National Oceanography Centre, Southampton

Cruise Report No. 55

RRS *Charles Darwin* Cruise 158

15-28 JUN 2004

Vigo - Fairlie

Ocean biogeochemistry

Principal Scientist

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2010

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ABSTRACT

Cruise CD158 to the Porcupine Abyssal Plain (PAP) maintained the long term observatory site on the Porcupine Abyssal Plain (PAP) at 49N 16.5W and continued a series of multidisciplinary occuaptions of the site. There were two objectives, A: to recover and redeploy various moorings and landers some of which were part of the EU funded ANIMATE project, and B: 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. These all contribute to the NERC funded BICEP project.

KEYWORDS

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NB Ships Personnel list unavailable at time of issuing this report

Cruise photo

Itinerary

Sailed Vigo	16:10	16/06/2004
Arrived PAP site	04:00	18/06/2004
Departed	20:00	25/06/2004
Arrive	08:00	28/06/2004

Objectives

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.

Reports

Primary Production and New Production

Sophie Seeyave & Mike Lucas

Primary productivity and new production incubations were undertaken on seawater samples collected on pre-dawn 500m CTD casts on 19, 21, 22, 23 and 25 June (see Table). Seawater was collected from 10 L Niskin bottles into darkened 10 L polyethylene carboys (new production) or 2.0 L black polyethylene bottles (primary production) using silicon tubing, from water depths corresponding to 97, 55, 33, 14, 1 and 0.1% light depths. Both light and sampling depths corresponded closely with primary production measurements made on an earlier northbound AMT cruise (AMT-14) that visited the PAP site on 29 May (CTD No: 088).

1. Primary Productivity (14C)

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 1 and 0.1 % of surface irradiance for approximately 10h.

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 polycarbonate Millipore filters. For the size-fractionated measurements, samples were filtered through a 10µm mesh prior to the vacuum filtration in order to obtain the productivity of the <10µm fraction of the population.

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 was added.

On two occasions (23/06 and 25/06), the 0.2 µm Millipore filters were replaced by 2.0µm filters for the size-fractionated experiment in order to assess the contribution of the >2.0µm fraction to primary productivity.

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 100µl from 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 assumed to be slightly less than the ambient NO3 concentrations measured on the earlier AMT-14 cruise; ie ~5µM in surface waters, increasing to ~8µM at the 0.1% light depth (~90m). Ammonium and urea additions were kept consistently at 0.05µM, following ammonium and urea measurements on the previous AMT-14 cruise (S. Painter, pers. comm.).

The bottles were incubated for ~10 hours alongside the primary production experiments, and terminated by filtering onto 25 mm ashed GF/F filters. This is the same protocol as adopted by the AMT community. After filtration, the filters were stored at –20 ˚C to await analysis by isotope mass spectrometry back at SOC.

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. Frozen and preserved samples

3.1. Nutrients

Samples were taken at every light depth and frozen for subsequent NO_3, NH_4, urea, Si & PO_4 analyeses back at SOC. Water was drawn directly from the 10L polyethylene bottles into 60 ml Diluvial containers, and frozen immediately at –20 ˚C. Samples were also collected directly from each Niskin bottle to a depth of 200m. Samples from the Ro and Rt ammonium regeneration bottles were also taken to assess ammonium re-cycling.

3.2. Chlorophyll

500 ml samples were collected from the same bottles as nutrient and ^{15}N productivity samples and immediately filtered onto 25 mm GF/F filters. Additionally, a chlorophyll measurement was made at 40m (depth of ANIMATE Sensors) and another at 150m to secure the immediate aphotic layer chlorophyll signature. These were stored frozen at –80 ˚C prior to pigment extraction and analyses back at SOC.

3.3. HPLC

25mm GF/F filters obtained from filtration of 2L from the Ro ammonium regeneration sample (see above) were frozen at –80°C for subsequent HPLC analyses back at SOC.

3.4. Phytoplankton taxonomy

Three 50 ml samples were taken from productivity rate bottle depths (first three stations only) directly into clear glass bottles, one containing 0.5ml of Lugol's solution and the other containing 1 ml formaldehyde. Phytoplankton counts and bio-volume estimates will be made back at SOC on settled samples using inverted microscopy methods.

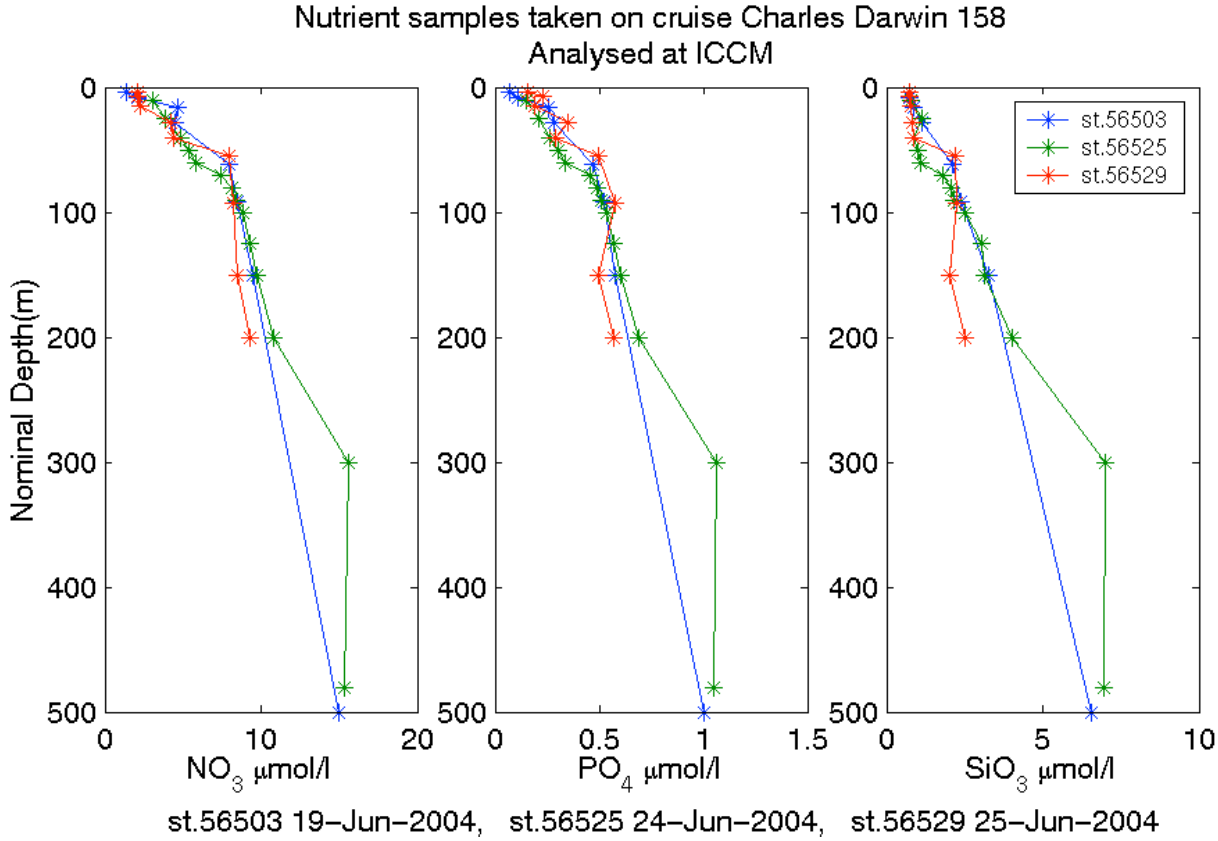
Date	**CTD Station**	**Sampling depths**			
		PP, New production & nutrients	Chl-a	HPLC	Phytoplankton
19/06	56503	4, 8, 16, 28, 62, 92	4, 8, 16, 28, 62, 92, 150	4, 8, 16, 28, 62, 92	4, 28, 62
21/06	56510	4, 8, 16, 27, 55, 80	4, 8, 16, 27, 40 55, 80, 150	4, 8, 16, 27, 55, 80	16
22/06	56516	4, 8, 16, 28, 62, 92	4, 8, 16, 28, 40 62, 92, 150	4, 8, 16, 28, 62, 92	N/A
23/06	56520	4, 9, 17, 31, 67, 99	4, 9, 17, 31, 40, 67, 99, 150	4, 9, 17, 31, 40, 67, 99, 150	N/A
25/06	56529	4, 8, 16, 28, 62, 92	4, 8, 16, 28, 40, 62, 92, 150	4, 8, 16, 28, 62, 92	N/A

Nitrate analysis

Frozen and preserved samples

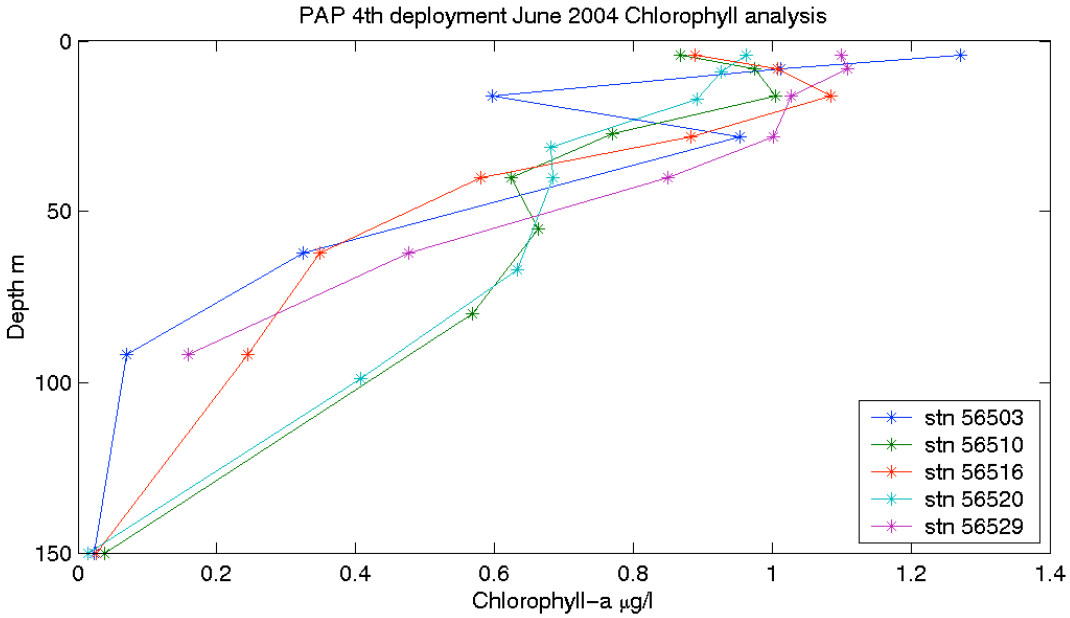
Samples were taken down to a depth 500m. All stations show reduced nutrients above the thermocline, with nitrate and phosphate levels reduced to almost zero at the surface. Silicate levels show similar profiles levelling out at approx. 1µmol/l. The nitrate and Phosphate values are typical PAP site summer values and are preceded by a rapid shallowing of the mixed layer depth, stratification and bloom conditions.

