SOUTHAMPTON OCEANOGRAPHY CENTRE

CRUISE REPORT No. 48

FS *POSEIDON* CRUISE 300/1
04 JUL - 16 JUL 2003

Biogeochemistry at the
Porcupine Abyssal Plain Observatory

Principal Scientist
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2004

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DOCUMENT DATA SHEET

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ABSTRACT

There were two main objectives of this cruise. Both focus on the long term observatory site on the Porcupine Abyssal Plain (PAP) at 49N 16.5W. The first objective was to recover and redeploy various moorings and landers some of which were part of the EU funded ANIMATE project. The second objective which contributes to the NERC funded BICEP project was to measure particulate export from the surface layer using a variety of complementary approaches and to characterise the site from a biological and chemical perspective in order to interpret the export data. Almost all of the objectives were successfully achieved.

KEYWORDS

ANIMATE, BICEP, cruise 300/1 2003, Porcupine Abyssal Plain, *Poseidon*

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Cruise Report

Compiled by: Dr Richard Lampitt

Ship: F.S.Poseidon **Cruise No.: 300/1**

Dates of Cruise: July 4-16 2003

Areas of Research: Ocean Biogeochemistry

Port Calls: None

Institute: Southampton Oceanography Centre

Chief Scientist: Dr Richard Lampitt

Number of Scientists: 10

Projects: Mooring maintenance within EU-funded project ANIMATE and export flux measurements.

Contents

1. Scientific personnel

Name	**Function**	**Institute**	**Leg**
Lampitt R.	Principal Scientist	SOC	1
Wynar J	Mooring coordinator	SOC	1
McLachlan R	Mooring engineer	SOC	1
Brown L	Biogeochemistry Principal Investigator	SOC	1
Léauté F	Biogeochemistry assistant	SOC	1
Boorman B	Technical coordinator	SOC	1
Turnewitsch R	Biogeochemistry Principal Investigator	SOC	1
Lankhorst M	Physical oceanographer	IFM	1
Krischker P	Biogeochemistry technician	IFM	1
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2. Research programme

There were two main objectives of the cruise. Both focus on the long term observatory site on the Porcupine Abyssal Plain (PAP) at 49N 16.5W. The first objective was to recover and redeploy various moorings and landers some of which were part of the EU funded ANIMATE project. The second objective which contributes to the NERC funded BICEP project was to measure particulate export from the surface layer using a variety of complementary approaches and to characterise the site from a biological and chemical perspective in order to interpret the export data.

3. Narrative

The estimated departure from Ponta Delgada was at 0815h on Friday 4th July. Unfortunately due to a delay by FEDEX in delivery of the SAMI PCO_2 sensor, sailing was delayed till 2155h. With good weather we progressed well and early on 6th carried out the first station, a CTD that was a trial run of the CTD and the primary production protocols to ensure that when we reached the PAP site, there would be no delays or errors. This was a very worthwhile exercise and entirely successful. We arrived at the PAP site on Tuesday 8th with slightly worse sea conditions. Unfortunately as the CTD was about the enter the water the Captain decided that the sea water on deck produced an unsafe working environment and the station was abandoned. We then attempted to recover one of the moorings that had been deployed in October 2002 (PAP#2). Although the top portion of this had come loose and been recovered in February 2003, we hoped the rest of the mooring was still in place. No acoustic contact could be made and after several hours trying to find and release the mooring the attempt was abandoned. A later acoustic search using the ships echo sounder also failed to find it. Following from this was a highly successful buoyancy test of the new PELAGRA drifting sediment trap and successful recovery of the PAP#1 mooring with its suite of biogeochemical and physical sensors. Microcats and releases were then tested on a CTD deployment to 4850m depth before a final station to sample mesozooplankton at about midnight, the first of 5 such samples. The following day 9th saw our first primary production CTD deployment at PAP, a highly successful deployment. This was not the case shortly afterwards when the benthic lander Bathysnap was detected but would not release its ballast weight. After several hours, attempts were abandoned and the device presumed lost. A version of Bathysnap (Fluorosnap) was then deployed without problems for recovery either in November 2003 or in the summer of 2004. The primary production CTD was repeated on 10th along with microcats for calibration purposes and then further attempts to recover PAP#2 and the Bathysnap but without success. Following this, Stand Alone Pumps (SAPs) were deployed to collect material for ^{234}Thorium analyses with which to assess particle export flux. The PELAGRA trap was then subjected to a buoyancy test but firmly attached to a safety line. An echo sounder search of the PAP#2 site at the end of the day finally convinced us that the mooring had completely disappeared. Once again the primary production CTD deployment started the day on 11th followed by mesozooplankton sampling. The sediment trap mooring (PAP#3) was then recovered having been deployed in October 2002. Although there was rather little material in the sampling cups, the three traps appeared to have worked perfectly. Following this was the final tethered buoyancy test of the PELAGRA trap before we felt sufficiently confident to deploy in un-tethered. This worked fine but with a significant influence of the tether on the behaviour of the trap. After the usual Primary production CTD and mesozooplankton sampling before dawn on 12th the PAP#1 mooring was redeployed but with the addition of microcats that would have been used on a redeployed PAP#2 mooring. There was insufficient equipment to construct another PAP#2 mooring. Following the successful deployment of PAP#1, the PELAGRA trap was at last deployed un-tethered with a scheduled deployment of 15 hours at a depth of 100m. Some inspired guesswork was involved in deciding on the appropriate level of ballast for this depth but this proved to be very close to the correct level. The sediment trap mooring PAP#3 was then successfully deployed for recovery in Summer 2004. In order to obtain a precise fix on the deployed PAP#1 mooring and to determine if it could be detected using the ships sonar system, a survey was carried out at the site during which the mooring was definitely detected on two occasions with hard acoustic returns from several structures on the mooring. The 13th started with the usual primary production CTD leading on to a highly successful recovery of the PELAGRA trap in excellent sea conditions. Immediately after recovery, a CTD was carried out for comparison with the sensors on the PELAGRA.

Passage to Scotland then began with the prospect of recovering the DOBO lander for Aberdeen University (Prof Monty Priede) just off the continental slope. This was achieved in a short space of time with disembarkation starting in the Port of Glasgow at 0800h on 17th July 2003.

4. Scientific report and first results

Primary Production and New Production

Primary productivity and new production incubations were undertaken on seawater samples collected on pre-dawn CTD casts at stations 405, 411, 415, 422 and 426. 8-10 litres of seawater were collected from 10 L Niskin bottles into darkened 10 L polythene carboys (new production) or 2 L polycarbonate bottles (primary production) using rubber hosing, from water pressures of 100, 65, 28, 15, 10 and 2 dbar.

^{14}C incubations for primary production measurements were carried out in 125 ml acid-rinsed polycarbonate bottles, which were rinsed once with sample water then filled. Three replicate samples and one dark bottle were taken at each depth, to assess the precision of the analyses and to correct for non-photosynthetic carbon uptake respectively. Each bottle was inoculated with 100 µl of 100 µCi ml^{-1} $NaH^{14}CO_3$ in an artificial seawater solution using a repeat Finnpipette. The ^{14}C spike activity was calibrated by diluting 100 µl of spike in 10 ml Carbosorb CO_2-trapping agent and taking five100 µl subsamples. The sample bottles were incubated until dusk in on-deck incubators cooled by subsurface seawater from the shipboard supply and shaded by Lee filter screens representing 97, 55, 33, 14 1 and 0.1 % of surface irradiance. The incubations were terminated by filtering under vacuum onto 25 mm diameter 0.2 µm polycarbonate filters. The filters were placed in 6 ml polythene vials and fumed over concentrated HCl for 15 minutes before drying overnight in a dessicator. 5 ml Wallac LumaGel scintillation cocktail was added to each vial, and preliminary shipboard measurements carried out on a PerkinElmer Betascout desktop scintillation counter (IFM Kiel). Samples will be recounted on a conventional liquid scintillation counter at SOC on return to shore.

Three subsamples 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 5 mM stock solutions of $K^{15}NO_3$, $^{15}NH_4Cl$ and $CO(^{15}NH_2)_2$ respectively. The volume of ^{15}N spike in each case was adjusted to represent approximately 10% of the ambient substrate concentration. Ambient nitrate concentrations were measured daily by the colorimetric method detailed below, and were typically 0.5 µM above 50 m and 5-6 µM below. Ammonium and urea additions were kept consistently at 0.05 µM, following ammonium measurements on a previous cruise in a similar area (S. Painter, pers. comm). The bottles were incubated for 4-6 hours alongside the primary production experiments, and terminated by filtering onto 25 mm GF/F filters using a positive pressure filter system. The filters were dried in a dessicator, then stored at –20 ˚C awaiting analysis by isotope mass spectrometry. A limited number of replicate and dark bottle measurements were also made.

Nitrate analysis

100 ml samples were collected directly into glass Schott bottles from the depths at which ^{15}N uptake experiments were to be carried out, and analysed within 4 hours using a method based on that of Strickland and Parsons (1977). 2 ml of 7 M ammonium chloride solution is added to the sample, which is then passed through a glass reduction column containing activated copper-cadmium. The first 45 ml is discarded and the following 50 ml collected for analysis. 1 ml of sulphanilamide solution (5 ml sulphanilamide in 300 ml dH_20 and 50 ml conc. HCl) is added to the sample and allowed to react for five minutes. 1 ml 4 mM n-(1napthyl) ethylenediamine dihydrochloride was added allowed to react for a further 15-20 minutes. Samples were analysed at 540 nm wavelength using a Unicam 8625 spectrophotometer in absorbance mode and a 1 cm cell. The absorbance-concentration relationship was determined by analysing a 20 µM solution of KNO_3 in artificial seawater, and analytical blanks assessed using distilled water.

Frozen and preserved samples

Nutrients – Samples taken from every CTD cast at 500, 150, 125, 100, 65, 28, 15, 10 and 2 dbar. Water was drawn directly from the Niskin bottles into 60 ml Diluvial containers, and frozen immediately at –20 ˚C. Samples were also collected from the Niskin bottles at production rate depths for ammonium, and at the end of the nitrate and ammonium incubations to assess recycling (Figure 1).

Chlorophyll – 200 ml samples were collected from the same bottles as nutrient samples and immediately filtered under positive pressure onto 25 mm GF/F filters. These were stored frozen at –20 ˚C prior to analysis (Figure 2).

Phytoplankton taxonomy – Two 100 ml samples taken from productivity rate bottle depths directly into brown glass bottles, one containing 1ml of Lugol's solution and the other containing 2 ml formaldehyde.

