National Oceanography Centre, Southampton

Cruise Report No. 52

RRS *Discovery* Cruise 296

14-23 JUL 2005
Cork, Eire to Lisbon, Portugal

PAP observatory development

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2010

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ABSTRACT

Discovery cruise 296 was one of a sequence of cruises to the repeat study site on the Porcupine Abyssal Plain, the so called "PAP observatory" at 49˚N, 16.5˚W. This study site has a water depth of 4800m and has been studied since 1989 from the perspective of the upper water column biogeochemistry, the downward flux of particulate matter and the ecology and biogeochemistry of the underlying seabed. The site is 300km to the northeast of the location of the JGOFS NABE site that was the focus of an international experiment in 1989. Since 2003 it has formed part of the ANIMATE network of observatories in the Northeast Atlantic.

This cruise followed immediately from D295T during which similar work was carried out. This report therefore covers the activity which was common to both cruises as well as that which was only carried out on D296 (Benthic studies).

KEYWORDS

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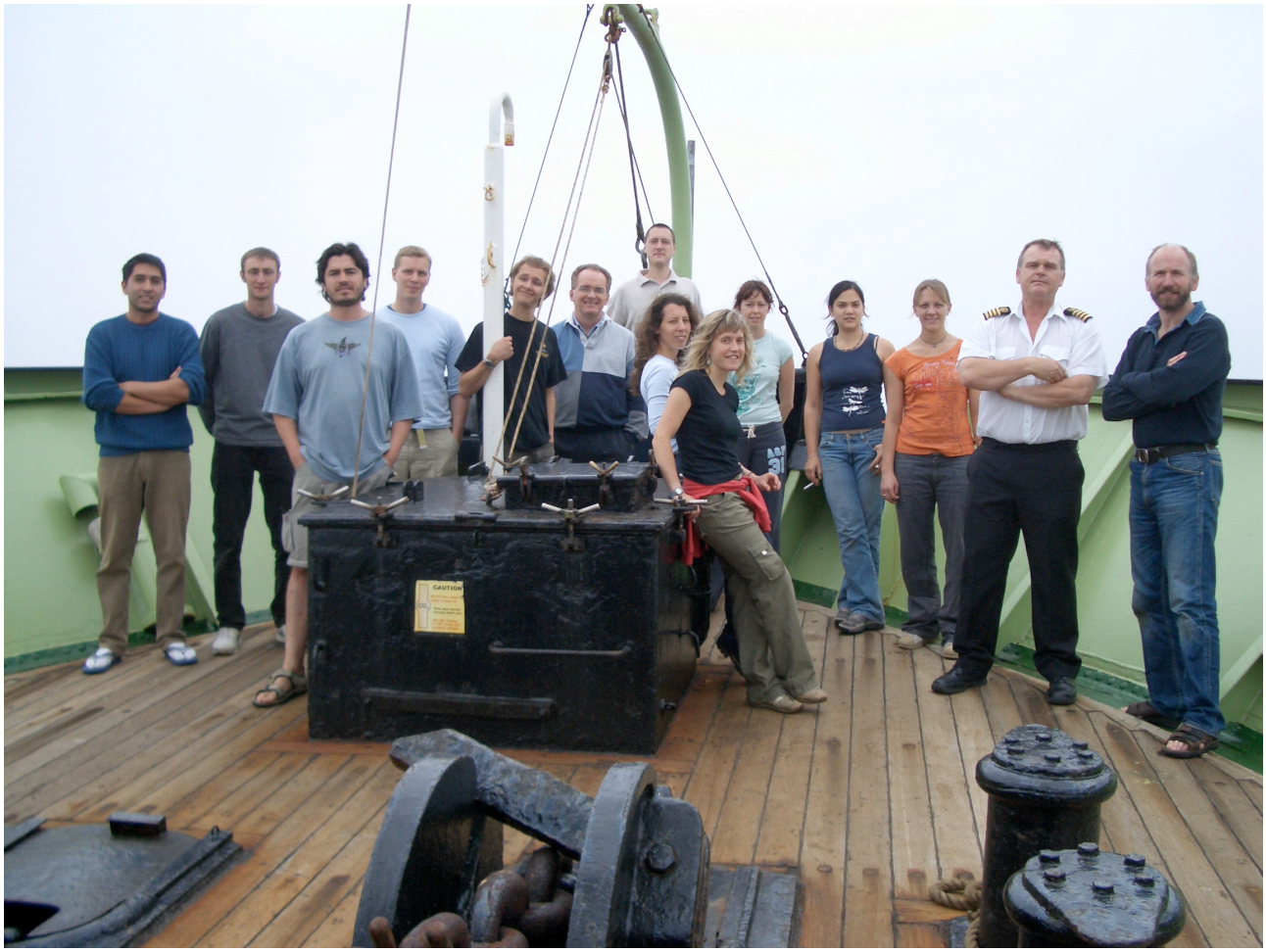
CAUTION

Scientific and Technical Personnel

1	Richard Lampitt	NOC
2	David Billet	NOC
3	Ben Boorman	NOC
4	James Cooper	NOC
5	Xana da Silva	NOC
6	Simon Dodd	NOC
7	Ross Holland	NOC
8	Janne Kaariainen	NOC
9	Blanca Puig Mauriz	NOC
10	Jason Scott	NOC
11	Sophie Seeyave	NOC
12	Tania Smith	NOC
13	Eulogio Soto	NOC
14	Mark Stinchcombe	NOC
15	Kim Tanneberger	NOC
16	Sandy Thomalla	NOC
17	Geraint West	NOC
18	Martin Bridger	NOC
19	James Cooper	NOC
20	Christian Crowe	NOC
21	Colin Day	NOC
22	Simon Dodd	NOC
23	David Edge	NOC
24	Mateen Furling	NOC
25	Duncan Matthews	NOC
26	Rob McLachlan	NOC
27	Steve McPhail	NOC
28	Nick Millard	NOC
29	Miles Pebody	NOC
30	James Perrett	NOC
31	Ian Rouse	NOC
32	Nicholas Rundle	NOC
33	Pete Stevenson	NOC
34	David Turner	NOC
35	Andy Webb	NOC
36	David Webb	NOC

Ships Personnel

1	R Chamberlain	Master
2	R. Warner	Chief Officer
3	T. Owoso	2
4	J.Holmes	3rd Officer
5	B.McDonald	Ch/Eng
6	J.Clarke	2nd Eng
7	J.Harnett	3rd Eng
8	C.Uttley	3rdEng
9	D.Jacob	E.T.O
10	A.Maclean	CPO(D)
11	S.Smith	CPO(S)
12	M.Trevaskis	ExtCPOD
13	S.Day	POD
14	I..Cantlie	SG 1A
15	R.Spencer	SG 1A
16	J.Roberts	SG1A
17	D.Anderson	SG1A
18	J.Smyth	MM1A
19	E.Staite	S.C.M
20	S.Nagle	Chef
21	J.Giddings	Ass Chef
22	L.Sutton	Steward

Itinerary

Sailed Cork 1000h GMT 14th July 2005

Arrived work area evening of 15th July

Departed work area 2330h 19th July

Arrive Lisbon 0900h 23rd July

Objectives

1: To recover the ANIMATE moorings deployed on CD158 in June 2004

2: To deploy similar moorings but with the addition of a McLane moored profiler:

a) PAP#1. Biogeochemical mooring

b) PAP#2. Physical mooring

c) PAP#3. Deep sediment trap.

d) PAP#4. McLane Moored profiler

e) Bathysnap

3: To trial the new in situ flow cytometer.

4: To measure directly export flux using the new drifting sediment trap *PELAGRA*

5: To estimate export flux from budgets of the particle reactive element, ^{234}Thorium

Introduction

Discovery cruise 296 was one of a sequence of cruises to the repeat study site on the Porcupine Abyssal Plain, the so called "PAP observatory" at 49˚N, 16.5˚W. This study site has a water depth of 4800m and has been studied since 1989 from the perspective of the upper water column biogeochemistry, the downward flux of particulate matter and the ecology and biogeochemistry of the underlying seabed. The site is 300km to the northeast of the location of the JGOFS NABE site that was the focus of an international experiment in 1989. Since 2003 it has formed part of the ANIMATE network of observatories in the Northeast Atlantic.

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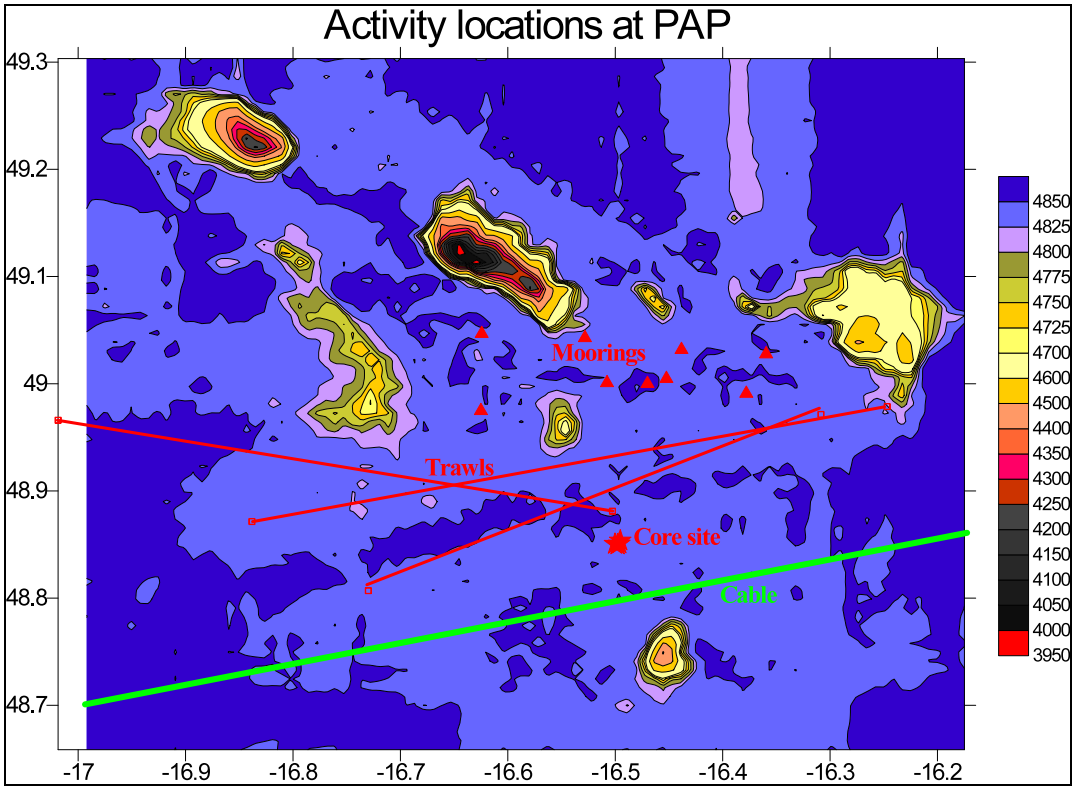


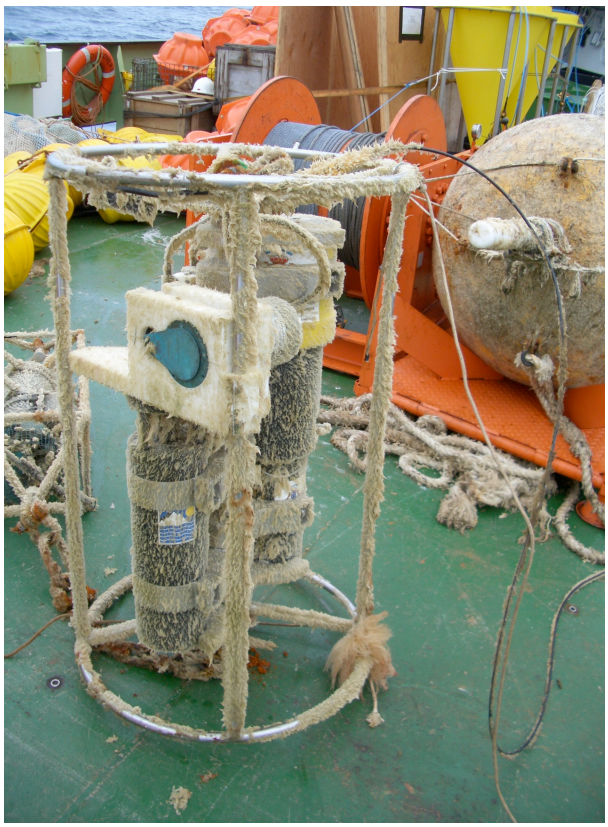
Richard Lampitt

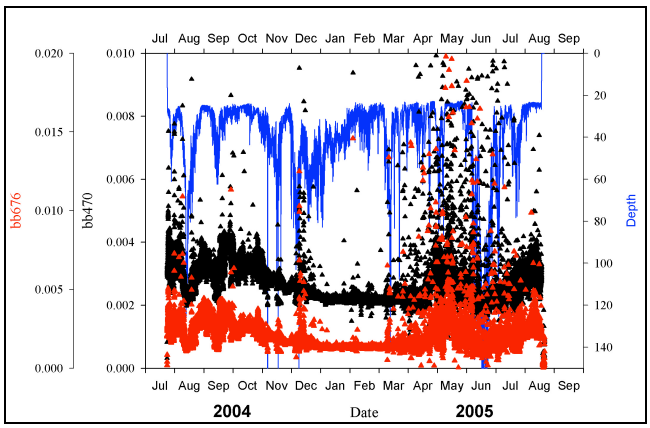
Reports

Recovery of Sensors

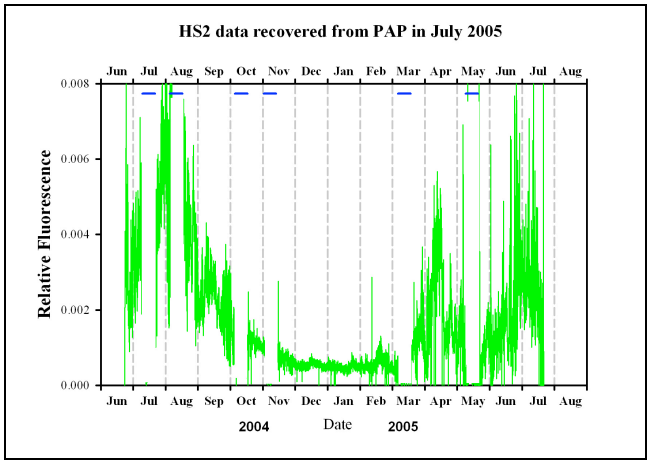
Technical details of the mooring recoveries are presented later in this report. Below are examples of data recovered from the sensors. Gaps in the data reflect times when the sensor frame was below the upper mixed layer depth and so are not representative of upper mixed layer conditions. The sensor frame descended to 160m on occasions as a result of high current speeds knocking down the mooring.

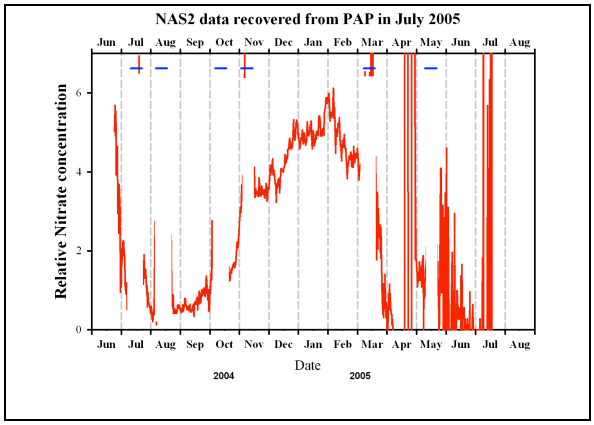
In spite of significant biofouling (see picture) good data were recovered from all sensors.





Biogeochemical sensor frame recovered after 12 months at PAP.




NAS2 data recovered from PAP in July 2005
Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
Relative Nitrate concentration
0
2
4
6
Jun Jul Aug Sep Oct Nov Dec Jan Feb Mar Apr May Jun Jul Aug
Date
2004
2005

Inorganic nutrients

Preamble

Analysis for nitrate and nitrite (hereinafter nitrate), phosphate and silicate was undertaken on a scalar sanplus autoanalyser following methods described by Kirkwood (1994) with the exception that the pump rates through the phosphate line are increased by a factor of 1.5 which improves reproducibility and peak shape. Samples were drawn from niskin bottles on the CTD or from the underway non-toxic supply into 25ml *sterilin* coulter counter vials and kept refrigerated at 4^{o}C until analysis which commenced within 24 hours. Stations were run singularly with each 2 samples being analysed from each bottle as a duplicate. Overall 12 runs were undertaken. An artificial seawater matrix (ASW) of 40g/l sodium chloride was used as the intersample wash and standard matrix. The nutrient free status of this solution was checked by running Ocean Scientific International (OSI) nutrient free seawater on every run. A single set of mixed standards were made up by diluting 5 mM solutions made from weighed dried salts in 1 litre of ASW into plastic 1 litre volumetric flasks that had been cleaned by soaking MQ water. Data was transferred to another computer using an Integral 128MB USB memory stick. This allowed fast data transfer between computers so time between sample analysis and data work up was done almost within a few hours. Data processing was undertaken using Skalar proprietary software. The wash time and sample time were 75 seconds; the lines were washed daily with 10% *Decon*. Time series of baseline, bulk standard concentration, instrument sensitivity, calibration curve correlation coefficient, nitrate reduction efficiency and duplicate difference were compiled and updated on a daily basis.

Performance of the analyser

1) On previous cruises there had been troubles with the autosampler, but these problems were not repeated on this cruise.

2) On a couple of runs it appeared that the silicate baseline was drifting down. No reason for this could be found and it only happened twice during the cruise. The affects of this are thought to be minimal as the drift was small and constant, so the drift correction of the data analysis software would have cancelled out this affect.