Figure 1.Vertical profiles of nutrient concentration



Chlorophyll-a shows mixed trends. Stn 56503 shows a zig zag profile with a max near surface, decreasing to a min at about 20m and then increasing again at the top of the thermocline. Stn 56529 follows a similar though less extreme profile. Stns 56510 and 56516 show another profile. Increasing form the surface to a maxima at 20m then decreasing towards the top of and through the themocline. Stns 56520 and 565529 show a general decrease form the surface to and below the thermocline. These profiles reflect the variation around the site. But are typical summer values.

Figure 2 Chlorophyll concentration profiles.



Louise Brown and Sue Hartmann

^{234}Thorium measurement

Background

Sandy Thomalla University of Cape Town

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 primary production CTD cast each morning (see Table1 for station positions). Ten litre water samples were collected from nine depths to 500m. The sampling distribution is concentrated in the surface 300m where a significant export of thorium on settling particles is expected to result in radioactive disequilibrium between thorium and uranium. The samples collected at 500m represent radioactive equilibrium between ^{234}Th and ^{238}U.

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

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 extraction efficiency of the precipitate was tested at CTD 56529 by collecting the filtered sea water after the MnO_2 precipitate had been filtered out and adding the chemicals again. After letting the water stand for 8 hours the precipitate was once again filtered out and processed and the filters counted to see if any thorium was still present in the water.

^{234}Th decays via beta decay to ^{234}Pa. ^{234}Pa has higher energy betas than ^{234}Th. It has a short half life of 1.2 minutes and therefore always in radioactive equilibrium with ^{234}Th. Hence, what actually is measured by the beta counter is ^{234}Pa decaying via beta decay to ^{234}U.

On CTD 56525 six replicate samples were taken at 1000m to assess the precision of the sampling process. These samples are all processed in the same way to test the reproducibility of the sampling methods. Accuracy may be assessed by comparing the determined activity of total ^{234}Th with the ^{238}U activity at depth 1000m.

At each of the thorium depths, a 2 litre sample was filtered onto GFF filters for particulate organic carbon (POC) and particulate organic nitrogen (PON). Filters are stored frozen at -20^{o}C for future analysis at the Southampton Oceanography Centre. These samples were collected in particular to determine how the ratio of total POC and PON to ^{234}Th changed through the water column.

The large particulate thorium fraction >60µm was sampled by deploying 3 in-situ Stand Alone Pumps (SAP). Instead of deploying one SAP pump at 100m which is the standard depth of sampling, 3 pumps were deployed at 50m, 100m and 150m to determine how the ratio of POC and PON to ^{234}Thorium changed with depth. A 293mm 60µm nylon mesh was inserted into the filter holder of the SAP which was set to pump for 960 minutes. Once the SAPS pumps are back on board the 60µm mesh is removed and rinsed with 1 litre of filtered thorium free sea water. The SAP sample is then split using a Fulsam sample splitter. 6/8^{ths} of the sample is filtered onto 142mm 0.8µm polycarbonate filters for ^{234}Th which are then processed and counted in the beta counter. 1/8th of the sample is filtered onto GFF filters for POC and PON analysis and stored in the -20 degree freezer.

Table1. Thorium station positions

CTD Number	Date	Time	Latitude	Longitude
56503	19-Jun	05:25	48 50.8 N	16 30.1 W
56511	21-Jun	05:55	48 59.91 N	16 30.31 W
56516	22-Jun	06:27	48 48.45 N	16 43.89 W
56520	23-Jun	05:38	48 58.02 N	16 30.16 W
56525	24-Jun	13:22	48 59.36 N	16 30.22 W
56529	25-Jun	05:29	48 49.91 N	16 35.49 W

Mesozooplankton Vertical Hauls

Operators: *Ivo Grigorov & Ben Boorman*

WP2 (200µm meshsize) was deployed twice from a depth of 200m to the surface. Both deployments were at dawn, on heavily overcast mornings. Sunrise times for the deployment days were 0402 GMT and 0403 GMT respectively (http://aa.usno.navy.mil/).

The vertical tows 200-0m were completed in 17min resulting in a speed of 11.7 m/min or 0.19 m/sec. The samples were transferred in 2.5L glass jars and preserved in a final concentration of 10% formalin.

Deployment times refer to the start of haul in of WP2 net from 200m to the surface.

Deployment 1/2
Station: 56509

Date: 21-VI-2004
Time: 0500 GMT
Depth: 200m
Net: WP2 (200µm meshsize)

Sample description: *Themisto compressa* amphipods and salps

Deployment 2/2
Station: 56528

Date: 25-VI-2004
Time: 0455 GMT
Depth: 200m
Net: WP2 (200µm meshsize)

Sample description: *T. compressa*, no salps

Benthic fauna

Bathysnap

Ben Boorman

This is a time-lapse camera system, deployed on a mooring to give long term images of the sea-floor. One system was recovered during the cruise. It has not been opened so it is not known whether the film has run through yet.

After some problems, and a steep learning curve in the darkroom, another system was deployed at 48º 00.28'N and 16º 27.13'W, in a water depth of 4806m.This position was chosen to keep the moorings in one area away from the areas where trawling can take place.

Otter Trawl

Ben Boorman

The Otter Trawl (OTSB14) is a commercial shrimp trawl used to catch megafauna. It is usually deployed with a wireout to depth ratio of at least 2.5 to 1, but with only 8000m of wire available and a target depth of c.4800m to be attained, changes in the rigging were required. A 200kg chain clump was attached to the end of the main warp at the point where the two 50m sweeps are connected by a system of swivels. This extra weight allowed the net to reach the seabed but with reduced catches. This may be because the chain clump announced the presence of the net before it arrived allowing the faster moving animals to evade the mouth, or because the net had to be towed too slowly to prevent it flying off the bottom. A maximum towing speed of about 1.5 knots was all that could be maintained, where 2.5-3 knots is the norm.

The three trawls were all fished blind as there was no beam-steering unit, working Waverly recorder or servoscribe on the winch potentiometer. However, with the vertical beam only it was possible to observe the monitor traces for part of the descent, and the new monitor does not appear to be better than the old version, and seems to lock off at some stage of the tow. It will work on deck when the pressure switch is operated manually.

The first two tows were very muddy while the third was very clean. There were no differences observed or planned in the their respective tows.

Multicorer

Andy Gooday

The multicorer was deployed on four occasions at a site located slightly to the north (48º 51'N) of the previous standard coring site. The shift is position was made necessary by the laying of a cable close to the previous site. On each occasion, the corer worked well and returned a full set of 12 cores, ranging in length from 31 cm to 34 cm. Those from Station 56519, obtained during unfavourable sea conditions, were overlain by cloudy water. The others were in perfect condition.

The cores were used for a variety of purposes, namely 1) sediment biogeochemistry, 2) source of fresh foraminiferal specimens for molecular and morphological characterisation, 3) sliced into layer down to 10 cm for faunal studies, 4) unfixed material returned to UK for live ciliate studies (Dr. G. Esteban, CEH Dorset).

Benthic Foraminifera

Cores for foraminiferal studies were kept in the constant temperature laboratory at all times. As soon as possible after collection, the top 1 cm of sediment was sliced off and sieved on a 300 μm mesh screen using the original core-top water or chilled seawater. The residue was then sorted in a Petrie dish on ice for foraminifera that appeared live (i.e. had convincing test contents). Monothalamous forms such as komokiaceans and related soft-walled taxa were selected because of their exceptional phylogenetic importance. The sorted foraminifera were divided into morphospecies, photographed (Fig. 1), and either placed in a vial with 0.1 ml guanidine buffer or frozen in liquid nitrogen for molecular analysis, or fixed in 10% formalin for morphological study. A total of 57 monothalamous morphospecies was recognised with up to 25 occurring at particular stations (Table 1). Of these, 43 were komokiaceans and related chain-like forms and the remainder were spherical and tubular species belonged to other groups. In addition, five xenophyophore species were recognised, including a distinctive new species of the genus *Homogammina*. Only three species (*Edgetonia floccula,* Komoki sp. 3, *Staphylion* sp., mud-walled '*Crithionina'*), occurred at all four stations. Others exhibited patchy distributions and in some cases were common in individual samples but rare or absent elsewhere.

