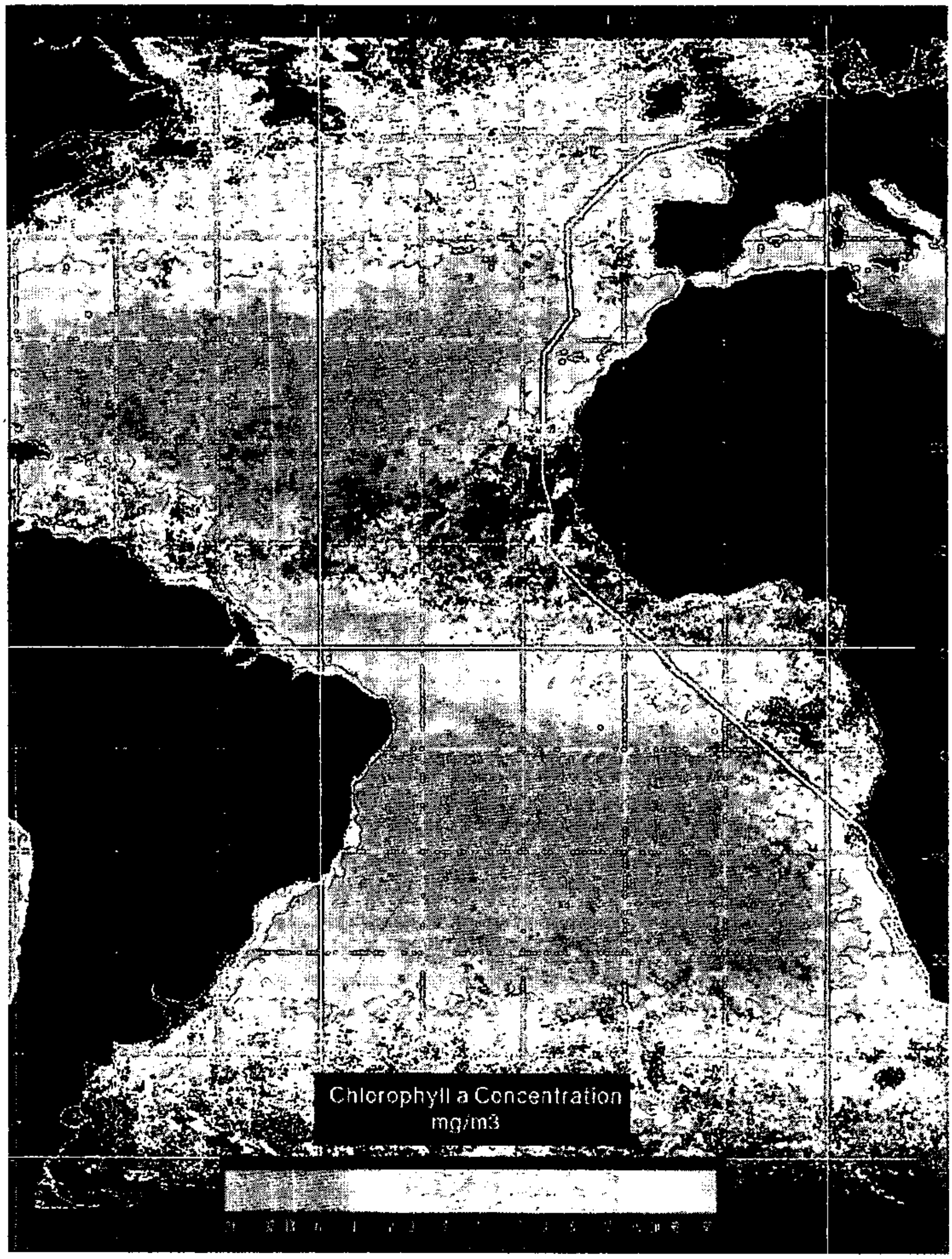
ATLANTIC MERIDIONAL TRANSECT (AMT)



AMT 6 CRUISE REPORT

CENTRE FOR
COASTAL &
MARINE
SCIENCES

Atlantic Meridional Transect

AMT-6 CRUISE REPORT

Cape Town to Grimsby,
14 May to 16 June 1998.

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ABSTRACT

This report describes the conduct and outcome of the scientific research programme of the sixth Atlantic Meridional Transect cruise (AMT-6) on board the RRS James Clark Ross from Cape Town, RSA to Grimsby, UK, from 15 May to 16 June 1998.
The long-term objectives of the AMT programme are:
1. To understand the links between biogeochemical processes, biogenic gas exchange, air-sea interactions and the effects on and the responses of oceanic ecosystems to climate change;
2. To investigate the functional roles of biological particles and processes of ecosystem dynamics which influence ocean colour; as such the programme relates directly algorithm development and the validation and interpretation of remotely sensed observations of ocean colour.

AMT-6 departed from Cape Town in mid-May, so it was exceptional with respect to previous AMT cruises in that it was 4 weeks later in the season and it could not follow the standard transect route from the Falkland Isles to the UK. The research focused on the Benguelan ecosystems off the coast of the Republic of South Africa and Namibia and other upwelling systems along the route. Diplomatic clearances to sample within 200 mile EEZ had been requested and granted by many African and European states. We acknowledge the permissions given by RSA, Namibia, Senegal, Cape Verde Islands, Portugal, Spain and France.
The cruise was designated a study of the "Functional relationships of bio-optical properties and phytoplankton productivity in upwelling and highly productive ecosystems in the Atlantic Ocean, South Africa to the UK". Thanks to an outstanding science team, exceptional fine weather, blue skies and regular, daily satellite imagery of SST (from AVHRR) and Ocean colour (Chlorophyll concentration and water reflectance from SeaWiFS) the key objectives were met successfully.