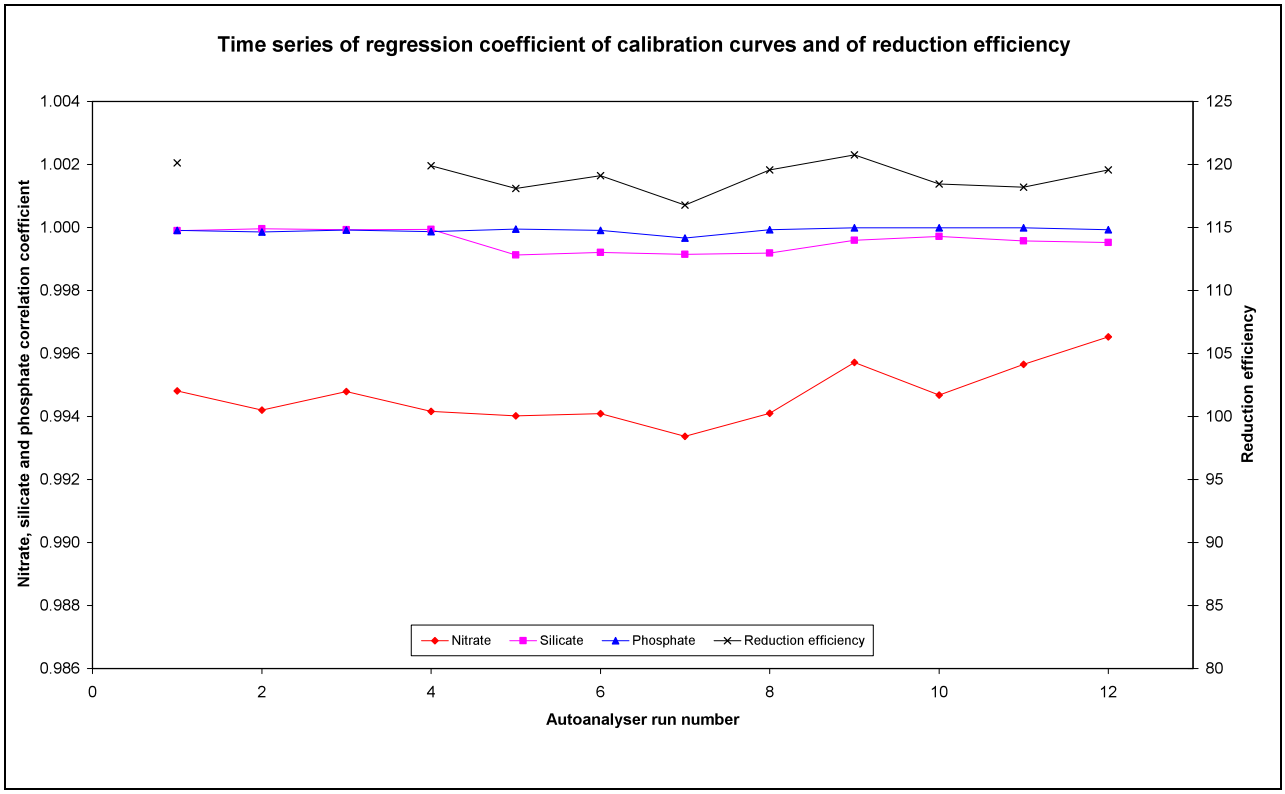
3) Towards the end of the cruise, the baselines took a long time to settle. The reason for this is unclear and it wouldn't have affected the end results.

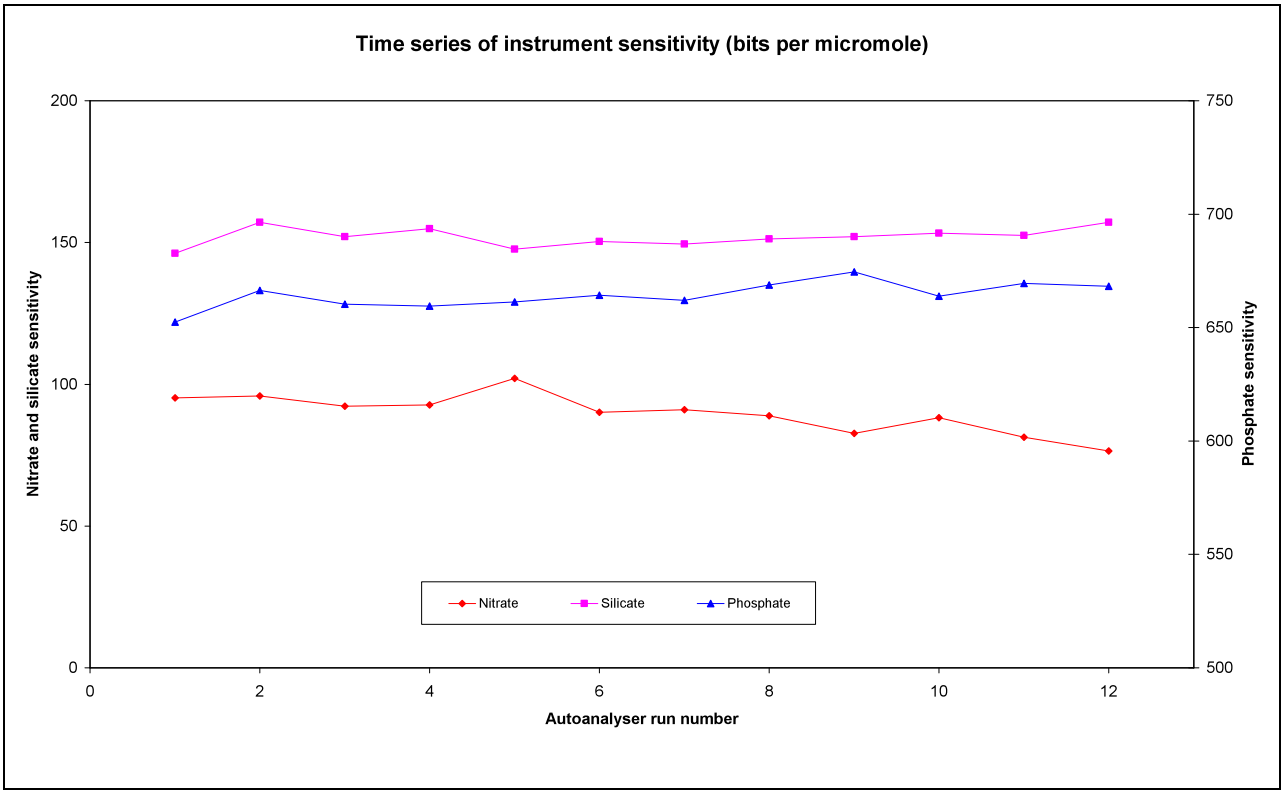
4) For a couple of runs there was a silicate contamination within the ASW wash bottle so that peaks were observed when washes were run using water from this bottle. This was got around by moving the peak point to the trough between two peaks as the wash water is also ASW so again it wouldn't have affected the end results. The wash bottle was thoroughly cleaned and the problem was then not seen again.

Analyser performance

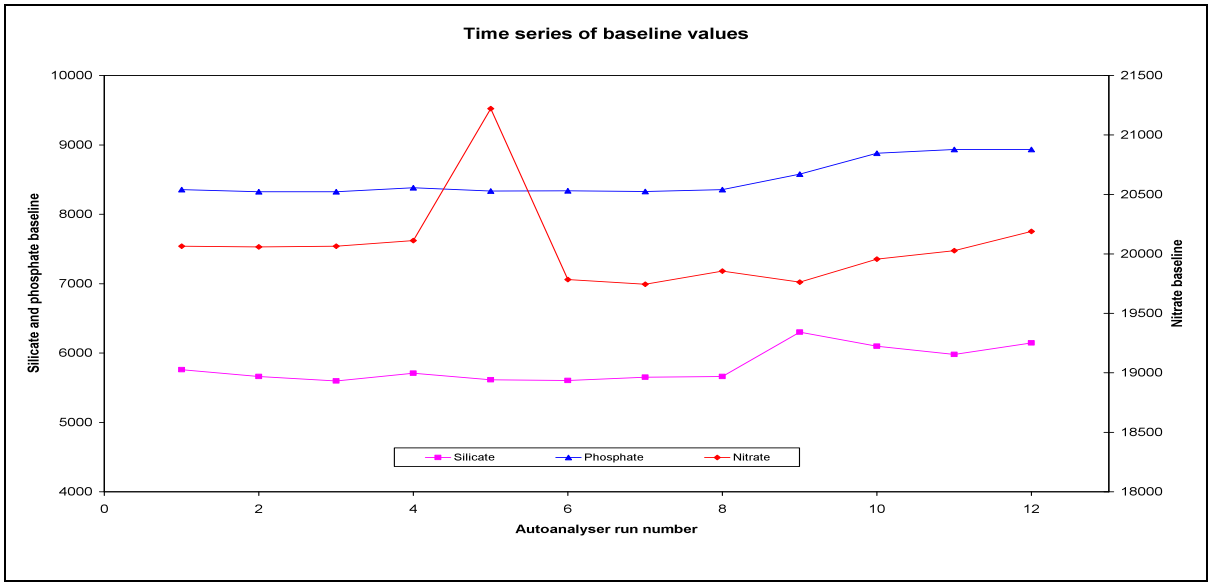
The performance of the analyser is monitored via the following parameters: baseline value, calibration curve slope, regression coefficient of the calibration curve, nitrate reduction efficiency. The instrument sensitivity for silicate and phosphate didn't vary much over the course of the cruise, no more than 5%. The Nitrate sensitivity varied by between 10 and 15%, getting steadily less as the cruise progressed. The reason for this is unclear, there was no obvious contamination.
The quality of the calibration curves was generally good with 100% of the silicate and phosphate regression coefficients being greater than 0.999. The nitrate was slightly lower but still all the regression coefficients were higher than 0.993 with most being 0.994 or higher. The reduction efficiency of the cadmium column was greater than 100% for the whole of the cruise, the lowest value being 117% but with the majority of values over 118%. The efficiency stayed relatively constant over the course of the cruise.

Time series of these parameters are shown in figures.

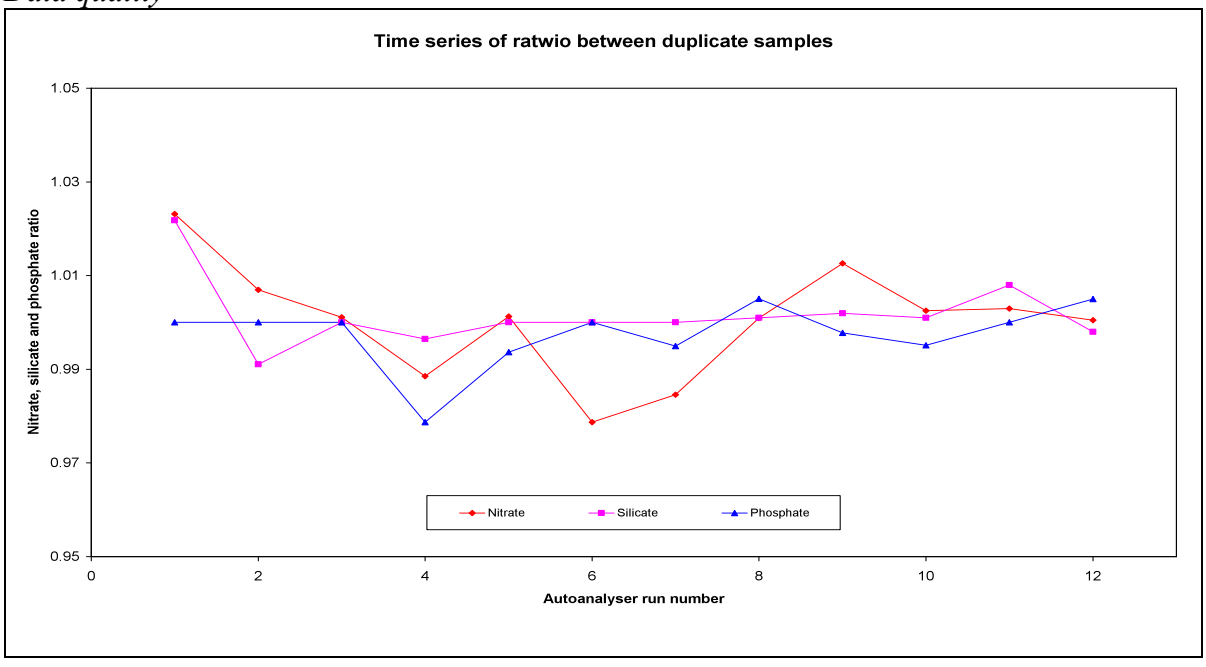




The baselines of the three inorganic nutrients changed slightly through the cruise. All three baselines showed signs of increasing as the cruise went on, though there were no problems with the runs themselves. There was also one run where a very high nitrate baseline was seen. This occurred in a run when the baseline showed some level of drifting, an indication the run was put on to early, before the baseline had settled. The drift samples and wash samples though allowed the Skalar software to take this drifting into account when calculating the results so that there would be no effects on the final data.



Data quality



The short term precision of the measurements was evaluated by running a duplicate of each sample. The ratio between the two duplicates was calculated and plotted. The ratios all fell within 0.98 and 1.02 of each other with nitrate showing the most variability.

Mark Stinchcome

PCO2 sampling

Sea water samples were taken from the CTD rosette in order to calibrate the *in situ* SAMI PCO_2 sensor. Water samples were preserved using 100 µl of saturated mercuric chloride solution:

7g of HgCl2 powder (ACS grade, crystal) was pre-weighed into a plastic bottle and added to 100ml distilled/deionized water at sea. After preservation, the bottle were tightly sealed and sent for analysis to Prof Arne Koertzinger at IFM-GOEMAR in Kiel, Germany.

Station:	**15714**			
Date:	**18/07/2005**			
Time start:	**03:10**	GMT		
Location:	**49.0296667**	**16.62783333**		
	North	**West**		
Sample Bottle	**Niskin**	**Pressure**	**Temperature**	**Salinity**
7185	1	500	11.09	35.51
4214	4	300	11.56	35.55
2938	11	70	13.45	35.70
6914	13	60	13.53	35.87
F720	15	45	15.00	35.64
6655	16	30	15.73	35.64
5928	18	20	15.78	35.64
4072	20	12	16.03	35.64
2925	23	3	17.70	35.66
8106				
2780				
1367				
4171				
2214				
F518				
F230				
F336				

Comment:	Niskin#1 did not clear of bubbles during filling
	of sample bottle.

Richard Lampitt

Microbial Diversity

Instruments
D295T **:** Becton Dickinson FACSort

D296: Becton Dickinson FACSort , Cytobuoy Cytosense

CTD Sampling
All shallow CTD casts were sampled for flow cytometric analysis. D295T Casts were analysed for changes in bacterioplankton and picophytoplankton community structure with depth. D296 Casts were analysed for bacterioplankton and nanophytoplankton community structure so that direct comparisons between FACSort and Cytosense data could be made. Bacterioplankton were not analysed for cast 15706 as Cytosense drained an unexpected volume of sample in the interim period between individual sampling events, leaving enough sample for nanophytoplankton analysis by FACSort only. A greater volume of sample was taken from bottles in subsequent casts to avoid the recurrence of this problem. Variation in phytoplankton community structure was observed between bottles fired at replicated depths, consequently 10 bottles were fired at 20 metres on CTD cast 15719 to investigate this further.

Cruise: D295 T

CTD Number	Bottle Number	Depth (M)	Bacterioplankton	Picophytoplankton
295 1	4	250	√	√
295 1	8	150	√	√
295 1	9	100	√	√
295 1	11	70	√	√
295 1	13	50	√	√
295 1	14	25	√	√
295 1	16	15	√	√
295 1	20	10	√	√
295 1	23	Surface	√	√
295 4	6	58	√	√
295 4	8	35	√	√
295 4	9	22	√	√
295 4	12	12	√	√
295 4	15	7	√	√
295 4	21	3	√	√
295 5	1	500	√	√
295 5	6	500	√	√
295 5	3	300	√	√
295 5	4	300	√	√
295 5	7	100	√	√
295 5	8	100	√	√
295 5	9	200	√	√
295 5	10	200	√	√
295 5	11	70	√	√
295 5	12	70	√	√
295 5	13	60	√	√
295 5	14	60	√	√
295 5	15	30	√	√

295 5	16	30	√	√
295 5	20	12	√	√
295 5	21	7	√	√
295 5	22	7	√	√
295 5	23	3	√	√
295 5	24	3	√	√

Cruise: D296

CTD Number	Bottle Number	Depth (M)	Bacterioplankton	Nanophytoplankton	Cytosense
15706	4	300	X	X	√
15706	5	300	X	√	√
15706	6	200	X	√	√
15706	7	200	X	√	√
15706	8	150	X	√	√
15706	9	100	X	√	√
15706	10	100	X	√	√
15706	11	70	X	√	√
15706	12	70	X	√	√
15706	13	60	X	√	√
15706	14	60	X	√	√
15706	15	45	X	√	√
15706	16	30	X	√	√
15706	17	30	X	√	√
15706	18	20	X	√	√
15706	19	12	X	√	√
15706	20	12	X	√	√
15706	21	7	X	√	√
15706	22	7	X	√	√
15706	23	3	X	√	√
15706	24	3	X	√	√
15714	6	200	√	√	√
15714	7	200	√	√	√
15714	8	200	√	√	√
15714	9	100	√	√	√
15714	10	100	√	√	√
15714	11	70	√	√	√
15714	12	70	√	√	√
15714	13	60	√	√	√
15714	14	60	√	√	√
15714	15	45	√	√	√
15714	16	30	√	√	√
15714	17	30	√	√	√
15714	18	20	√	√	√
15714	19	12	√	√	√
15714	20	12	√	√	√
15714	21	7	√	√	√
15714	22	7	√	√	√
15714	23	3	√	√	√
15714	24	3	√	√	√
15719	1	200	√	√	√
15719	3	150	√	√	√
15719	4	150	√	√	√
15719	5	100	√	√	√
15719	6	75	√	√	√
15719	8	40	√	√	√
15719	9	30	√	√	√
15719	10	20	√	√	√
15719	11	20	√	√	√
15719	12	20	√	√	√
15719	13	20	√	√	√
15719	14	20	√	√	√
15719	15	20	√	√	√

15719	16	20	√	√	√
15719	17	20	√	√	√
15719	18	20	√	√	√
15719	19	20	√	√	√
15719	20	20	√	√	√
15719	21	10	√	√	√
15719	22	10	√	√	√
15720	6	200	√	√	√
15720	7	200	√	√	√
15720	8	200	√	√	√
15720	9	100	√	√	√
15720	10	100	√	√	√
15720	11	70	√	√	√
15720	12	70	√	√	√
15720	13	60	√	√	√
15720	14	60	√	√	√
15720	15	45	√	√	√
15720	16	30	√	√	√
15720	17	30	√	√	√
15720	18	20	√	√	√
15720	19	12	√	√	√
15720	20	12	√	√	√
15720	21	7	√	√	√
15720	22	7	√	√	√
15720	23	3	√	√	√
15720	24	3	√	√	√