This extensive collection of material will be used for several purposes. The distribution and abundance data will form the basis for a survey of species occurrences at within and between deployment scales. Analysis of small subunit ribosomal DNA gene sequences of guanidine-fixed and frozen specimens will be conducted in the laboratory of Dr Jan Pawlowski (Geneva). A particular target will be the komokiaceans, an enigmatic group for which no gene sequences are presently available. If successful, these analyses will lead to a better understanding of the position of the Komokiacea within the evolutionary radiation of monothalalmous foraminifera. Finally, the majority of the species collected are undescribed. We will describe the more important of these new species on the basis of morphological and, hopefully, molecular criteria.

Table 1. Distribution of monothalamous foraminiferan and xenophyophore species (>300 μm sieve fraction) between multicorer stations

Station	56502	56508	56519	56527
Komokiacea				
Baculella sp.		X		
Chain sp.1	X			
Chain sp.2		X		
Chain sp.3		X		
Chain sp.4		X		
Chain sp.5		X		
Chain sp.6				X
Crambis sp.		X		
Edgertonia argillispherula	X	X		
Edgertonia floccula	X	X	X	X
Edgertonia sp.1		X		
Edgertonia sp.2			X	
Elongate Mudball			X	
Komoki sp.1	X			
Komoki sp.2	X			
Komoki sp.3	X	X	X	X
Komoki sp.4	X			
Komoki sp.5		X		
Komoki sp.5?		X		
Komoki sp.6		X		
Indeterminate sp.1			X	X
Indeterminate sp.2			X	X
Lana sp.1	X			
Lana sp.2	X			
Lana sp.3		X		
Lana sp.4		X		
Lana Mudball			X	
Mud Ball Komoki sp.1		X		

Mud Ball Komoki sp.2		X		
Narrow Branching Tube			X	
Reticulated Tube	X			
Reticulum sp.1	X			
Reticulum sp.2	X			
Reticulum sp.3			X	
Rhizammina sp.1	X			
Rhizammina sp.2	X			
Rhizammina narrow sp.3			X	X
Rhizammina wide sp.4				X
Rhizammina like tube				X
Septuma	X	X	X	
Septuma?			X	
Spider-like *Septuma*				X
Staphylion	X	X	X	X
Other Monothalamous Foraminifera				
Agglutinated Silver Sausage		X		
Bathysiphon sp.			X	
Black Oval Allogromiid		X		
Black Round Allogromiid	X			
Black Round Allogromiid with cover	X			
Branch Organic Sack			X	
Brown Elongate Allogromiid				
Mud Walled “Crithionina	X	X	X	X
Muddy Tube sp.1		X		
Muddy Tube sp.2		X	X	
Organic walled sack sp.1			X	
Organic walled sack sp.2			X	
Tube sp.1		X		
Xenophyophores				
Aschemonella sp.	X			
Homogammina sp. nov.	X			
Galatheammina sp.			X	
Psammina sp.			X	
Reticulammina labyrinthica			X	
Rhizammina thick tubes	X	X		

Eva Ramirez, Ian Hudson, Andrew Gooday, Ben Boorman,
Anna Sabatini and Ivailo Grigorov

Rationale

Since the late 1970's the site at the Porcupine Abyssal Plain (PAP) has been used as a time-series location for the sampling of benthic mega, macro and meiofauna, in conjunction with the sampling of the flux of particulate organic matter to the seabed.
The PAP site is now well established as a long-term study area for the effects of the fall of phytodetritus on the dynamics of the benthic community. Part of the time-series focuses around the use of a semi-balloon otter trawl (OTSB 14) to sample the benthic megafauna to examine the biomass, abundance and size of the benthic population both annually and interannually.

St. 56506

Sunday 20th June 2004 – 0010: Deploy OTSB 14 with iron pig, as there are only 7800 m of wire on the winch. Ben Boorman fishes the trawl overnight, but the beam steering is not working, so no clear signal is received in the monitor.

Net shot: 0010, 48°52'39''N - 16°49'79''W.
Net on bottom: 0305 (aprox), 48°55'01''N - 16°34'73''W.
Start hauling at 0530.
Net off bottom: 0623 (aprox), 48°56'54''N - 16°26'25''W.
Net on board at 0930.

Small catch but OK. Muddy catch.
The net was picked carefully for *Amperima rosea* and specimens of other species. The main catch was sorted on the sieving table.
Ian Hudson took holothurian specimens to dissect in the cold room for pigment and lipid analyses (see below).

All samples are sorted, weighed and fixed in the wet lab (Figure 1).

Comments:

1- This was a small catch but with all the representative species normally found at PAP.
2- The biomass of *Amperima rosea* is small compared to previous samples.

3- A high number of *Oneirophanta mutabilis* is parasitised with a gastropod that makes a hole on the ventral body wall and attaches itself inside the holothurian. In one of the specimens, the adult parasite was accompanied by 3 gastropod juveniles.

St. 56515

Monday 21st – Tuesday 22nd June 2004. Deploy OTSB 14 with iron pig. Beam steering still not working.

Net shot: 1945, 48°57'98''N - 16°19'18''W.

Net on bottom: 2305 (aprox), 48°51'61''N - 16°33'55''W.

Start hauling at 0145.

Net off bottom: 0245 (aprox), 48°50'14''N - 16°38'72''W.

Net on board at 0500.

Larger catch but similar to previous trawl. Catch with more mud. Ben thinks the net got stuck on the bottom when starting to haul, which will explain the mud. Because of the mud, the specimens are very well preserved. Net picked on deck. Sample sorted on sieving table.
Ian Hudson took holothurian specimens to dissect in the cold room for pigment and lipid analyses (see below).
Eva Ramirez takes 10 *Oneirophanta mutabilis* for gonad samples for TEM (see below).

All samples were sorted, weighed and fixed in the wet lab (Figure 1).

Comments:

1- Biomass of *Amperima rosea* still small.

2- Some very large and very well kept specimens of *Psychropotes longicauda* and *Pseudostichopus villosus*.

St. 56523

Wednesday 23rd – Thursday 24th June 2004. Deploy OTSB 14 with iron pig. Beam steering still not working.

Net shot: 2200, 48°53'18''N - 16°30'88''W.

Net on bottom: 0145 – 0206 (aprox), 48°56'09''N - 16°48'05''W.

Start hauling at 0406.

Net off bottom: 0505 (aprox), 48°56'87''N - 16°54'09''W.

Net on board at 0730 (24/06/04).

The smallest catch of the three trawls, with no mud.

Ian Hudson took holothurian specimens to dissect in the cold room for pigment and lipid analyses (see below).

Eva Ramirez took 10 *Oneirophanta mutabilis* for gonad samples for TEM (see below).

All samples are sorted, weighed and fixed in the wet lab (Figure 1).

Comments:

1- There seems to be more *Amperima rosea* and other small specimens of other species on the net this time. However, the biomass of *Amperima rosea* is still small in comparison.

2- All the benthic trawls showed increased numbers of *Peniagone diaphana,* a species previously heavily affected by the Amperima event. Notably many of the specimens were quite large for this species and had gut contents that were full of fine phytodetritus.

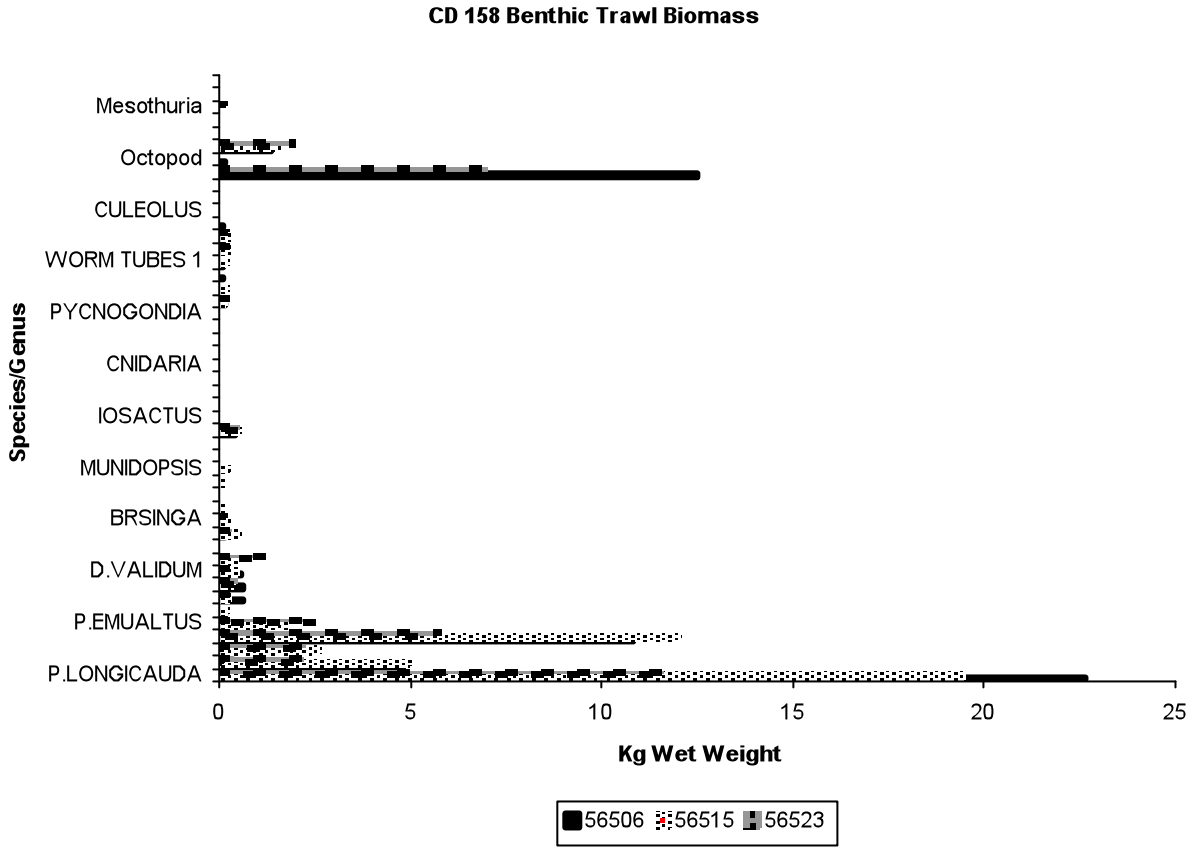


Figure 1. The biomass measurements of benthic megafauna sampled with the OTSB 14 over three hauls on cruise CD 158.

