the grapnel and catch the top buoy since the various instruments installed under the top buoy might be damaged. Therefore the hook installed the end of the long pole, a long rope connected with the hook were used in this time.

(f) While recovering mooring ropes/cables, the ship was steered by side thrusters so that they might be led right astern. It is easy to carry out the work if the ship proceeds to upwind.

(g) Since the BGC mooring in which a lot of observation equipment and sediment traps are installed, it cannot be strongly towed. The ship’s speed was kept about 1 knot or less. When these observation equipments were slung up the ship, Care was needed in handling them not to upset the observation equipment. The result of the ship’s Log speed is shown in Fig.6.2-4.

(4.2) Working hours for recovering the MMP/BGC moorings

The result is shown in Table 6.2-1 and the following matters are pointed out.

(a) The time consumed in recovery of the MMP mooring was 2 hours and 56 minutes. It is less than that of the BGC mooring for the following reasons.

① Number of the installed observation equipment is only the MMP in the mooring.

② The ship’s speed during recovering the MMP mooring was able to increase.

③ Since the working boat had been used to catch the top buoy, it was not necessary to wait until all of the mooring surfaced.

(b) About the working hours of the recovery BGC mooring, At K1 site it was 5:10, at K2 site it was 4:25. There is a difference at time to catch the top buoy if K1 site and K2 site are compared. The reason is to have gone twice because of having failed in catching the top buoy in K1 site as the surfaced glass balls obstructed the ship’s course.

(c) Except (a) and (b), there was no big difference in the time consumed to each work among 3 moorings.

(5) Data archive

All data will be archived on board.

(6) Remarks

It was the first time that R/V ”MIRAI” did real recovery work for the MMP/BGC moorings with a delicate, complex structure.

It is remarkable to have caught the top buoy from the upper deck of the ship with high freeboard by the hook/the long pole.

This work was completed without trouble. This great achievement by “MIRAI” might become a milestone in the observation history and these actual results will become effective at future work.

Table 6.2-1 RECOVERY OF MMP/BGC MOORINGS DURING MR02-K05

Mooring No.	K1-MMP
Location	51.3N, 165.3E
Date	18.Oct.02
Water depth	5133.2
Com'ced work	6:30
Released from sinker	6:32
Glass balls surfaced	6:33
Sent working boat	6:36
Sling rope connected with buoy	6:45
Picked up working boat	6:50
Winded up top buoy	7:11
Recovery of MMP	8:54
Recovery of balls/releaser	9:24
Finished work	9:26
Total working hours	2:56

Time consumed

in preparation for recovery	0:02
in rising of top buoy	0:01
in working of boat	0:17
in recovery of top buoy	0:21
in recovery of MMP	1:43
in recovery of balls/releaser	0:32
Total working hours	2:56

Maneuvering data

MOORING NUMBER	K1-MMP
Course when approaching (deg)	40
Course when catching b'y (deg)	25
Wind direction (deg)	290
Wind velocity (m/s)	7
Current direction (deg)	350
Current velocity (knot)	0.5
Swell direction	EAST
Wave height (m)	2.1

Mooring No.	K1-BGC	K2-BGC
Location	51.3N, 165.2E	47N, 160E
Date	17.Oct.02	22.Oct.02
Water depth (m)	5135	5206.2
Com'ced work	7:35	6:45
Released from sinker	7:39	6:46
Top buoy surfaced	7:40	6:47
Glass balls surfaced	8:27	7:37
Catched top buoy by hook & pole	9:10	7:51
Winded up top buoy	9:35	8:04
Recovery of equipments	10:17	8:21
Recovery of sediment1	10:47	8:56
Recovery of sediment2	11:28	9:33
Recovery of sediment3	12:28	10:55
Recovery of balls/releaser	12:42	11:09
Finished work	12:45	11:10
Total working hours	5:10	4:25

Time consumed

in preparation for recovery	0:04	0:01
in rising of glass balls	0:48	0:51
in catch of top buoy	1:08	0:27
in recovery of top buoy	1:12	0:52
in recovery of sediment	1:41	1:59
in recovery of balls/releaser	0:17	0:15
Total working hours	5:10	4:25