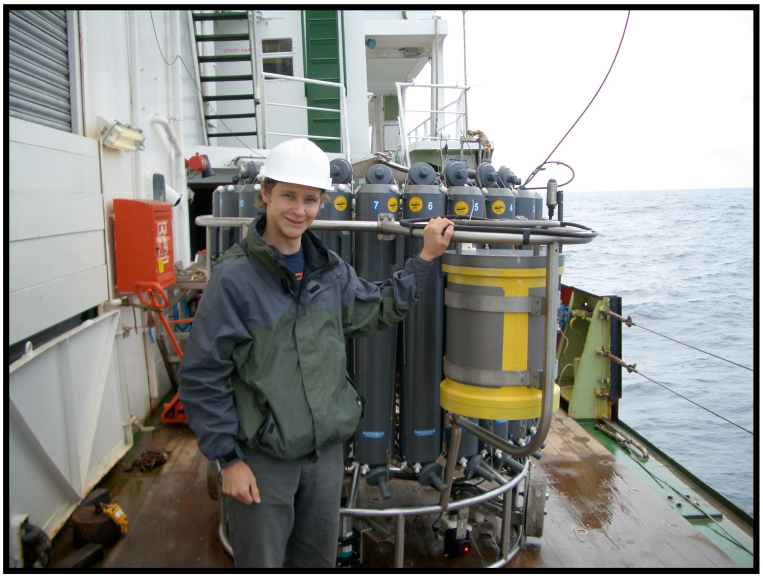
Underway Sampling Regime

Three transects across the Celtic Sea, from Falmouth, Cornwall, UK, to the Porcupine Abyssal Plain (PAP) site, and from the PAP site to Cork, Co. Cork, ROI were undertaken. The transects were intended to support data collected on microbial spatial variability during the 2004 Terschelling Celtic Sea Cruise. Samples were drawn from the ships non-toxic supply using a Tecan Miniprep 60 Liquid handling robot. Samples were analysed flow-cytometrically using the Becton Dickinson FACSort instrument in order determine spatial variability in Bacterioplankton and Picophytoplankton community structure. Sampling was begun at half hourly intervals at 2100 (GMT) on 04/07/05. The satisfactory performance of new autoloader equipment, not previously used at sea, facilitated the increase in sampling frequency from half hourly to every 20 minutes at 1220 on 05/07/05. The transect was discontinued on arrival at the PAP site at 1100 on 07/07/05. At 1200, on 07/07/05, an hourly sampling regime, increased to half hourly at 2200 on 08/07/05, was commenced to investigate smaller-scale spatial variability whilst on station, and steaming between stations. This sampling was facilitated by a lower than anticipated frequency of CTD's on D295T. Upon leaving the PAP site for Cork, sampling frequency was increased to 20 minutes at 1100 on 11/07/05. The last sample of the transect was drawn at 0900 on 13/07/05 as the ships non-toxic supply was discontinued on the approach to Cobh, Co. Cork.

A final transect, from Cork to the PAP site was begun at 1430 on 14/07/05 and half-hourly samples were analysed using the FACSort and Cytosense instruments. The transect was discontinued upon arriving on station at the PAP site at 1030 on 16/07/05. A summary of underway sampling is outlined in the table below.

DATE	Sampling frequency	Time of frequency change
04/07/2005	30 minutes	21:00
05/07/2005	20 minutes	12:20
06/07/2005	20 minutes	
07/07/2005	60 minutes	12:00
08/07/2005	30 minutes	22:00
09/07/2005	30 minutes	
10/07/2005	30 minutes	
11/07/2005	20 minutes	11:00
12/07/2005	20 minutes	
13/07/2005	20 minutes	9:00
14/07/2005	30 minutes	14:30
15/07/2005	30 minutes	
16/07/2005	30 minutes	10:30

Trial of Cytosub



Owing to Software problems, Cytosub was not operational for the Cruise, however it was submerged to the maximum depth recommended by the manufacturer (200m) in association with CTD 15719. Upon returning to the surface, both Cytosub (yellow cylinder in photo) and its associated battery pack were found to have been watertight to the recommended depth.

Ross Holland

Phytoplankton Sampling

For the phytoplankton analysis, water samples were collected from eight different CTD during the D295/296 cruise. Approximately 5L of water were collected in plastic carboys using plastic tubes connected to the different Niskin bottles of the CTD. The carboys were immediately wrapped in black plastic bags to keep the samples in the dark and were stored in the cold room prior to processing.

Pigment analysis

2 L of water were measured with a measuring cylinder and filtered through a 25 mm GFF filter using a specially designed positive pressure filtration rig. Once all the water had passed through the filter it was removed from the holder using tweezers and placed in a cryovial. A second duplicate sample was also filtered and the filter placed in the same cryovial. The vial was clearly labelled with sample ID, station, depth and placed in liquid nitrogen until transported to NOCS in dry ice, for analysis.

Microscope identification

Two 100 ml brown glass bottles were filled with 80 ml of the seawater sample and using a pipette, 1 ml of Lugols was added to one bottle and 2 ml of 4% formaldehyde to the other in the fume hood. The samples were then stored in plastic boxes for transport to NOCS for identification and counting.

Flow cytometry identification
For each sample, two cryovials (one a duplicate) were filled with 1.8 ml of seawater and 50 ul of 37% added to each. The formaldehyde had previously been filtered through an in line filter and stored in the 4°C fridge before use. Each vial was marked with sample ID, station and depth,

placed in the fridge at 4°C and after 24 hours transferred to the –20°C freezer. Samples were transported to NOCS in dry ice, for subsequent analysis.

Blanca Puig Mauriz and Denise Smythe-Wright

Carbon and Nitrogen export estimated from ^{234}Thorium and ^{238}U disequilibria

Biological activity in surface waters drives the oceanic particle cycle, which in turn controls the scavenging of trace metals and sedimentation to the sea floor. Carbon fixation and carbon export is central to understanding oceanic productivity, and its long term effect on atmospheric CO_2 concentration. The particle- reactive radioisotope ^{234}Th (half life 24.1 days) is often in disequilibrium with its parent nuclide ^{238}U in surface ocean waters. This occurs because ^{234}Th but not ^{238}U partitions strongly onto particle surfaces and its removal on the sinking flux of material leads to radioactive disequilibrium. Consequently ^{234}Th/^{238}U disequilibrium is potentially a powerful tool to study the downward flux of carbon in the ocean via sinking particles.

Knowledge of the integrated disequilibrium in the water column combined with a steady-state assumption and with the decay constant of ^{234}Th yields an estimate for the flux of ^{234}Th from the surface ocean caused by settling particles. To calculate the POC flux from the surface ocean, the ratio of POC to ^{234}Th on sinking particles is multiplied by the estimated ^{234}Th flux.

Methods

Samples for thorium analysis were collected from the CTD at three stations on D295 and three on D296 (see Table1 for station positions). Ten litre water samples were collected from ten depths to 500m. The sampling distribution is concentrated in the surface where a significant export of thorium on settling particles is expected to result in radioactive disequilibrium between thorium and uranium. The sampling depths in the surface 70m were determined by the light depths used for productivity incubations. The sample at 500m represents radioactive equilibrium between ^{234}Th and ^{238}U.

Total uranium is calculated from salinity and does not have to be measured independently.

Total ^{234}Th is measured by adding potassium permanganate ($KMnO_6$), manganese dichloride ($MnCl_2$), and concentrated ammonia (NH_3) to the 10 litre water sample. Dissolved and particulate ^{234}Th is precipitated from the water as MnO_2 precipitate within 8 hours. This precipitate is filtered onto 142mm 0.8µm polycarbonate filters which are then folded in a reproducible way, wrapped in mylar foil and counted directly in a beta counter. Appropriate corrections are made for self-absorption of radiation due to the filter and for detector efficiencies <100%, and corrections for ^{234}Th decay and ^{234}Th in growth from ^{238}U decay since sampling.

The reproducibility and precision of the method was tested at station 15689/2 where 6 of the Niskin bottles allocated to thorium were fired at 1000m. At this depth, the removal rate of ^{234}Th is slow compared to its radioactive decay rate, and the total ^{234}Th activity should equal the ^{238}U activity. The extraction efficiency of the precipitate was tested at station 15720, where following the filtration of the precipitate, the filtered sea water was collected and the precipitation process repeated to test whether all the thorium was removed from the sample by the first precipitate.

At each of the thorium depths samples for particulate organic carbon (POC) and particulate organic nitrogen (PON) were filtered onto ashed GFF filters. Filters are stored frozen at -20^{o}C for future analysis at the National Oceanography Centre, Southampton. These samples were collected in particular to determine how the ratio of total POC and PON to ^{234}Th varied through the water column.

The ratio of organic C and N to 234^{Th} in the sinking particulate pool was measured in two ways. For the first method, large particles >50µm were considered to represent the large particles settling out of the water column, this size class was collected by filtering large volumes of sea water through a 143mm diameter 50µm nylon mesh using battery operated in situ pumps (SAPS). Replicate samples were collected using two pumps placed at 100m and set to pump for 90 minutes. The SAPS station 15713 was carried out at 49^{o} 01.66' S and 16^{o} 37.44' W and coincided with CTD station 15714. Once on board the samples on the mesh were re-suspended using one litre of thorium free filtered sea water and split using a fulsam splitter. 5/8^{ths} of the sample was filtered onto 142mm 0.8µm polycarbonate filters for ^{234}Th analyses. 1/8th of the sample was filtered onto pre-combusted and pre-weighed 25mm GFF filters and stored frozen in Petri dishes for subsequent POC and PON analysis. The final 1/8th of the sample was stored in Lugols and Formalin for microscopy.

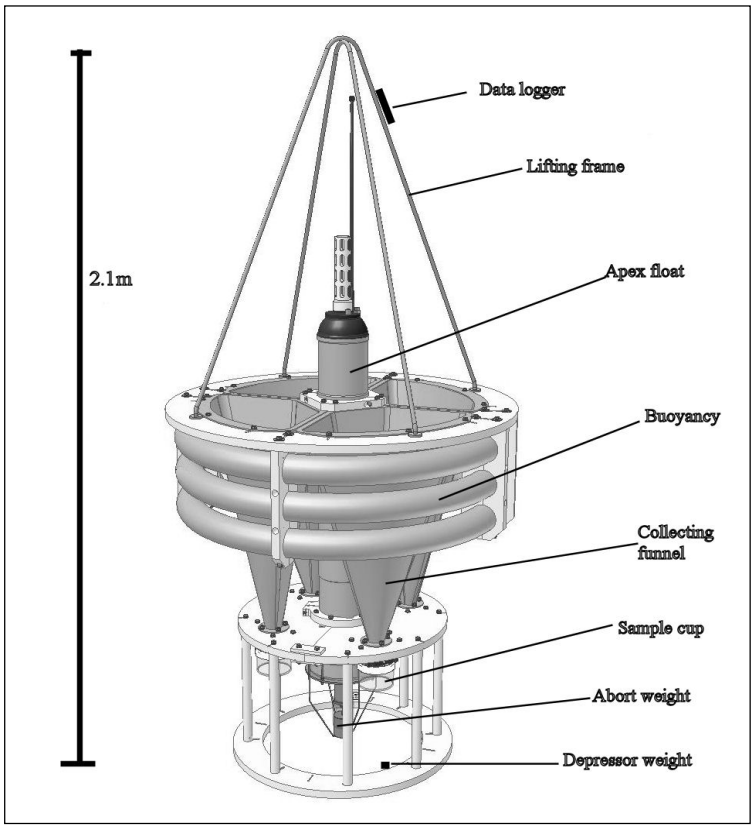
In the second method the sinking particulate pool was collected using the neutrally buoyant barotropic PELAGRA trap which collected the sinking flux at 150m over 2 days. One of the four sampling cups was split using the fulsam splitter. 3/4 of the sample was filtered onto 142mm 0.8µm polycarbonate filters for ^{234}Th analyses and 1/4 was filtered onto a pre-combusted and pre-weighed 47mm GFF filter for POC PON analysis. The filtrate from the POC/PON filtration was collected and stored in the fridge. It will be interesting to see how the C: ^{234}Th ratio from the >50µm size fraction collected with the SAPS pump compares with the C: ^{234}Th ratio of the settling material collected using the PELAGRA trap.

Table1. Thorium station positions

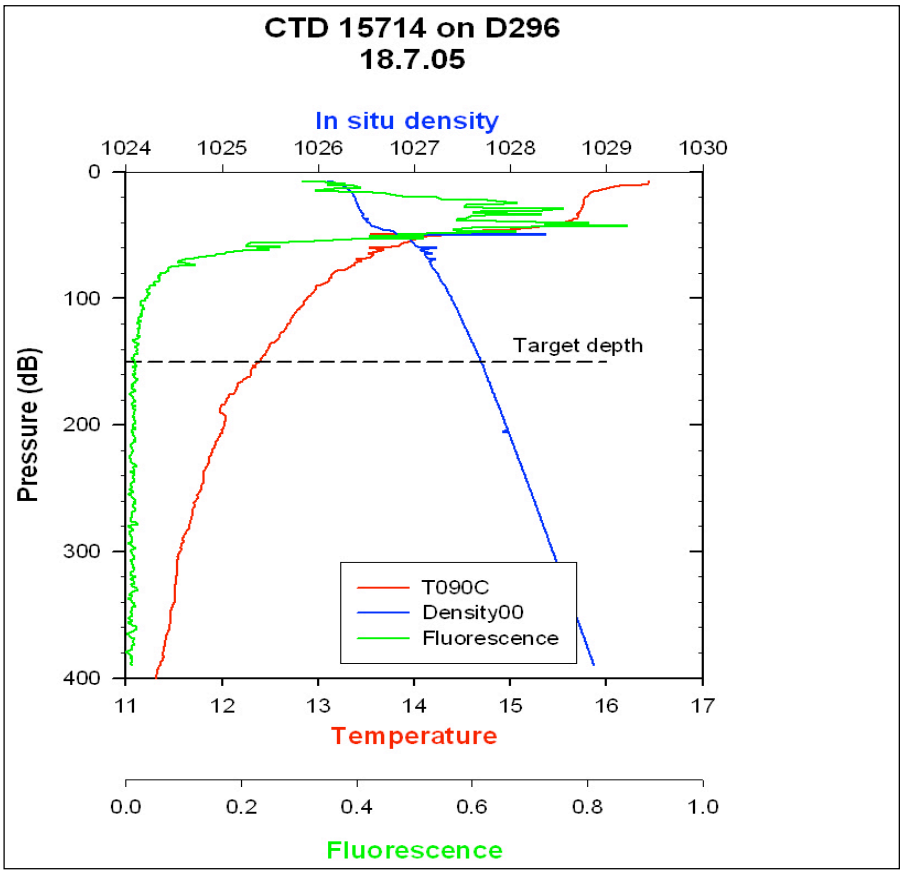
Cruise	Station Number	Date	Latitude	Longitude
D295	15686	07/07/2005	49° 02.95' S	16° 25.47' W
D295	15689/2	07/07/2005	49° 02.16' S	16° 46.10' W
D295	15701	11/07/2005	49° 00.72' S	16° 32.95' W
D296	15706	16/07/2005	48° 57.05' S	16° 29.94' W
D296	15714	18/07/2005	49° 01.00' S	16° 37.30' W
D296	15720	20/07/2005	48° 50.4' S	16° 30.90' W

Sandy Thomalla

Direct measurement of export using the drifting sediment trap PELAGRA



The downward flux of particulate material out of the upper mixed layer of the ocean is one which has a major effect on biogeochemical processes in the oceans and on the earth system as a whole. This flux necessarily decreases with increased depth as the material is remineralised or dissolves and it is widely accepted that the rate of decrease in flux diminishes with depth such that in the deep water column (eg >2000m) the rate of decrease with depth is slight. There are several means by which downward flux can be estimated but almost all of these are indirect methods such as those based on budgets of nutrients or of radioisotopes such as ^{234}Thorium. The only direct method uses the particle interceptor or sediment trap. Such devices have very serious problems when used in the upper part of the water column. This is due to hydrodynamic effects on the settling particles and contamination of the collected material by zooplankton that have swum into the collecting cup. We have designed and constructed a novel free drifting neutrally buoyant sediment trap; PELAGRA which was expected to remove both of these fundamental problems of upper ocean sediment trap estimates of flux. This uses a modified ARGO float to maintain its location in a predetermined horizon of depth (Isobaric model) or density (Isopycnal model). It is designed to be deployed just below the upper mixed layer of the ocean for periods of up to a week.



The practice followed when using these traps is to make a CTD cast to find the water density and temperature at the intended target depth. From this the ballast required is added to the traps and a short deployment carried out to determine if this is correct. Subsequent test deployments are not usually required before flux measurements are made. The CTD profile (see figure) showed a strong subsurface chlorophyll maximum and a target depth of 150m was selected for the final deployments.

During the two cruises D295T and D296 two PELAGRA traps were used, P#1 (Isobaric) being deployed twice and P#2 (Isopycnal) three times.