Direct measurement of Export flux

Direct measurement of export flux was achieved using PELAGRA traps at depth. These were successfully deployed and recovered with sufficient material to provide base for further analysis.

Richard Lampitt

Observatory data: Moorings Report

Introduction

One of the primary objectives of CD158 was the turn-round of the three ANIMATE moorings at the PAP observatory site.

After a delay due to problems winding a new CTD wire onto the ships winches, the RRS *Charles Darwin* finally sailed from Vigo in northern Spain at 16:00 local time on the 16th June 2004. The cruise left the PAP site at approx. 16:30 on the 25th June and docked alongside in Fairlie, Scotland on the 28th June.

It was decided that on reaching the PAP site the initial operation would be a mooring recovery, PAP2, which was the satellite telemetry one and the most complex to handle.

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

PAP2 Recovery

The vessel arrived at the PAP site on the 18th June where a sighting of the surface satellite buoy was expected or a signal detected on the Gonio Argos D.F. This however, was not the case so an acoustic interrogation of the releases was attempted. PAP2 was equipped with dual RT661's (#460 and #868 supplied by IFM Kiel) and on interrogation both gave immediate and consistent responses (e.g. 4952m, 4951m, 4953m) in a water depth of 4815m (uncorrected).

The release command was transmitted to #460 and confirmation received at 17:50. Using acoustic ranging, the RT was monitored rising to the surface with an ascent rate of approx. 80m/min. The mooring was sighted on the surface at 18:25 more than a mile from its nominal position. The top of the mooring was grappled at 19:00 at position

49º 05.3'N, 16º30.9'W. Due to the design of the mooring (see mooring diagrams, Appendix 2) there seemed no option but to haul the first 200m or so of the mooring in by hand until the sub-surface buoy was reached, at which point the wire could be attached to the

winch. Manually handling the wire was made difficult due to the slime that had built up during the deployment period. Recovery was completed at 22:10.

The mooring was instrumented with SBE37IMP microcats and MTD's (temperature and depth recorders). These were removed as they were reached in the following order, top-most first:

#2812 SBE37IMP
#2974 SBE37IMP
#24 MTD
#2486 SBE37IMP
#2934 SBE37IMP
#2718 SBE37IMP
#25 MTD
#2809 SBE37IMP
#26 MTD
#27 MTD
#2933 SBE37IMP
#28 MTD

The MTD's were to be returned direct to Kiel for data download. The microcats however, needed to be downloaded on board and due to the slow nature of the inductive link, this could take 8 hours per instrument. Problems were encountered with finding PC's which could work with the Seabird software, two machines eventually being used, one operating under Windows 2000 and the other using XP. Another problem appeared to occur using the IFM modem that was not always reliable.

Wire Test

These were conducted on the 19th June with the acoustic releases shackled to the CTD frame. They were carried out at a depth of approx. 4700m using RT #57, #315, #318 and #344 (for the list of codes see Appendix 1). Due to only two puffer tubes being available, each RT could only have one channel tested and this was decided to be the pyro. Each RT gave good ranges and when the CTD was recovered, it was found that all four puffers had fired.

PAP1 Recovery

The ship was in position to begin recovery of PAP1 on the 20th June. The mooring was again equipped with dual releases provided by IFM Kiel, #28 and #455. The latter RT was

commanded to release at 16:27 and gave consistent ranges whenever interrogated. The mooring was sighted at 16:45 and the top recovery line grappled at 17:00 in position

49º 02.3'N, 16º31.8'W. Recovery was finally complete by 19:30. The only difficulty was in handling it as it was covered in slimy growth for the first 30m or so, making it slippery. The sub-surface buoy was also largely covered in growth.

Only one microcat and the Workhorse Sentinel 300kHz ADCP needed to be serviced by UKORS staff, the remaining sensors being worked on by the scientific personnel. An attempt to download the data from the BB-ADCP was not made due to time constraints. The instrument was packed and returned to IFM Kiel for servicing.

Microcat Calibration

For this in-situ calibration (21st June) the microcats were fitted to the CTD frame and lowered to a depth of 1000m for approx. 15 minutes (CTD cast 4). They were programmed to self-log at a sampling interval of 10seconds. On recovery, the data was uploaded to a PC for comparison later. See the salinities spreadsheet (in the CD158 data archive) and cast 4 for the CTD and Autosal data.

PAP2 Deployment Mooring #2004/21

Deployment started at 15:18 on the 22nd June at position 49º 01.1'N, 16º 27.7'W in marginal sea conditions. The satellite buoy was lowered by hand into the water and the wire paid out manually attaching the microcats at the pre-determined points. After the pellet buoys had been deployed and as it was becoming more difficult to hold the wire while instruments were attached, the line was stopped off and the remaining wire coiled onto the deck. The sub-surface buoy was craned into position; the inductive wire routed through it and connected to the wire beneath. The telemetry wire then had its stopper removed and the wire, with instruments already attached, was paid over the stern as far as the s-s buoy. This was then lowered into the water by crane, the remaining wire already wound onto the winch. Deployment proceeded by paying out wire from the winch, pausing to attach the remaining instruments and stopping off to break the wire for the insertion of buoyancy packs and the dual RT units (#455 and #868, IFM Kiel units).

Unfortunately, by this time the drop point had been passed. However, the topography was assessed using EM12 data and it was decided no adjustments to the length of the mooring were necessary and the deployment could continue. Finally, the anchor clump was let go at 19:49 at position 49º 07.15'N, 16º 29.61'W, and water depth of 4804m (uncorrected), 4838m (corrected). The RT units were monitored to the sea floor using the waterfall display, arriving on the bottom at 20.17.

PAP1 Deployment Mooring # 2004/22

The deployment of PAP1 began at 16:06 on the 23rd June at position 48º 58.8'N, 16º 24.5'W. The recovery line and sphere was paid out by hand, then the first s-s buoy (fitted with an Argos beacon id: 24335) was lowered using the starboard pedestal crane, while the port crane lowered the two instrument packages. The s-s buoy was let go using a quick release hook when the instrument packages were in the water and the combined system streamed astern. Next, the syntactic float containing an upward looking RDI Sentinel 300kHz ADCP and a downward looking 75kHz Long Ranger, was connected into the line and lowered into the water using the starboard crane. Deployment proceeded by streaming the wire astern, and stopping off to connect in buoyancy packages and a dual pair of pyro-firing RTs (#57 and #315). The chain clump was slipped over the stern at 18:42 at position 49º 02.59'N, 16º 31.74'W in a water depth of 4803m (uncorrected), 4836m (corrected). One of the RT units was commanded to ping to allow monitoring to the sea floor. The anchor arrived on the bottom at 19:15 and the RT unit disabled.

PAP3 Recovery

The ship was hove-to on the PAP3 site on The 24th June, interrogation of the acoustic release began at approx. 10:30, and the RT commanded to ping continuously. This mooring is made up of 2 current meters, 2 sediment traps, but only a single pyro-firing RT unit (#469). Initially, the pyro channel fire command was sent, but after several minutes the waterfall display showed that the mooring had not separated from the sea floor, despite an "executed" signal being received by the deck unit. The release1 channel fire command was then sent and at 10:34, separation of the mooring from the bottom was confirmed. The ascent rate was estimated to be 45m/minute and the top buoyancy package sighted at 11:34.

The recovery line was grappled at 11:49 at position 49º 00.5'N, 16º 30.2'W, and the upper buoyancy package hauled in followed by the first sediment trap and RCM8. As the second buoyancy package was hauled in, it was seen that 8 of the 10 spheres had imploded. Recovery was completed by 12:44 with the RT unit on board.

PAP3 Deployment Mooring # 2004/23

The mooring deployment was delayed due to a fault in sediment trap #11262-06 that was discovered as the new schedule was being uploaded. The fault revealed itself as a low battery voltage warning although the batteries were new and had been tested. Unfortunately this warning inhibits further operation of the unit and so the electronics was replaced by that from one of the recovered traps, 11262-10.

Deployment then proceeded at 16:53 on the 24th June after replacing all instruments with serviced units, the crushed spheres replaced from spares, and winding on new polyester rope. Buoyancy and instrument packages were all lowered into the water using a combination of winch and block carried by the crane, connected into the line where required. A dual pair of pyro-firing releases (#318 and #344) were incorporated, the anchor clump being slipped at 18:22 at position 49º 00.04'N, 16º 30.45'W in a water depth of 4798m (uncorrected). The RT units were monitored to the sea floor, finally hitting bottom at 19:05, and giving a slant range of 4807m.

Concluding Notes

There are obvious advantages using either of the NERC deep-sea research vessels, namely *Charles Darwin* or the Discovery. These include familiarity with the ships and their limitations, and knowledge of the equipment available on board. An example of the latter point is the ability to connect a TT301 deck unit directly to the PES fish through the patch panel. This gives the user much improved reception compared to using an over-side dunking transducer. Finally, a further advantage is the known good working relationships with the deck crew and their familiarity with the operation.