1. Introduction

The Atlantic Meridional Transect (AMT) programme exploits the passage of the Royal Research Ship *James Clark Ross* (RRS JCR) latitudinally through the Atlantic Ocean (50 N to 52 S) between the U.K. and the Falkland Islands (FI). In September the JCR sails southward, sampling the boreal fall and the austral spring; and the following April it returns to the UK, sampling the austral fall and the spring conditions in the northern hemisphere. The ship's track crosses a range of ecosystems and physico-chemical regimes, within which conditions vary from sub-polar to tropical and from eutrophic shelf seas and upwelling systems to oligotrophic mid-ocean gyres. The JCR provides the ideal platform to measure physical, biological and bio-optical properties and processes through these diverse ecosystems of the North and South Atlantic Oceans.
There have been 5 AMT cruises to date: AMT-1 Sept./Oct. 1995, from UK to FI; AMT-2 April/May 1996, from FI to UK; AMT-3 Sept./Oct. 1996, from UK to FI; AMT-4 April/May 1997, from FI to UK; and AMT-5 Sept/Oct 1997, from UK to FI. Exceptionally, for AMT-6, the JCR was scheduled to depart from Cape Town, Republic of South Africa because of prior research activities in the Indian Ocean, leaving Cape Town on 15 May and arriving in Grimsby, UK on 16 June 1998. An extra research cruise (AMT-6b), with limited scientific objectives (station CTD and optics and surface layer C, T and pigments), on RRS Brandsfield in April/May 1998, covered the standard transect from Stanley to the UK, which was missed by the JCR passage from Cape Town (AMT-6).

1.1 AMT programme goals.

The AMT programme goals are:
To test and refine hypotheses on the responses of oceanic ecosystems and the coupled marine atmosphere to anthropogenically forced environmental change.
To develop a holistic research strategy, integrating shipboard measurements, remote sensing and modeling.
To provide calibration and validation of new satellite sensors of ocean colour, sea surface temperature, sea surface height and solar radiation.
To improve our knowledge of marine biogeochemical processes, ecosystem dynamics, food-webs and fisheries and characterize biogeochemical provinces.
To develop coupled physical-biological models of production and ecosystem dynamics.
To quantify oceanic responses to changes in abundance of radiatively and chemically-active trace gases.

1.2 Station strategy and procedures.

The normal strategy for AMT cruises is set by the requirement for the JCR to make passage between the UK and the FI within the allocated time of 25 d plus 6 d added for scientific research. The geographical range of 50 N, 1 W to 52 S, 58 W, amounts to approximately 7500 miles (13800 km), requiring an average distance of 240 miles per day, or 4° of latitude while on a N - S course (as on the 20 W line). For AMT-6, with a focus on high productivity, upwelling ecosystems and with 6 d extra for science spread over a shorter total course (35 S to 50 N), it was planned to spend more time in the areas of greatest interest (e.g. the Benguela). Thus the plan was to proceed northwards through the Benguela at only ca 150 miles per day, with more than one station as necessary and make a faster passage through the oligotrophic regions. Appendix A6-0 shows planned provisional station positions (revised plan of 17/04/98), with the re-cast dates following the enforced return to Cape Town on 20 May; the actual stations achieved are added. The outline plan was achieved without excessive speed and underway sampling was maintained for the whole transect. Note the JCR departed Cape Town on 15 May 1 day later than originally planned.

As planned, the main daily station commenced at *ca* 10.00 ship's time (08.00 GMT in the Southern Hemisphere) with a second, opportunistic optics station planned for early afternoon, if good sun/sky conditions prevailed. In the Southern Hemisphere and east of the Greenwich meridian, the morning station fell within the SeaWiFS window (+ / – 2 h of the overpass, ca 11.00 GMT). Further north and west, the window was later at ca 12.00 to 13.00 GMT and the afternoon, opportunistic optical station was a necessity to meet the cruise objectives. The principal objectives were to acquire optical measurements with SeaOPS, SeaFALLS, LoCNESS and miniNESS at the SeaWiFS wavelengths, with concurrent data on phytoplankton pigments and species, water for primary productivity, biogases, nutrients, N-cycling and zooplankton.
The main instruments deployed were:
1. SeaOPS for the measurement of Ed(λ) and Lu(λ), with CTD, Chlorophyll fluorescence 'Fl'. SeaOPS was deployed from the stern, starboard crane with the vessel positioned with the sun on the stern or the starboard side quarter.
2. SeaFALLS, a freefall probe with Ed(λ), Lu(λ), CTD & Fl. SeaFALLS was deployed from the stern.
3. LoCNESS, a low cost freefall probe with Ed(λ), Lu(λ), CTD & Fl, deployed from the stern.
4. MiniNESS, a small, freefall probe with Ed(λ), Lu(λ), CTD & Fl, deployed from the stern.
5. SeaSPEC a full spectral Ed(λ), Lu(λ) sensor (350 to 800 nm), deployed in place of SeaOPS.

6. SeaSAS a full spectral Ed(λ), Lwn(λ) sensor (350 to 800 nm), mounted on the stern trawl post.
7. Sea-Bird 911plus CTD, with Fl, Transmission & PAR sensors and a 12 x 30 l rosette bottle sampler for water for phytoplankton pigments and productivity etc. from 12 depths to 200 m. The CTD was deployed from the dedicated gantry and winch mid-ships.
8. Zooplankton nets were deployed from the forward crane independent of other operations.

Experience from previous AMT cruises on JCR, showed that it was possible to conduct the stations safely, with up to 4 main instrument systems deployed simultaneously. The Optics casts required the sun on the starboard quarter or stern, and often in the Southern Hemisphere this meant that the wind (SE trades) was on the stern. For station keeping in these conditions, the vessel would be moving astern, which was not conducive to the deployment of the freefall optical probes simultaneously with the CTD and SeaOPS. When possible, CTD and SeaOPS casts were synchronous, profiled at the same rate; the rate was set at 0.2 m/s by the speed of the SeaOPS winch. At the maximum depth for the optics cast, the CTD system was profiled at a safe speed to the maximum depth of 200 m. The instruments were not synchronised for the up-casts. SeaFALLS, LoCNESS and miniNESS were profiled independently and usually after the completion of the CTD cast.