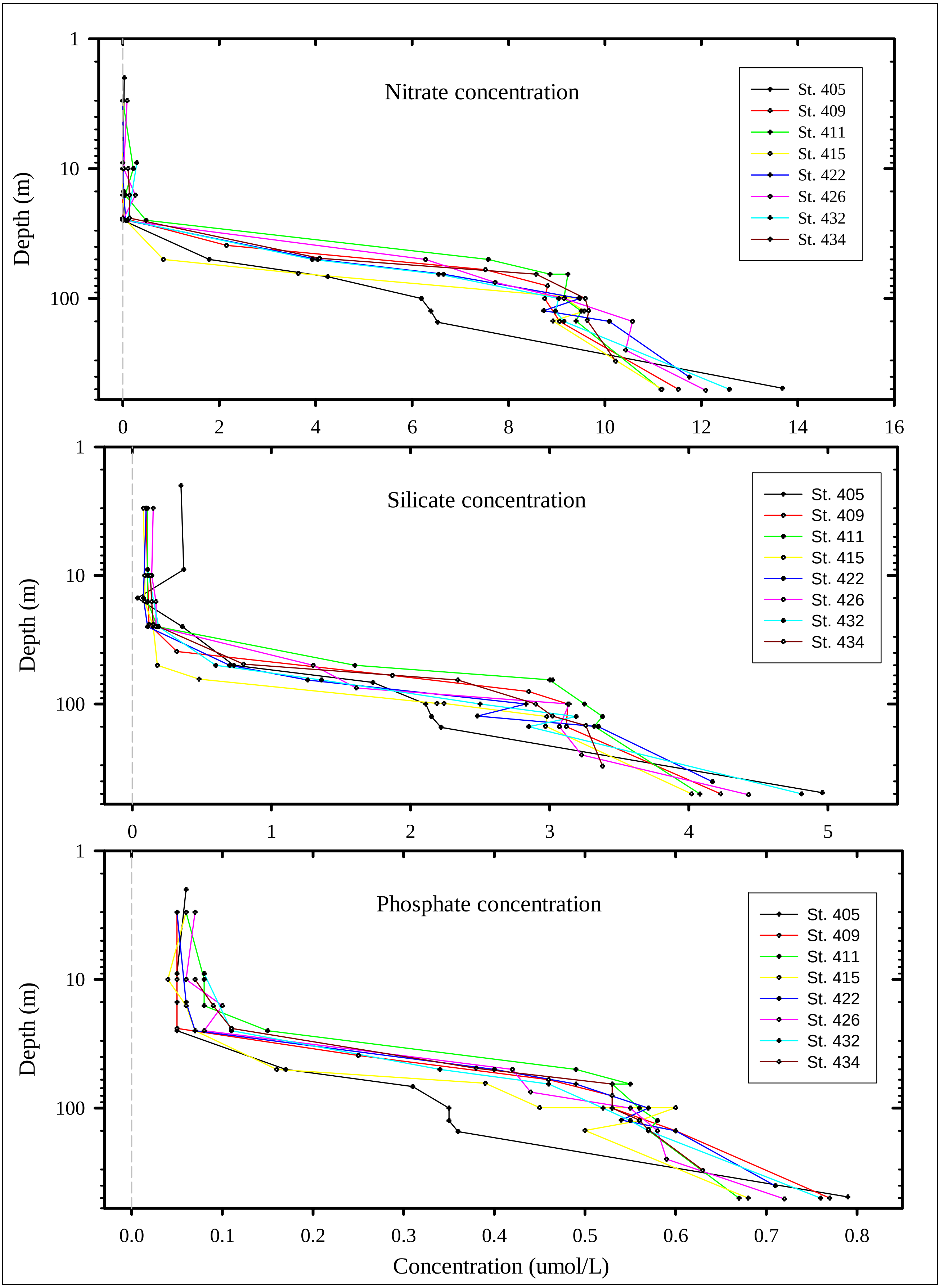

Figure 1.Vertical profiles of nutrient concentration

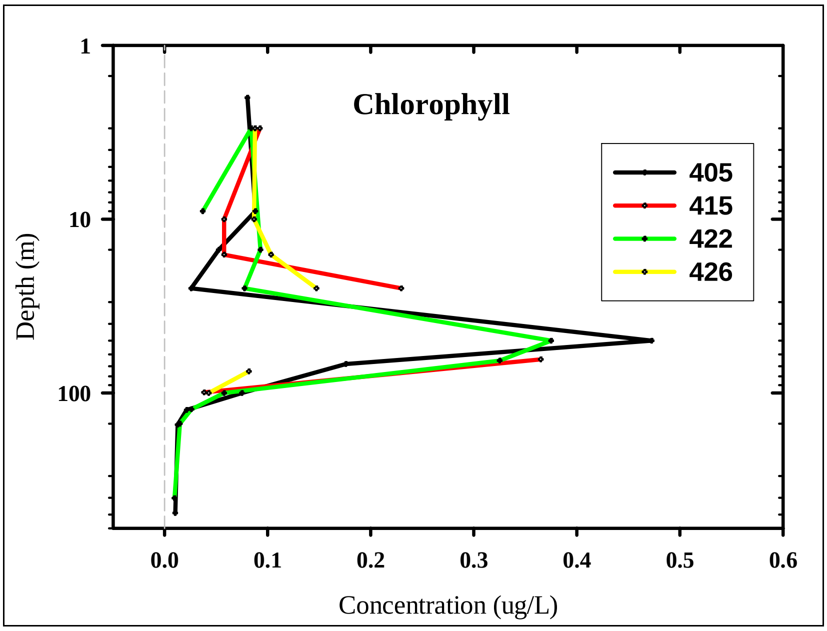

Figure 2 Chlorophyll concentration profiles.

Louise Brown and Sue Hartmann

Photosynthetically Active Radiation (PAR)

This was measured using a PAR Sensor: DRP-5 serial # 30471. Calibration: 8.20mv/kw/m^2
The sensor was attached to the railing on the aft end of the monkey island pointing upwards and with a clear view of the sky.

Table 1. Data on PAR collected at discrete times while at the PAP station

Date	Time GMT	Sensor Output	PAR
		mv	KW/m2
10/07/2003	17:00	2.60	21.32
	17:30	0.80	6.56
	18:30	0.20	1.64
11/07/2003	05:10	0.00	0.00
	07:00	0.10	0.82
	09:00	0.50	4.10
	09:16	0.65	5.33
	10:39	1.25	10.25
	11:01	1.15	9.43
	13:06	1.90	15.58
	13:30	2.10	17.22
	17:30	0.50	4.10
	18:30	1.40	11.48
	19:55	0.30	2.46
12/07/2003	08:15	1.40	11.48
	08:49	1.60	13.12
	09:12	1.80	14.76
	09:35	1.90	15.58
	10:26	2.60	21.32
	13:45	3.30	27.06
	14:21	3.10	25.42
	15:00	2.00	16.40
	15:27	1.90	15.58
	15:52	1.30	10.66
	17:00	0.75	6.15

Richard Lampitt

^{234}Thorium measurement

Background

To get an independent estimate of the downward particle flux in the surface ocean in addition to the flux as determined by the PELAGRA trap an approach using integrated radioactive ^{234}Th/^{238}U disequilibria was employed.

If there is considerable production of large sinking particles and a considerable downward flux of particulate material from the surface ocean towards the ocean interior particle-reactive ^{234}Th is lost from the surface ocean not only by its own decay but also on particles settling from the surface ocean. Then the rate of ^{234}Th decay in the surface ocean is smaller than the rate of ^{234}Th production by decay of its conservative (non-particle reactive) and very long-lived parent nuclide ^{238}U, a situation called radioactive disequilibrium. At depths between 100 and 300m new production of settling particles reaches low values and radioactive equilibrium is reached again. Integrating the radioactive disequilibrium in the surface ocean and assuming a steady state downward fluxes of ^{234}Th can be calculated. These fluxes are compared to ^{234}Th fluxes as determined by the sediment trap.

Sampling

Samples were taken using three different techniques: (1) a SBE CTD + 10-Litre-bottle rosette (provided by IfM, Kiel) to collect ^{234}Th on total particulate material and dissolved ^{234}Th, (2) two Challenger Oceanic Stand Alone Pumping Systems (SAPS) to collect ^{234}Th on particles larger than 70µm (assumed to comprise the bulk of truly settling particles), and (3) the PELAGRA trap to collect ^{234}Th on settling particles (Table 2).

Table 2. Samples taken for ^{234}Th analysis.

Equipment	station	sampling depths	other information	processed volume of water per depth (L)
SBE CTD rosette	405	1475 dbar	for total ^{234}Th; bottle no. 1, 2, 5, 6, 7, 8, 9, 10, 11, 12	7
	409	1000, 1500, 2000, 2999, 3499, 4000, 4498, 4832 dbar	for total ^{234}Th; bottle no. 14, 13, 12, 10, 9, 8, 7, 6	7
	426	3, 25, 50, 75, 100, 150, 249, 508 dbar	for total ^{234}Th; bottle no. 12, 11, 10, 9, 8, 7, 6, 5	7
	432	9, 25, 50, 75, 100, 150, 250, 500 dbar	for total ^{234}Th; 24, 22, 14, 13, 12, 11, 10, 9	7
SAPS	419	pump #1: 85m pump #2: 95m	for ^{234}Th and POC on particles >70µm (filtered by PES mesh)	1191.0 (flow rate: 1488.8 L/hr) 691.9 (flow rate: 864.9 L/hr)
PELAGRA	429	0-400m	½ split of cup D for particulate ^{234}Th and POC	-

On the way to the PAP site water was sampled with the CTD at ca. 1475dbar (station 405). At this depth ^{234}Th and ^{238}U are expected to be in radioactive equilibrium. To test the precision (analyses of replicates), accuracy (comparison of determined values with equilibrium value), and extraction efficiency of the ^{234}Th method the content of 8 CTD–rosette bottles was processed for total (particulate + dissolved) ^{234}Th twice (see below).

To get an overall picture of the ^{234}Th dynamics at the PAP site the water column was sampled for total ^{234}Th from 1000dbar down to the seafloor at ca. 4850dbar (station 409), and twice from the ocean surface down to ca. 500dbar (stations 426 and 432). Two SAPS were simultaneously deployed at 85dbar (pump #1) and 95dbar (pump #2) for 48 minutes (station 419). Pump #1 and pump #2 filtered 1191.0 L and 691.9 L of seawater, respectively (the flow rate of pump #2 was lower presumably due to a battery problem), at corresponding flow rates of 1488.8 L/hr and 864.9 L/hr.

A half split of the sample in cup D from the un-tethered PELAGRA deployment (station 429) was taken for the measurement of particulate ^{234}Th.

Sample processing

CTD bottle samples – Sample water was drained from CTD bottles into 10 litre canisters. From the 10 L canisters exactly 7 litres were transferred into another set of canisters. To scavenge dissolved thorium from the water by MnO_2 formation 3 drops of 30% NH_3 solution, 88µl of concentrated $KMnO_4$ solution and 35 µl of concentrated $MnCl_2$ solution were added to the sample and mixed. After 8 hours MnO2 particles were large enough to be filtered together with natural particles. For pressure filtration at 200-300mbar overpressure 142mm diameter polycarbonate filters with 0.4µm pores were used. The filters were dried, folded into a reproducible geometry to fit the detectors in the beta counter (see below), wrapped up in very thin Mylar foil, and labelled on the back. The folded filters were stored in a dry place until measurement.

SAPS samples – One layer of 70 µm polyester mesh was loaded onto 293mm diameter filter holders mounted on the SAPS. SAPS batteries were recharged before deployment. The SAPS were programmed to have a delay time of 30 minutes and a pump time of 48 minutes (Table 2). The pumps were deployed on winch 5 at 85 and 95m. After pump recovery the filter holders were removed from the pumps and carefully opened in the lab. There were clearly visible amounts of material on the mesh. The mesh was carefully transferred from the filter holder into a large funnel. One litre of Th-free water (from the CTD-samples) and a wash bottle was used to rinse most of the particles on the mesh into a graduated cylinder. A folsum splitter was used to split the suspension. For ^{234}Th analyses ¼ split of the pump #1 sample and ½ split of the pump #2 sample were quantitatively suction-filtered onto 142mm diameter polycarbonate filters with 0.4µm pores. The filters were processed in the same way as the CTD-rosette samples. For POC measurements for each pump ¼ split was stored frozen at –20ºC until further processing at SOC.

PELAGRA sample – The contents of sample cup D were split in half in the folsum splitter. One ½ split was also suction-filtered onto 142mm diameter polycarbonate filters with 0.4µm pores. The filter was processed in the same way as filters for the CTD-bottle samples. The other ½ split was filtered for POC determination onto ashed and pre-weighed 25mm diameter GF/F filters with pores of nominal 0.7µm.

Samples are currently being measured for ^{234}Th at the SOC labs using a Risø GM-25-5 beta counter. Activities of conservative ^{238}U will be calculated from calibrated salinity data.