The use of the two aft pedestal cranes during the deployment of PAP1 proved to be very effective.

Feedback from IFM Kiel shows that the PAP2 instruments are at the correct depths and relaying data via the satellite link proving the operation of the mooring. Unfortunately, probably due to the marginal weather conditions at the time of the deployment, the top microcat appears to have been damaged and not sending any conductivity data. One other microcat is also failing to transmit.

Some of the materials used in the PAP3 mooring appear to have suffered considerably from corrosion. Notably, the shackles of both sediment traps corroded badly and may have contaminated the contents of the sample bottles. The lower of the two RCMs (#9415) also appears to have been attacked vigorously with the paint work of the case extensively "bubbled" and the zinc anodes "fizzed" away.

Appendices: moorings

Appendix 1: Acoustic Release Codes

RT661 S/N	WINDOW CODE	DIAGNOSTIC	PYROTECHNIC	RELEASE 1	PINGER	OFF CODE	MODE
460**	5811	N/A	N/A	[W] 5813	N/A	N/A	B
868**	4297	N/A	N/A	[W] 4219	N/A	4294	A
455**	4273	N/A	N/A	[W] 4266	N/A	4274	A
28**	5023	N/A	N/A	[W] 5024	N/A	N/A	A
469*	6971	[W]6987	[W]6991	[W]6985	6976	6973	A

*Wait time: 15s
*Window active: 60s
** Units provided by IFM Kiel

Natural Environment Research Council — Southampton Oceanography Centre

Ocean Engineering Division

UKORS

MORS SYSTEMS

Operational Sheet

CRUISE CD158 DATE **May 2004**

TYPE RT 661 CS

FUNCTION RELEASE TRANSPONDER PYRO FIRER

SERIAL No. 57

Delivery MAR 1992

Int Frequency		Reply Frequency
FR1 =	9.0KHZ	FT1 = 9.5KHZ
FR2 =	9.5KHZ	FT2 = 9.0KHZ
FR3C =	10.5KHZ	
FR4 =	11.5KHZ	FT4 = 10KHZ

FT0,FT5,FT6,FT11,FT15 = 8.0KHZ MODE A

FT7,FT8,FT9,FT10 = 12.0KHZ MODE B

Function / Code	TT301	Reply	Specifications
WINDOW	64A1	FT0	Wait time 15sec Active 60sec
ON FR1-FR2	64A2	FT0	
OFF FR1-FR2-PINGER	64A3	FT0	
RELEASE 1 (W)	6411	FT0	
RELEASE 2	64A6(n/a)	FT0-FT6	
DIAGNOSTIC	64A7	FT0-FT8	Measure delay 3sec Vert offset 10sec
PYROTECHNIC(W)	6421	FT0-FT4	Wait time4 s Pulse 32s TESTED OK
PINGER (W)	6421	FT0-FT5	Pulse width Ms Recur sec

Power Configuration 3 banks of D Alkaline installed
1 bank of 1 Alkaline PP3 installed

Power partition Standby - power motor

Diagnostic Measure t(FT7) - t(FT0) - 3s (13 s in horizontal position)

Cells voltage (V) Diagnostic measure x 4.1

Batteries fitted : May 2004

Wire test : at 4700m on 19th June 2004

Functions check : OK

Deployed Mooring : PAP1 Date : 23rd June 2004

Recovery limit: Date :

Recovered : Date :

Ocean Engineering Division

UKORS

MORS SYSTEMS

Operational Sheet

CRUISE: CD158 DATE: May 2004

TYPE	RT6X1 OEM UNIT
FUNCTION	RELEASE TRANSPONDER PYRO FIRER
SERIAL No.	315
Delivery	12/06/1995

Int Frequency	Reply Frequency
FR1 = 9.0KHZ	FT1 = 14KHZ
FR2 = 14.0KHZ	FT2 = 9KHZ
FR3 = 11.0KHZ	
FR4 = 13.0KHZ	FT4 = 10KHZ

FT0,FT5,FT6,FT7,FT8,FT9,FT10,FT11,FT15 = 8 KHZ MODE A

Function / Code	TT301	Reply	Specifications
WINDOW	9525	FT0	Wait time 15sec Active 60sec
ON FR1-FR2	9526	FT0	
OFF FR1-FR2-PINGER	9527	FT0	
RELEASE 1 (W)	9585	FT0-FT5	
RELEASE 2 (W)	9586(NA)	FT0-FT6	
DIAGNOSTIC(W)	9587	FT0-FT7	Measure delay 3sec Vert offset 10sec
PYROTECHNIC(W)	9591	FT0-FT11	Wait time 4s Pulse 30s
PINGER	9530	FT0-FT4	Pulse width Ms Recur sec

Power Configuration	3 banks of ALKALINE D installed
	1 bank of 1 Alkaline PP3 installed ..
Power partition	Standby - power motor

Diagnostic Measure	t(FT7) - t(FT0) - 3s (13 s in horizontal position)
Cells voltage (V)	Diagnostic measure x 4.1
Batteries fitted	: MAY 2004

WIRED AS CONTINUOUS WIRING TO BULKHEADS OLD TYPE RELAY BOARD.
REPLACEMENT END CAP AND BULKHEADS 27TH MAY 2003

Wire test	: at 4700m on 19th June 2004
Functions check	: OK
Deployed Mooring	: PAP1 Date : 23rd June 2004

Recovery limit: Date :

Recovered : Date :

Ocean Engineering Division
UKORS

MORS SYSTEMS

Operational Sheet

CRUISE CD158 DATE MAY 2004

TYPE RT 661 OEM
Function Release Transponder pyro firer

SERIAL No. 318
Delivery AUG 1995

Int Frequency		Reply Frequency
FR1 =	9.0KHZ	FT1 = 14KHZ
FR2 =	14KHZ	FT2 = 9.0KHZ
FR3 =	11.0KHZ	
FR4 =	13.0KHZ	FT4 = 10KHZ

FT0,FT5,FT6,FT7,FT8,FT9,FT10,FT11,FT15 = 8.0KHZ MODE A

Function / Code	TT301	Reply	Specifications
WINDOW	9561	FT0	Wait time 15sec Active 60sec
ON FR1-FR2	9562	FT0	
OFF FR1-FR2-PINGER	9563	FT0	
RELEASE 1 (W)	9585	FT0-FT6	8 SEC PULSE OK
RELEASE 2 (W)	9586(n/a)	FT0-FT7	
DIAGNOSTIC(W)	9587	FT0-FT8	Measure delay 3sec Vert offset 10sec
PYROTECHNIC(W)	9591	FT0-FT4	Wait time4 s Pulse 32s 30 SEC PULSE OK
PINGER	9566	FT0-FT5	Pulse width4.06 Ms Recur 2sec NO WIN

Power Configuration 3 banks of D ALKALINE installed
1 bank of 1 Alkaline PP3 installed
Power partition Standby - power motor

Diagnostic Measure t(FT7) - t(FT0) - 3s (13 s in horizontal position)
Cells voltage (V) Diagnostic measure x 4.1
Batteries fitted : May 2004

Wire test : at 4700m on 19th June 2004
Functions check : OK
Deployed Mooring : PAP3 Date : 24th June 2004

Recovery limit: Date :

Recovered : Date :

Ocean Engineering Division
UKORS

MORS SYSTEMS
Operational Sheet

CRUISE CD158 DATE MAY2004

TYPE	RT661 CS
FUNCTION	RELEASE TRANSPONDER PYRO FIRER
SERIAL No.	344
Delivery	11-10-96

Int Frequency	Reply Frequency
FR1 = 9khz	FT1 = 9.5khz
FR2 = 9.5khz	FT2 = 9.0khz
FR3 = 11khz	FT0 = 8 khz
FR4 = 14khz	FT4 = 10khz

FT0,FT5,FT6, FT11,FT15,FT7,FT8,FT9,FT10 = 8.0khz MODE A

Function / Code	TT301	Reply	Specifications
WINDOW	B561	FT0	Wait time sec Active sec
ON FR1-FR2	B562	FT0	
OFF FR1-FR2-PINGER	B563	FT0	
RELEASE 1	B564	FT0-FT0	NO WINDOW
RELEASE 2 (W)	B586(na)	FT0-FT6	
DIAGNOSTIC	B565	FT0-FT7	Measure delay sec Vert offset sec
PYROTECHNIC(W)	B591	FT0-FT11	Wait time s Pulse s
PINGER	B581	FT0-FT4	Pulse width Ms Recur sec

Power Configuration	3 banks of D installed for 1 bank of Alkaline PP3 installed for
Power partition	Standby - power motor

Diagnostic Measure	t(FT7) - t(FT0) - 3s (13 s in horizontal position)
Cells voltage (V)	Diagnostic measure x 4.1
Batteries fitted	: May 2004

Wire test	: at 4700m on 19th June 2004	
Functions check	: OK	
Deployed Mooring	: PAP3	Date : 24th June 2004

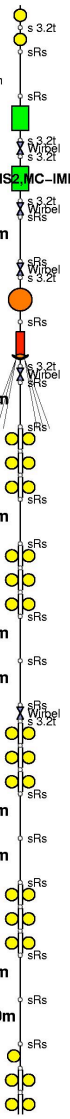
Recovery limit: Date :

Recovered : Date :

Appendix 2: Recovered Moorings

ANIMATE/PAP1–3, launched during P306, 18–NOV–2003, WD #24335 — 27–Feb–2004 19:59 — Page # 1 / 3

depth (incl. stretch)	component S/N	rope # & Length	Distance from lower rope end	in/out of water comment
31 m	Sphere 11"			
39 m	Frame ICCM SAMI #26,NAS2E,HS2,MC–IMP #2800			
152 m	FL45" (open) WH #1940			
154 m	ADCP–dow #1614			
1002 m	6Benthos			
1376 m	6Benthos			
2382 m	6Benthos			
3388 m	6Benthos			
4393 m	5Benthos			