The Sea-Bird CTD 911plus with 12 x 30 liter water bottles, purchased by NASA for AMT-5, gave sufficient water that normally only one cast was needed per station. Extra casts were needed to test the system when a mal-function of the rosette system was detected (pairs of bottles closing simultaneously when only one was fired). When the pattern of miss-firing was determined, one cast was sufficient. The rosette 'pylon' firing mechanism was replaced with a new unit at Madeira. The second station in the afternoon was always opportunistically timed to fall within the SeaWiFS window (+/- 2 h of the overpass) so as to exploit the most favourable sky conditions with least cloud cover. In general this worked well and many of the afternoon stations were in excellent cloud-free conditions. A total of 66 stations were worked and data acquired, 52 CTD casts 40 SeaOPS, 227 SeaFALLS, 58 LoCNESS, 88 miniNESS and SeaSPEC casts, making AMT-6 a highly productive cruise for bio-optical data.
The combined CTD & OPTICS station list for AMT-6 is given in Appendix A6-1.

1.3 Scientific Personnel

AMT-6 scientific personnel were drawn from 10 Institutes, Laboratories and Universities and 4 countries besides the UK. The scientific team is listed below.

Plymouth Marine Laboratory:

JIM AIKEN, Principal Scientist, Optics, UOR, Physical Oceanography.
MALCOLM WOODWARD, Nutrients.
CAROL ROBINSON, OXYGEN PRODUCTION AND RESPIRATION.
PABLO SERRET, OXYGEN PRODUCTION AND RESPIRATION.
ANDY REES, 15N PRODUCTION.
and University of Plymouth RACHEL WOODD-WALKER, Zooplankton.
ANDY BOWIE, IRON.

University of Plymouth:

DEREK PILGRIM, AC-9, DOC, POC, & S, T calibrations.

NASA, Goddard Space Flight Centre, USA:

STANFORD HOOKER, Optics.
STEPHANE MARITORENA, Optics, from 9 to 16 June, Madeira to Grimsby.

Satlantic Inc., Bedford, Canada:

CYRIL DEMPSEY, Optics

University of Miami:

JIM BROWN, Optics, from 15 May to 9 June, Cape Town to Madeira.

Southampton Oceanographic Centre:

PATRICK HOLLIGAN, Pigments and Fluorometry
DAVE SUGGETT, Pigments and Fluorometry

RSA Dept of Fisheries, Cape Town, RSA:

RAY BARLOW, HPLC Phytoplankton Pigments.

University of Cape Town, RSA:

MIKE LUCAS, 15N Production.

University of Vigo, Spain:

GAVIN TILSTONE, Primary Production, EVA TIERRA, Primary Production

British Antarctic Survey:

DAVE RICHMOND, COMPUTING SUPPORT
VSEVOLOD AFANASYEV, CTD AND ELECTRONICS

1.4 Acknowledgements
AMT receives resources and financial support a variety of research initiatives and diverse sources.
The **Centre for Coastal and Marine Sciences** funds additional time added to the passage of the JCR.
The **PML Strategic research projects 1 & 4** provide scientific support, equipment and resources.
The **NERC community research project PRIME** funds two core AMT projects:
Bio-optical Signatures (PIs, Aiken, PML & Holligan, SOC; RA Moore, PML);
Zooplankton characterisation (PIs, Robins, Harris, PML & Pilgrim, U o Plymouth).
NASA SeaWiFS project (PI, Hooker) provides financial support, state-of-the-art optical sensors and calibration equipment; a Sea-bird 911+ CTD & 12 x 30 l water bottle rosette was provided for AMT-6.
EU CANIGO project (PIs Robins, Pingree, Fernandez & Anadon) has informal links.
There are links with the **Joint Research Centre of the EU at Ispra,** through EU projects (PI Zibordi).
The Principle Scientist and the scientific party acknowledge the assistance of the Officers and crew of the RRS James Clark Ross, led by Captain Chris Elliott. Their professional skills have contributed hugely to the success of the scientific research of the AMT programme.

2.CRUISE ITINERARY, TRACK & NARRATIVE

2.1 Itinerary

09 May	PML & UK personnel fly to Cape Town
12 May	JCR arrived Cape Town
13 May	Mobilization commenced
15 May	JCR departed Cape Town, scientific research commenced
18 May	Inshore to Offshore section, in southern Benguela
	Stowaways found; 18.00 h altered course for return to Cape Town
20 May	Off Cape Town, stowaways disembarked, resumed AMT northbound
20 May	Sampling in Benguela completed; Gulf of Guinea
31 May	Crossed the Equator
03 June	Altered course to northbound on 20° W line
5/6 June	NW African upwelling region
07 June	Entered CANIGO region
09 June	Exchanged personnel at Madeira; new CTD rosette pylon
11 June	Completed sampling in CANIGO region
13 June	Shelf break crossing at 48° 42' N
14 June	Western English Channel, South of Plymouth
15 June	Southern North Sea
16 June am	Docked Grimsby, unloaded equipment.
16 June pm	Returned to Plymouth

2.2 Cruise Track

AMT-6 cruise departed Cape Town 15 May 1998, progressing northwards close to the coast of South Africa, where the most intense upwelling was evident as shown by satellite imagery of SST (cold water) and colour (high biomass). The satellite images were used to navigate the vessel into particular features and devise a cruise track for greatest diversity of biology and productivity. During an inshore to offshore section, stowaways were found on board, necessitating the return to Cape Town, delaying the cruise by 3 days but giving an extra 2 days sampling in the southern Benguela. In the northern Benguela, the cruise track was adjusted to sample features of high biomass and high reflectance, as shown by current SeaWiFS data, representing different phytoplankton assemblages. At the Namibian, Angolan border (ca 17.5° S) the cruise track crossed the front into the oligotrophic water of the 'Gulf of Guinea'. The equatorial upwelling was crossed five days later. The cruise track joined the nominal 20° W line at ca 10° N, deviating inshore to 19° W to sample high biomass features of the NW African Upwelling in Senegalese waters. The front to the north of the upwelling showed the sharp change to the oligotrophic waters of the CANIGO region (20 N to 42 N). Six stations were dedicated to CANIGO objectives, with intensive productivity measurements at each. North of these there was one deep-water CTD cast to 1500m, which was used for determining the concentrations of Iron and nutrients. At the shelf break, a substantial bloom of Phaeocystis added to the phytoplankton diversity encountered, with an intensive patch of coccolithophores on the shelf and a bloom of mixed phytoplankton south of Plymouth.
Charts of the cruise track are presented in Fig. 1. Cruise Track, part 1, 35 S to 10 N and Fig. 2. Cruise Track, part 2, Equator to 50 N.