Station list:	**Discovery 295T**								
						Start Position		End Position	
Station	**Series**	**Date**	**Start time**	**End time**	**Activity**	**Decimal degrees**			
		July	**GMT**	**GMT**		North	East	North	East
15686		7	01:35	02:40	CTD (Idranaut cal)	49.043	-16.418	49.038	-16.435
15699	1	10/17	23:08		PELAGRA 1	49.002	-16.507		
	2	10/11	23:12	07:02	PELAGRA 2	49.002	-16.507	49.012	-16.558
Station list:	**Discovery 296**								
						Start Position		End Position	
Station	**Series**	**Date**	**Start time**	**End time**	**Activity**	**Decimal degrees**			
		July	**GMT**	**GMT**		North	East	North	East
15706		16	04:20	05:15	CTD	48.951	-16.500		
15710		16-18	12:20	07:25	PELAGRA 2	49.012	-16.453	48.900	-16.237
		17		09:09	Recover P#1 from D295			48.568	-17.378
15714		18	03:10	04:14	CTD	49.028	-16.617	49.030	-16.628
15716	1	18/20	15:08	07:12	PELAGRA 2	48.863	-16.511	48.903	-16.153
	2	18/20	15:15	07:35	PELAGRA 1	48.863	-16.511	48.896	-16.144
15719		19	15:10	15:50	CTD	49.003	-16.602		

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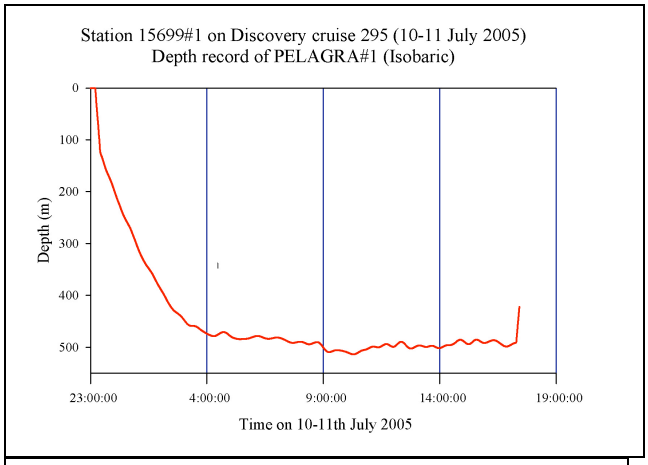
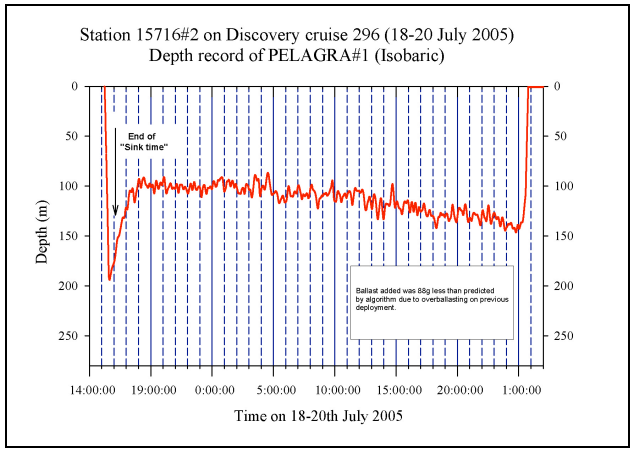
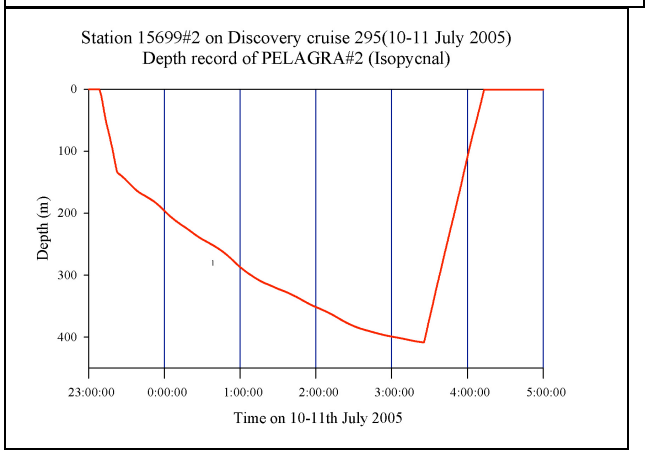
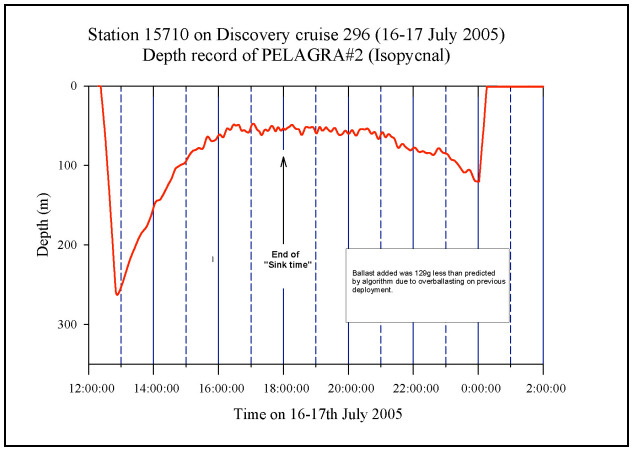
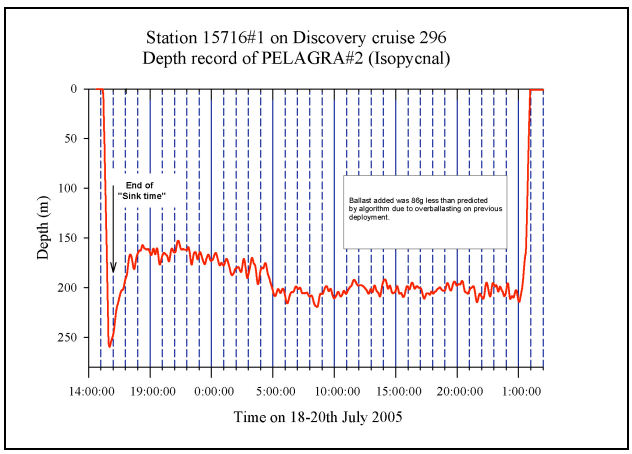

Station 15699#1 on Discovery cruise 295 (10-11 July 2005)
Depth record of PELAGRA#1 (Isobaric)
Depth (m)
0
100
200
300
400
500
23:00:00
4:00:00
9:00:00
14:00:00
19:00:00
Time on 10-11th July 2005


Station 15716#2 on Discovery cruise 296 (18-20 July 2005)
Depth record of PELAGRA#1 (Isobaric)
Depth (m)
End of "Sink time"
Ballast added was 88g less than predicted by algorithm due to overballasting on previous deployment.
14:00:00
19:00:00
0:00:00
5:00:00
10:00:00
15:00:00
20:00:00
1:00:00
Time on 18-20th July 2005


Station 15699#2 on Discovery cruise 295(10-11 July 2005)
Depth record of PELAGRA#2 (Isopycnal)
Depth (m)
23:00:00
0:00:00
1:00:00
2:00:00
3:00:00
4:00:00
5:00:00
Time on 10-11th July 2005


Station 15710 on Discovery cruise 296 (16-17 July 2005)
Depth record of PELAGRA#2 (Isopycnal)
Depth (m)
End of "Sink time"
Ballast added was 129g less than predicted by algorithm due to overballasting on previous deployment.
12:00:00
14:00:00
16:00:00
18:00:00
20:00:00
22:00:00
0:00:00
2:00:00
Time on 16-17th July 2005


Station 15716#1 on Discovery cruise 296
Depth record of PELAGRA#2 (Isopycnal)
Depth (m)
End of "Sink time"
Ballast added was 86g less than predicted by algorithm due to overballasting on previous deployment.
14:00:00
19:00:00
0:00:00
5:00:00
10:00:00
15:00:00
20:00:00
1:00:00
Time on 18-20th July 2005

As can be seen from the depth records, a prolonged deployment was achieved for both of the traps stabilising at depths of 150 and 200m.

Richard Lampitt

Primary Productivity and New Production

Primary productivity and new production incubations were undertaken on seawater samples collected on pre-dawn 500m CTD casts on 7, 8 & 11 July (D295T) and 16, 18 & 20 July (D296) (see Table 1). Seawater was collected from 10L Niskin bottles into darkened 10L polyethylene carboys using silicon tubing, from water depths corresponding to 97, 55, 33, 14, 4.5 and 1% surface incident irradiance.

1. Primary Productivity (^{14}C)

For each light depth, 4 seawater samples (3 replicates at each depth and 1 dark bottle) were inoculated with 10 µCi $NaOH^{14}CO_3$ (100µl stock solution) in 80ml acid-rinsed polycarbonate bottles. The same procedure was carried out for size- fractionated primary productivity. The bottles were placed in an on-deck incubator cooled by subsurface seawater from the shipboard supply and shaded by Lee filter screens representing 97, 55, 33, 14, 4.5 and 1% of surface irradiance 8-16h depending on the start time of the incubation. The incubation duration was designed to be centered around midday.

5 total activity standards were made up in 7ml polycarbonate vials by adding 10ml Carbosorb (CO_2 trapping agent) to 100µl ^{14}C working stock then dispensing 100µl of this solution into the vials and adding 5ml Permafluor scintillation cocktail.

At the end of the experiment, samples were filtered under vacuum onto 25mm diameter, 0.2µm Whatman (total productivity) or 10µm Osmonics (size fractionated) polycarbonate filters.

Filters were rinsed with filtered seawater and acid-fumed under a fume hood for 45min-1h to expell any unfixed ^{14}C, then placed into 7ml polyethylene Pony vials to which 5ml Hi-Safe scintillation cocktail were added.

2. New and regenerated production (^{15}N)

2.1. Uptakes

Three sub-samples were taken for analyses of new and regenerated production; one each for nitrate, ammonium and urea uptake. 2 L samples were decanted into rinsed polycarbonate bottles and inoculated with $K^{15}NO_3$, $^{15}NH_4Cl$ and $CO(^{15}NH_2)_2$ to reach a final concentration of 0.05µM NO3 and 0.025µM NH4 and urea, which represented approximately 10% of the ambient substrate concentration.

The bottles were incubated alongside the primary production experiments, and terminated by filtering onto 25 mm ashed GF/F filters. The filters were stored at –20 ˚C until analysis by isotope mass spectrometry back at NOC.

2.2. Ammonium regeneration

Ammonium regeneration experiments were conducted simultaneously with the ammonium uptake experiments. This is essential to correct the NH_4 uptakes for NH_4 re-cycling. A second 2L bottle was spiked with 100µl of $^{15}NH_4Cl$ as for the uptake experiments, but this was immediately filtered through a 25mm (ashed) Whatman GF/F filter to collect 900ml filtrate to derive the 14N:15N isotopic ratio at time zero (Ro). Exactly 1.0ml NH_4Cl solution (0.5349g l-1) was added to each bottle as a "carrier" prior to freezing the samples at –20°C. The filter from this sample was retained for HPLC analyses. (See below). At the end of the NH_4 uptake filtration, 900ml filtrate was recovered to measure ^{15}N isotopic dilution by excreted NH_4, carrier was added as before and the sample (Rt) also frozen as before.

3. Nutrients

Samples were taken at every light depth and analysed on-board for NO3, PO4 and Si (see section on nutrients). Triplicate samples were frozen at –20°C for NH_4 and urea analyses. Water was drawn directly from the 10L polyethylene bottles into 60 ml Diluvial containers, and frozen immediately at –20 ˚C. Samples from the Ro and Rt ammonium regeneration bottles were also taken to assess ammonium re-cycling.

4. Chlorophyll

The filters used for the R_0 filtration (see section 2.2.) were kept frozen at -20°C for later chlorophyll analysis. 1L was also filtered onto 10 (07/07) or 2µm (all other days) polycarbonate filters for the size fractionated productivity experiments.

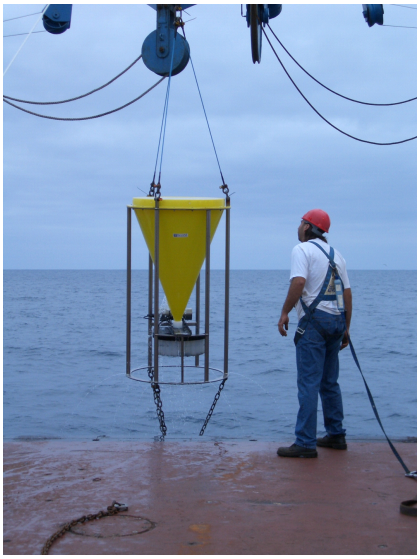
Date	CTD Station	Sampling depths
07/07	15686	3, 10, 15, 25, 70, 100
08/07	15689#3	3, 7, 12, 22, 35, 58
11/07	15701	3, 7, 12, 30, 60, 70
16/07	15706	3, 7, 12, 30, 60, 70
18/07	15714	3, 7, 12, 30, 60, 70
20/07	15720	3, 7, 12, 30, 60, 70

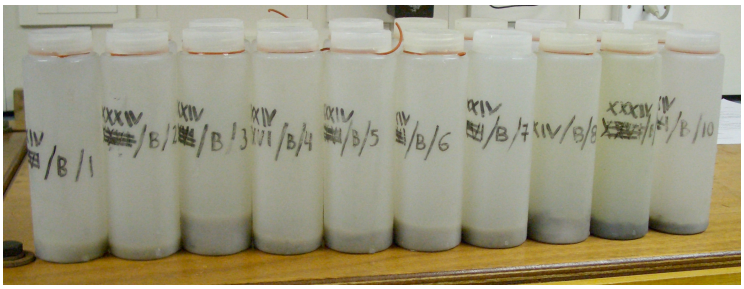
Station list for primary production and new production.

Sophie Seeyave

Direct measurement of deep ocean particle flux using sediment traps

As part of the continuing program to measure deep water downward particle flux at the PAP site, the sediment trap mooring deployed in June 2004 was recovered (see photo) and a new one deployed. The recovered samples (see photo) were of sufficient quantity for a wide range of analyses. The deployed traps (3000m and 4700m depth) will be recovered in July 2006.





Richard Lampitt

Mesozooplankton Vertical Hauls

A WP2 (200µm mesh size) was deployed on two days from a depth of 200m to the surface. Deployments were at dawn. Sunrise and sunset times were 0521 GMT and 2103 GMT respectively (http://aa.usno.navy.mil/).

The vertical tows 200-0m were completed in about 15min resulting in a speed of about 12 m/min or 0.2 m/sec. The samples were transferred in 2.5L glass jars and preserved in a final concentration of 10% formalin.

D296

Station	Ser.	Date	Time	Deg North		Deg West	
15707	1	16/07/2005	04:30	48	57.05	16	29.99
	2	16/07/2005	04:50	48	57.03	16	29.54
15722	1	20/07/2005	02:50	48	50.30	16	31.00
	2	20/07/2005	03:15	48	50.20	16	31.10

Richard Lampitt

Bathysnap

One long-term Bathysnap time-lapse camera system laid in June 2004 (St. 56530#1) was retrieved, refurbished and redeployed (St 15723#1) in the same position for collection in the summer of 2006.

The Bathysnap recovered appeared to have worked well and abut two thirds of the film had passed through the camera, as expected with a frame interval of 8 hours. About 1200 frames will have been shot. There was more corrosion evident than might normally be expected and it is possible that when the system was deployed the chain used in the mooring may not have been galvanised.

Bathysnap on recovery (left)

The camera system was turned around and reloaded with film within 1 day. The camera was set in motion at 2125Z 17:vii:05 and when checked two days later flashed on deck at the correct time of 2124 (19:vii:05). The photo interval set was 8 hours. Bathysnap was deployed at 0520Z on 20:vii:05. Mors Release 332, with a pyro firer.

Ben Boorman

Megacorer and Combicorer

A new Megacorer purchased by UKORS was used in two configurations. One with twelve 100mm cores, as in normal Megacorer operations, and the other with core catcher units specially constructed to take 57mm core tubes in addition to some 100mm core tubes, termed the Combicorer. In all deployments of the Combicorer three 57mm core tube units were used together with nine 100mm core tubes (making a total of 12 units on the coring head in each case). The Combicorer was used in order to 1) try and save sampling time, 2) collect meiofauna samples

concurrently with macrofauna samples and 3) maintain a consistent sampling method for the meiofauna time series, which has been built up using 57mm core tubes in the past.

Unfortunately, for reasons that are not immediately obvious, the 57mm tube units failed on all deployments (5 attempts). For the final two deployments of the cruise (Stas 15720#2 and 15724#1) only 100mm tube units were used.

The Megacore units also proved temperamental and did not sample consistently. En route to the Porcupine Abyssal Plain a test deployment of the Combicorer was made at 2188m depth in the Porcupine Seabight. Eight of the nine 100mm cores took a sample. The sediments were quite form and so although not all the core catchers closed the samples were retained in the tubes. When cutting the cores it was clear that they were very stiff and sticky and would not have fallen out of the tubes very easily. On the Porcupine Abyssal Plain there was less success. Only four (St 15705#1), three (St. 15712#1), seven (St. 15712#2 and St 15720#1) 100mm tube units took a sample successfully of the nine possible in each case; in total just over a 50% success rate. Sadly, when twelve 100mm core tube units were used on the final two deployments of the Megacorer (Stas. 15720#2 and 15724#1) only a 50% success rate was achieved.

Core samples taken in the Porcupine Seabight (St 15704#1) were used to practice core cutting techniques and were then discarded.

The deployments of the Megacorer were completed successfully, but at St 15712#1 the main warp caught around the main shaft of the corer preventing the complete retraction of the coring head. On recovery at the sea surface the corer had to be suspended above the deck while the weight of the corer was taken on the CTD wire. The core tube units were then removed by hand before the corer was lowered onto the deck.

Coring operations were also slowed down by very regular modifications to the scrolling mechanism. This required the almost constant attention by one member of the crew in the winch room and was less than ideal.

Despite the general lack of success with sampling, a number of samples were sieved for macrofauna and other samples were used for protozoan and metazoan meiofauna studies. In

addition, some cores were sliced for sediment chemistry analyses (amino acids, pigments and lipids).

Ben Boorman, David Billett

Macrofauna

Macrofauna samples were sieved at 300µm and 500µm at four depth horizons, 0-1cm, 1-3cm, 3-5cm and 5-10cm. Cores were combined to provide a large enough sample for analysis. The samples from 0-1cm and 1-3 cm were placed in formalin before sieving. The following table gives details of the stations and the number of cores used at each.

Station	Depth (m)	N	W	No. of cores
15705#1	**4840**	**48° 51.34**	**16° 31.33**	**4**
15712#2	**4840**	**48° 51.55**	**16° 29.95**	**6**
15720#1	**4838**	**48° 51.49**	**16° 29.66**	**7**

Janne Kaariainen, Eulogio Soto, David Billett

Meiofauna

No multicore units on the Megacorer fired and as a result all the samples taken for meiofauna were sub-sampled from megacore tubes my penetrating a multicore tube inside the magacore tube manually.

1. Metazoan meiofauna (Ann Vanreusel samples)

1-cm layers to 5 cm depth (i.e. 5 slices)

2. Foraminifera

Slice into 0-0.5 cm, 0.5-1.0 cm, 1.0-1.5 cm, 1.5-2.0 cm, 2-3 cm, 3-4 cm, 4-5 cm, 5-6 cm, 6-7 cm, 7-8 cm, 8-9 cm and 9-10 cm layers using cutting ring and a cutting plate.

3. Technique:

A cutting ring made from an old core tube of the same diameter was used to support upper layers of soupy sediment and marked appropriately at 0.5 and 1 cm thicknesses. The cutting plate was then inserted between the top of the core tube and the bottom of the cutting ring to provide slices of sediment from a known layer within the sediment. Any sediment sticking to the cutting ring was washed into a 500ml sample bottle using filtered seawater using a funnel to guide the sediment slice into the bottle. Sediment from the top surface of the cutting plate was washed into same bottle. Sediment on the **bottom** surface of plate, however, was washed into next bottle (i.e. the next, deeper layer). Deeper sediment layers were extruded from the core tube by 1 cm, as measured with ruler, before slicing it off with the cutting plate, and placed directly into the bottle. Each layer was preserved in buffered, filtered 5% sweater formalin. The bottles were well shaken before storage.