Maneuvering data

MOORING NUMBER	K1-BGC	K2-BGC
Course when approaching (deg)	350	40
Course when catching b'y (deg)	280	20
Wind direction (deg)	350	20
Wind velocity (m/s)	6	5
Current direction (deg)	90	320
Current velocity (knot)	0.2	0.5
Swell direction	EAST	NNE
Wave height (m)	3	3.1

Fig.6.2-1 FIGURE OF RECOVERY MMP

Location: 51-17.91N, 165-18.05E

Date: 18th October 2002

Wind: <290> 7 m/s, Current: <350> 0.5 knot

Swell: East, Wave height: 2.1 m, Weather: c

Depth:5133.2 m

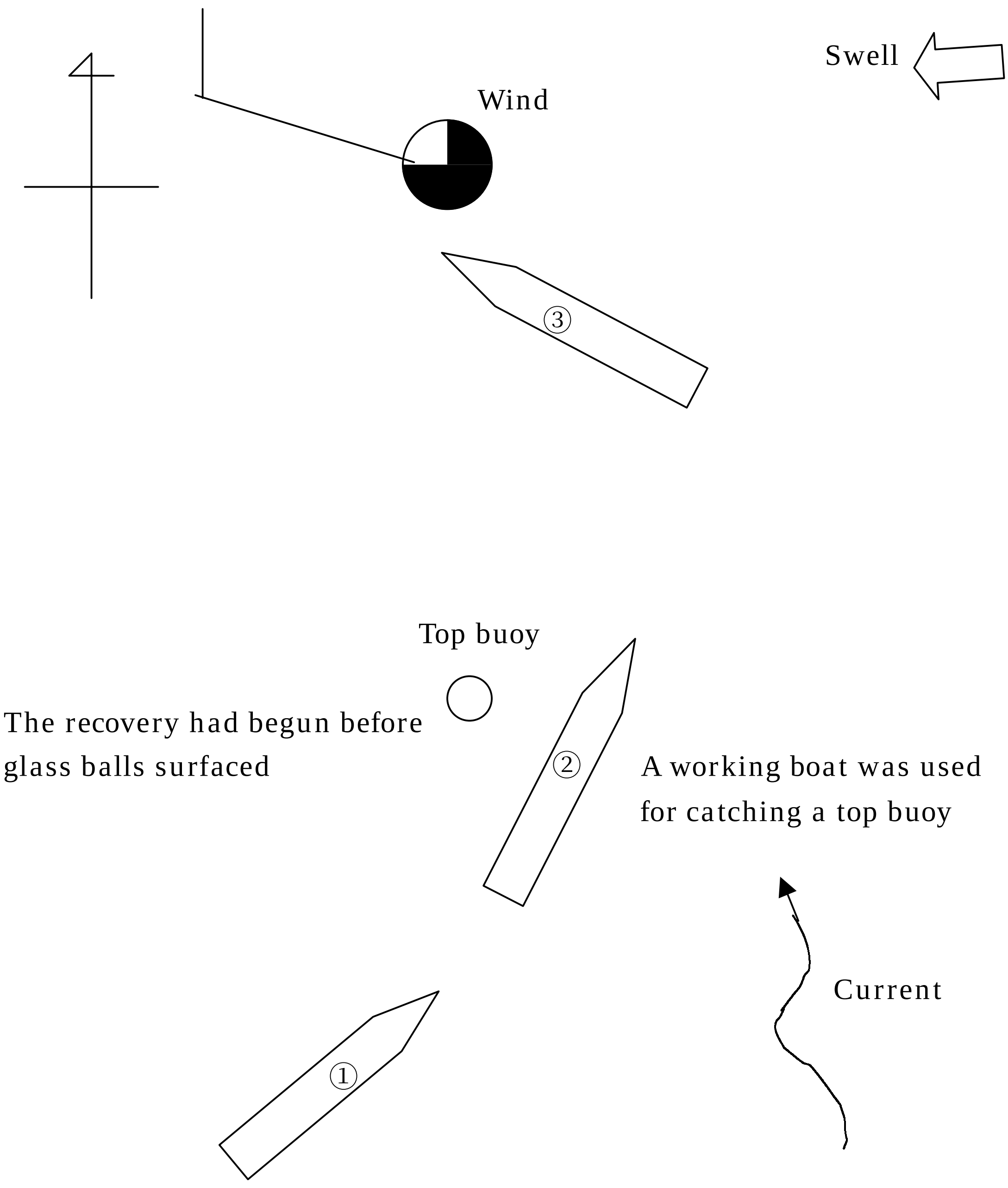


Fig.6.2-2 FIGURE OF RECOVERY BGC

Location: 51-19.935N, 165-12.278E

Date: 17th October 2002

Wind: <350> 6 m/s, Current: <090> 0.2 knot

Swell: East, Wave height: 3.0 m, Weather: c

Depth:5135 m

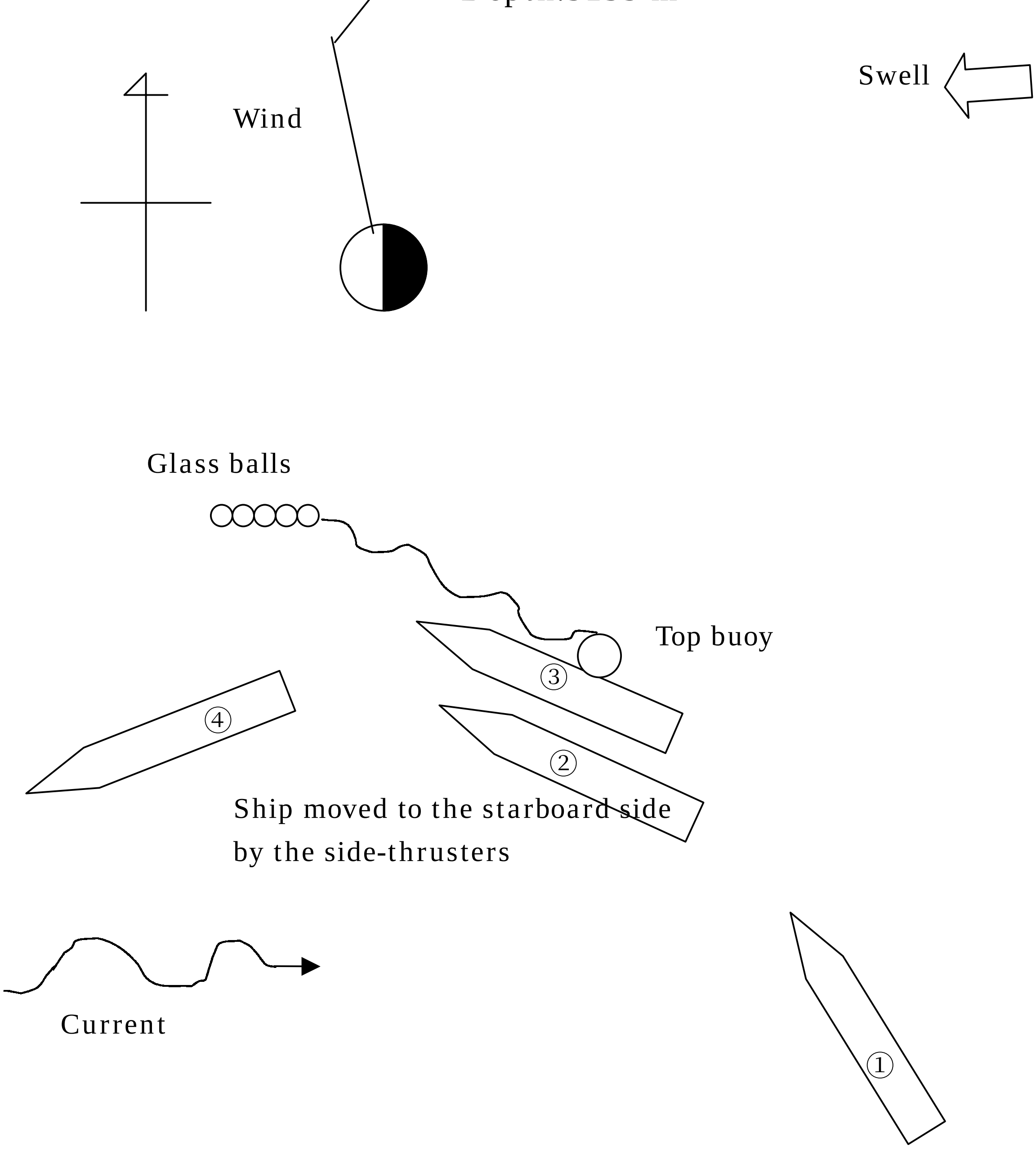


Fig.6.2-3 FIGURE OF RECOVERY BGC

Location: 47-00.324N, 159-58.246E

Date: 22nd October 2002
Wind: <020> 5 m/s, Current: <320> 0.5 knot
Swell: NNE, Wave height: 3.1 m, Weather: c
Depth:5206.2 m