Fig.1. Cruise Track, part 1, 35 S to 10 N

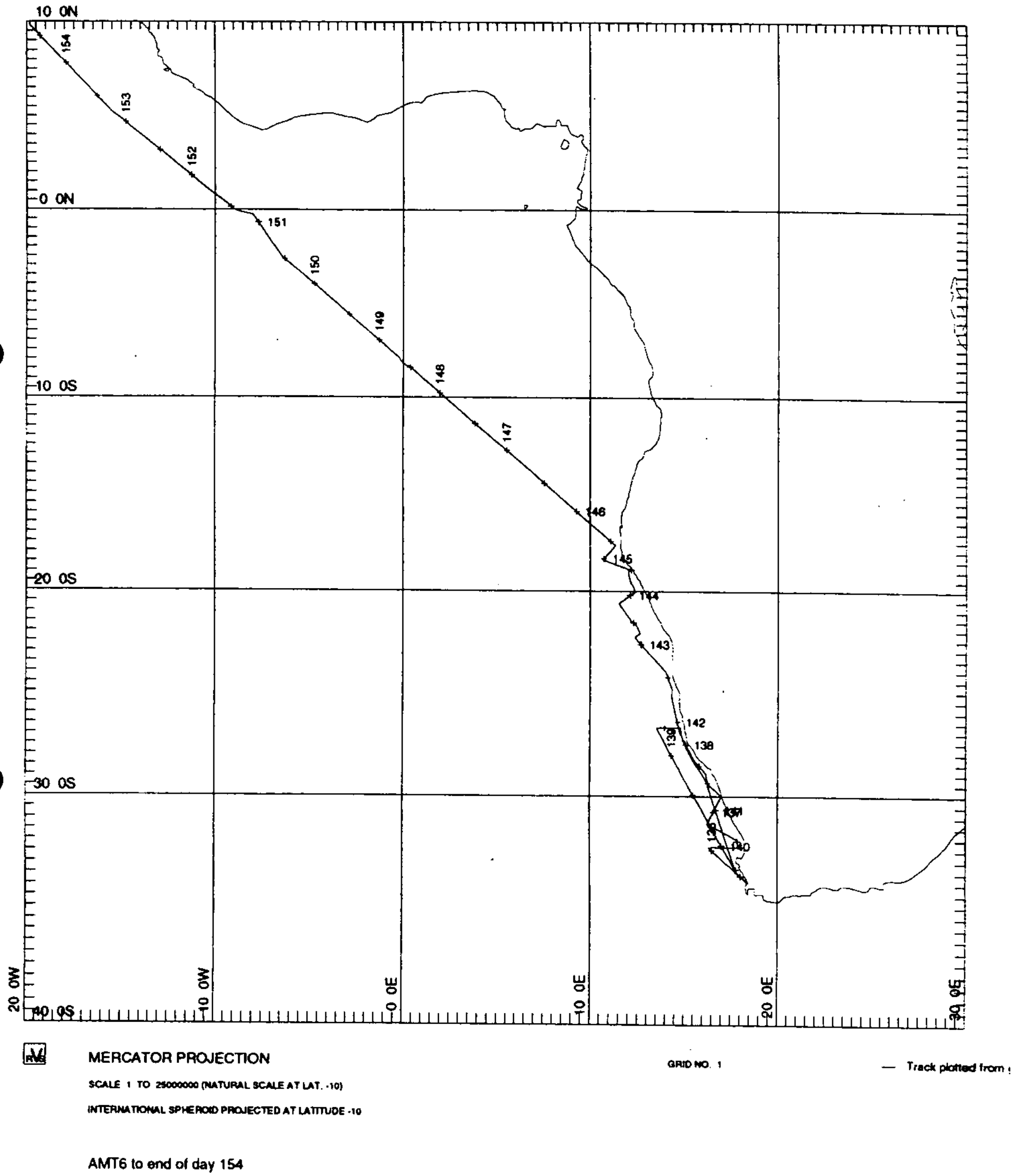
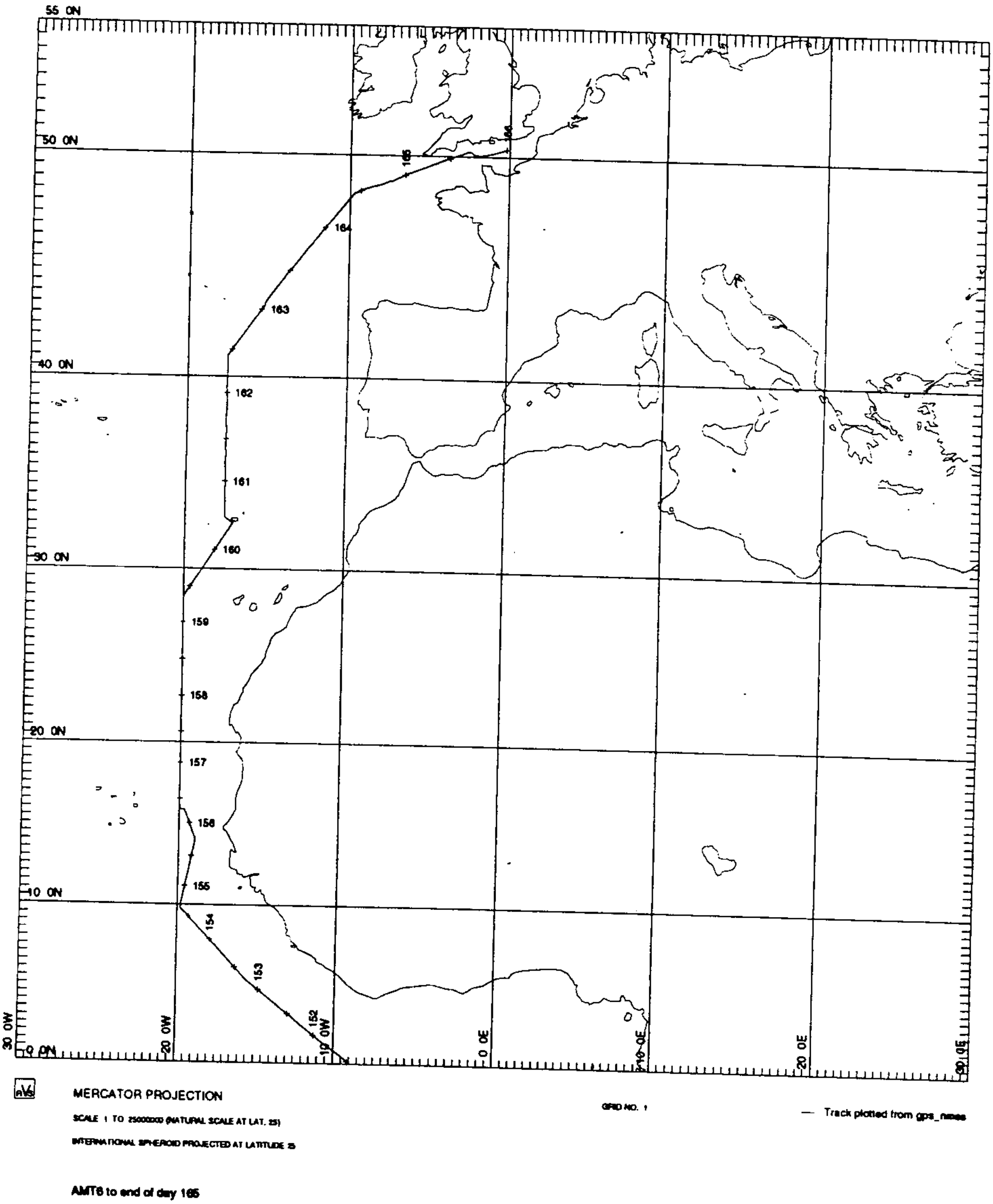