Xana da Silva, Tania Smith

4. Metazoan meiofaunal samples:

Station	Date	Equipment	Depth (m)	Core	Samples	Comments
15712#1	17.VII.05	Combicorer	4840	1	5 slices	Good. 37 cm long: 10.5 cm whitish grey mud, overlain by darker brown mud
15720#2	19.VII.05	Mega 12	4840	3	5 slices	Good. 38.5 cm long. 10.5 cm whitish grey mud, followed by 4 cm dark brown layer overlain by lighter brown layer
15724#2	20.VII.05	Mega 12	4836	1	5 slices	Good. 35 cm long. 10 cm whitish grey mud, followed by 3 cm dark brown layer overlain by lighter brown layer

5. Foraminiferal meiofaunal samples:

Station	Date	Equipment	Depth (m)	Core	Samples	Comments
15704#1	15.VII.05	Combicorer	2188		None	Komokiacean and radiolarian? Preserved in formalin 5ml nalgene pot
15712#1	17.VII.05	Combicorer	4840	3	12 slices	Good. 41.5 cm long: 10 cm whitish grey mud, followed by 3 cm dark brown layer

						overlain by lighter brown layer
15712#1	17.VII.05	Combicorer	4840	3	1 ml from top of sediment, with 2 ml of veralin water, preserved at room temp.	Same as above
15720#2	19.VII.05	Mega 12	4840	7	12 slices	Good. 38.5 cm long. 10.5 cm whitish grey mud, followed by 4.5 cm dark brown layer overlain by lighter brown layer
15724#2	20.VII.05	Mega 12	4836	1	12 slices	Good. 37 cm long. 10 cm whitish grey mud, followed by 2.5 cm dark brown layer overlain by lighter brown layer

Otter Trawl

Two otter trawls were completed (Stas. 15711#1 and 15717#1), both collecting good and varied catches. However, the fishing nature of the two trawls was rather different. At St 15711#1 tension on the wire built up gradually soon after the wire had been paid out to 12800m and the ship's speed had been reduced to 1.5 kts. The tension was suddenly released after about 1 hour indicating that the net had probably snagged something on the seabed early in the trawl. A similar, smaller incident occurred later in the trawl. In addition, it is likely that during hauling the net caught the top of a small flat, 20m high abyssal hill, which had been seen earlier on the echo sounder record during the trawl. Despite these problems there was no damage evident to the net. The second trawl did not have these problems and there was some doubt at one stage whether it had been in contact with the seabed. However, this catch returned a good catch of fish as well as invertebrates. The monitor in both cases cut out during the descent of the net and hence there was no information from the mercury switches on the trawl door to assist in fishing. There was some doubt as to whether the beam steering unit on the ship was working. It is clear that a radical rethink on how otter trawls are undertaken in deep water is needed.

Trawl samples from the Porcupine Abyssal Plain are notable for the many different phyla represented. Most occur in low abundance and low biomass, but most marine phyla are collected

consistently in this area. The catches are dominated in terms of both abundance and biomass by holothurians, notably *Psychropotes longicauda*, *Pseudostichopus villosus*, *Oneirophanta mutabilis* and *Amperima rosea*. *Amperima* was not as abundant this time as seen in previous years. A significant number of Molpadia blakei of various sizes were collected and the catches were notable for a few specimens of *Ellipinion mollis*, *Protankyra brychia*, *Pseudostichopus aemulatus Peniagone diaphana* and *Benthodytes sp. (*probably *B. sordida)*. Several species of actiniarians were also abundant, often attached to work tubes and clinker. Asteroids were represented by the mud-swallowing porcellanasterids *Hyphalaster inermis* and *Styracaster* spp. (probably *S. elongatus* and *S. chuni*), as well as *Dytaster grandis*, *Freyella elegans* and *Freyastera* sp. (probably *F. benthophila*). Crustacea were represented by *Polycheles* sp., *Munidopsis* (probably *M. crassa*) and *Plesiopenaeus* sp., as well as several natants collected in midwater. The fish catch was photographed and selected specimens were retained, notably some exotic forms, such as gulper eels, collected in midwater.

The catch was preserved in formalin for transfer to alcohol when the samples are returned to the National Oceanography Centre, Southampton. Selected holothurians were dissected in order to study the relationship between the detritus being fed upon and the chemical composition of the gonad, gut wall and body wall, with particular reference to carotenoid pigments that appear to play an important role in reproductive output and recruitment success. The material preserved to study the sexual chemistry of deep-sea fauna is detailed in a separate section below.

Ben Boorman, Tania Smith, David Billett, Janne Kaariainen, Xana da Silva and Eulogio Soto

Abyssal megafauna

Most organisms on the deep-sea floor are deposit feeders, which depend on the downward flux of organic matter for their energy and essential nutrients. Changes in surface water productivity have been proposed as important drivers for variation in the biodiversity of deep-sea sediments, with biogeochemical provinces evident in surface waters mirrored in benthic community structure at the broad scale.

Holothurians are found in great abundance in the deep sea and are thought to be significant reservoirs of organic and inorganic carbon. Time-series sampling of megafauna at a specific locality on the Porcupine Abyssal Plain c. 48°50’N 16°30’W has shown radical changes in the

abundance of holothurians and the dominance of certain species. The samples taken from the two trawls during this cruise will be used to help to elucidate if there is a link between the supply of reproductively important carotenoids and holothurian species diversity.

Intact representatives of each of the species of holothurian recovered from the trawl were taken put in cold water and transferred to the constant temperature room. They were dissected for gut content, gut wall and gonads. The samples were quick frozen in liquid Nitrogen and then transferred into the -80 freezer. The samples will be analyzed at NOCS for pigments, using the HPLC Gibbs method.

Details of the samples taken are given in the following tables.

Species Abbreviations – Onm = *Oneirophanta mutabilis*, Pdi = *Peniagone diaphana*, Psl = *Psychropotes longicauda*, Pseudo em = *Pseudostichopus aemulatus*, Pseudo vil = *Pseudostichopus villosus*, P pro = *Paroriza prouhoi*, D val = *Deima validum*, and Molpadia = *Molpadia blakei*.

Unless stated otherwise gut and gut wall samples were taken from the middle section of the intestines.

The gut wall sample was taken from the area corresponding to the gut sediment sample.

Tania Smith

Station 15711#1 – 17/vii/05

Cryovial	Species	Gut	Gut wall	Gonad	Comments
3	Onm 1	X			Start 0430
4	Onm 1		X		
5	Onm 1			X	spent gonad
6	Onm 2	X			start 0445
7	Onm 2		X		
8	Onm 2			X	Lots of eggs - female
9	Pdi 1	X			Has gloopy guts - easily contaminated by the wall?

10	Pdi 1		X		
11	Pdi 1			X	
12	Onm 3	X			start 0510
13	Onm 3		X		
14	Onm 3			X	female
15	Onm 3		X		Foregut - red pigmented
16	Onm 4	X			
17	Onm 4		X		
18	Onm 4			X	
19	Onm 4		X		Foregut - red pigmented wall
20	Onm 5	X			
21	Onm 5		X		
22	Onm 5				No gonads
23	Onm 5		X		
24	Onm 6	X			
25	Onm 6		X		
26	Onm 6				No gonads
27	Onm 6		X		Foregut
28	Psl 1	X			
29	Psl 1		X		
30	Psl 1			X	Big eggs!
31	Psl 1		X		Foregut
32	Psl 2	X			
33	Psl 2		X		
34	Psl 2			X	Big eggs!

35	Psl 2		X		Foregut
36	Psl 2	X			Foregut
37	Psl 2				1 egg
38	Psl 2				2 eggs
39	Psl 2				3 eggs Finish 0635
40	Psl 3				Guts burst - no sample
41	Psl 4	X			
42	Psl 4		X		
43	Psl 4			X	
44	Psl 5	X			
45	Psl 5		X		(no gonad)
46	Pseudo em 1	X			
47	Psudo em 1		X		
48	Pseudo em 1			X	Part of gonad put in formalin (male ?)
49	Pseudo em 2	X			
50	Pseudo em 2		X		
51	Pseudo em 2			X	pale gonad
52	Pseudo em 3	X			Hard to dissect without bursting gut
53	Pseudo em 3		X		
54	Pseudo em 3			X	Pale gonads
55	Pseudo em 4	X			
56	Pseudo em 4		X		
57	Pseudo em 4			X	orangey gonads - some fixed in formalin
58	Pseudo em 5	X			
59	Pseudo em 5		X		

60	Pseudo em 5			X	
61	Pseudo em 5	X			cleaner sample away from wall
62	Pseudo vil 1	X			
63	Pseudo vil 1		X		
64	Pseudo vil 1			X	female
65	Pseudo vil 2	X			
66	Pseudo vil 2		X		
67	Pseudo vil 2			X	Male
68	Pseudo vil 3	X			
69	Pseudo vil 3		X		
70	Pseudo vil 3			X	Male
72	Pseudo vil 4	X			
73	Pseudo vil 4		X		
74	Pseudo vil 4			X	Male
75	Pseudo vil 5	X			Good gut contents
76	Pseudo vil 5		X		
77	Pseudo vil 5			X	Male
78	*Benthodytes*	X			start 1030 gloopy guts
79	*Benthodytes*		X		
80	*Benthodytes*			X	Purple eggs
81	P pro 1	X			
82	P pro 1		X		
83	P pro 1			X	Male
84	P pro 1			X	Female
86	P pro 2	X			

87	P pro 2		X		
89	P pro 2			X	female gonads No male
90	P pro 3	X			
91	P pro 3		X		
94	P pro 4	X			
95	P pro 4		X		
96	P pro 4			X	male
97	P pro 4			X	female
98	P pro 5	X			
99	P pro 5		X		
100	P pro 5			X	Male
101	P pro 5			X	Female
102	D. val 1	X			
103	D. val 1		X		
105	D. val 1	X			foregut (may be contaminated)
106	D. val 1		X		red pigmented wall
107	*Molpadia* 1	X			
108	*Molpadia* 1		X		
109	*Molpadia* 1			X	
110	*Molpadia* 1	X			foregut
111	*Molpadia* 1		X		deep purple wall
112	*Molpadia* 2	X			
113	*Molpadia* 2		X		
114	*Molpadia* 2			X	white - maybe male

Station 15717#1 – 19/vii/05
Lengths and weights of holothurians dissected (not dissected in grey)

Holthurian	Weight g	Length body mm	length body and tail
Oneirophanta mutabilis 1	76.3	105	
Oneirophanta mutabilis 2	53.3	95	
Oneirophanta mutabilis 3	52.4	81	
Pseudostichopus villosus 1	64.4	144	
Pseudostichopus villosus 2	164.6	148	
Pseudostichopus villosus 3	91	111	
Pseudostichopus villosus 4	192.8	146	
Pseudostichopus villosus 5	189.3	156	
Pseudostichopus villosus 6	153.1	152	
Pseudostichopus villosus 7	172.4	166	
Oneirophanta mutabilis 4	48	78	
Oneirophanta mutabilis 5	83.6	105	
Psudostichopus villosus 8	167.3	149	
Oneirophanta mutabilis 6	68	85	
Oneirophanta mutabilis 7	144.7	120	
Oneirophanta mutabilis 8	52.8	87	
Holothurian	**Weight g**	**Length body mm**	**length body and tail**
Oneirophanta mutabilis 9	75.2	84	
Oneirophanta mutabilis 10	55.7	95	
Molpadia 1	53.4	85	
Molpadia 2	60.9	85	
Molpadia 3	65.7	84	
Molpadia 4	31	61	
Psychropotes longicauda 1	81	138	229
Psychropotes longicauda 2	137.4	162	286
Psychropotes longicauda 3	130.5	168	306
Psychropotes longicauda 4	147.6	146	220
Psychropotes longicauda 5	408.6	181	363
Psychropotes longicauda 6	231	162	290
Psychropotes longicauda 7	412.5	205	348
Psychropotes longicauda 8	191.5		
Psychropotes longicauda 9	272.3	192	340

Samples taken (labelled with red pen)
Species Abbreviations – P long = *Psychropotes longicauda*, Mol = *Molpadia blakei*, Onm = *Oneirophanta mutabilis* and Pseudo vil = *Pseudostichopus villosus*.

Cryovial	Species	Gut	Gut wall	Gonad	Comments
1	P. long 5	X			
2	P. long 5		X		orange pigment on wall

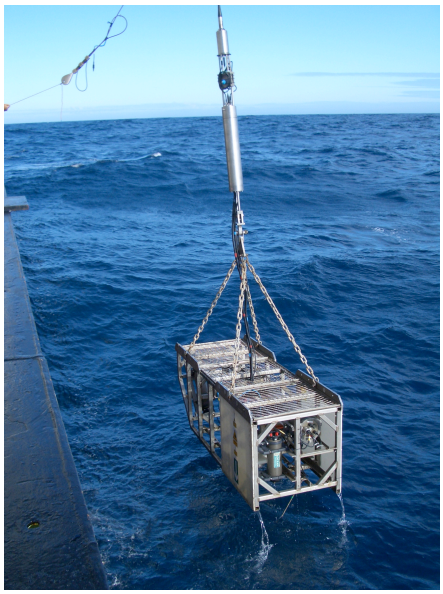
3	P. long 5			X	male
6	P long 4	X			start 0445
7	P long 4		X		(no gonads)
8	P long 3	X			
9	P long 3		X		wall not in good condition, taken from hind gut
10	P long 3			X	
11	P long 2	X			
12	P long 2		X		(no gonads)
13	P long 1	X			may be contaminated
14	P long 1		X		(No gonads)
15	Mol 4	X			guts split
16	Mol 4		X		contaminated? orange wall
17	Mol 4			X	Female
18	Mol 3	X			
19	Mol 3		X		
20	Mol 3			X	female
21	Mol 3	X			Foregut
22	Mol 3		X		foregut - good sample
23	Mol 2 (picture taken)	X			
24	Mol 2		X		Dark orange streaks on wall
25	Mol 2			X	no gonads…
26	Mol 2	X			foregut
27	Mol 2		X		foregut
27	Mol A			X	eggs and juice
29	Mol 1 B			X	eggs and juice

30	Mol 2			X	eggs and juice
31	Mol 1			X	eggs and ovaries
32	Mol 2			X	eggs and ovaries
33	Onm 10	X			
34	Onm 10		X		
35	Onm 10			X	female
36	Onm 10		X		Foregut - sediment directly against wall stained red
37	Onm 9	X			
38	Onm 9		X		
39	Onm 9				no gonads
40	Onm 8	X			
41	Onm 8		X		
42	Onm 8	X			Foregut
43	Onm 8		X		Foregut
44	Onm 7	X			
45	Onm 7		X		(no gonad)
46	Onm 7	X			Foregut
47	Onm 7		X		Foregut
48	Onm 6	X			
49	Onm 6		X		
50	Onm 6			X	
51	Onm 6	X			foregut
52	Onm 6		X		foregut
55	P vil 8	X			
56	P vil 8		X		No dark foregut

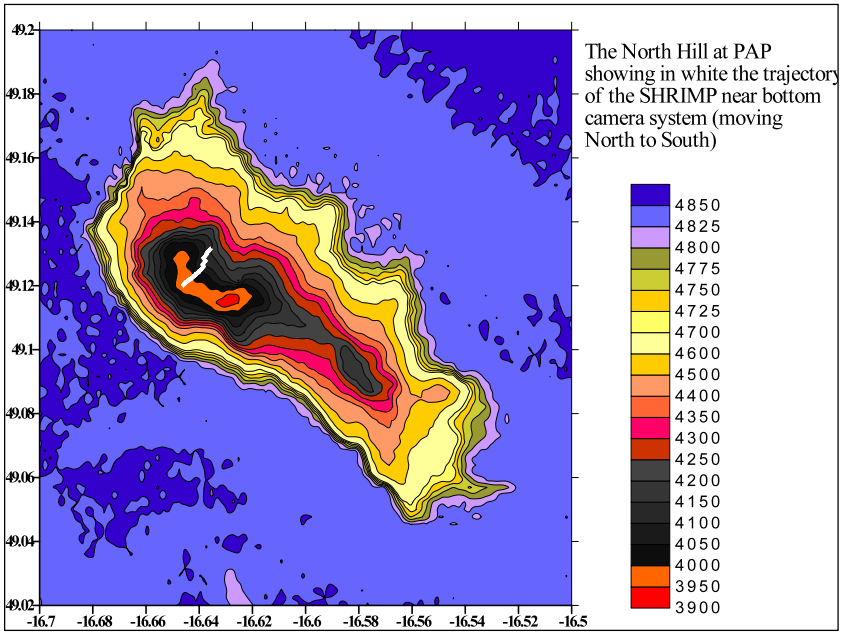
57	P vil 8			X	
58	Onm 5	X			
59	Onm 5		X		
60	Onm 5			X	Foregut
61	Onm 5		X		
62	P vil 7	X			
63	P vil 7		X		
64	P vil 7			X	male
65	P vil 6	X			
66	P vil 6		X		
67	P vil 6			X	male
68	P long 6			X	7 cryos of gonoducts and eggs
69	P long 7	X			
70	P long 7		X		
72	P long 7			X	male
73	P vil 3	X			
74	P vil 3		X		
75	P vil 3			X	female
76	P vil 2	X			
77	P vil 2		X		
75	P vil 2			X	female

Shrimp deployment

The near bottom camera system SHRIMP (see photo) was deployed on the seamount to the north of the PAP site in order both to trial the new SHRIMP control system but also to obtain visual data from this very rocky environment which can not be samples using trawls, cores or grabs.



Shrimp during recovery (Left.)



Trajectory of the shrimp deployment(Left)

Moorings

Moorings recovered

Mrg No.	Mooring ID	Deployed	Recovered
2004/21	PAP 1	CD158 JUNE 04	D295T JULY 05
2004/22	PAP 2	CD158 JUNE 04	D295T JULY 05
2004/23	PAP 3	CD158 JUNE 04	D295T JULY 05

MOORINGS DEPLOYED

Mrg No.	Mooring ID	Deployed	Recovery
2005/33	PAP 1	D295T JULY 05	2006
2005/34	PAP 2	D295T JULY 05	2006
2005/35	PAP 3	D295T JULY 05	2006
2005/36	PAP 4 MMP	D295T JULY 05	2006

Diary of events.

Monday 4th July.