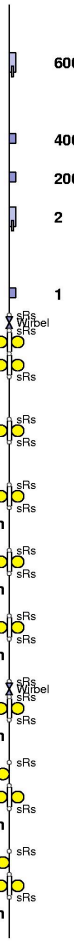
ANIMATE/PAP1–3, launched during P306, 18–NOV–2003, WD #24335					27–Feb–2004 19:59 Page # 2 / 3
depth (incl. stretch)	**component**	**S/N**	**rope #** **& Length**	**Distance from** **lower rope end**	**in/out of water** **comment**
			sRs		
			#11 320m 1/4" ins		
			sRs		
			#12 50m 1/4" ins		
			sRs		
			#13 20m 1/4" ins		
4787 m	**6Benthos**		sRs		
			sRs		
			#14 10m 1/4" ins		
			sRs		
			Wirbel s 3.2t		
4800 m	**AR–2**	**#455, #28**			
			s 3.2t		
			#15 1m chain–16		
			s 3.2t		
			#16 30m 1/4" ins		
			s 3.2t		
			#17 2m chain–16		
			s 3.2t		
4834 m	**Anchor (5)**	**5 Railwheels**			

ANIMATE/PAP2–3, launched during P306, 17–NOV–2003, WD #12264

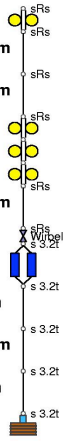
27–Feb–2004
20:03
Page # 1 / 4

depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment
–227 m	Sat–Trans				
			#1 10m Tele 4 mm ins		
–216 m	MC	01/01 IM #2812			
			#2 15m Tele 4 mm ins		
–201 m	MC	02/02 IMP #2974			
			#3 235m Tele 4 mm ins		
37 m	MC	03/03 IMP #2486			
			#4 30m Tele 4 mm ins		
67 m	MTD	04/01 MTD #24	#5 40m Tele 4 mm ins		
107 m	MC	05/04 IM #2934			
			#6 40m Tele 4 mm ins		
			sRs		
149 m	FL45" (open)	WD #12264			
			sRs		
			#7 top 852m 3/16" ins		
152 m	MC	06/05 IMP #2718		850	
252 m	MTD	07/02 MTD #25		750	

ANIMATE/PAP2–3, launched during P306, 17–NOV–2003, WD #12264					27–Feb–2004 20:03 Page # 2 / 4
depth (incl. stretch)	**component**	**S/N**	**rope # & Length**	**Distance from lower rope end**	**in/out of water comment**
403 m	MC	08/06 IM #2809		600	
603 m	MTD	09/03 MTD #26		400	
803 m	MTD	10/04 MTD #27		200	
1002 m	MC	11/07 IM #2933		2	
1003 m	MTD	12/05 MTD #28	#7 bottom	1	
1005 m	4Benthos				
1382 m	2Benthos		#8 375m 3/16" ins		
1885 m	2Benthos		#9 500m 3/16" ins		
2387 m	2Benthos		#10 500m 3/16" ins		
2889 m	2Benthos		#11 500m 3/16" ins		
3391 m	2Benthos		#12 500m 3/16" ins		
3893 m	3Benthos		#13 500m 1/4" ins		
4396 m	3Benthos		#14 500m 1/4" ins		
			#15 320m 1/4" ins		



depth (incl. stretch)	component	S/N	rope # & Length	Distance from lower rope end	in/out of water comment
4718 m	2Benthos				
4790 m	6Benthos				
4803 m	AR–2	#868, #460			
4837 m	Anchor (5)	5 Railwheels			



Appendix 4: PAP3 Instrument Details

Recovered RCM's:

POSITION	TYPE	S/N	CONDUCTIVITY	TEMPERATURE	PRESSURE	LAST RECORD DATE/TIME
1750mab	RCM 8	11571	N/A	LOW	N/A	25/6/04 @ 14:07 Z
100mab	RCM 8	9415	N/A	LOW	N/A	25/6/04 @ 14:08 Z

Deployed RCM's:

POSITION	TYPE	S/N	CONDUCTIVITY	TEMPERATURE	PRESSURE	FIRST RECORD DATE/TIME
1750mab	RCM 8	3308	N/A	LOW	N/A	24/6/04 @ 10:00 Z
100mab	RCM 8	3259	N/A	LOW	N/A	24/6/04 @ 10:00 Z

Recovered Sediment Traps Schedule: Upper Trap (3000m),

Software version: pst-21c3.c
Compiled: Oct 18 2002 1:09:34
Electronics S/N: ML11262-10

Data recording start time = 07/12/2003 13:08:19
Data recording stop time = 06/24/2004 15:18:40

HEADER

_____

Deployment XXXI 3000m at PAP

SCHEDULE

_____

Event 01 of 22 @ 07/13/2003 12:00:00
Event 02 of 22 @ 07/27/2003 12:00:00
Event 03 of 22 @ 08/10/2003 12:00:00
Event 04 of 22 @ 08/24/2003 12:00:00
Event 05 of 22 @ 09/07/2003 12:00:00
Event 06 of 22 @ 09/21/2003 12:00:00
Event 07 of 22 @ 10/05/2003 12:00:00
Event 08 of 22 @ 11/02/2003 12:00:00
Event 09 of 22 @ 11/30/2003 12:00:00
Event 10 of 22 @ 12/28/2003 12:00:00
Event 11 of 22 @ 01/25/2004 12:00:00
Event 12 of 22 @ 02/22/2004 12:00:00
Event 13 of 22 @ 03/21/2004 12:00:00
Event 14 of 22 @ 04/04/2004 12:00:00
Event 15 of 22 @ 04/18/2004 12:00:00
Event 16 of 22 @ 05/02/2004 12:00:00
Event 17 of 22 @ 05/16/2004 12:00:00
Event 18 of 22 @ 05/30/2004 12:00:00
Event 19 of 22 @ 06/13/2004 12:00:00
Event 20 of 22 @ 06/27/2004 12:00:00
Event 21 of 22 @ 07/11/2004 12:00:00
Event 22 of 22 @ 07/25/2004 12:00:00

Recovered Sediment Traps Schedule: Lower Trap (100mab),

Software version: pst-21c3.c
Compiled: Oct 18 2002 1:09:34
Electronics S/N: ML11262-09

Data recording start time = 07/12/2003 13:04:12
Data recording stop time = 05/30/2004 12:00:30

HEADER

_____

Deployment XXXI Trap B 100mab at PAP

SCHEDULE

_____

Event 01 of 22 @ 07/13/2003 12:00:00
Event 02 of 22 @ 07/27/2003 12:00:00
Event 03 of 22 @ 08/10/2003 12:00:00
Event 04 of 22 @ 08/24/2003 12:00:00
Event 05 of 22 @ 09/07/2003 12:00:00
Event 06 of 22 @ 09/21/2003 12:00:00
Event 07 of 22 @ 10/05/2003 12:00:00
Event 08 of 22 @ 11/02/2003 12:00:00
Event 09 of 22 @ 11/30/2003 12:00:00
Event 10 of 22 @ 12/28/2003 12:00:00
Event 11 of 22 @ 01/25/2004 12:00:00
Event 12 of 22 @ 02/22/2004 12:00:00
Event 13 of 22 @ 03/21/2004 12:00:00
Event 14 of 22 @ 04/04/2004 12:00:00
Event 15 of 22 @ 04/18/2004 12:00:00
Event 16 of 22 @ 05/02/2004 12:00:00
Event 17 of 22 @ 05/16/2004 12:00:00
Event 18 of 22 @ 05/30/2004 12:00:00
Event 19 of 22 @ 06/13/2004 12:00:00
Event 20 of 22 @ 06/27/2004 12:00:00
Event 21 of 22 @ 07/11/2004 12:00:00
Event 22 of 22 @ 07/25/2004 12:00:00

Deployed Sediment Traps: Upper Trap (3000m),

McLane Research Laboratories, USA
ParFlux 21-Cup Sediment Trap
with Compass and Tilt
Version: pst-21c3.c S/N: ML11262-10

Schedule Verification

Event 1 of 22 = 06/27/2004 12:00:00
Event 2 of 22 = 07/11/2004 12:00:00
Event 3 of 22 = 07/25/2004 12:00:00
Event 4 of 22 = 08/08/2004 12:00:00
Event 5 of 22 = 08/22/2004 12:00:00
Event 6 of 22 = 09/05/2004 12:00:00
Event 7 of 22 = 09/19/2004 12:00:00
Event 8 of 22 = 10/03/2004 12:00:00
Event 9 of 22 = 11/14/2004 12:00:00
Event 10 of 22 = 12/26/2004 12:00:00
Event 11 of 22 = 02/06/2005 12:00:00
Event 12 of 22 = 03/20/2005 12:00:00
Event 13 of 22 = 04/03/2005 12:00:00
Event 14 of 22 = 04/17/2005 12:00:00
Event 15 of 22 = 05/01/2005 12:00:00
Event 16 of 22 = 05/15/2005 12:00:00
Event 17 of 22 = 05/29/2005 12:00:00
Event 18 of 22 = 06/12/2005 12:00:00
Event 19 of 22 = 06/26/2005 12:00:00
Event 20 of 22 = 07/10/2005 12:00:00
Event 21 of 22 = 07/24/2005 12:00:00
Event 22 of 22 = 08/07/2005 12:00:00

Modify an event (Yes/No) [N] ? n

Current Header reads:

Deployment XXXIV 3000m at PAP station 52526
Charles Darwin cruise 158 (Trap A)