Fig. 2. Cruise Track, part 2, Equator to 50 N



2.3 Narrative

Cruises don't often start from Cape Town, but when they do it's a beautiful place to start from. The RRS James Clark Ross arrived on schedule in Cape Town at 7.30 a.m. on the morning of Tuesday 12 May and the science team from the previous cruise de-mobilised on the first day in port. The AMT-6 scientific party joined the vessel at 08.00 h on Wednesday 13 May and mobilisation commenced, as various items of scientific equipment arrived from diverse points of origin. The main PML sea-freight shipment was held up in customs for 7 d, because of the other goods in the same container and was not delivered until late Wednesday, delaying sailing by 24 h. We got underway at 10.00 (local time) Friday 15 May. The non-toxic sea water supplies and under-way logging were switched-on soon after departure and the scientific research commenced. The first station under clear blue skies and in deep green water was at 13.00 h on 15 May and comprised the CTD (SeaBird 911plus with Chlorophyll fluorescence, Transmissometer, PAR and 12 x 30 l water bottle rosette), Optics casts (SeaOPS and SeaFALLS) and zooplankton nets. Two bottles on the rosette mis-fired due to 'hang-ups', but the success rate for the first station was acceptable. Measurements showed some of the 'power-cords' of the water bottles were under the recommended tension and these were replaced.
The second station on Saturday 16 May under blue skies and in green seas went smoothly, with 100% success on the CTD rosette, bar some small leakages. Power cords were replaced as necessary and the problems solved in time for the afternoon station. Both stations provided excellent optical measurements in waters of relatively high chlorophyll concentration (5 mg/m3). Good AVHRR imagery of SST from Scarla Weeks in Cape Town and SeaWiFS imagery from NASA, Goddard, were invaluable for choosing station positions in areas of maximum biomass and in setting survey courses through interesting mesoscale features on the overnight transects to the following day's station position. Clear skies and calm, green seas followed for the third day in a row for stations 4 and 5 on Sunday and with all experiments fully operational, the scientific party generally felt they had hit the 'sea running' for AMT-6.
At 04.00 GMT on Monday morning (18/5), the first inshore to offshore 'productivity' transect started as scheduled, towing the UOR and FRRF between stations; these were linked to lab P/I experiments using water from the 4 CTD casts and surface water at intermediate positions. Shortly after the first station, 2 stowaways were located and consternation prevailed briefly as the ship came to grips with the predicament. Fortunately the scientific plan was uninterrupted and the section of 4 stations were completed before the vessel made an about turn to return our unwanted passengers to Cape Town. En route to Cape Town and on return to the survey area, some stations were completed so there was a scientific bonus, albeit a 3-day delay to the planned arrival in Grimsby was incurred.

With the exception of some high cirrus clouds (mostly thin, rarely thick) the next 5 days in the Benguela ecosystem was almost entirely under clear blue skies and the OPTICS team made hay. By the end of the first 11 days, over 200 optical profiles had been 'put-in-the-can', mostly using the 'freefall' profilers. The general pattern of two CTD casts per day at 10.00 am and 2.00 pm ship's time was established, with the FRRF on the CTD for each cast and in the UOR for a tow between stations and a second tow from the pm station to 20.00h. A second inshore to offshore 'productivity section' and coupled P/I experiment was conducted on 23 May at the northern end of the Benguela. The second FRRF was used in 'flow-through mode in the wet lab and provided continuous measurements of photosynthetic parameters and productivity. These, when linked to biomass, pigments and nutrients measurements, gave results in 'real-time' that were enthralling to the old hands, as much as the fresh-faced, new kids on the block!