Sailed from Falmouth.

Wound on moorings PAP1 and PAP4 mmp.

Prepared deck hardware and instrumentation for sea.

Checked ARGOS beacons with GONIO, all OK.

Tuesday 5th July.

Wound on PAP3 sediment trap mooring. Batteried up, checked and started setting up instruments for deployment.

Wednesday 6th July.

Laid out Kiel supplied telemetry wire and buoy. Terminated the wire with sub sea connectors for use on the swivels. Fitted swivel and clamped SBE 37 to wire and conducted a test. The test involved using the GONIO to pick up the signal from the tele buoy. The signal is then de coded using a laptop with the Kiel supplied DECODE software. This all worked well.

Thursday 7th July.

0530 gmt, attempted to recover PAP1, after a number of unsuccessful attempts to communicate with both releases, using both new and old deck units, it became apparent that the only course of action was to send the release command to the releases and keep a look out. This was unsuccessful so the decision was made to head for the PAP2 deployment position.
Deployment of PAP2 started at 0945gmt. The telemetry buoy and wire was deployed by hand up to the sub surface steel sphere, the rest of the mooring was deployed in the conventional manner, stopping at pre determined points to clamp on the seabirds, and using the stopper chain to insert the buoyancy in line. Anchor away at 1223gmt.
Ranged on releases on the way down.
1400 gmt, started deployment of PAP4 mmp mooring. All went well. Ready to release anchor at 1600 gmt, unfortunately we ended up over a mound so we made a slight turn to Port and steamed to correct depth, anchor away at 1740 gmt. Ranged releases on the way down.
Checked GONIO to make sure ARGOS went under.

Friday 8th July.

0900 gmt, started interrogation of releases on PAP2. No meaningful ranges were received from the releases. Release commands sent to both releases a number of times and we slowly made our way to the mooring position. The sub surface buoy was spotted on the surface and we headed towards it.
Upon recovery it became apparent that the mooring had been snagged by a fishing vessel which would explain why the telemetry buoy had stopped working and subsequently disappeared.
One of the wires parted on recovery. This happened on the low tension side of the double barrel system. Investigation revealed that the wire had been terminated with a press type fitting similar to the ESCO fittings we use at NOC, unfortunately there was no protection put over the exposed wire (heat shrink or boot) and so the bare wire had been open to the elements for a year or so. This obviously resulted in severe corrosion. There were no injuries resulting from the wire parting.

Friday 8th July cont.

At approximately 1600 gmt the subsurface buoy of PAP4 mmp mooring that we had deployed on the 7th, was spotted on the surface. We had no ARGOS signal on the GONIO.

The decision was made to leave the recovery until the morning as light was fading and so was our will to live.

Saturday 9th July.

0900 gmt, interrogated PAP4 mmp release, good ranges were received and the release was fired. As we could already see the sub surface sphere, we were ready to recover straight away, and so we did. It all went well.

The wires, all PARAFIL construction, were turned around ready for a re-deployment. We measured the lengths of the PARAFIL as we went and all the lengths were accurate.

The conclusion to why the subsurface buoy was on the surface is that we had not gone passed the mound far enough and so had hit the mound on its outer edge.

The ARGOS beacon had not worked; we stripped it down and could find nothing obvious that was wrong with it. We put it back together and tested it again with the GONIO, it was working again. It was obviously an intermittent fault and the decision was made to deploy the suspect ARGOS beacon on PAP1 and use the good beacon on PAP4 mmp. This decision was made on the basis that it was better to have a beacon that might work rather than none at all, and put the good beacon on PAP4 as it is a more expensive mooring.

Wound on mooring PAP1 ready for deployment.

.

031.2

03.2

03.2

03.2

03.2

03.2

03.2

03.2

03.2

03.2

03.2 - but the job was put to Downers as a reputable company and to see an error of this magnitude in a 900m length would be horrendous. No repeat measurement was made at NOC on return from Downers.

Parafil line length - the Parafil line has been consistently correct in length throughout the RAPID 26.N mooring arrays and the suppliers Linear Composites are specialists in this field.

Stretch of Parafil - there should be limited movement of this material as per RAPID moorings and we do not expect significant errors to come from this source. However these are long lengths compared to any other application and this needs more investigation. Lengths not measured at NOC pre deploy.

Depth - soundings were made throughout the operation and depths corrected - the ground is essentially flat and a variation of 60+ metres should have been easily noticed.

Thus it appears that the subsurface buoy is at 25 metres depth which is a relative safe depth and immediate recovery need not take place.

-

1) All line lengths need UKORS check measuring prior to deploy using a known accurate measuring device.

2) On return to the site in 2006, the mooring is to be navigated acoustically to determine an accurate geographical position and from this to sound the position to re-establish depth on the mooring site.

3) Recover the mooring and measure all the mooring lines accurately onboard. Establish if there are any line length errors.

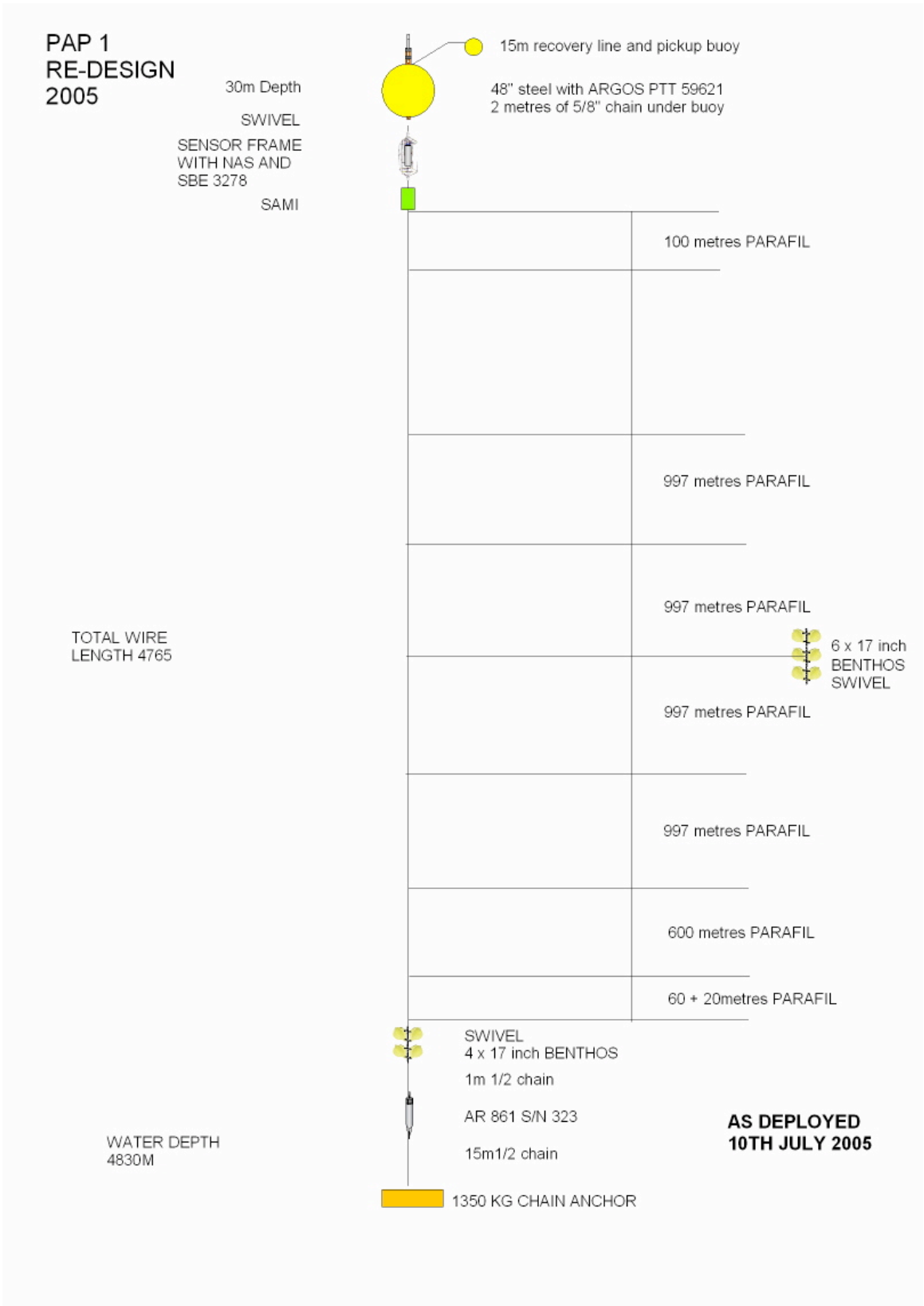
4) Before deploy as above measure all lines onto winch - either at sea or pre-wound at NOC.

Action - to do the above - essential. Implications more time will be required at NOC and some more investment in measuring and reeling is seen as necessary.

To investigate installation of an ARGOS beacon to the subs buoy - this also has applications for RAPID telemetry applications - thus if telemetry is wiped out either due to upper mooring line failure or instrumental failure there is a back up emergency beacon on the "main" part of the mooring .
At present with no telemetry buoy we have no knowledge of what is going on at PAP1. This also acts as a backup subsequent to deploy to check that the subsurface is indeed submerged.

In the light of the above we should now consider using only syntactic buoys as the main subsurface buoy for telemetry moorings applications, as these are capable of carrying embedded ARGOS beacons within the hull, steel is not. Implications are cost?

Notes compiled by Ian Waddington after the meeting held on 15th August 2005.


PAP 1
RE-DESIGN
2005
30m Depth
SWIVEL
SENSOR FRAME
WITH NAS AND
SBE 3278
SAMI
15m recovery line and pickup buoy
48" steel with ARGOS PTT 59621
2 metres of 5/8" chain under buoy
100 metres PARAFIL
997 metres PARAFIL
997 metres PARAFIL
6 x 17 inch
BENTHOS
SWIVEL
997 metres PARAFIL
997 metres PARAFIL
600 metres PARAFIL
60 + 20metres PARAFIL
TOTAL WIRE
LENGTH 4765
SWIVEL
4 x 17 inch BENTHOS
1m 1/2 chain
AR 861 S/N 323
15m1/2 chain
1350 KG CHAIN ANCHOR
WATER DEPTH
4830M
AS DEPLOYED
10TH JULY 2005

MRG ID: PAP 1

MRG ID: PAP 1

CRUISE D295T

UKORS MOORINGS GROUP

FALMOUTH - UK DEPLOYMENT **UKORS ID** 2005/33

LATITUDE 49 2.8N **DATE** 10/7/05

LONGITUDE 16 37.5W **DAY**

NOTE ALL TIMES RECORDED IN GMT

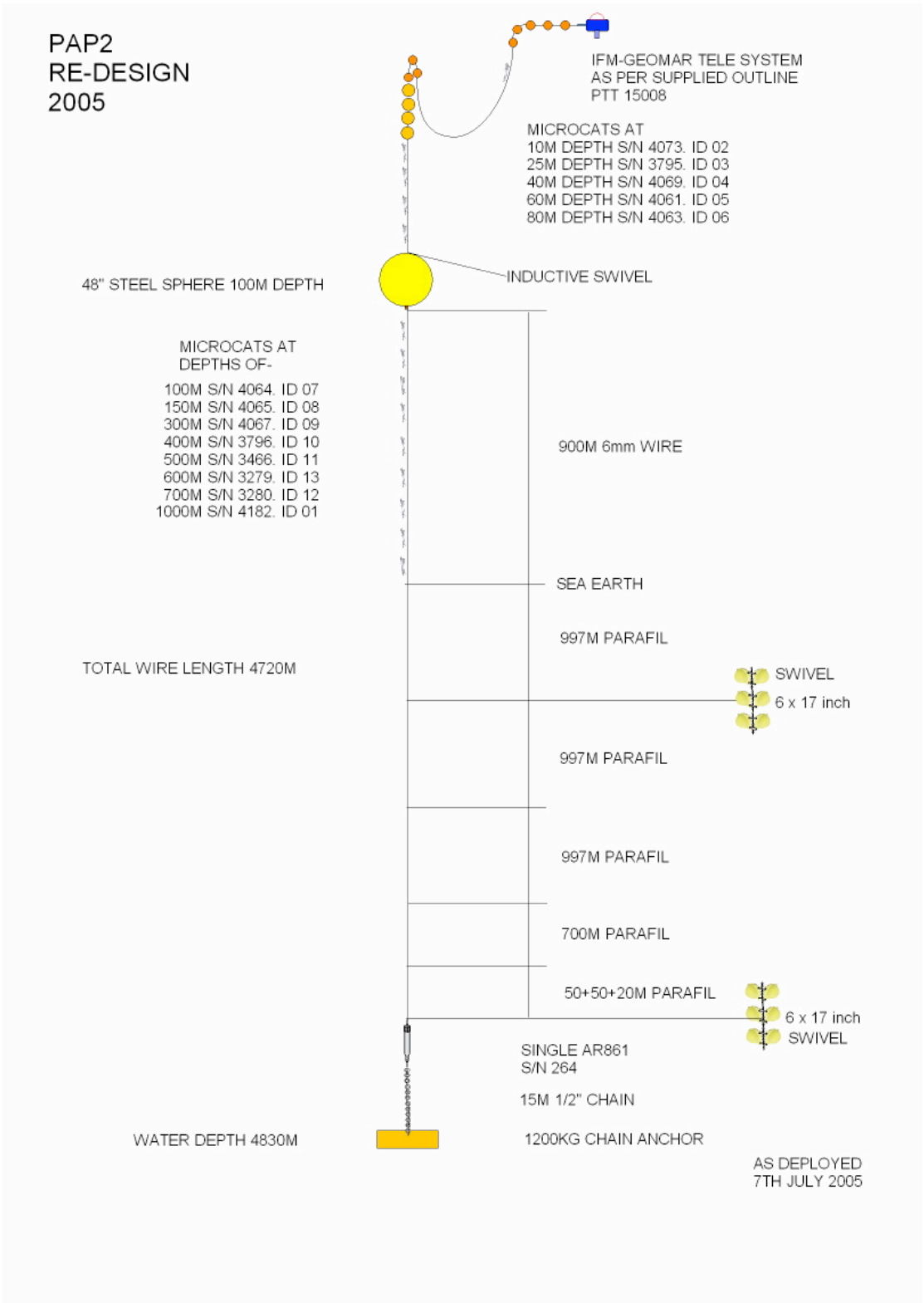
COMMENCE TIME 1050

COMPLETION TIME 1230

ITEM	SER NO	COMMENT	TIME
GLASS 17 PICK UP		YELLOW	1050
REC LINE		15M 20MM POLYPROP	
48" STEEL SPHERE		SUB-SURFACE	
ARGOS BEACON	TO6-049	PTT 59621	
SENSOR FRAME	3278	SBE 37	
SAMI			
PARAFIL		100M	
PARAFIL		997M	
PARAFIL		997M	
BOUYANCY		6 OFF 17" GLASS SPHERES	
PARAFIL		997M	
PARAFIL		997M	
PARAFIL		600M	
PARAFIL		60M	
PARAFIL		20M	
BUOYANCY		4 OFF 17" GLASS SPHERES	
CHAIN ½"		1M	
ACOUSTIC RELEASE	323	AR861	
CHAIN ½"		15M	
CHAIN ANCHOR		1350KG	1230

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS


PAP2
RE-DESIGN
2005
IFM-GEOMAR TELE SYSTEM
AS PER SUPPLIED OUTLINE
PTT 15008
MICROCATS AT
10M DEPTH S/N 4073. ID 02
25M DEPTH S/N 3795. ID 03
40M DEPTH S/N 4069. ID 04
60M DEPTH S/N 4061. ID 05
80M DEPTH S/N 4063. ID 06
48" STEEL SPHERE 100M DEPTH
INDUCTIVE SWIVEL
MICROCATS AT
DEPTHS OF-
100M S/N 4064. ID 07
150M S/N 4065. ID 08
300M S/N 4067. ID 09
400M S/N 3796. ID 10
500M S/N 3466. ID 11
600M S/N 3279. ID 13
700M S/N 3280. ID 12
1000M S/N 4182. ID 01
900M 6mm WIRE
SEA EARTH
997M PARAFIL
TOTAL WIRE LENGTH 4720M
SWIVEL
6 x 17 inch
997M PARAFIL
997M PARAFIL
700M PARAFIL
50+50+20M PARAFIL
6 x 17 inch
SWIVEL
SINGLE AR861
S/N 264
15M 1/2" CHAIN
WATER DEPTH 4830M
1200KG CHAIN ANCHOR
AS DEPLOYED
7TH JULY 2005

UKORS MOORINGS GROUP

CRUISE D295T

MRG ID: PAP 2

FALMOUTH - UK DEPLOYMENT **UKORS ID** 2005/34

LATITUDE 49 1.9N **DATE** 7/7/05

LONGITUDE 16 26.3W **DAY**

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 0945

COMPLETION TIME 1223

ITEM	SER NO	COMMENT	TIME
TELEMETRY BUOY		KIEL SUPPLIED	0945
3/16" JACKETED WIRE		KIEL SUPPLIED	
MICROCAT	4073	ID 02	
MICROCAT	3795	ID 03	
MICROCAT	4069	ID 04	
MICROCAT	4061	ID 05	
MICROCAT	4063	ID 06	
48" STEEL SPHERE		SUB-SURFACE WITH TELE SWIVEL	
6 – 8MM WIRE		900M	
MICROCAT	4064	ID 07	
MICROCAT	4065	ID 08	
MICROCAT	4067	ID 09	
MICROCAT	3796	ID 10	
MICROCAT	3466	ID 11	
MICROCAT	3279	ID 13	
MICROCAT	3280	ID 12	
MICROCAT	4182	ID 01	
SEA EARTH		ON TERMINATION	
PARAFIL		997M	
BUOYANCY		6 OFF 17" GLASS SPHERES	
PARAFIL		997M 997M 700M 120M	
BUOYANCY		6 OFF 17" GLASS SPHERES	
ACOUSTIC RELEASE	264	AR861	
CHAIN ½"		15M	
CHAIN ANCHOR		1200KG	1223