Results

<u>Very</u> preliminary results indicate that at the PAP site there were a detectable ^{234}Th/^{238}U disequilibrium <1 down to ca. 50-75m indicating particle export, a ^{234}Th/^{238}U disequilibrium >1 below this layer and ca. 300m indicating shallow remineralisation, and values approaching equilibrium below this depth.

Robert Turnewitsch

Direct measurement of Export flux

There are some major difficulties in measuring downward particle flux in the upper part of the water column. Nevertheless this is the region over which the greatest change in flux occurs and where data are crucial for biogeochemical models of the ocean. During this cruise a novel drifting sediment trap (PELAGRA) was used to make such measurements for the first time in the open ocean. Previous trials deployments had been made in shallow waters off Oban (Scotland) but since then some modifications had been made such as incorporation of a titanium recovery hoop and removal of all ropes.
Four deployments were made during the cruise with increasing levels of sophistication.

Station 407
No ballast weight was added to the instrument, buoyancy was inflated to 230mls. The instrument was lowered over the port side and then capsized to demonstrate self-righting capability and stability on the surface. This was carried out twice and on both occasions the performance was satisfactory.

Station 420
Ballast test to determine additional weight required for sinking. A light surface polypropylene line was attached for safety. Although the instrument did eventually sink, this was due to the fact that it was being towed by the safety line, the top plate acting as a hydroplane. After addition of 690.5 g ballast, sinking occurred at about 0.6m/min. As the APEX buoyancy control system was not activated, variations in sinking rate were probably due

to forces on the safety line. The drop weight was successfully jettisoned as programmed (see Figure 3a).

Station 425
Sink test with 386g ballast but still with safety line attached.
APEX float programmed :
Wait time: 60 mins
Sink time: 100mins
Down time: 6 hrs
Park pressure: 40dB
In this deployment, the device appeared to work perfectly including transmission of positional data by ARGOS satellite on reaching the surface. However it was concluded that occasional tension by the safety line had a major effect on the depth profile and that the only real test of the system would be without the line (see Figure 3b).

Station 429
Un-tethered deployment and the first scientific use of PELAGRA. A ballast weight of 300.9g was added and the APEX programmed as follows:

Sink time :	150 mins
Down interval:	15 hours
Wait time:	1 hour
Park pressure:	100dB

The deployment was highly successful in that the APEX float attempted to raise the trap to the prescribed park depth of 100m during the deployment. Unfortunately there was not quite sufficient time for it to reach the park depth (see Figure 3c) so its park behaviour could not be recorded. The computational model of its behaviour in this particular water column (Figure 4) agrees closely with the observed behaviour. The delays in obtaining positional data via Argos are significant and must be considered for future deployments. Sighting the instrument was not easy even with an onboard Gonio receiver and it was decided to develop a means to improve visibilty without compromising function. Recovery by Poseidon was simple due to the low freeboard of the ship and excellent weather conditions. On other ships and with worse conditions, difficulties may be encountered. Some excellent samples of settling material were obtained and are now being analysed chemically and microscopically. The fluxes so far calculated agree closely with those predicted from the measurements of new production.

Characteristics of the deployment:

Sink speed:	1.6m/min
Max depth:	400m
End-time pressure:	185dB
End time to drop-weight time:	100 mins
End-time ascent speed before weight drop:	1.2m/min
Rapid sampling:	continuous
Drift distance:	14.1nm (26.3km)
Surfacing to sat fix interval:	11 mins
Delay of Sat fix transmission to Poseidon:	2 hours
Surfacing to Gonio reception interval:	3.3hours
Surfacing to recovery interval:	4.75 hours

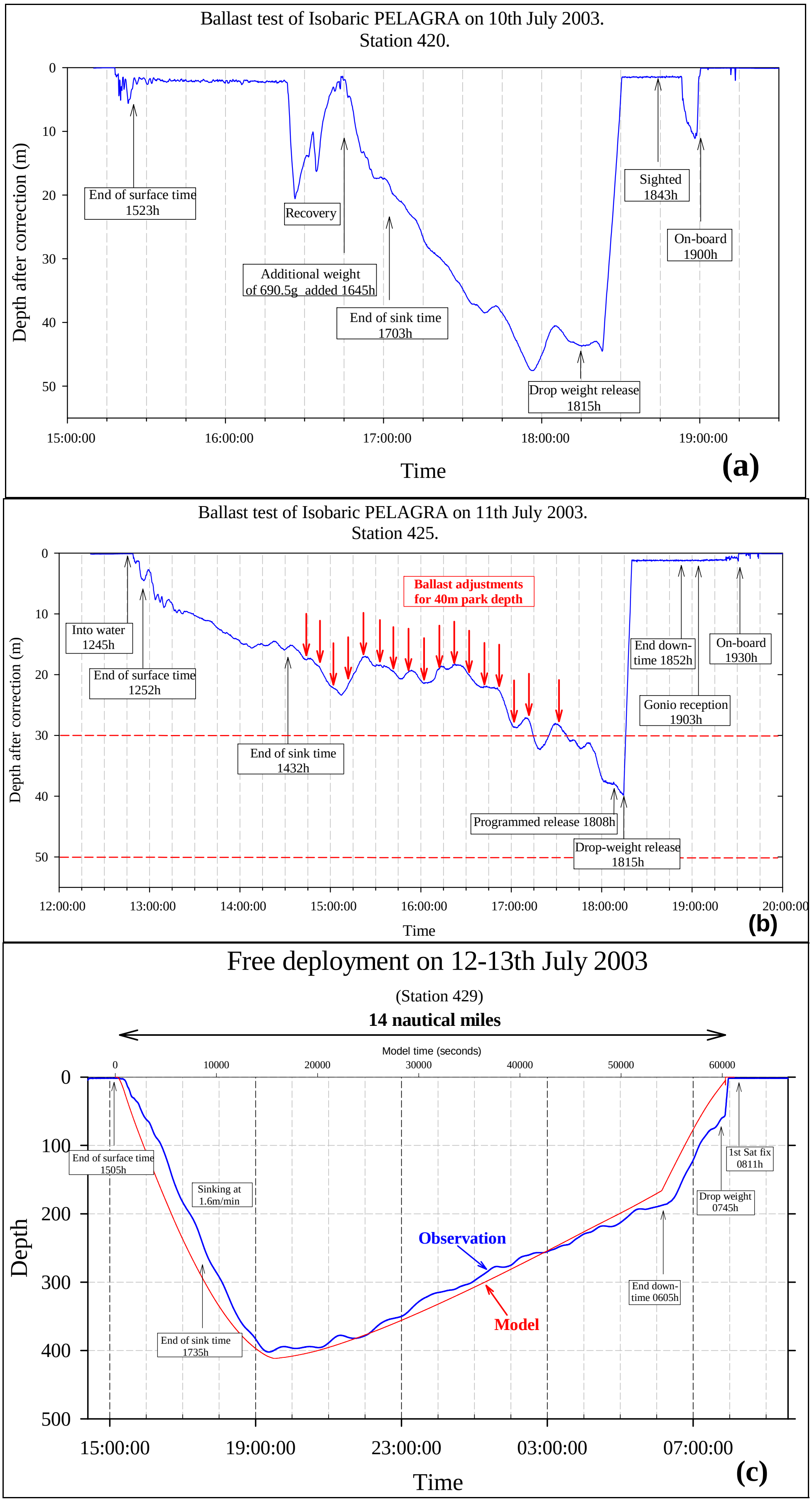

Figure 3 Time depth profiles of the deployments of PELAGRA. In figure 1c, the output of the computational model of the deployment is also presented based on the measured CTD profiles.

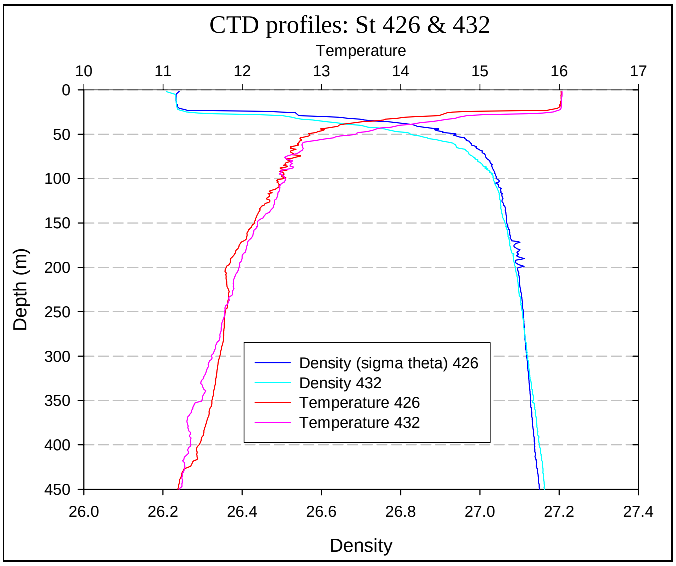

Figure 4. CTD profiles before and after the un-tethered deployment of PELAGRA (Figure 3c)

Richard Lampitt

Mesozooplankton samples

Mesozooplankton were sampled on 5 occasions using replicated vertical hauls of a WP2 net with mesh size 200µm. The net was raised at a speed of 0.2m/s. Hauls were taken from 200m depth and were immediately preserved in 5% formalin for subsequent species identification and biomass determination in collaboration with Dr Philippe Guyard (Portsmouth University, UK).

Table 3 Times and location of samples collection for mesozooplankton.

Station	Bottles	Date	Time Start	Time at 200 m	Time End	Latitude	Longitude	Depth [m]	Velocity Winch [m/s]	Notes
410	3	08/07/2003	23:10	23:31	23:47	48° 58,88' N	16° 36,87' W	200	0.2	
410 / 1	6	08/07/2003	23:58	00:12	00:28	48° 58,53' N	16° 37,30' W	200	0.2	
412	%	09/07/2003	%	%	%	%	%	200	0.2	discarded
412 / 1	%	09/07/2003	%	%	%	%	%	200	0.2	discarded
416	3	10/07/2003	05:32	05:43	05:55	49° 00,16' N	16° 31,20' W	200	0.2	
416 / 1	1	10/07/2003	05:57	06:10	06:22	48° 59,99' N	16° 31,73' W	200	0.2	
423	4	11/07/2003	05:39	05:51	06:03	48° 59,39' N	16° 31,61' W	200	0.2	
423 /1	3	11/07/2003	06:17	06:31	06:44	48° 59,07' N	16° 32,34' W	200	0.2	
427	3	12/07/2003	05:48	06:00	06:13	48° 59,77' N	16° 26,73' W	200	0.2	
427 / 1	2	12/07/2003	06:18	06:28	06:40	48° 59,77' N	16° 26,71' W	200	0.2	

Sylvia Stegmann and Richard Lampitt

Microplankton samples

Water samples were taken from all eight CTD deployments and preserved for later analysis of microplankton by flow cytometry. 1.6ml samples (Table 4) were fixed in 1% PFA solution. They were then stored at +2°C for 24hours before transfer to a freezer at –60°C. Analysis was completed at SOC in August providing data on vertical distributions of Synechococcus, Prochlorococcus, ultraphytoplankton and bacterioplankton.