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

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

Deployed Sediment Traps: Lower Trap (100mab),

McLane Research Laboratories, USA
ParFlux 21-Cup Sediment Trap
Version: pst-21_0.c S/N: ML11262-04

Schedule Verification

Event 1 of 22 = 06/27/76 12:00:00
Event 2 of 22 = 07/11/76 12:00:00
Event 3 of 22 = 07/25/76 12:00:00
Event 4 of 22 = 08/08/76 12:00:00
Event 5 of 22 = 08/22/76 12:00:00
Event 6 of 22 = 09/05/76 12:00:00
Event 7 of 22 = 09/19/76 12:00:00
Event 8 of 22 = 10/03/76 12:00:00
Event 9 of 22 = 11/14/76 12:00:00
Event 10 of 22 = 12/26/76 12:00:00
Event 11 of 22 = 02/06/77 12:00:00
Event 12 of 22 = 03/20/77 12:00:00
Event 13 of 22 = 04/03/77 12:00:00
Event 14 of 22 = 04/17/77 12:00:00
Event 15 of 22 = 05/01/77 12:00:00
Event 16 of 22 = 05/15/77 12:00:00
Event 17 of 22 = 05/29/77 12:00:00
Event 18 of 22 = 06/12/77 12:00:00
Event 19 of 22 = 06/26/77 12:00:00
Event 20 of 22 = 07/10/77 12:00:00
Event 21 of 22 = 07/24/77 12:00:00
Event 22 of 22 = 08/07/77 12:00:00

Current Header reads:

Trap B Mooring XXXIV 4700m (100mab) at PAP Station No.56526
on *Charles Darwin* 158

John Wynar

Scientific equipment B: Instruments.

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

-

Data Logging

Computer technician - Dougal Mountifield

Data was logged from the following instruments using MkII Level A's to the Level B. The data was then parsed to the Level C (Solaris workstation). The following data was logged during the cruise:

Instrument	Level C Data Stream
Trimble 4000 DL GPS	GPS_4000
	GPS_NMEA
Fugro SeaStar DGPS	GPS_G12
Ashtec ADU2 GPS	GPS_ASH
Simrad EA500D PES	EA500D1
Chernikeef Log	LOG_CHF
Ships' Gyro	GYRONMEA
Winch CLAM system	WINCH
SurfaceMet System	SURFMET
RD VMADCP (RS232)	ADCP_MIN

The Level ABC system ran with no problems during the cruise.

Raw Data

There were no problems with any of the navigation instruments during the cruise, however, the Chernikeef log needs calibration. Pinger use on some deployments caused expected bottom detection failure on the EA500. The Surfmet PC failed at 04 177 04:15, JRBN suspects faulty hard disk.

Processed Data

GPS, log and gyro streams were used to produce relmov, bestnav and bestdrf. Carter area corrections were applied to the PES data after despiking with rvsedit on rawdep to produce prodep. Surfmet data was processed for absolute windspeed and direction (pro_wind) and salinity and density (protsg).

ASCII Listings

ASCII listings were made of all data streams using listit. Two intervals during Pelagra deployments were produced at 1 minute and 10 minute navigation fixes. In addition, a listing of bestnav was produced at 10 minute intervals during the whole cruise. A listing of station locations for the whole cruise was also provided. UKORS were provided with depths from

prodep for the two moorings sites and salinity from protsg for calibration against underway samples.

VMADCP for Pelagra Drift Assessment

Considerable time was spent trying to get robust surface current information from the VMADCP to assess the likely drift vector for deployed PELAGRA floats. Eventually dead-reckoning and the Gonio DF signal strength was used to successfully locate the floats.

EM12 Multibeam

The SIMRAD EM12 swath system was run through the cruise collecting data (18 lines run). The PS ran opportunistic lines when possible and a good survey was made of the Porcupine Abyssal Plain (PAP) site. Merlin was used to provide sun shaded, contoured imagery as the cruise progressed. No processing was applied, but Neptune was used for archiving the raw data. A final plot of the survey area was provided to the PSO with 50m contours and 100m annotations. Plots were in postscript and jpeg format in A4 and A3 at 600dpi. A complete data archive from Mermaid of /data1/proc/CD158 and /data2/raw/CD158 was provided on CD to the PSO.

Seabird 9/11 + CTD

Eight CTD casts were completed during the cruise. The first cast was used to produce density data for ballast tuning of Pelagra, the second to produce an SVP for the EM12. Data was processed using the Seabird software suite and profile plots were made of all instruments. Data was mounted on the Level C for inclusion within daily backups. UKORS were provided with bottle files for calibration against bottle salinity samples.

Network & Printers

Extensive use was made of the ship's network and the new Gigabit infrastructure worked without any problems. The wireless network and the A4 colour laser and A3 inkjet was also used.

Email Facilities

The webmail, local mail and AMS ship to shore systems were used extensively by all users. There were no problems and the trial policy of free at the point of use personal accounts worked very well. All users stayed below the allocation of 150k per week in & out.

Archives

The PSO was provided with 3 CD archives:

Level ABC centrally logged data and miscellaneous PC files
Seabird CTD data
Simrad EM12 swath bathymetry data

A readme file that describes the contents of the archive was included in the root folder of each disc.