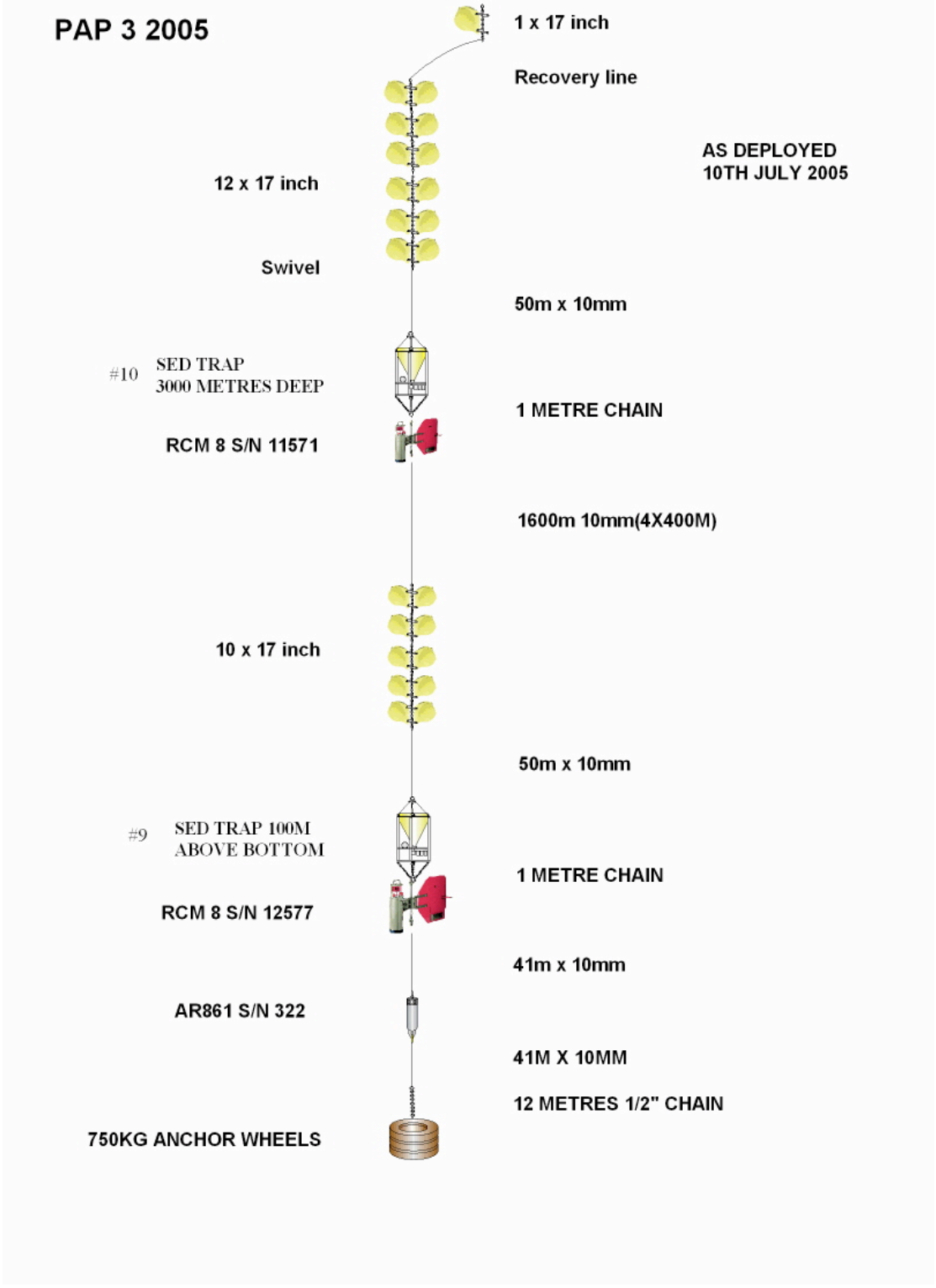
MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

TELEMETRY SYSTEM SUPPLIED BY KIEL UP TO SUB SURFACE BUOY
MINUS SWIVEL AND SEABIRDS

UKORS PERSONNEL

ROB MCLACHLAN AND CHRIS CROWE


PAP 3 2005
1 x 17 inch
Recovery line
AS DEPLOYED
10TH JULY 2005
12 x 17 inch
Swivel
50m x 10mm
#10
SED TRAP
3000 METRES DEEP
1 METRE CHAIN
RCM 8 S/N 11571
1600m 10mm(4X400M)
10 x 17 inch
50m x 10mm
#9
SED TRAP 100M
ABOVE BOTTOM
1 METRE CHAIN
RCM 8 S/N 12577
41m x 10mm
AR861 S/N 322
41M X 10MM
12 METRES 1/2" CHAIN
750KG ANCHOR WHEELS

UKORS MOORINGS

GROUP CRUISE D295T

MRG ID PAP 3

FAIRLEY - GOVAN DEPLOYMENT

UKORS ID 2005/35

LATITUDE 49 1.7N

DATE 10/7/05

LONGITUDE 16 21.6W

DAY

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME 1805

COMPLETION TIME 1935

ITEM	SER NO	COMMENT	TIME
PICK UP BUOY		17" GLASS SPHERE	1805
RECOVERY LINE		15M POLYPROP	
BUOYANCY		12 OFF 17" GLASS SPHERES	
10MM POLYESTER		50M	
SEDIMENT TRAP	11262-06	DIRECTLY ABOVE RCM	
RCM 8	11571		
10MM POLYESTER		1600M (4 OFF 400M)	
BUOYANCY		10 OF 17" GLASS SPHERES	
10MM POLYESTER		50M	
SEDIMENT TRAP	11262-08	DIRECTLY ABOVE RCM	
RCM 8	12577		
10MM POLYESTER		41M	
ACOUSTIC RELEASE	322	AR 861	
10MM POLYESTER		41M	
CHAIN ½"		12M	
ANCHOR		800KG WHEELS	1925

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

UKORS PERSONNEL

ROB MCLACHLAN AND CHRIS CROWE

UKORS MOORINGS GROUP

CRUISE D295T

		MRG ID	PAP4 MMP
FALMOUTH - UK	DEPLOYMENT	**UKORS ID**	2005/36
LATITUDE	48 58.5N	**DATE**	10/7/05
LONGITUDE	16 37.5W	**DAY**	

NOTE ALL TIMES RECORDED IN GMT

COMMENCE TIME	1340
COMPLETION TIME	1540

ITEM	SER NO	COMMENT	TIME
PICK UP BUOY		17" GLASS SPHERE	1340
RECOVERY LINE		15M POLYPROP	
48" STEEL SPHERE			
ARGOS BEACON	TO6-050	PTT 59622	
PARAFIL		997M	
MMP STOP		AT 31M DEEP	
MMP		DEPLOYED USING SLIP ROPE	
MMP STOP		AT 1000M	
PARAFIL		997M	
BUOYANCY		6 OFF 17" GLASS SPHERES	
PARAFIL		997M	
PARAFIL		997M	
PARAFIL		700M	
PARAFIL		85M	
BUOYANCY		4 OFF 17" GLASS SPHERES	
CHAIN ½"		1M	
ACOUSTIC RELEASE	324	AR 861	
CHAIN ½"		15M	
CHAIN ANCHOR		1350KG	1540

MOORING METHOD FREEFALL DEPLOYMENT

COMMENTS

UKORS PERSONNEL

ROB MCLACHLAN AND CHRIS CROWE

ACOUSTIC RELEASE DETAIL

The acoustic releases used throughout the array are IXSEA AR861 units each having a unique ARM command but with common other commands throughout as;

RELEASE	1455
RELEASE WITH PINGER	1456
PINGER ON	1447
PINGER OFF	1448
DIAGNOSTIC	1449

MOORING	SER.NO	ARM/RANGING
PAP 1	323	14D3
PAP 2	264	14B5
PAP 3	322	14D2
PAP 4	324	14D4

CURRENT METERS

Aanderaa current meter's are used in the pap mooring array – RCM 7/8 a rotor vane instrument.
They are self recording to a data storage device.
The RCM 7/8 type is set to record at 60 sec intervals.
Scaling set up and calibration of sensors was carried out at NOC.

SUMMARY

CURRENT METER SERIAL NO.	Temp range	SAMPLE INT.	DATE / DAY
Rcm 8 11571	Position 1 (low)	60 secs	
Rcm 8 12577	Position 1 (low)	60 secs	

SEDIMENT TRAPS

The sediment traps were set up by Richard Lampitt and C.Crowe
Using crosscut for windows.
Several problems were encountered with one trap having a older firmware version which had a several bugs.
The trap wouldn't take a year long deployment.
So we had to work out what it could take, whether it was a time problem or a power problem. It ended up that it wouldn't deploy for a length of time and would sample the full 22 samples.
Below are the two final set ups named trap `A` ML11262-08 and trap `B` ML11262-06. Faulty unit.

```
        McLane Research Laboratories, USA
          ParFlux 21-Cup Sediment Trap
             With Compass and Tilt
       Version: pst-21c0.c   S/N: ML11262-06

       ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
       º           Main Menu           º
       ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
           Sun Jul 10 14:49:51 2005

       <1> Set Time            <5> Create Schedule
       <2> Diagnostics         <6> Deploy System
       <3> Fill Containers     <7> Offload Data
       <4> Sleep               <8> Contacting McLane

        Selection? 6

Is the rotator aligned to the
open hole (Yes/No) [N] ? y

Clock reads 07/10/105  14:49:56
Change time & date (Yes/No) [N] ? n

Existing deployment data file will be
erased.  Continue (Yes/No) [N] ? y

Enter new deployment schedule (Yes/No) [N] ? y

Enter the number of events to program  (0 to 22) ? 15

       ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
       º         Schedule Menu         º
       ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼

        <1> Enter each event time
        <2> Enter start date & interval
        <3> Enter start date & end date
        <M> Main Menu

        Selection  ? 1

Schedule Verification

Event   1 of  15 = 07/11/105  12:00:00
Event   2 of  15 = 07/24/105  12:00:00
Event   3 of  15 = 08/07/105  12:00:00
Event   4 of  15 = 08/21/105  12:00:00
Event   5 of  15 = 09/04/105  12:00:00
Event   6 of  15 = 09/18/105  12:00:00
```

```
Event   7 of  15 = 10/02/105  12:00:00
Event   8 of  15 = 10/16/105  12:00:00
Event   9 of  15 = 11/13/105  12:00:00
Event  10 of  15 = 12/25/105  12:00:00
Event  11 of  15 = 02/05/106  12:00:00
Event  12 of  15 = 03/19/106  12:00:00
Event  13 of  15 = 04/16/106  12:00:00
Event  14 of  15 = 04/30/106  12:00:00
Event  15 of  15 = 05/14/106  12:00:00

Modify an event  (Yes/No) [N] ? n
Current Header reads:


Do you want a different header (Yes/No) [N] ? y
Enter new header (three lines, 80 characters/line)

> dep.xxxx d295t trap b
>
>
Current Header reads:

dep.xxxx d295t trap b

Do you want a different header (Yes/No) [N] ? n

Enter tilt sample interval [minutes] (45 to 120) ? 120

System status:


 07/10/105  14:55:49   21.9 Vb    26øC   1øT  289øH  aligned


Caution:  Deployment will overwrite the
        EEPROM data backup cache.

Proceed with the deployment (Yes/No) [N] ? y

 >>> Remove communication cable and <<<
      >>> attach dummy plug. <<<
>>> Sediment trap is ready to deploy. <<<



<07/10/105  14:55:57> Waiting for Event 01 of 15 @ 07/11/105  12:00:00

<07/10/105  14:55:58> Sleeping . . .
```

```
     McLane Research Laboratories, USA
       ParFlux 21-Cup Sediment Trap
          with Compass and Tilt
   Version: pst-21c3.c   S/N: ML11262-08

    ÉÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ»
    º          Main Menu          º
    ÈÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍÍ¼
       Sun Jul 10 14:57:09 2005

   <1> Set Time           <5> Create Schedule
   <2> Diagnostics         <6> Deploy System
   <3> Fill Containers      <7> Offload Data
   <4> Sleep               <8> Contacting McLane

     Selection  ? 6

Is the rotator aligned to the
open hole (Yes/No) [N] ? y

Clock reads 07/10/2005 14:57:14
Change time & date (Yes/No) [N] ? n

Existing deployment data file will be
erased.  Continue (Yes/No) [N] ? y

Enter new deployment schedule (Yes/No) [N] ? n

Schedule Verification

Event   1 of  22 = 07/11/2005 12:00:00
Event   2 of  22 = 07/24/2005 12:00:00
Event   3 of  22 = 08/07/2005 12:00:00
Event   4 of  22 = 08/21/2005 12:00:00
Event   5 of  22 = 09/04/2005 12:00:00
Event   6 of  22 = 09/18/2005 12:00:00
Event   7 of  22 = 10/02/2005 12:00:00
Event   8 of  22 = 10/16/2005 12:00:00
Event   9 of  22 = 11/13/2005 12:00:00
Event  10 of  22 = 12/25/2005 12:00:00
Event  11 of  22 = 02/05/2006 12:00:00
Event  12 of  22 = 03/19/2006 12:00:00
Event  13 of  22 = 04/16/2006 12:00:00
Event  14 of  22 = 04/30/2006 12:00:00
Event  15 of  22 = 05/14/2006 12:00:00
Event  16 of  22 = 05/28/2006 12:00:00
Press any key to continue.
Event  17 of  22 = 06/11/2006 12:00:00
```

```
Event  18 of  22 = 06/25/2006 12:00:00
Event  19 of  22 = 07/09/2006 12:00:00
Event  20 of  22 = 07/23/2006 12:00:00
Event  21 of  22 = 08/06/2006 12:00:00
Event  22 of  22 = 08/20/2006 12:00:00

Modify an event  (Yes/No) [N] ? n
Current Header reads:


Do you want a different header (Yes/No) [N] ? y
Enter new header (three lines, 80 characters/line)

> dep.xxxx d295t trap a
>
>
Current Header reads:

dep.xxxx d295t trap a

Do you want a different header (Yes/No) [N] ? n

Enter tilt sample interval [minutes] (59 to 140) ? 140

System status:


 07/10/2005 14:58:07   20.9 Vb    26øC   2øT  347øH  aligned


Caution:  Deployment will overwrite the
          EEPROM data backup cache.

Proceed with the deployment (Yes/No) [N] ? y

 >>> Remove communication cable and <<<
      >>> attach dummy plug. <<<
>>> Sediment trap is ready to deploy. <<<



<07/10/2005 14:58:12> Waiting for Event 01 of 22 @ 07/11/2005 12:00:00

<07/10/2005 14:58:13> Sleeping . .
```

McLane Moored Profiler Ballast Sheet	
Project:	**SOC/Stuart Cunningham**
Date Ballasted:	**11/6/2003**
MMP S/N:	**11672-02**
MMP Electronics S/N:	**5237**
CTD S/N:	**41CP-0701**
ACM S/N:	**1667**
Glass Sphere #1 S/N:	**104476**
Glass Sphere #2 S/N:	**104513**
MMP Software Version:	**mmp-3_01.c**
Deployment Defined Values (Given By User)	**Mooring EB2**
Deployment (Neutral) Pressure (in db):	1700
Deployment (Neutral) Temperature (in °C):	4.933
Deployment (Neutral) Salinity (pss):	35.1545
Deployment (Neutral) Density (in g/cc):	1.0355404
Deployment Site Latitude:	26 29.9'
Deployment Site Longitude:	18 20'
Deployment Date:	not given
Recovery Date:	not given
Measured Weights (note: water weights are to 1g accuracy and air weights are to 10g accuracy)	
MMP Air Weight w/o battery (in g):	61340
Tare Water Weight (includes test battery air weight) (in g):	7070
MMP+Tare Water Weight (in g):	451.7
Lithium Battery Air Weight (in g): **BATTERY NUMBER 59**	5220
Calculated Values and Ballasting Constants	
1 - MMP Water Weight (in g):	-1398.3
2 - Ballast Tank Water Temperature (in °C):	18
3 - Water Density (from table in g/cc):	0.998625
4 - MMP Volume (in cc)	68051.87
5 - MMP Compressibility Constant (in cc/db)	0.3
6 - MMP Volume Change @ Deployment Pres. (in cc):	510
7 - MMP Volume @ deployment Pres. (in cc):	67541.87
8 - MMP Volume Temp. Correction Const. (in cc/°C):	6
9 - Temperature Difference (in °C):	13.067
10 - MMP Volume Change @ Deployment Temp.(in cc):	78.402
11 - MMP Volume @ Deployment Temp. & Pres.(in cc):	67463.47
12 - Calculated Air Weight for Neutral MMP @ Deployment Pressure (in g):	69861.15
13 - Weight Difference (in g):	3301.15
14 - Ballast Weight (in g):	**3173**
15 - Average Motor Current Difference from Previous Deployment (in mA):	0
16 - Effective Motor Current Change for Neutrally Bouyant MMP (in mA):	0
17 - Ballast Air Weight Correction based on 4 g/mA Effective Motor Current (in g)	0
18 - Ballast Water Weight Correction based on density of lead (in g):	0
19 - Corrected Ballast Weight (in g):	**3173**
Notes:	
Item 15 is calculated as Average Down Profile Motor Current - Average Up Profile Motor Current	
If ballast is added to pressure housing item 19 is ballast air weight.	
If ballast is added outside the pressure housing item 19 is ballast water weight.	

MMP SET UP

serial 11872-01

profiling start date 10/07/05 deployed 15:35 ,
start down 18:00
start profiling 23:00
“ “ finish date 12/07/06
doing 1031 profiles

times GMT .

pairs burst = 1
paired profiles = enabled
shallow pressure = 30 dbar (Richard changed from 40 dbar and was aware of the power implications of ramming the stopper) c.crowe.
deep pressure = 1000dbar
shallow error = 100dbar
deep error = 50dbar

SBE SET UP

#ID INTERVAL =1200
#ID SAMPLENUM=0
#ID START DDMMYY=070705
#ID START HHMMSS=051000
#ID STARTLATER

THE TELEMTRY BUOY TRANSMITTED EVERY FOUR HOURS FOR AROUND 90 MIN`S
.

Acknowledgements

Without the excellent help and professionalism of the ship's officers and crew, none of this would have been possible. As principal scientist I extend my thanks Captain Roger Chamberlain and all of his staff on board.