Table 4. Samples collected for microplankton enumeration

Station --->	405		409		411		415		422		426		432		434	
CTD	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#	Press.	Samp.#
Bott. #																
5									402	6-1						
6					501	4-1			150	6-2						
7					149	4-2			124	6-3						
8					125	4-3			100	6-4						
9					100	4-4			65	6-5						
10					65	4-5			50	6-6						
11					50	4-6	500	5-1	25	6-7						
12					25	4-7	149	5-2	15	6-8						
13	490	1-1	500	3-1	16	4-8	125	5-3	9	6-9						
14	152	1-2	150	3-2	10	4-9	99	5-4	3	6-10						
15	125	1-3	125	3-3			64	5-5			508	7-1	500	8-1	304	9-1
16	100	1-4	100	3-4			50	5-6			150	7-2	150	8-2	147	9-2
17	68	1-5	80	3-5			25	5-7			125	7-3	125	8-3	124	9-3
18	50	1-6	60	3-6			16	5-8			100	7-4	100	8-4		
19	25	1-7	39	3-7			10	5-9			64	7-5	65	8-5	100	9-4
20	15	1-8	24	3-8			3	5-10			50	7-6	50	8-6	65	9-5
21	9	1-9	10	3-9							25	7-7	25	8-7	49	9-6
22	2	1-10	3	3-10							16	7-8	25	8-8	24	9-7
23											10	7-9	9	8-9	16	9-8
24											3	7-10	9	8-10	10	9-9

Frédérique Léauté

Observatory data

The three ANIMATE observatory moorings were deployed in October 2002 on Discovery cruise 266. As reported above, PAP#2 provided data only during the period 7.10.02 – 10.12.02 but as this had been telemetered to shore before breakage of the mooring, the data were safe, a demonstration of the value of telemetering. Other data were recorded *in situ* on the sensor package at a nominal depth of 60m. These comprised, nutrients, PCO_2, fluorescence, particle backscatter and CTD. Details can be found on the ANIMATE web site http://www.soc.soton.ac.uk/animate/index.php

Richard Lampitt

5. Scientific equipment: moorings and instruments

Scientific equipment A: Moorings

This cruise was the second of the ANIMATE series scheduled to turn around moorings PAP#1 and #2 (deployed for the first time in October 2002) and PAP#3.

At a meeting attended by the ship's Master, Boatswain, the PS, J Wynar and R McLachlan, over-side operations were discussed. Due to the small deck area astern and in accordance with the ship's normal working practice, it was decided that all mooring operations could be handled over the port side. This system also allowed the bridge to observe deck operations directly as the port side could be seen from the rear of the bridge. One implication of this method however, meant that the wire mooring lines would have to be wound off their drums (because they had been supplied in reverse order ready for winding onto a winch) and then re-wound onto other drums ready for deployment.

All times given in the following report are in GMT unless otherwise stated.

Wire Tests

A wire test was conducted using the releases (which were of the fusible link type) on reaching the PAP site (station 409) at a depth of 4782 (Table 5):

Table 5

RT661 S/N	Release 1	Pyro (release)	Range	Diagnostic value
315	4736	2856	4737	4292
469	3849	3792	4735	5483

On recovery, all the "puffers" were found to have blown and therefore both channels on the releases had operated correctly.

PAP#2 Recovery Failure

This mooring was deployed at 48° 59.26N 016° 28.08W on 7.10.02 on Discovery cruise 266. Part or all of the mooring broke loose from its anchor on 10.12.02 and after drifting for over two months the top section was recovered by RV Triton on 1.3.03 and returned to SOC. A lower section including the main buoyancy was recovered by a Faroes inspection vessel in July 2003 at 61° 48'N 7° 8'W.

Poseidon reached the PAP#2 site on 8th July at 08.30 and the interrogation of the acoustic release (s/n: 360) was begun using a TT301 (s/n: 22) and over-side transducer. An attempt to release the mooring was made despite poor range reception. No ranges consistent with the 4800m water depth were obtained and the spare deck unit (s/n: 84) was substituted. This unit gave consistent but shallow ranges (i.e.: 1552, 1572, 1586) implying that the mooring had indeed released and was on or near the surface. A visual search by the Poseidon was made in case the mooring was in fact adrift aided by occasional acoustic ranging with the TT301. The ranges obtained from the TT301 were found unreliable and the attempt was abandoned for the time being.

On the 10th July a further attempt was made to locate and release the mooring. Both TT301 units and transducers were used in both mode A and B. Consistent ranges were found impossible to achieve and so, after several hours, this attempt too was abandoned. Diagnostic values of 3661 and 3016 were obtained, but these were very different to those measured when the mooring was deployed (see report for D266).

Incidentally, had the mooring been recovered it would not have been deployed as planned due to the failure of the replacement telemetry buoy shortly after sailing. The Microcat SBE 37's recovered and several additional ones would have been incorporated into the PAP#1 mooring.

A detailed acoustic search of the area was carried out between 1945h on 10.7.03 and 0320h on 11.7.03 but no sign of the mooring could be found (Figure 5)

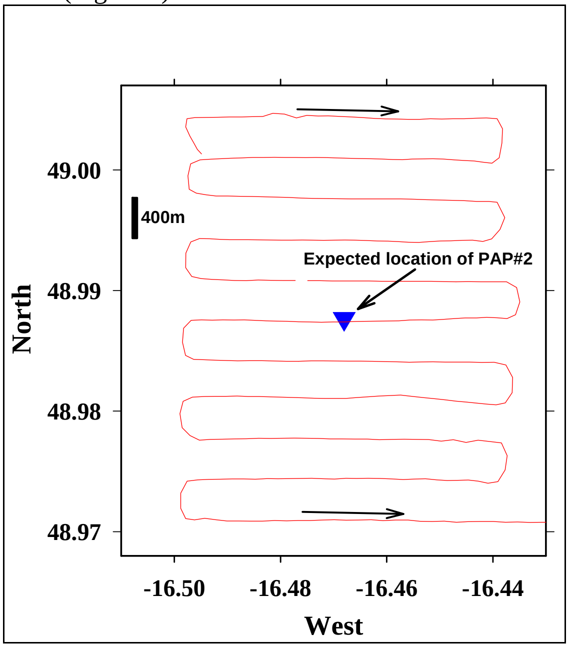

Figure 5. Cruise track during acoustic search for PAP#2 mooring.

Benthic time lapse photography

The DEEPSEAS group at the SOC has a long-term study site at the Porcupine Seabight; included in this study is the use of time-lapse cameras. Attempts were made to recover one such camera system that was deployed as *Discovery Station No.15054#26.* At 0857GMT on 09/07/03 the release was fired and seemed to work first time on both Pyro channels. However, no sensible ranges were observed, and an extensive search of the area failed to reveal the system on the surface. Further tests indicate that the mooring is still on the seabed. Another attempt was made to fire the release the following day but again without success. Recovery will be attempted again using a fish, rather than a dunking transducer, and with a waterfall display to give a better indication of the release's movement.

A second camera system was deployed using a paired flashgun on a new Roughsnap frame, at 49º 00.994'N and 16º 26.766'W. The mooring was deployed at 1824GMT and reached the seabed at 2006GMT. Sensible ranges were observed throughout the descent, but with many spurious returns.

Ben Boorman

PAP#1 Recovery

After abandoning the search for PAP#2 on 8th July, it was decided to recover PAP#1. The vessel was on site at 12.50 and the acoustic release (s/n: 216) interrogated using a TT301. Slant ranges of the order of 4933m were obtained which were consistent with the water depth of 4800m. The release command was transmitted and a successful "received" and then "executed" signal was received at 12.55. The sub-surface buoy was only of the order of 60m deep and was fitted with an Argos beacon that began transmitting on breaking the surface. The beacon's signal was acquired by the Gonio D.F. receiver aboard Poseidon and the vessel headed for it. Ranging on the acoustic release however, showed the RT661 rising through the water column (e.g. 4794m, 4636m), brought near to the surface by the distributed buoyancy.

The recovery was carried out over the port side using an auxiliary winch. The timings of the recovery are given below (see relevant Mooring Operational Sheet). One point to note here is the implosion of one glass buoyancy sphere at approx. 1325m (i.e. the third buoyancy package). Although this was one of a pack of six, fortunately the others remained intact. To confuse matters further, the fifth buoyancy pack had become entangled in the line above the fourth pack. The packages were eventually extricated and the recovery completed.

PAP#3 Recovery

The recovery of PAP#3 took place on 11th July. The acoustic release (s/n: 370) was interrogated and a range of 4736m and a diagnostic value of 4980 was returned. The release command was transmitted and a received and executed signal returned at 08.12. Subsequent slant ranges (e.g. 4586m and 4472m) at intervals of 2 minutes indicated an ascent rate of approx. 50m/min. The uppermost buoyancy package was spotted on the surface at 08.42; significant timings of the recovery are given below (see relevant Mooring Operational Sheet).

During the recovery, a termination on one line leading to the second buoyancy pack parted at the winch block. The pack fell back into the water without hitting the ship and was recovered using grapnels. In addition, of the third and deepest buoyancy package, four of the six had imploded, the glass residue remaining inside the hard hats.

All traps appeared to have worked perfectly although with less material collected for the time of year than in previous years. See Deep ocean McLane Sediment Traps

The PAP#3 mooring recovered carried 3 traps (1000, 3000 and 4700m depth) whereas only two traps were attached to the mooring deployed (3000 and 4700m depth).

Table 8 for sampling schedule and Figure 6 for flux estimates

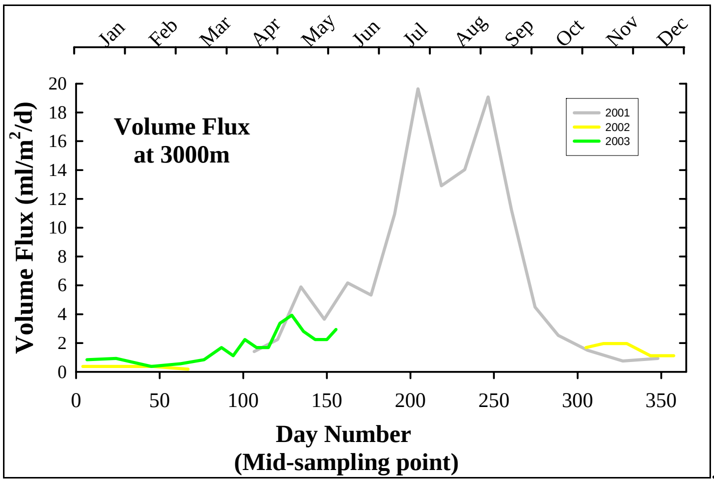

Figure 6. Volume flux of material collected at 3000m depth since 2001.

PAP#1 Re-deployment

The deployment of PAP#1 began at 09.25 on the 12th July, operations being carried out over the port side. The sub-surface buoy was fitted with an Argos beacon (PTT. id: 24335) and the acoustic release was of the "pyro-firer" type, s/n: 315 (Figure 8).

The mooring was different to the original in that it now incorporated the Microcat CT loggers that had been scheduled to be fitted to PAP#2. In addition, an extra 30m wire rope had been added to the mooring above the release in order that the instrumentation was in the correct water layer. Significant timings are recorded below (see relevant Mooring Operational Sheet).

Anchor release was at 13.09, position: 49° 00.61'N, 016° 25.51'W, in a water depth of 4806m. The sub-surface buoy was seen to dive at position: 48° 59.85'N, 016° 26.95'W.

An acoustic survey was carried out from 2000h on 12.7.03 and the mooring was located at 2312h and 2315h with hard acoustic returns from depths of 137, 178, 322 and 361m that may have been from the Microcats. No signal was seen from the top buoyancy sphere at about 40m depth Confirmation of the depth of the mooring top was one of the objectives of the acoustic survey. Unfortunately the ships navigation log was inoperable during this period of the search but from the bridge log the cruise track can be constructed (Figure 7).