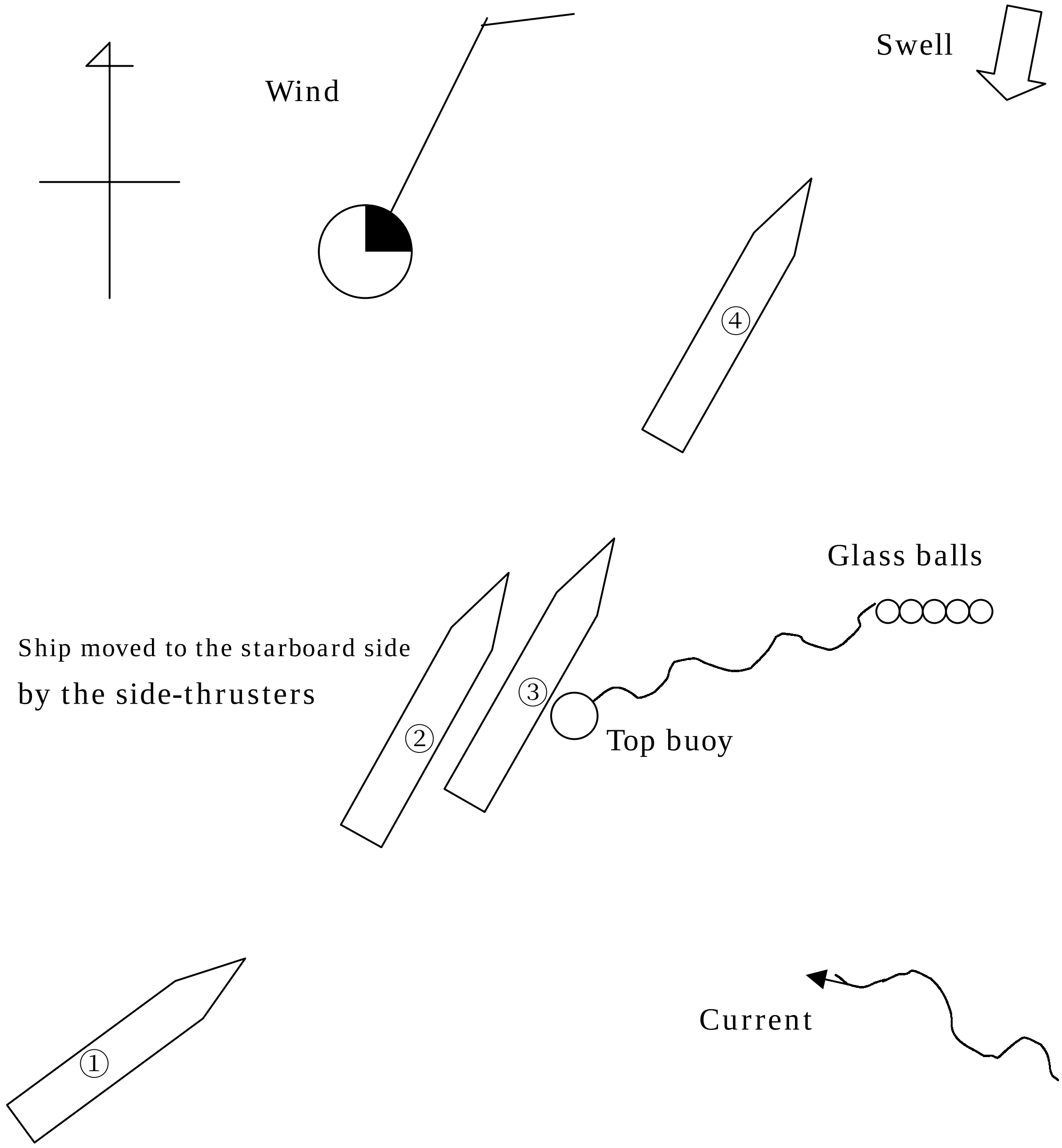


Fig 6.2-4 Ship's Speed (Recovery)