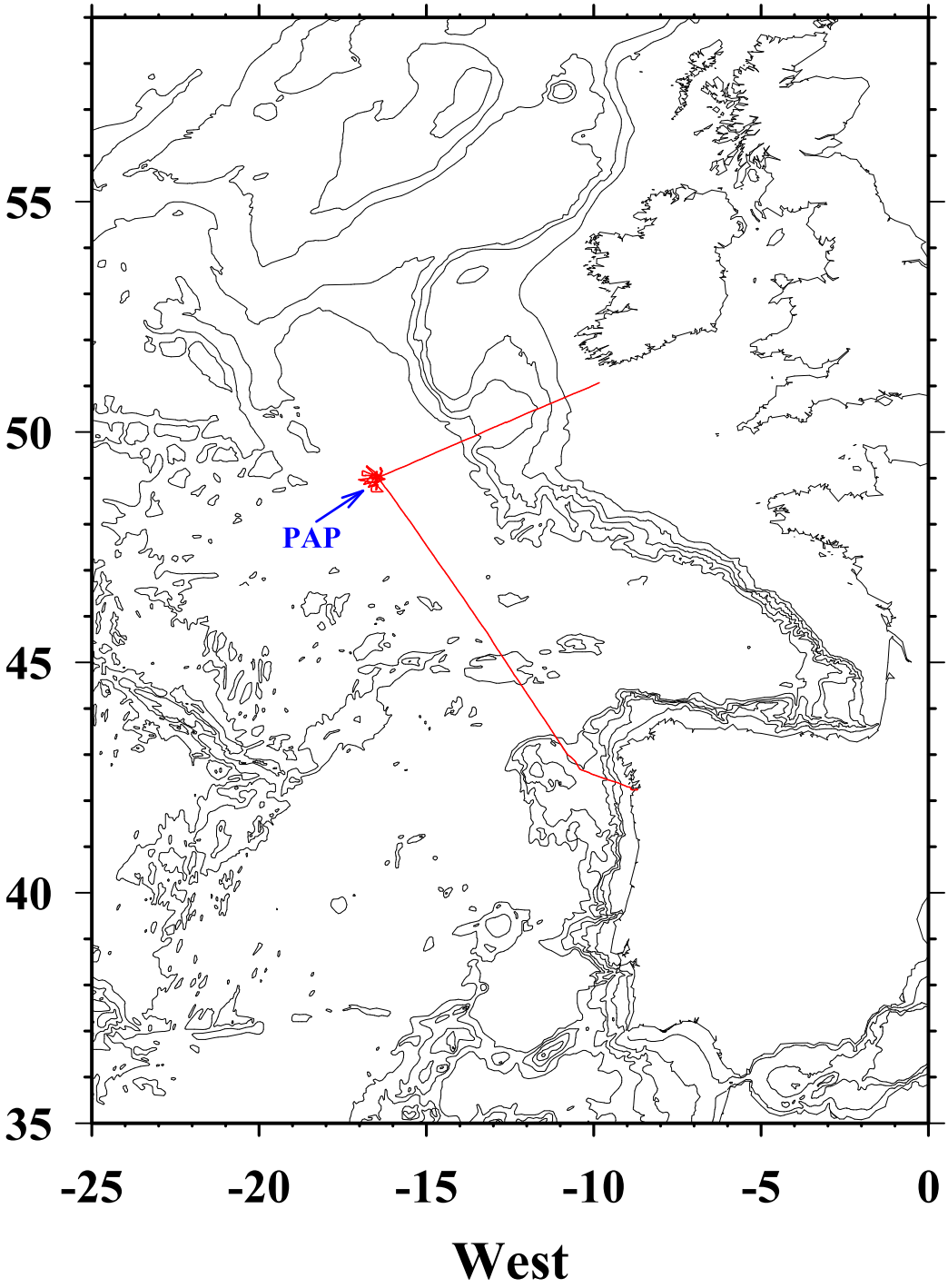
6. Acknowledgements

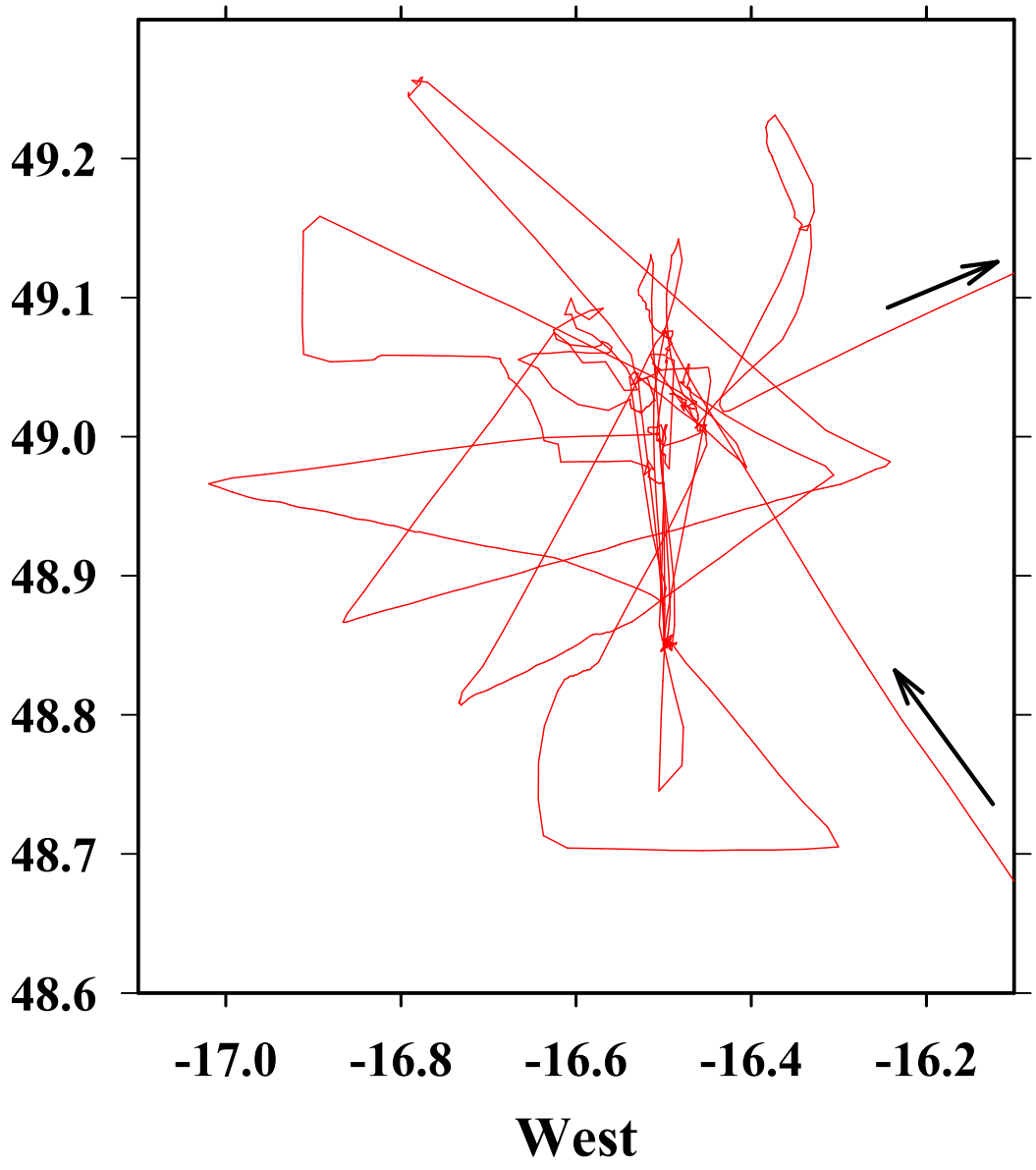
The PSO would like to acknowledge the excellent support given by the ship side during this cruise. These thanks are warmly extended to all components including the deck hands, engineers, bridge officers and the galley staff.

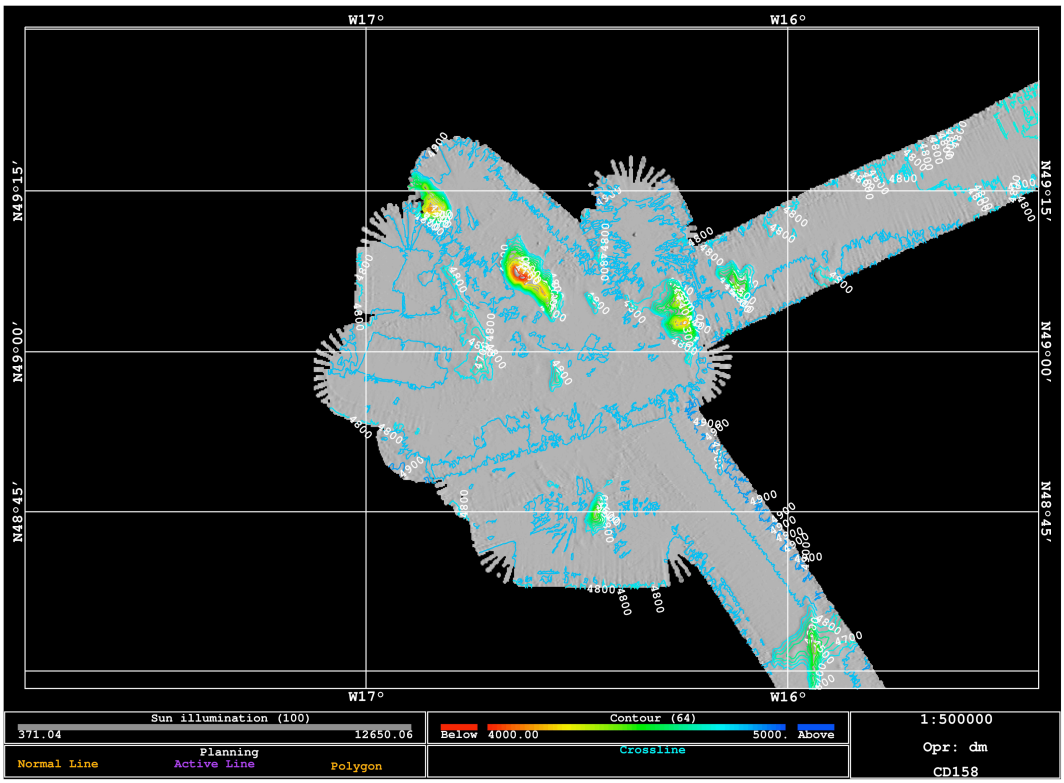
Richard Lampitt

7. Appendices

Appendix A: Maps




49.2
49.1
49.0
48.9
48.8
48.7
48.6
-17.0
-16.8
-16.6
-16.4
-16.2
West


W17°
W16°
N49°15'
N49°00'
N48°45'
Sun illumination (100)
371.04
12650.06
Contour (64)
Below 4000.00
5000. Above
1:500000
Opr: dm
CD158
Planning
Normal Line
Active Line
Polygon
Crossline

Appendix B: Station list

Station list *Charles Darwin* 158

Station	Series	Date June	Start time GMT	End time GMT	Activity	Start Position North	Start Position East	End Position North	End Position East
56501		18	18:51	23:10	Recover PAP#2	49.08336	-16.5154	49.04072	-16.5092
56502		19	01:20		Multicorer	48.8534	-16.4953		
56503			05:24		CTD	48.84645	-16.5012		
56504	#1		08:48	13:00	PELAGRA ballast test (end time is recovery)	49.04155	-16.5267	49.01819	-16.529
	#2		08:54	14:24		49.0414	-16.5268	49.02055	-16.5371
56505			09:34		CTD to 4700m	49.02554	-16.5121		
56506		20	00:09	10:10	Benthic Trawl	48.87145	-16.8382	48.97871	-16.2469
56507			16:30	19:30	Recover PAP#1	49.04511	-16.5317	49.04902	-16.4743
56508			21:56		Multicorer	48.85034	-16.5002		
56509		21	04:30		Mesozooplankton net	49.00319	-16.5009		
56510			05:54		CTD to 500m	48.99874	-16.5054		
56511			08:06		Recover Bathysnap	49.0038	-16.4574		
56512			08:47	10:57	Deploy PELAGRA for Gonio calibration	49.00866	-16.451	49.02787	-16.4805
56513			13:19		SAPs to 100m	49.0243	-16.4625		
56514			16:35		CTD to 1000m for microcats	49.03878	-16.4784		
56515			19:28	06:05 on 22.06.04	Benthic Trawl	48.97137	-16.3085	48.80697	-16.7299
56516		22	06:26		CTD to 500m	48.80832	-16.7333		
56517	#1		09:54	10:08 on 23.6.04	PELAGRA ballast test (end time is recovery)	49.0761	-16.498	49.0749	-16.5024
	#2		10:00	10:46 on 23.6.04		49.07612	-16.5009	49.07186	-16.4908
56518			15:18	19:49	Deploy PAP#2	49.01691	-16.4611	49.11812	-16.4938
56519			23:48		Multicorer	48.84977	-16.4978		

56520		23	05:37		CTD to 500m	48.96704	-16.5026	
56521			16:06	18:42	Deploy PAP#1	48.97989	-16.4081	49.0428 -16.5282
56522	#1		21:17	14:59 on 25.06.04	PELAGRA # 1(end time is recovery)	48.87868	-16.4995	49.15248 -16.3419
	#2		21:21	13:28 on 25.06.04	PELAGRA # 3 (end time is recovery)	48.87901	-16.5002	49.2015 -16.376
56523			21:39	08:15 on 24.06.04	Benthic Trawl	48.88115	-16.5026	48.96597 -17.0187
56524		24	10:36		Recover PAP#3	49.00203	-16.5055	
56525			13:22		CTD to 1000m for Thorium	48.98946	-16.5037	
56526			16:53	18:22	Deploy PAP#3	49.03653	-16.5005	49.00082 -16.5077
56527			20:46		Multicorer	48.85063	-16.4962	
56528		25	04:34		Mesozooplankton net	48.82796	-16.6043	
56529			05:30		CTD to 500m	48.83183	-16.5916	
56530			07:47	07:50	Deploy Bathysnap	49.0064	-16.4528	49.00469 -16.4524