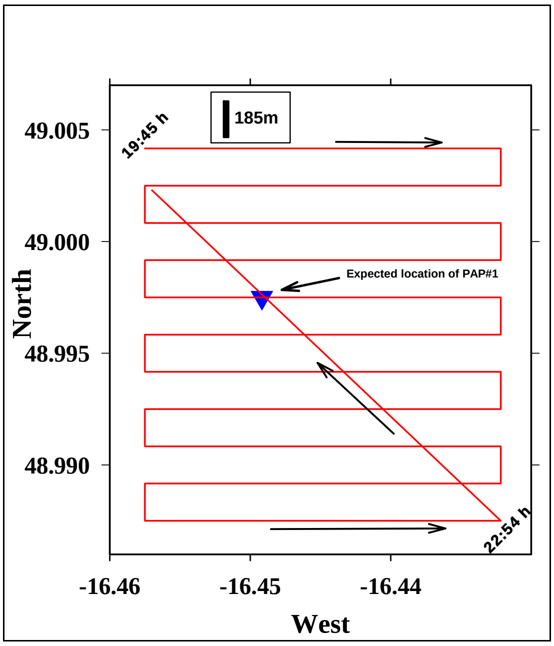

Figure 7. Cruise track during survey around the location of the deployed PAP#1 mooring.

PAP#3 Re-deployment

PAP#3's deployment commenced shortly after the end of PAP#1's at 15.50. The release was again of the pyro-firer type, s/n: 469. The mooring has been modified to the extent that it now only comprises just two Aanderaa RCM's, two McLane sediment traps and associated buoyancy, anchor weight etc. (Figure 9). No leaks were observed from the sediment trap's sample bottles during the deployment. See Table 9 for trap sampling schedule.

Anchor release was at position: 49° 00.57'N, 016° 29.70'W, in a water depth of 4802m. The sub-surface buoy was seen to dive at position: 49° 00.12'N, 016° 30.46'W.

DOBO Lander Recovery

On the 14th July the vessel was on site for the recovery of the Aberdeen DOBO lander. The lander is fitted with a dual release system comprising an RT661 (s/n: 486) and an AR661 (s/n: 497). The AR was interrogated and commanded to release first (at 03.51), but this instrument did not give consistent slant ranges – 1152m – in a water depth of 4000m. A release command was then transmitted to the RT unit (at 03.52) which returned a range of 3962m. At 03.54 a slant range of 3898m was obtained from the RT unit indicating that the lander had released and was rising at an ascent rate of 31m/min. On recovery of the lander onto the ship, it was subsequently noted that in fact both acoustic units had operated correctly. There was substantial corrosion on some of the stainless steel shackles.

Concluding Notes

Although recovery of moorings over the port side of the Poseidon is workable, it is not ideal. The limited overhead height between the deck and the winch block and its guard reduces the usefulness of this approach. On several occasions, the packages being deployed were too long and a method using ropes to shorten them was improvised. Deployments too were slow due to the method of using the drift of the ship to provide distance away from the mooring. In addition, lines and instruments frequently drifted close to the stern of the ship during a deployment potentially endangering the equipment and hazarding the vessel itself.

More frequent use of submersible radio beacons should be considered as an aid to finding moorings on the surface, indeed even to indicate that they *have* surfaced. This would have saved valuable ship time during the cruise rather than searching in vain for moorings that had actually not surfaced. This problem arose due to the inability to successfully interrogate the acoustic releases consistently (see following point) or to monitor the pinger signal due to the failure of the waterfall display.

The TT301 deck unit on many (perhaps every?) occasions gave false indications of "received" and "executed". This in itself caused some confusion as to whether the acoustic release had in fact replied, giving rise to subjective conclusions as to the operation of the RT unit.

John Wynar

Table 6: Acoustic Release Details

RT661 S/N	WINDOW CODE	DIAGNOSTIC	PYROTECHNIC	RELEASE 1	PINGER	OFF CODE	MODE
216	EC47	[W]EC84	N/A	[W]EC83	[W]EC94	EC49	A
315	9525	[W]9587	[W] 9591	[W] 9585	9530	9527	A
360	EC06	[W]EC87	N/A	[W]EC85	[W]EC94	EC08	B
370	EC42	[W]EC87	N/A	[W]EC85	[W]EC94	EC44	B
469	6971	[W]6987	[W]6991	[W]6985	6976	6973	A

Wait time: 15s
Active time: 60s

Table 7: PAP#3 Instrument Details

RCM Details

POSITION	TYPE	S/N	CONDUCTIVITY	TEMPERATURE	PRESSURE	START DATE/TIME
1750mab	RCM8	11571	N/A	LOW	N/A	6/7/03 @ 09:00:00 Z
100mab	RCM8	9415	N/A	LOW	N/A	6/7/03 @ 09:00:00 Z

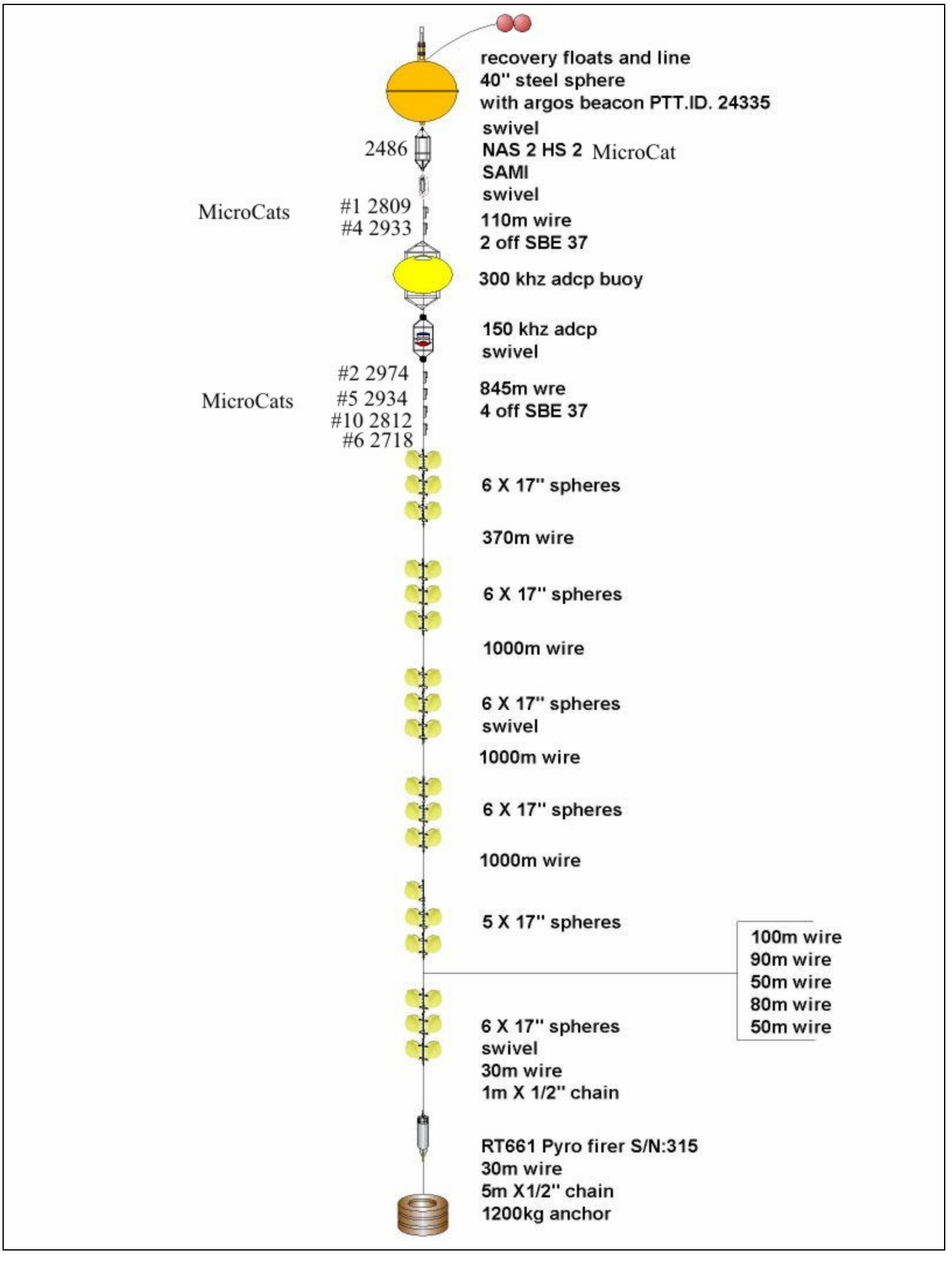

Figure 8: PAP#1 mooring as deployed on 12.7.03

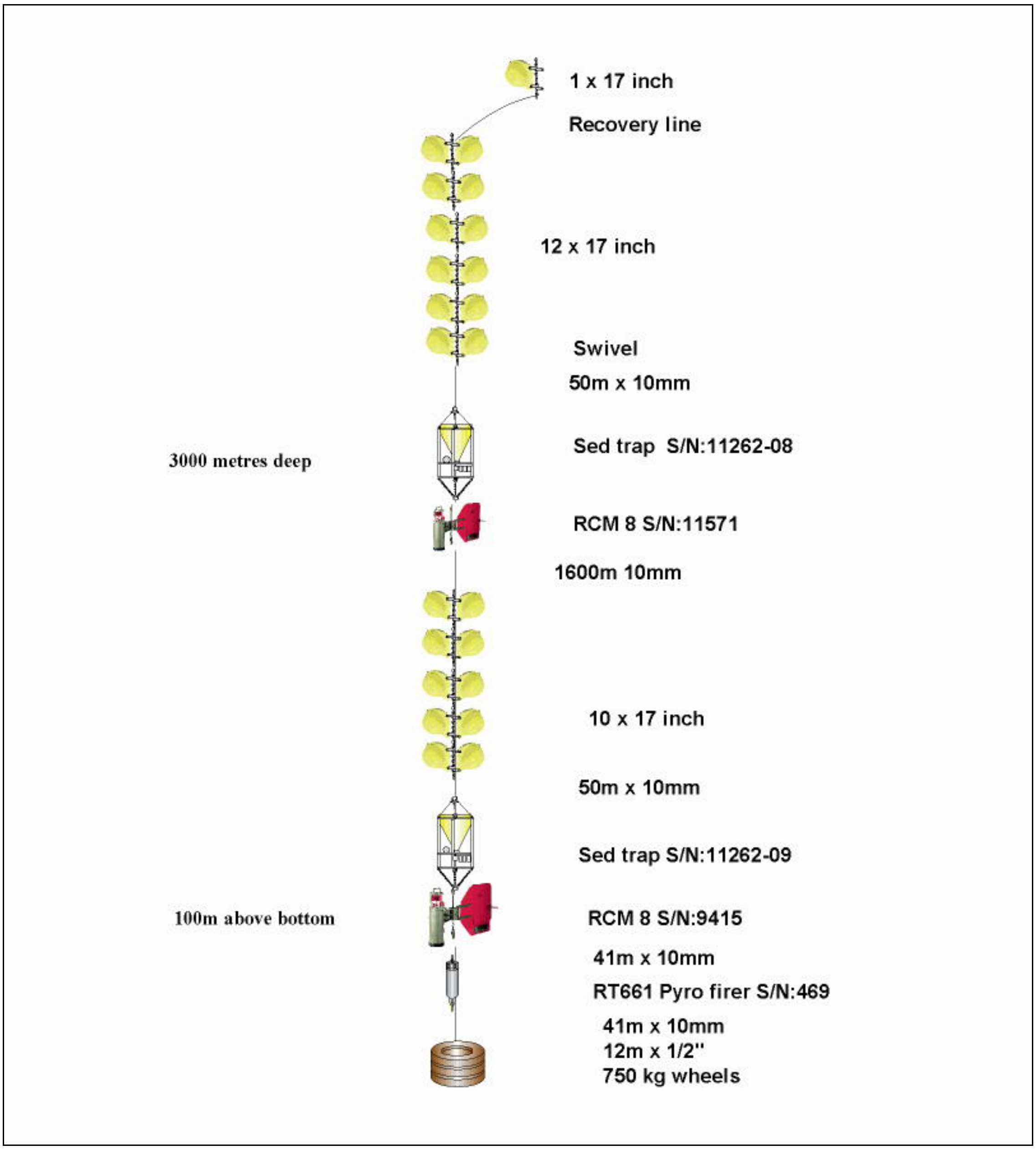

Figure 9: PAP#3 mooring with McLane sediment traps at depths of 3000m and 4700m (100mab).