The diversity of the Benguelan system was even more enthralling, not just the spatial heterogeneity of structure and biomass but the diversity of phytoplankton species. Throughout the area we encountered at least 6 different phytoplankton assemblages: large, small and colonial diatoms, small and large dinoflafellates, red tides up to 30 mg.m^{-3} chlorophyll concentration, even the ubiquitous coccolithophores. These were identified and tracked from a SeaWiFS band 555 nm image, again emphasising the value of near real time imagery.
The Zooplankton were equally diverse. In fact, the first samples on board each morning were from 'Rachel's zooplankton nets' and the bucket samples were gazed into eagerly by everyone, scientists and crew alike. There were lots of 'jellies', many small and some up to 2 m in length and 30 cm diameter. There were many seals, in their tens, around the ship at each station and many seabirds were a feature of this highly productive ecosystem.
We were fortunate in getting permission from both the South African and Namibian governments to work in their waters. We have to thank the respective ministries of Foreign Affairs and Fisheries and the help of the First Secretary in the British High Commission in Windhoek (Namibia) and Luanda (Angola) for their sterling efforts.
The only negative aspect of the scientific operations, was the identification of a mal-function of the CTD rosette, causing some bottles to be fired together in error. After extensive testing, the pattern of failures was identified and a workable sequence of operations established. It seemed likely that the problem could not be rectified at sea so it was deemed necessary to check it regularly.

The final day in the Benguela was 25 May and working offshore throughout the day, the ship's track crossed the front between the upwelled, nutrient rich water to the warmer water offshore. Chlorophyll concentrations fell from 2.4 mg/m^3 at the morning station to 0.8 mg/m^3 afternoon, still mesotrophic and 'green' water. To cope with the mal-function of the CTD rosette system, an order-of-firing was established and tested, by an extra CTD cast at the surface (2 depths), each morning, confirming performance and providing extra water, making everyone happy! Working westward through the Gulf of Guinea we were still surprised by the degree of diversity and general productivity of the ecosystems; the mixed layer was generally shallow (40 to 50 m) with a sub-surface chlorophyll maximum in the thermocline and surface chlorophyll concentrations about 0.2 mg/m^3. There was only one station with concentrations less than 0.1 mg/m^3, which could be described as truly oligotrophic.
These mesotrophic conditions persisted throughout the south Atlantic, notably through the Equatorial upwelling, which was imaged as a broad (100 km N-S) 'green' region over the equator by SeaWiFS data, relayed to the ship. The satellite colour and SST data allowed us to sample it with UOR/FRRF tows, into and out of a station in the middle of the feature (concentration ca 0.33 mg/m^3). Northwest of this, mixed layer depths of *ca* 40-50 m and surface chlorophyll concentrations of 0.2 to 0.3 mg/m^3 were observed, higher than expected.
The crossing-the-line ceremony was the usual highlight for everyone, old hands and new initiates alike. It was followed by an evening BBQ featuring polo giganticus, and as the mid-point of the cruise, gave most people a slight break in the relentless daily station sampling, which is the characteristic of AMT cruises.

Approaching the 20 W line from the south and east, the mixed layer depth (MLD) shallowed further (20 to 30 m) and the phytoplankton populations in the surface layer and the thermocline increased to up to 2 mg/m^3. Remarkably these populations were very mixed, with diatoms, haptophytes, cyanobacteria and dinoflagellates co-existing.

With permissions from Cape Verdes and Senegal, but not Mauritania, we were able to sample the

NW African upwelling relatively unrestricted, though limited time permitted only a small deviation off the 20 W line. As it happened, SeaWiFS images showed the high productivity zone extending well beyond the 20 W line, contrary to expectations and with higher concentrations of pigments than was usual for AMT northbound cruises. Single band (555 nm) images showed regions of high reflectance inter-mixed with high absorption, indicating diverse phytoplankton assemblages with diverse biological and optical properties, all of which were sampled. The contrast with the Southern and Northern Benguelan upwelling systems (both different) was notable, with cyanobacteria and coccolithophores the dominant phytoplankton. All the three systems turned out to be different than expected in many ways and together gave interesting inter-comparisons.

A salinity front of 0.65 in 10 km marked the transition from the upwelling high productivity zone to blue water as the JCR moved into the CANIGO region. This proved to be the most oligotrophic zone encountered on AMT-6 or on any previous AMT cruise, with surface chlorophyll concentrations often as low as 0.03 $mg.m^{-3}$. Off Madeira (9 June), we exchanged personnel as arranged, Stephane Maritorena replacing Jim Brown; after a turnaround of only 15 minutes, the cruise track northwards was resumed. North of Madeira, there were 3 more CANIGO stations, making 6 in total. The only deep CTD cast (to 1500 m) at *ca* 45°N provided deep-water samples for Iron and nutrients and some water for productivity of the surface layers.

Approaching the European shelf, new satellite imaging from PML focused our attention on the shelf break upwelling (at *ca* 48° 43' N 8° 40' W) and a coccolithophore bloom on the shelf further east. Both were sampled at stations on Sat. 13 June; the upwelling turned out to be a 'phaeocystis bloom', adding further to the diversity of assemblages encountered on the cruise.

On Sunday 14 June the morning station was due south of Plymouth at (49° 50' N, 4° 10' W), again in a late spring bloom of phytoplankton of mixed species and taxa. The weather was generally overcast, so this was one of the few occasions when no good optical casts were acquired. Later, further to the west, an afternoon optics cast in good conditions was obtained, just east of Start Point in the mixed water of the eastern English Channel. As it turned out, this was our last station measurement, as cloudy weather prevailed during the passage up the southern N. Sea to Grimsby.

All scientific activities are listed in the Scientific Bridge Log, Appendix A6-2.