Richard Lampitt

Appendices

Appendix 1: CTD bottle log

Cruise	D295T
Cast	1
Station	15686
Date	07/07/2005
Lat	49°2.974N
Long	16°25.260W
Water depth	727m
Time in	0136 GMT
Time at bottom	0200 GMT
Time on deck	0240 GMT

*frozen
** analysed on board

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cy
		ICCM*	SOC**	Mark	Tot	>10µm	Tot, >10µm	Tot, <2, <20µm							Lugols	Formalin	Ross
3	300	300	300	7								300	300	300	300	300	
4	250	250	250	6								250	250	250	250	250	250
7	200																
8	150	150	150									150	150	150	150	150	150
9	100	100b	100b	5	1%	1%	1%	1%	1%	1%	1%			100b	100b	100b	100
10	100	100a	100a									100	100	100a	100a	100a	
11	70	70b	70b	4	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%			70b	70b	70b	70
12	70	70a	70a									70	70	70a	70a	70a	
13	50	50	51									50	50	50	50	50	50
14	25	25b	25b	3	14%	14%	14%	14%	14%	14%	14%			25	25	25	25
15	25	25a	25a														
16	15	15b	15b	2	33%	33%	33%	33%	33%	33%	33%			15b	15b	15b	15
19	15	15a	15a									15	15	15a	15a	15a	
20	10	10c	10c					55% (size frac)	55%	55%	55%			10b	10b	10b	10
21	10	10b	10b		55%	55%	55%	55%	55%	55%	55%						
22	10	10a	10a									10	10	10a	10a	10a	
23	surface	surf b	surf b	1	97%	97%	97%	97%	97%	97%	97%			surf b	surf b	surf b	surf
24	surface	surf a	surf a									surf	surf	surf a	surf a	surf a	

Cruise	D295T
Cast	3
Station	15689 #2
Date	07/07/2005
Lat	49°2.900N
Long	16°40.100W
Water depth	4811
Time in	2011GMT
Time at bottom	2133GMT
Time on deck	2342GMT

*frozen
** analysed on board

Bottle #	Depth (m)	Nutrients		Chlorophyll		14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Tot	>10µm									Lugols	Formalin	Ross	Blanca
1	4500			X	X	X	X	X	X	X			4500	4500	4500	X	4500
2	4000	4000	4000	X	X	X	X	X	X	X	4000	4000	4000	4000	4000	X	4000
3	3500	3500	3500	X	X	X	X	X	X	X	3500	3500	3500	3500	3500	X	3500
4	3000			X	X	X	X	X	X	X			3000	3000	3000	X	3000
7	2500	2500b	2500b	X	X	X	X	X	X	X	2500	2500	2500	2500	2500	X	2500
8	2000	2500c	2500c	X	X	X	X	X	X	X			2000	2000	2000	X	2000
9	1500	1500	1501	X	X	X	X	X	X	X			1500	1500	1500	X	1500
10	1000	1000e	1000e	X	X	X	X	X	X	X	1000	1000	1000	1000	1000	X	1000
11	1000	1000d	1000d	X	X	X	X	X	X	X	1000	1000	1000	1000	1000	X	1000
12	1000	1000c	1000c	X	X	X	X	X	X	X	1000	1000	1000	1000	1000	X	1000
13	1000	1000b	1000b	X	X	X	X	X	X	X	1000	1000	1000	1000	1000	X	1000
14	1000	1000a	1000a	X	X	X	X	X	X	X	1000	1000	1000	1000	1000	X	1000
15	750	750	750	X	X	X	X	X	X	X	1000	1000	750	750	750	X	750
16	500	500	500	X	X	X	X	X	X	X			500	500	500	X	500
19	250	250	250	X	X	X	X	X	X	X			250	250	250	X	250
20	150	150	150	X	X	X	X	X	X	X			150	150	150	X	150
21	100	100	100	X	X	X	X	X	X	X			100	100	100	X	100
22	50			X	X	X	X	X	X	X			50	50	50	X	50
23	25	25	25	X	X	X	X	X	X	X			25	25	25	X	25
24	10	10	10	X	X	X	X	X	X	X			10	10	10	X	10

Cruise	D295T
Cast	4
Station	15689 #3
Date	08/07/2005
Lat	49°2.100
Long	16°39.8
Water depth	4810
Time in	0057GMT
Time at bottom	0105GMT
Time on deck	0120GMT

*frozen
** analysed on board

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot							Lugols	Formalin	Ross	Blanca
1	58	58c	58c	X														
6	58	58b	58b	X	1%	1%	1%	1%	1%	1%	1%	X	X	X	X	X	58	X
3	58	58a	58a	X								X	X	X	X	X		X
4	35	35c	35c	X	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	4.5%	X	X	X	X	X	35b	X
7	35	35b	35b	X								X	X	X	X	X	35a	X
8	35	35a	35a	X								X	X	X	X	X		X
9	22	22c	22c	X	14%	14%	14%	14%	14%	14%	14%	X	X	X	X	X		X
10	22	22b	22b	X								X	X	X	X	X		X
11	22	22a	22a	X								X	X	X	X	X		X
12	12	12c	12c	X	33%	33%	33%	33%	33%	33%	33%	X	X	X	X	X	12	X
13	12	12b	12b	X								X	X	X	X	X		X
14	12	12a	12a	X								X	X	X	X	X		X
15	7	7c	7c	X	55%	55%	55%	55%	55%	55%	55%	X	X	X	X	X	7	X
26	7	7b	7b	X								X	X	X	X	X		X
19	7	7a	7a	X								X	X	X	X	X		X
20	3	3e	4e	X								X	X	X	X	X		X
21	3	3d	3d	X								X	X	X	X	X	3	X
22	3	3c	3c	X								X	X	X	X	X		X
23	3	3b	3b	X								X	X	X	X	X		X
24	3	3a	3a	X	97%	97%	97%	97%	97%	97%	97%	X	X	X	X	X		X

Cruise	D295T
Cast	5
Station	15701
Date	11/07/2005
Lat	49°0.690N
Long	16°32.754
Water depth	4808
Time in	0506 GMT
Time at bottom	0522 GMT
Time on deck	0606 GMT

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cy
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot							Lugols	Formalin	Ross
1	500	500b	500b											500	500	500	500b
6	500	500a	500a									500	500				500a
3	300	300b	300b											300	300	300	300b
4	300	300a	300a									300	300				300a
7	100	100b	100b											100	100	100	100b
8	100	100a	100a									100	100				100a
9	200	200b	200b											200	200	200	200b
10	200	200a	200a									200	200				200a
11	70	70b	70b											70	70	70	70b
12	70	70a	70a		1%	1%	1%	1%	1%	1%	1%	70	70				70a
13	60	60b	60b											60	60	60	60b
14	60	60a	60a		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	60	60				60a
15	30	30b	30b											30	30	30	30b
26	30	30a	30a		14%	14%	14%	14%	14%	14%	14%	30	30				30a
19	12	12b	12b														12b
20	12	12a	12a		33%	33%	33%	33%	33%	33%	33%			12	12	12	12a
21	7	7b	7b											7	7	7	7b
22	7	7a	7a		55%	55%	55%	55%	55%		55%	7	7				7a
23	3	3b	3b											3	3	3	3b
24	3	3a	3a		97%	97%	97%	97%	97%	97%	97%	3	3				3a

Cruise	D296
Cast	1
Station	15706
Date	16/07/2005
Lat	48°57.1N
Long	16°29.9
Water depth	4806
Time in	0425 GMT
Time at bottom	0441 GMT
Time on deck	0515 GMT

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot, >2µm							Lugols	Formalin	Ross	Blanca
1	500	500b	500b									500	500	500	500	500		500
2	500																	
3	500	500a	500a															
4	300	300b	300b									300	300	300	300	300	300b	300
5	300	300a	300a															
6	200	200b	200b									200	200	200	200	200	200b	200
7	200	200a	200a														200a	
8	150	150	150											150	150	150	150	150
9	100	100b	100b									100	100	100	100	100	100b	100
10	100	100a	100a														100a	
11	70	70b	70b									70	70	70	70	70	70b	70
12	70	70a	70a		1%	1%	1%	1%	1%	1%	1%						70a	
13	60	60b	60b									60	60	60	60	60	60b	60
14	60	60a	60a		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%						60a	
15	45	45	45											45	45	45	45	45
16	30	30b	30b									30	30	30	30	30	30b	30
17	30	30a	30a		14%	14%	14%	14%	14%	14%	14%						30a	
18	20	20	20											20	20	20	20	20
19	12	12b	12b									12	12	12	12	12	12b	12
20	12	12a	12a		33%	33%	33%	33%	33%	33%	33%						12a	
21	7	7b	7b									7	7	7	7	7	7b	7
22	7	7a	7a		55%	55%	55%	55%	55%	55%	55%						7a	
23	3	3b	3b									3	3	3	3	3	3b	3
24	3	3a	3a		97%	97%	97%	97%	97%	97%	97%						3a	

Cruise	D296
Cast	2
Station	15714
Date	18/07/2005
Lat	49°1.6430N
Long	16°37.202
Water depth	4786
Time in	0311 GMT
Time at bottom	0325 GMT
Time on deck	0413 GMT

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot							Lugols	Formalin	Ross	Blanca
1	500	500b	500b									500	500	500	500	500		500
2	FAILED																	
3	500	500a	500a															
4	300	300b	300b									300	300	300	300	300		300
5	300	300a	300a															
6	200	200c	200c									200	200	200	200	200	200c	200
7	200	200b	200b														200b	
8	200	200a	200a														200a	
9	100											100	100	100	100	100	100b	100
10	100	100	100														100a	
11	70	70b	70b		1%	1%	1%	1%	1%	1%	1%			70	70	70	70b	70
12	70	70a	70a														70a	
13	60	60b	60b									60	60	60	60	60	60b	60
14	60	60a	60a		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%						60a	
15	45	45	45											45	45	45	45	45
16	30	30b	30b									30	30	30	30	30	30b	30
17	30	30a	30a		14%	14%	14%	14%	14%	14%	14%						30a	
18	20	20	20											20	20	20	20	20
19	12	12b	12b									12	12	12	12	12	12b	12
20	12	12a	12a		33%	33%	33%	33%	33%	33%	33%						12a	
21	7	7b	7b									7	7	7	7	7	7b	7
22	7	7a	7a		55%	55%	55%	55%	55%	55%	55%						7a	
23	3	3b	3b									3	3	3	3	3	3b	3
24	3	3a	3a		97%	97%	97%	97%	97%	97%	97%						3a	

Cruise	D296	NB upward looking PAR sensor fitted
Cast	3	
Station	15719	
Date	19/07/2005	
Lat	49°0.169N	
Long	16°36.102	
Water depth	4785	
Time in	1518 GMT	
Time at botto	1525 GMT	
Time on deck	1550 GMT	

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot, >2µm							Lugols	Formalin	Ross	Blanca
1	200	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	200	X
2	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
3	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	150	X
4	150	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	150	X
5	100	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	100	X
6	75	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	75	X
7	50	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X
8	40	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	40	X
9	30	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	30	X
10	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
11	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
12	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
13	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
14	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
15	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
16	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
17	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
18	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
19	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
20	20	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	20	X
21	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10	X
22	10	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	10	X
23	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3	X
24	3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	3	X

Cruise	D296
Cast	4
Station	15720
Date	20/07/2005
Lat	48°50.4N
Long	16°30.9W
Water depth	4807
Time in	0245 GMT
Time at bottom	0300 GMT
Time on deck	0338 GMT

* Sandy used non toxic supply for this depth

Bottle #	Depth (m)	Nutrients		Chlorophyll			14C	15N	NH4 regen.	NH4	Urea	234Th	POC	HPLC	Phytoplankton		Flow cytometry	
		ICCM*	SOC**	Mark	Tot	>2µm	Tot, >2µm	Tot							Lugols	Formalin	Ross	Blanca
1	500	500b	500b									500	500	500	500	500		500
2	N/A																	
3	500	500a	500a															
4	300	300	300									300	300	300	300	300		300
5	300																	
6	200	200c	200c									200	200	200	200	200	200c	200
7	200	200b	200b														200b	
8	200	200a	200a														200a	
9	100																100b	
10	100	100	100									100	100	100	100	100	100a	100
11	70	70	70		1%	1%	1%	1%	1%	1%	1%			70	70	70	70b	70
12	70																70a	
13	60	60b	60b									60	60	60	60	60	60b	60
14	60	60a	60a		4.50%	4.50%	4.50%	4.50%	4.50%	4.50%	4.50%						60a	
15	45	45	45											45	45	45	45	45
16	30	30b	30b									30	30	30	30	30	30b	30
17	30	30a	30a		14%	14%	14%	14%	14%	14%	14%						30a	
18	20	20	20											20	20	20	20	20
19	12	12b	12b									12	12	12	12	12	12b	12
20	12	12a	12a		33%	33%	33%	33%	33%	33%	33%						12a	
21	7	7b	7b									7	7	7	7	7	7b	7
22	7	7a	7a		55%	55%	55%	55%	55%	55%	55%						7a	
23	3											NT*	NT*				3b	
24	3	3	3		97%	97%	97%	97%	97%	97%	97%			3	3	3	3a	3

Appendix 2: Station list

Station list: Discovery 295													
						Start Position				End Position			
Station	Series	Date	Start time	End time	Activity	North		West		North		West	
		July	GMT	GMT		deg	min	deg	min	deg	min	deg	min
15686		7	01:35	02:40	CTD for PP	49	2.6	16	25.1	49	2.3	16	26.1
15687		7	09:47	12:29	Deploy PAP#2 moring (Physics)	49	0.1	16	19.9	49	1.9	16	26.3
15688		7	13:52	17:41	Deploy PAP#4 mooring (MMP)	49	2.8	16	28.5	49	4.1	16	37.8
15689	1	7	19:30	19:46	CTD for PAR to 100m	49	3.0	16	39.9	49	2.9	16	40.0
	2	7	20:12	23:40	CTD to 4811m	49	2.9	16	40.2	49	2.2	16	40.0
	3	8	00:57	01:28	CTD for PP	49	2.0	16	39.8	49	1.9	16	39.9
15690		8	05:29	07:10	Autosub	49	0.0	16	39.8	48	59.5	16	40.3
15691		8	09:45	15:02	Recover PAP#2 mooring from CD 158 dep.	49	6.4	16	29.4	49	8.7	16	32.8
15692		8	17:30	22:20	Autosub	48	58.9	16	40.0	49	2.6	16	37.9
15693		9	08:54	11:38	Recover PAP#4 from station 15688	49	3.9	16	38.4	49	5.0	16	35.5
15694		9	14:09	21:13	Autosub	49	0	16	39.9	48	59.7	16	42.0
15695		9	22:26	23:04	Shrimp	49	0.6	16	43.2	49	0.0	16	42.8
15696		10	10:49	12:38	Deploy PAP#1 mooring (BGC)	49	4.1	16	41.8	49	2.8	16	37.5
15697		10	13:47	15:45	Deploy PAP#4 mooring (MMP)	49	2.6	16	37.7	48	58.5	16	37.5
15698		10	18:05	19:24	Deploy PAP#3 mooring (ST)	49	3.4	16	23.4	49	1.7	16	21.6
15699	1	10/17	23:08		PELAGRA 1	49	0.1	16	30.4				
	2	10/11	23:12	07:02	PELAGRA 2	49	0.1	16	30.4	49	0.7	16	33.5
15700		10/11	23:52	04:32	Shrimp	49	0.1	16	32.9	49	0.1	16	33.0
15701		11	05:07	06:05	CTD	49	0.7	16	32.7	49	0.7	16	33.1
15702		12	11:18	19:00	Autosub	50	48.2	10	37	50	50.0	10	35.9
15703		12	14:48	15:47	Shrimp	50	48.1	10	36	50	47.2	10	35.9

Station list: Discovery 296																			
										Start Position				End Position			
Station	Series	Date	Start time	End time	Sample time	Water depth			Activity	North		West		North		West	
		July	GMT	GMT	Start	End	Corr. M			deg	min	deg	min	deg	min	deg	min
							start	end									
15704		15	03:20	05:15	04:15		2188		Megacore to 2200m	50	19.40	12	0.20	50	18.90	12	0.13
15705		15/16	23:23	03:08	01:21		4835		Megacore to 4800m					48	50.90	16	31.90
15706		16	04:20	05:15					CTD	48	57.05	16	29.99				
15707	1		04:30						Zooplankton net	48	57.05	16	29.99				
	2		04:50						Zooplankton net	48	57.03	16	29.54				
	3		05:12						Zooplankton net	48	57.00	16	29.29				
15708			06:30	09:22					Recover PAP#3 mooring	48	59.91	16	30.29	49	0.20	16	27.20
15709			09:48	11:45					Recover Bathysnap	49	0.20	16	27.20	49	0.00	16	27.00
15710		16-18	12:20	12:25					Deploy Pelagra#2 (Isopycnal)	49	0.71	16	27.20				
15711			13:47	04:02	20:10	23:40	4817	4840	Trawl	48	54.00	16	20.00	48	47.10	17	16.53
		17		09:09					Recover PELAGRA#1 from D295	49	0.1	16	30.4	48	34.07	17	22.70
15712	1		13:20	16:55	15:08		4840		Megacore	48	52.10	16	29.80	48	51.00	16	30.20
	2		18:52		20:38		4840		Megacore	48	52.02	16	29.95	48	50.89	16	30.39
15713		18	00:32	02:40					SAP	49	1.70	16	37.50	49	1.70	16	37.50
15714			03:10	04:14					CTD	49	1.70	16	37.00	49	1.78	16	37.67
			05:55	07:25					Recover PELAGRA#2	48	55.00	16	22.90	48	54.02	16	14.19
15715			09:42	13:20					Recover PAP#1	49	1.80	16	30.60	49	1.90	16	33.30
15716	1	18/20	15:08	07:12					Deploy PELAGRA 2	48	51.81	16	30.66	48	54.15	16	9.18
	2	18/20	15:15	07:35					Deploy PELAGRA 1	48	51.80	16	30.68	48	53.77	16	8.64
15717		18/19	16:08	05:40	22:05	01:00	4837	4842	Trawl	48	46.60	16	29.80	49	4.80	17	14.60
15718		19	09:00	14:15	10:25	12:15	4839	3951	Shrimp	49	8.00	16	37.90	49	6.30	16	40.00
15719			15:10	15:50					CTD	49	0.20	16	36.10	48	59.80	16	36.40
15720	1		17:08	20:43	18:54		4838		Megacore	48	51.99	16	29.95	48	50.90	16	29.80
	2	19/20	21:28	00:57	23:18		4840		Megacore	48	51.90	16	29.90	48	50.50	16	30.50
15721		20	02:45	03:38					CTD	48	50.30	16	30.90	48	49.90	16	31.30
15722	1		02:50	03:08					Zooplankton net	48	50.30	16	31.00	48	50.30	16	31.10
	2		03:15	03:32					Zooplankton net	48	50.20	16	31.10	48	50.00	16	31.20
15723			05:15	05:20					Bathysnap	49	0.21	16	27.20	49	0.14	16	27.23
15724			09:24	13:20	11:35		4836		Megacore	48	52.00	16	29.70	48	49.30	16	28.60