Natural Environment Research Council — Southampton Oceanography Centre

Ocean Engineering Division
UKORS

Mooring Operational Sheet

PROJECT : ANIMATE

UKORS Mooring No: Mooring Name: PAP1

DEPLOYMENT RECOVERY

	DEPLOYMENT	RECOVERY
CRUISE	**:POSEIDON 2003**	:
DEPLOYMENT SHIP	**:POSEIDON**	:
LATITUDE	**: 49°00.61'N**	:
LONGTITUDE	**: 16°25.51'W**	:
DATE/TIME	**:12th July 2003**	:

Methods Buoy first and towed around to position, deployment from starboard side.

Mooring diagram

EQUIPMENT	Ser.no/Length	Time in	Time out	Comments
40" steel sphere				*Previously 32"*
Pick up line 24mm	15m			
ARGOS Beacon	24335			SMM500
NAS2 + HS2 + SBE37	2486 P	09.25		HS2 : H2020343. Nominal depth 32m
SAMI logger				
SBE37	2809	09.35		#1 Nominal depth 57m
SBE37	2933	09.40		#4 Nominal depth 70m
45" syntactic + 300kHz ADCP		10.00		
150kHz ADCP				
SBE37	2974 P	10.05		#2 Nominal depth 162m
SBE37	2934	10.10		#5 Nominal depth 217m
SBE37	2812	10.15		#10 Nominal depth 289m
SBE37	2718 P	10.20		#6 Nominal depth 367m
6 x 17" glass spheres		10.45		
6 x 17" glass spheres		11.00		
6 x 17" glass spheres		11.30		
6 x 17" glass spheres		12.00		
5 x 17" glass spheres		12.30		
6 x 17" glass spheres		12.50		
Acoustic release RT661	315	13.00		Pyro firer
FRAM release link				
Anchor railway wheels	1200kg	13.09		Time mooring on seabed unknown

Acoustic Release Observations MODE A

WINDOW	9525	OFF	9527	REL .1.	(W)9585
Diagnostic	(W)9587	PINGER	9530	Pyrotechnic	(W)9591

ARGOS Beacon Observations

Beeper for several hours in lab. Observed on Gonio until sub-surface submerged.

Other Comments

Water depth was 4806m.
Sub-surface sphere was seen to submerge at position 48° 59.85'N, 16° 26.95'W.
Mooring time on seabed unknown due to inability to interrogate release efficiently with equipment onboard.

Ocean Engineering Division
UKORS

Mooring Operational Sheet

PROJECT: ANIMATE

UKORS Mooring No: **Mooring Name: PAP1**

	DEPLOYMENT		RECOVERY
CRUISE	:	:	**POSEIDON 2003**
DEPLOYMENT SHIP	:	:	**POSEIDON**
LATITUDE	:	:	**48° 59.04'N**
LONGTITUDE	:	:	**16° 25.44'W**
DATE/TIME	:	:	**8th July 2003**

Methods: recovery from starboard side.

Mooring diagram

EQUIPMENT	Ser.no/Length	Time in	Time out	Comments
32" steel sphere			13.45	
Pick up line 24mm	15m			
ARGOS Beacon	21442			IOS shallow
NAS2 + HS2 + SBE37	2486			#10
SAMI logger				
Swivel				
45" syntactic + 300kHz ADCP			14.10	
150kHz ADCP			14.15	
Swivel				
6 x 17" glass spheres			14.50	
6 x 17" glass spheres			15.05	
6 x 17" glass spheres			15.30	One of the pack of six imploded some time before recovery
6 x 17" glass spheres				This pack became entangled and was recovered after the next one.
5 x 17" glass spheres			16.10	
6 x 17" glass spheres			17.00	
Acoustic release RT661	216		17.10	

Acoustic Release Observations MODE A

WINDOW	EC47	OFF	EC49	REL .1.	(W) EC83
Diagnostic	(W) EC84	PINGER	(W) EC94	ON	EC48

ARGOS Beacon Observations

Beacon on surface was detected by Gonio receiver and aided search for mooring.

Other Comments

Water depth of 4844m as recorded during deployment on RRS Discovery on 8/10/02.

Ocean Engineering Division
UKORS

Mooring Operational Sheet

PROJECT: ANIMATE

UKORS Mooring No: Mooring Name: PAP3

DEPLOYMENT RECOVERY

CRUISE :**POSEIDON 2003** :
DEPLOYMENT SHIP:**POSEIDON** :
LATITUDE : **49°00.57'N** :
LONGTITUDE : **16°29.70'W** :
DATE/TIME :**12th July 2003** :
Methods Buoy first and towed around to position, deployment from starboard side.

Mooring diagram

EQUIPMENT	Ser.no/Length	Time in	Time out	Comments
17" glass sphere				
Pick up line 24mm	15m	15.50		
12 x 17" glass spheres		15.55		
Swivel				
McLane sediment trap	11262-08	16.05		21 bottle trap – no leaks observed.
RCM 8	11571			
10 x 17" glass spheres		17.15		
Swivel				
McLane sediment trap	11262-09	17.25		21 bottle trap – no leaks observed.
RCM 8	9415			
Acoustic release RT661	469	17.30		Pyro firer
FRAM release link				
½" chain	12m			
Anchor railway wheels	750kg	17.45		Time mooring on seabed unknown

Acoustic Release Observations MODE A

WINDOW	6971	OFF	6973	REL .1.	(W)6985
Diagnostic	(W)6987	PINGER	6976	Pyrotechnic	(W)6991

ARGOS Beacon Observations

No beacon supplied.

Other Comments

Water depth was 4802m.
Sub-surface sphere was seen to submerge at position 49° 00.12'N, 16° 30.46'W.
Mooring time on seabed unknown due to inability to interrogate release efficiently with equipment onboard.

Natural Environment Research Council — Southampton Oceanography Centre

Ocean Engineering Division
UKORS

Mooring Operational Sheet

PROJECT: ANIMATE

UKORS Mooring No: **Mooring Name: PAP3**

	DEPLOYMENT		RECOVERY
CRUISE	:	:	**POSEIDON 2003**
DEPLOYMENT SHIP	:	:	**POSEIDON**
LATITUDE	:	:	
LONGTITUDE	:	:	
DATE/TIME	:	:	**11th July 2003**

Methods: recovery from starboard side.

Mooring diagram

EQUIPMENT	Ser.no/Length	Time in	Time out	Comments
17" glass sphere			09.01	
Pick up line 24mm polyprop	15m			
12 x 17" glass spheres			09.04	
Swivel				
McLane sediment trap	11262-05		09.09	21 bottle trap – samples obtained poor.
RCM 7	11674		09.09	
			09.19	Line parted at termination above buoyancy pack.
9x 17" glass spheres			10.12	Buoyancy pack recovered.
Swivel				
McLane sediment trap	11262-01		10.20	21 bottle trap – no leaks observed.
RCM 8	9447		10.23	
6 x 17" glass spheres			11.03	Four of the six had imploded sometime before recovery.
Swivel				
McLane sediment trap	11262-04		11.09	21 bottle trap – no leaks observed.
RCM 8	12356		11.11	
Acoustic release RT661	370		11.14	

Acoustic Release Observations

WINDOW	EC42	OFF	EC44	REL .1.	(W) EC85
Diagnostic	(W) EC87	PINGER	(W) EC94	ON	EC43

ARGOS Beacon Observations

No beacon supplied.

Other Comments

On interrogating the release, a range of 4736m (uncorr.) was obtained, consistent with the water depth. A diagnostic reading of 4980 was measured. The RT661 was commanded to release at 08.12 and sighted on the surface at 08.42. Subsequent ranges inferred an ascent rate of 50m/min.

Scientific equipment B: Instruments.

Deep ocean McLane Sediment Traps

The PAP#3 mooring recovered carried 3 traps (1000, 3000 and 4700m depth) whereas only two traps were attached to the mooring deployed (3000 and 4700m depth).

Table 8 Sediment Trap Schedule of recovered PAP#3 traps.

All three recovered traps were 21 cup McLane traps and with the same sampling schedule. Below are the details for the top trap (trap A) at 1000m depth. They were deployed on Discovery cruise 266 on 4.10.02 identified as trap deployment XXVIII.

Sample code	**Open Date**	**Julian Day**	**Julian Day**	**Interval**
	at 1200h	**Open**	**Mid-day**	
XXVIII-A-1	06/10/02	300.5	305	7
XXVIII-A-2	13/10/02	307.5	315.5	14
XXVIII-A-3	27/10/02	321.5	329.5	14
XXVIII-A-4	10/11/02	335.5	343.5	14
XXVIII-A-5	24/11/02	349.5	357.5	14
XXVIII-A-6	08/12/02	363.5	6.5	14
XXVIII-A-7	22/12/02	377.5	24	21
XXVIII-A-8	12/01/03	398.5	45	21
XXVIII-A-9	02/02/03	419.5	62.5	14
XXVIII-A-10	16/02/03	433.5	76.5	14
XXVIII-A-11	02/03/03	447.5	87	7
XXVIII-A-12	09/03/03	454.5	94	7
XXVIII-A-13	16/03/03	461.5	101	7
XXVIII-A-14	23/03/03	468.5	108	7
XXVIII-A-15	30/03/03	475.5	115	7
XXVIII-A-16	06/04/03	482.5	122	7
XXVIII-A-17	13/04/03	489.5	129	7
XXVIII-A-18	20/04/03	496.5	136	7
XXVIII-A-19	27/04/03	503.5	143	7
XXVIII-A-20	04/05/03	510.5	150	7
XXVIII-A-21	11/05/03	517.5	155.5	4
	15/05/03	521.5		**Close**

Table 9: Sediment Trap Schedule of deployed PAP#3 traps

Both deployed traps were 21 cup McLane traps and with the same sampling schedule. Below are the details for the top trap (trap A) at 3000m depth. They are identified as trap deployment XXXI.

Sample code	Open Date at 1200h	Julian Day Open	Julian Day Mid-day	Interval
XXXI-A-1	13/07/03	193.5	198	7
XXXI-A-2	20/07/03	200.5	208.5	14
XXXI-A-3	03/08/03	214.5	222.5	14
XXXI-A-4	17/08/03	228.5	236.5	14
XXXI-A-5	31/08/03	242.5	250.5	14
XXXI-A-6	14/09/03	256.5	264.5	14
XXXI-A-7	28/09/03	270.5	282	21
XXXI-A-8	19/10/03	291.5	303	21
XXXI-A-9	09/11/03	312.5	324	21
XXXI-A-10	30/11/03	333.5	345	21
XXXI-A-11	21/12/03	354.5	1	21
XXXI-A-12	11/01/04	10.5	22	21
XXXI-A-13	01/02/04	31.5	43	21
XXXI-A-14	22/02/04	52.5	64	21
XXXI-A-15	14/03/04	73.5	81.5	14
XXXI-A-16	28/03/04	87.5	95.5	14
XXXI-A-17	11/04/04	101.5	109.5	14
XXXI-A-18	25/04/04	115.5	120	7
XXXI-A-19	02/05/04	122.5	127	7
XXXI-A-20	09/05/04	129.5	134	7
XXXI-A-21	16/05/04	136.5	141	7
	23/05/04	143.5		**Close**

MicroCat (SBE 37) instruments as used in PAP mooring.