3. RESEARCH REPORTS

3.1 Physical Oceanography CTD data & XBTs

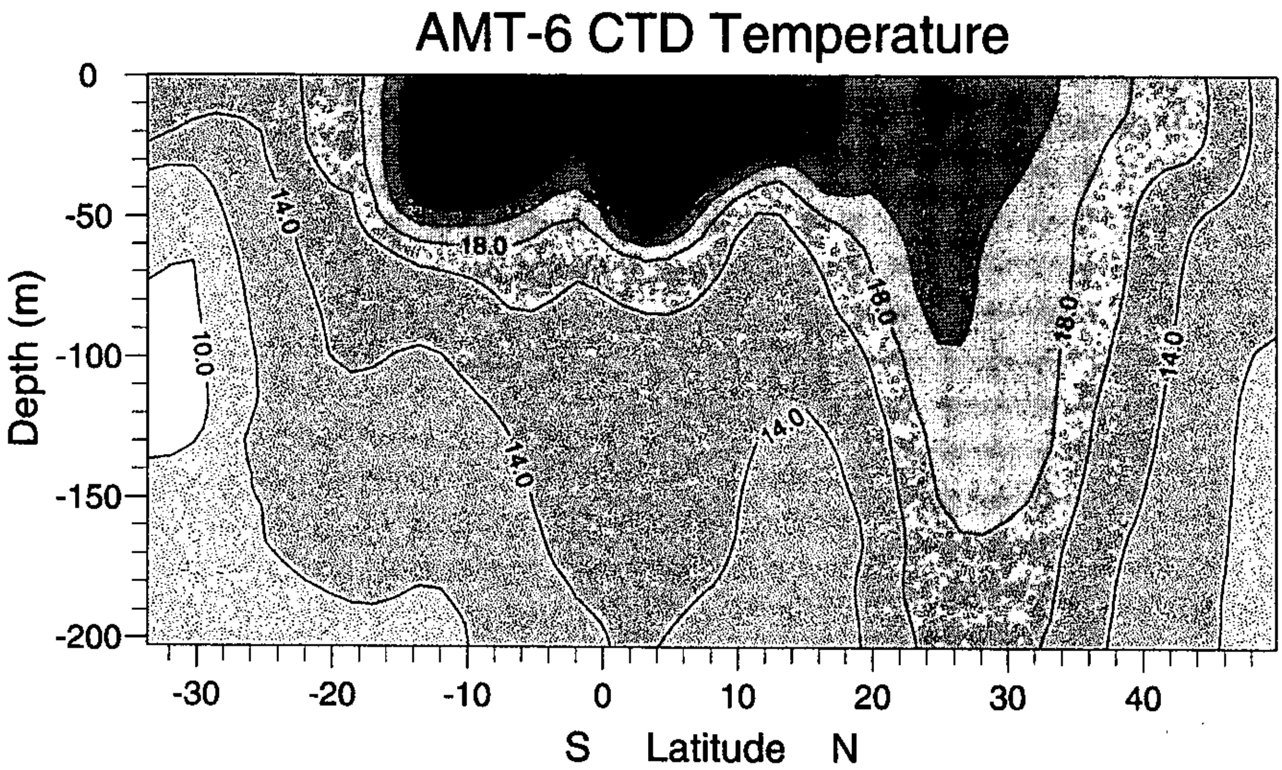
Jim Aiken & Derek Pilgrim, Plymouth Marine Laboratory & U o Plymouth.

Measurements of T & C at stations were made with the SeaBird 911plus CTD with additional sensors for Chlorophyll fluorescence (Chfl) water transmission at 660 nm (Tr) and PAR. In addition, most of the freefall optical profilers had supplementary sensors for CTD and Chfl. The UOR, while carrying a FRRF, also had sensors for CTD to provide vertical sections through the undulation depth range of 5 to 55 m. As normal for all AMT cruises on the JCR, measurements of C, T (SeaBird) and Chfl (Turner Mk 10) of the surface water, from the non-toxic supply at 7 m, were recorded by the Ocean Logger system. XBT deployments were limited to deep water off the continental shelf; a total of 99 XBTs were deployed, 66 T-7 and 33 T-5 at 6 knots as the ship left station. The XBT deployments are listed in Appendix A6-3.

There were 52 CTD casts (see Appendix A6-1), of which 12 were shallow (to 10 - 15 m) while testing the CTD firing mechanism and 1 deep (A6-50) to 1500 m. The remainder were to 100 to 200 m depending on the water depth whilst on the continental shelf and to a maximum of 400 m off-shelf, though, typically most were to 200 m. Water bottle depths for each CTD cast are listed in Appendix A6-4. Fig. 3a, b, c & d show the contoured vertical sections of T, S, Chfl and Tr for the complete cruise from 35 S to 50 N. Fig. 4a, b, c & d show the contoured vertical sections for the Northern Hemisphere only, for comparison with earlier AMT cruise measurements over the same sector. Salinity calibration bottles are listed in Appendix A6-5.

The surface layer T, S and σt for AMT-6 is shown in Fig. 5a, b & c.
The contoured vertical section of T from the XBTs is shown in Fig. 6.

Fig. 3 a, b. Vertical Section of Temperature (top) and Salinity (bottom) from CTD casts for all stations 35 S to 50 N