- Mooring PAP#2, originally containing nine MicroCats, had broken prior to the cruise. Two of these instruments had been recovered. Attempts to recover the remainder of PAP#2 were unsuccessful. Acoustic ranging of the releases produced spurious data. Whether the mooring was actually released and not sighted due to poor weather conditions, whether it was not in its position, or whether it failed to release its anchor weight is unknown. Mooring PAP#1, containing one MicroCat, was successfully recovered. Mooring PAP#2 was not re-deployed. Instead, six spare MicroCats and the one recovered were installed in PAP#1, which was successfully re-deployed.
- Since the PAP#1 mooring wire was not labelled at the MicroCat target depths, these were installed at depths very roughly estimated and measured on recovery in November (Poseidon cruise 306)
- Information on serial numbers, nominal depths and final mooring layout are available on the mooring drawing (Figure 8) and page 23.

- Prior to mooring deployment, all instruments were attached to the CTD for calibration purposes. For some instruments, this procedure had to be repeated due to accidental erasing of the calibration data. The corresponding CTD station numbers are 409 and 415.

- The mission data of the one MicroCat recovered from PAP#1 was downloaded (Figure 10)
-

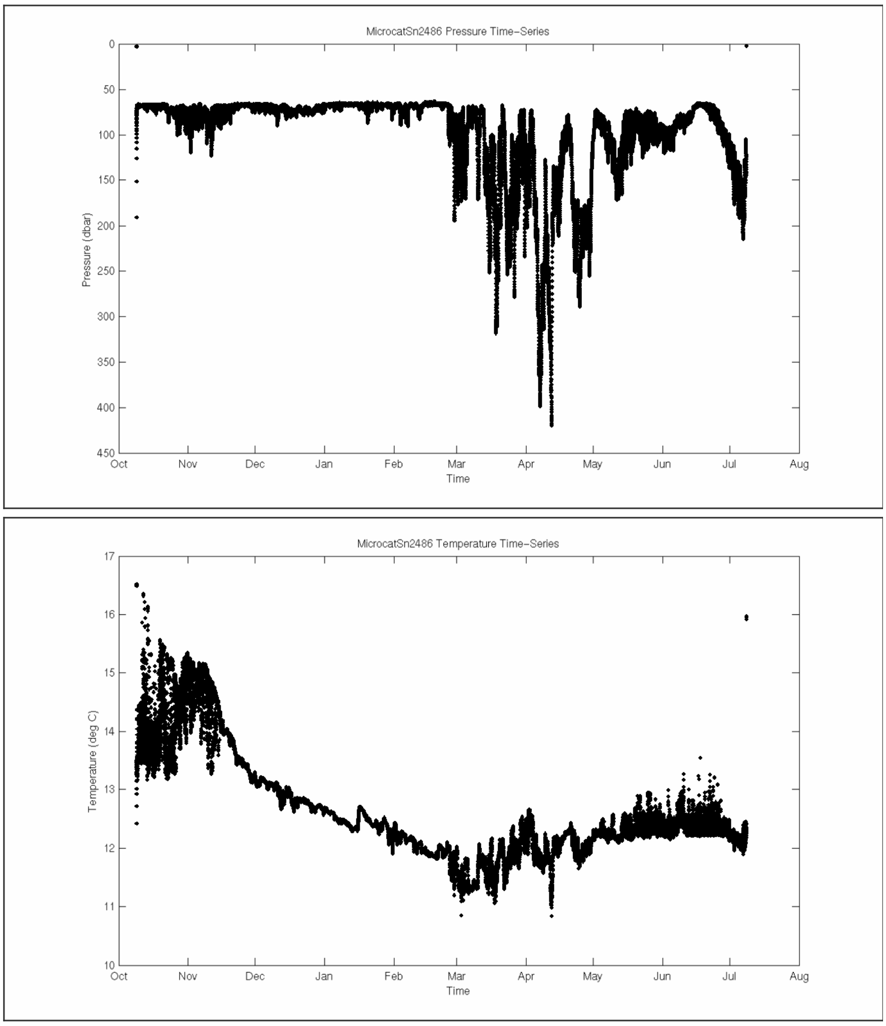

Figure 10. Data from the microcat attached to the sensor package on PAP#1 mooring.

Matthias Lankhorst

PClog as used during passage

The data must be considered uncalibrated, with no quality control applied.

PClog is the software collecting navigational and meteorological data automatically during the cruise.

Setup files for the software can be found in the subdirectory 'setup'.

The software itself is in the subdirectory 'programs'. Be aware of license regulations! The main purpose here is to enable post-processing of the raw binary files, which are unique to this software.

The raw (binary) data in the subdirectory 'data_bin' was converted to ASCII text using xlog, the data being in 'data_asc'. Due to bugs in xlog, it was necessary to split the data in two parts (one containing mainly navigational information, the other meteorological and hydrographic data). The files have '_nav' and '_sci' in their names, respectively. Files ending '*.asc' contain the data, while those ending in '*.asp' contain sensor description (unfortunately in German, a summary is given below).

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*_nav.asc file columns mean:

1 GPS date
2 GPS time
3 GPS lat
4 GPS lon
5 3d-GPS Heading
6 3d-GPS Pitch
7 3d-GPS Roll
8 Gyro Heading
9 Sounded Depth
10 Doppler Log Speed

*_sci.asc file columns mean:

1 GPS date
2 GPS time
3 Wind dir rel
4 Wind spd rel
5 Wind dir abs
6 Wind spd abs
7 Air temp
8 Rel Hygro
9 Air press
10 Sea temp (primitive sensor)
11 Sea temp (Thermosalinograph)
12 Sea cond (Thermosalinograph)
13 Sea sal (Thermosalinograph)
14 Sea dens sigma (Thermosalinograph)

Vessel-mounted ADCP

- The device had been installed prior to the cruise.
- Graphics display seems to be offset. Rotation by ship's course probably wrong.
- On 8 July, 04:00 UTC, the Heading Bias in the System Scaling submenu was changed from -25.20 to 0.
- Heading and speed data from ADU2, Gyro, and Dolog are properly received by the PClog computer.

- For calibration purposes:
- From 5 to 8 July, the ship's course was circa 30 degrees over long time periods (with minor interruptions).
- On July 14th, the ship's course was circa 67 degrees from at least 09:00 to 20:00 UTC.

- Bottom tracking was enabled on July 14th, circa 20:00, until the instrument was powered down on July 15th.

The data file names are pingdata.037 - pingdata.061 . The configuration file used was po300.cnf .

The manual explains that the data is CODAS-compatible.

Proper calibration using the navigational data of the ship needs to be performed after the cruise, prior to using any part of the data.

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Sensors on the PAP#1 mooring

A variety of sensors were attached to this mooring in addition to the microcats described above:

HS2 fluorimeter and backscatter sensor

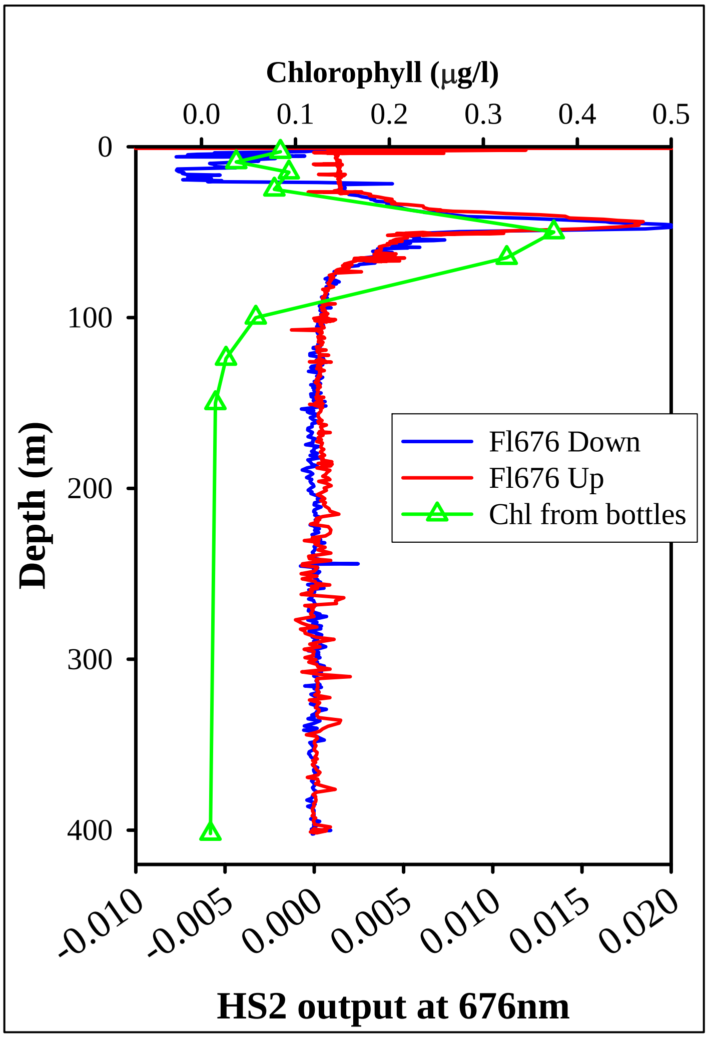

Figure 11: Vertical callibration of HS2 fluorimeter (Station 422) (Ser. # H2020342)

The HydroScat-2 is a fully autonomous in-situ optical backscattering sensor that measures the backscattering coefficient at two wavelengths and fluorescence at one wavelength. A burst of measurements were made once every two hours providing a description of the particles in the water column and the chlorophyll concentration. A copper shutter opens just prior to the measurement burst. The gap between the shutter and the lenses was about 1mm but this caused a massive deposit of copper oxide on the lenses such that they were totally opaque on recovery and as the rate of deposition is unknown the data obtained are of dubious value. A fresh unit (serial number H2020342) was prepared for the redeployment and appeared to function perfectly during the calibration deployment. However, just before deployment it could not be made to awaken from the sleep mode. The manufacturers subsequently advised in future we could try shorting all the terminal contacts!! The unit with copper deposit was therefore rapidly cleaned and prepared for deployment and the gap between the shutter and the lenses increased to 3mm. This unit has serial number H2020343.

NAS2 Nutrient sensor

The NAS-2E is an in-situ nutrient analyser for high-frequency time-series determination of nutrient concentrations in marine and fresh waters. Four versions are available for the measurement of nitrate (and/or nitrite) phosphate, silicate and now ammonia. The NAS-2E is typically deployed unattended for periods up to 60 days, although much longer deployments have been achieved. The device may be used near surface, in buoy and riverine applications, or be deployed at depths to 250 m in taut-line mooring scenarios. On the ANIMATE moorings only Nitrate is measured. It would appear that data were only obtained for the first three months of the deployment after which one of the reagent supplies failed.

SAMI-Sensor for PCO2

The SAMI-CO2 is a renewable reagent fibre optic sensor for measuring the partial pressure of carbon dioxide in water. It is capable of measuring the partial pressure of carbon dioxide over a range of approximately 200-600 µatm with a precision of ~ 1 µatm, unattended for up to one year. Its PVC housing is rated to withstand pressures to 100 meters. On return to SOC, no data appeared to be stored in the logger and the instrument was therefore returned to the manufacturers, Sunburst Sensors LLC. They confirmed that no data had been recorded. Water samples were taken for calibration of the new sensor that was deployed on 12th July.

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6. Acknowledgements

Without the excellent help and professionalism of the ship's officers and crew, none of this would have been possible. There is always a danger that language difficulties might affect communication but in this instance as a British principal scientist with a major part of the scientific and ships complement with German as a first language, I am delighted to be able to report that there was never any difficulty in communication.

I take this opportunity to thank all of the officers and crew for their fine endeavours. I would also like to thank Dr Thomas Mueller (IFM, Kiel) for his particular and invaluable efforts to ensure this cruise was a success.

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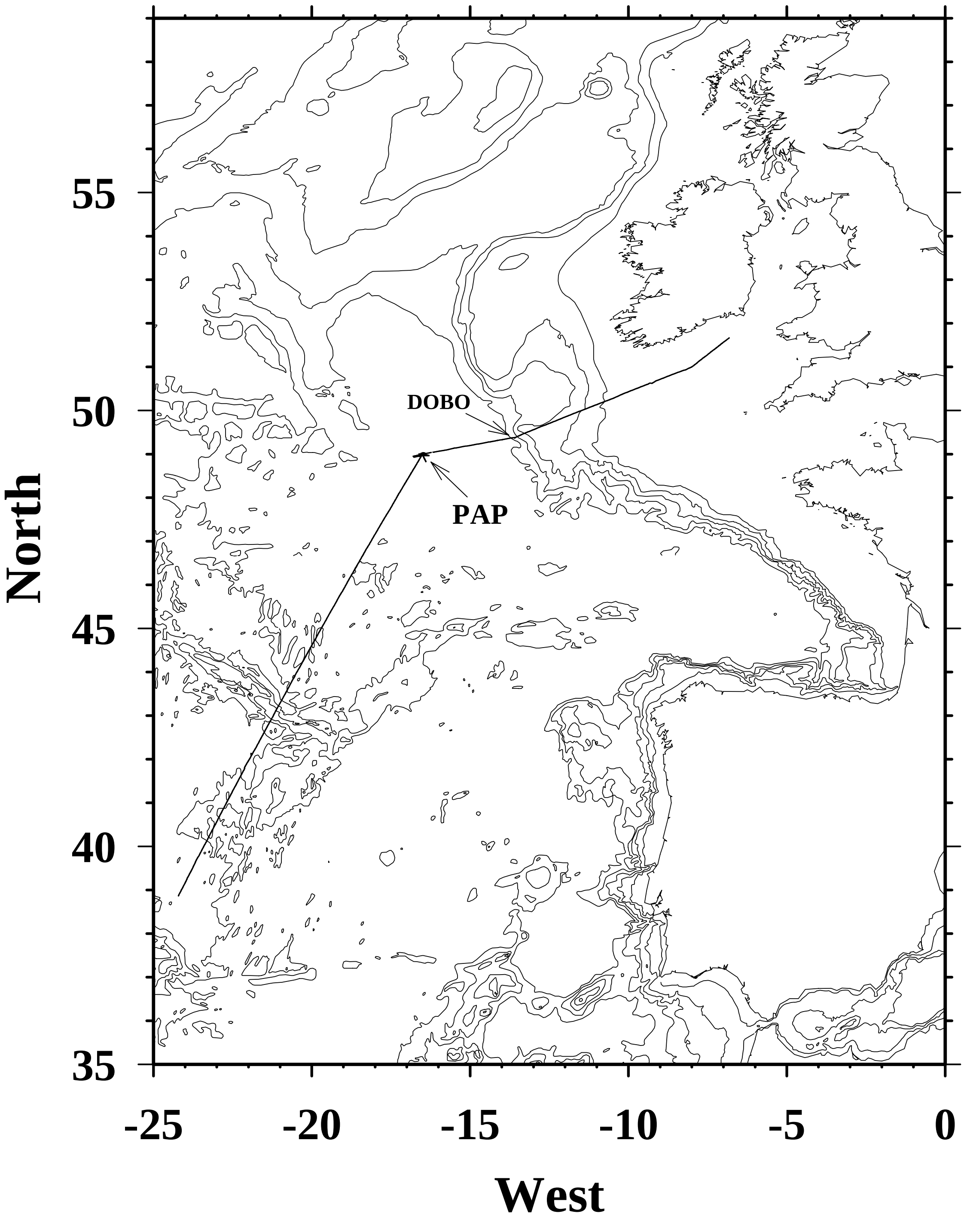
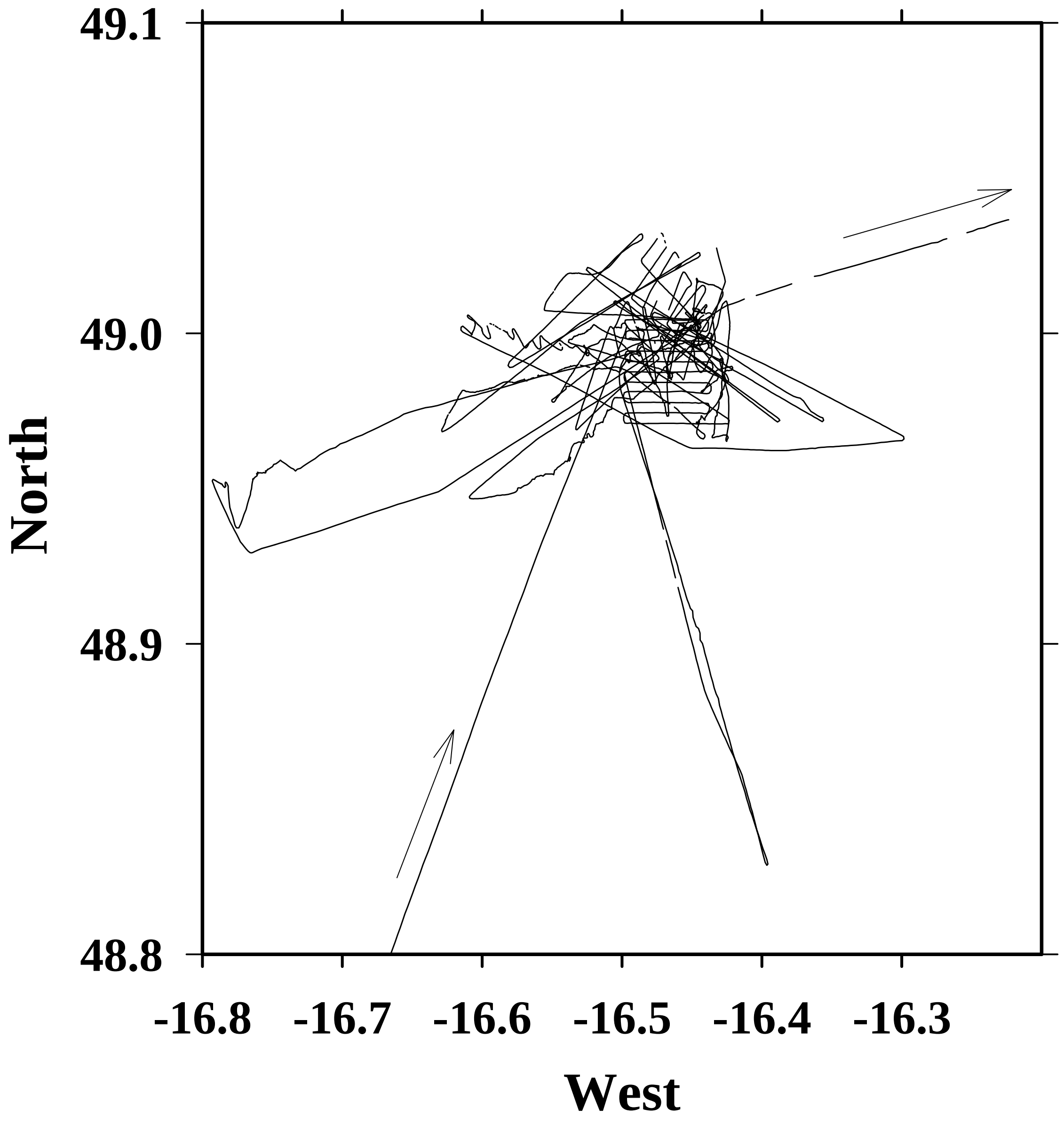
7. Appendices

Appendix A: Maps




49.1
49.0
48.9
48.8
North
-16.8
-16.7
-16.6
-16.5
-16.4
-16.3
West

Appendix B: Station list

Poseidon 300/1 Station list

Station	Start date	Start time	End time	Start position				End position				Approx Water depth	Approx. Sampler	Activity
	dd/mm/yyyy	GMT	GMT	deg N	min N	deg W	min W	deg N	min N	deg W	min W	(ucm)	max press (db)	
405	06/07/2003	04:42	06:07	41	41.72	22	7.19	41	47.66	22	7.55	3883	1400	CTD
406	08/07/2003	08:40	11:30	48	58.67	16	28.24	48	59.85	16	28.32			Attempt recovery of PAP#2 mooring
407		12:08	12:30	48	58.91	16	26.48						0	PELAGRA Float test
408		12:54	17:10	48	59.25	16	25.64	48	59.25	16	25.66			Recover PAP#1 mooring
409		18:45	23:04	48	59.32	16	32.46	48	58.87	16	36.62	4775	4850	CTD with microcats and releases
410		23:09	00:39	48	58.88	16	36.87	48	58.26	16	37.59	4803	200	Mesozooplankton net * 2
411	09/07/2003	05:02	05:40	49	1.14	16	31.50	49	1.16	16	32.22	4801	500	CTD
412		05:43	07:06	49	1.14	16	32.36	49	0.55	16	33.28	4803	200	Mesozooplankton net * 2
413		08:54	12:00	49	0.50	16	26.38	49	0.17	16	26.21	4805		Attempt recovery of Bathysnap
414		17:47	20:08	49	1.01	16	26.75	49	0.99	16	26.74	4802		Fluorosnap deployment
415	10/07/2003	03:00	05:22	48	59.87	16	28.69	49	0.14	16	31.12	4802	3000	CTD with microcats
416		05:25	06:25	49	0.16	16	31.20	48	59.88	16	32.15	4803	200	Mesozooplankton net * 2
417		07:27	09:45	48	59.16	16	27.95	48	59.12	16	27.41	4801		Second attempt recovery of PAP#2 mooring
418		10:12	11:30	49	0.06	16	26.75	49	0.15	16	26.76			Second attempt recovery of Bathysnap
419		13:10	14:43	48	59.70	16	27.24	48	58.87	16	29.12		95	SAPs at depths of 85 & 95m
420		15:50	19:10	48	58.63	16	30.43	48	57.00	16	34.46			PELAGRA buoyancy test on surface tether
421		21:48	03:20	49	0.26	16	29.60	48	58.24	16	26.55			Echo sounder search for PAP#2
422	11/07/2003	04:55	05:29	48	59.78	16	31.12	48	59.72	16	31.46		402	CTD with HS2 fluorimeter

423		05:33	06:45	48	59.39	16	31.61	48	58.70	16	32.85		200	Mesozooplankton net * 2
424		08:00	11:17	49	0.15	16	28.79	48	59.25	16	30.11			Recover PAP#3
425		12:30	19:37	48	59.62	16	31.46	48	59.97	16	36.45			PELAGRA buoyancy test on surface tether
426	12/07/2003	05:00	05:41	48	59.65	16	25.87	48	59.78	16	26.68		500	CTD
427		05:41	06:40	48	59.77	16	26.73	48	59.77	16	26.66	4803	200	Mesozooplankton net * 2
428		08:20	14:00	48	57.94	16	25.48	48	59.85	16	26.95	4805		Deploy PAP#1 mooring
429		14:06	14:19	48	59.98	16	26.30					4804	400	Deploy PELAGRA without tether
430		15:50	17:58	48	59.07	16	28.68	49	0.12	16	30.46	4805		Deploy PAP#3
431		19:45	22:54	49	0.25	16	27.45	48	59.25	16	25.93			Echo sounder survey of PAP#1
432	13/07/2003	08:19	10:07	48	59.82	16	27.28	48	59.74	16	29.17	4802	2000	CTD
433		11:30	12:46	48	56.72	16	47.01	48	57.05	16	47.01	4803		PELAGRA recovery
434		12:54	13:25	48	57.06	16	47.13	48	57.16	16	47.47	4800	300	CTD
435	14/07/2003	03:50	06:55	49	22.66	13	35.97	49	22.59	13	36.01	4000		Recovery of DOBO lander