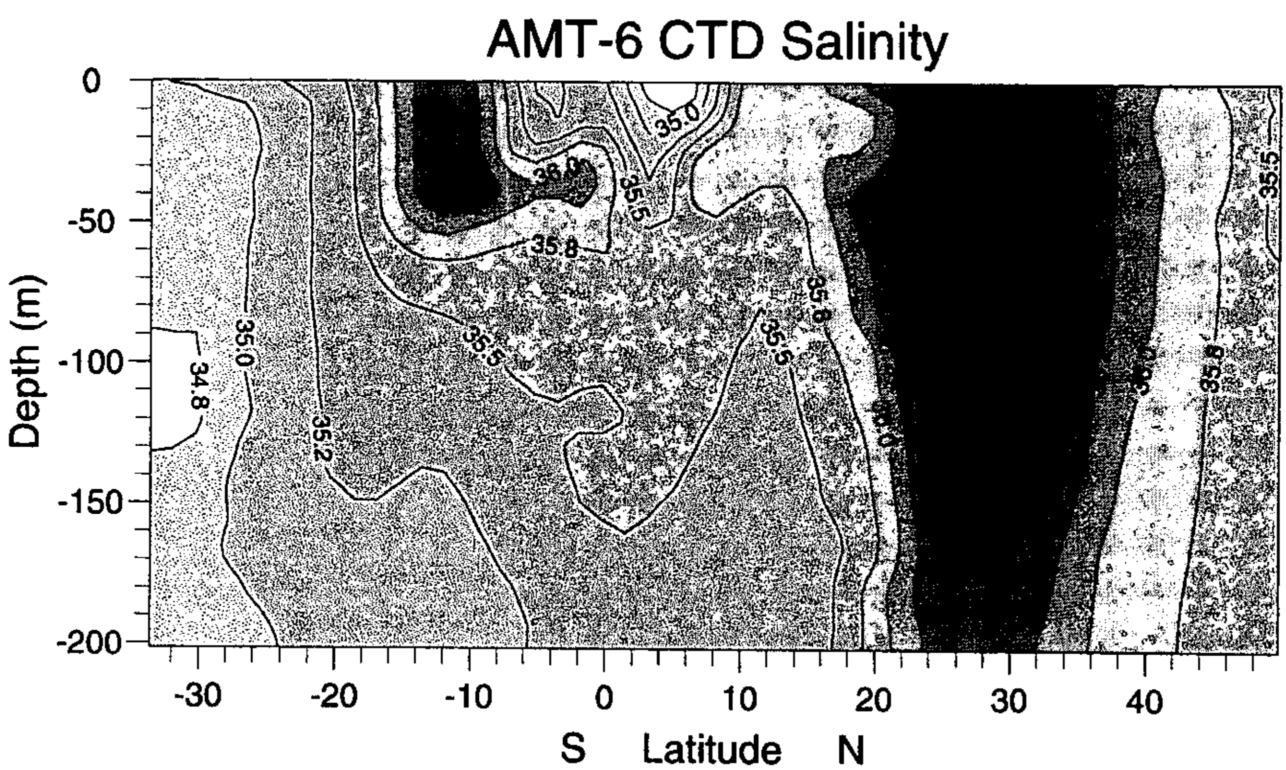
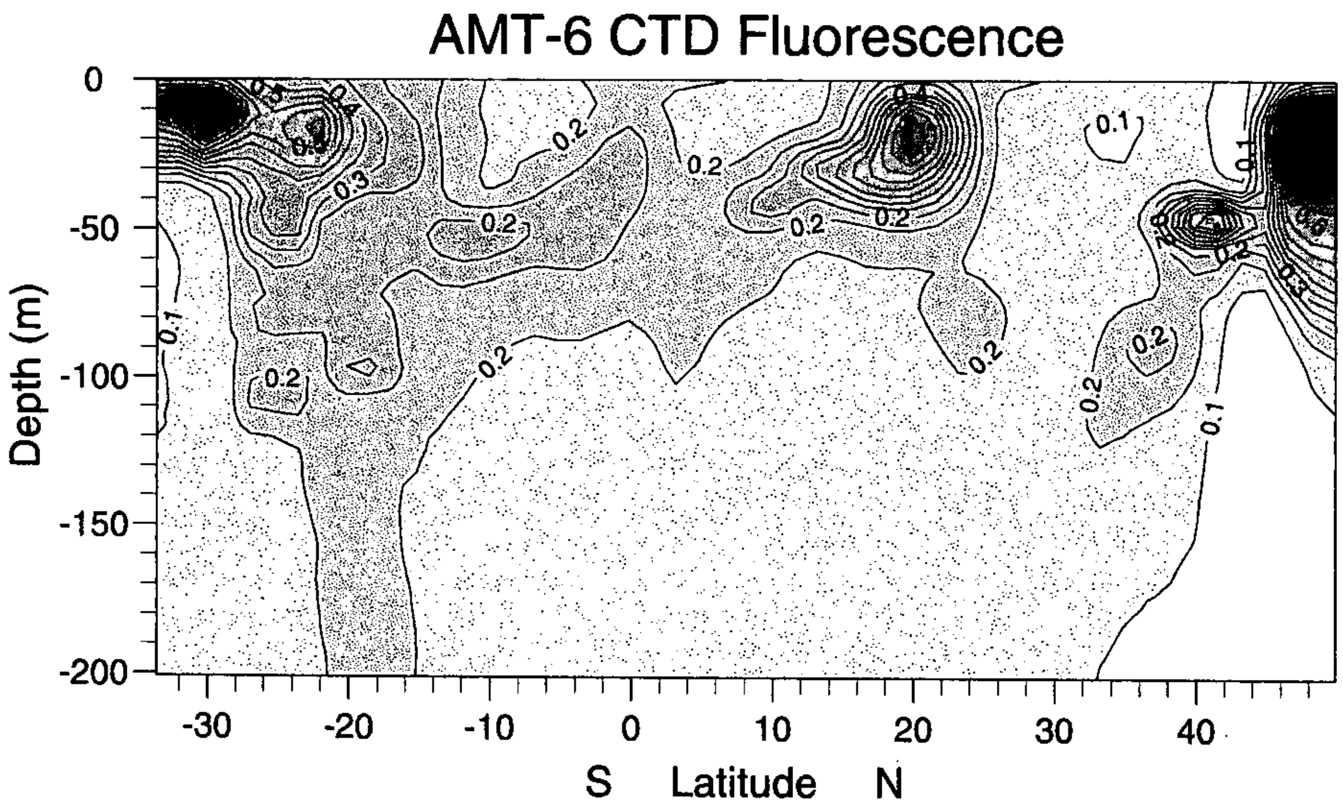


Fig. 3 c, d. Vertical Section of Fuorescence (top) and Transmission (bottom) from CTD casts for all stations 35 S to 50 N



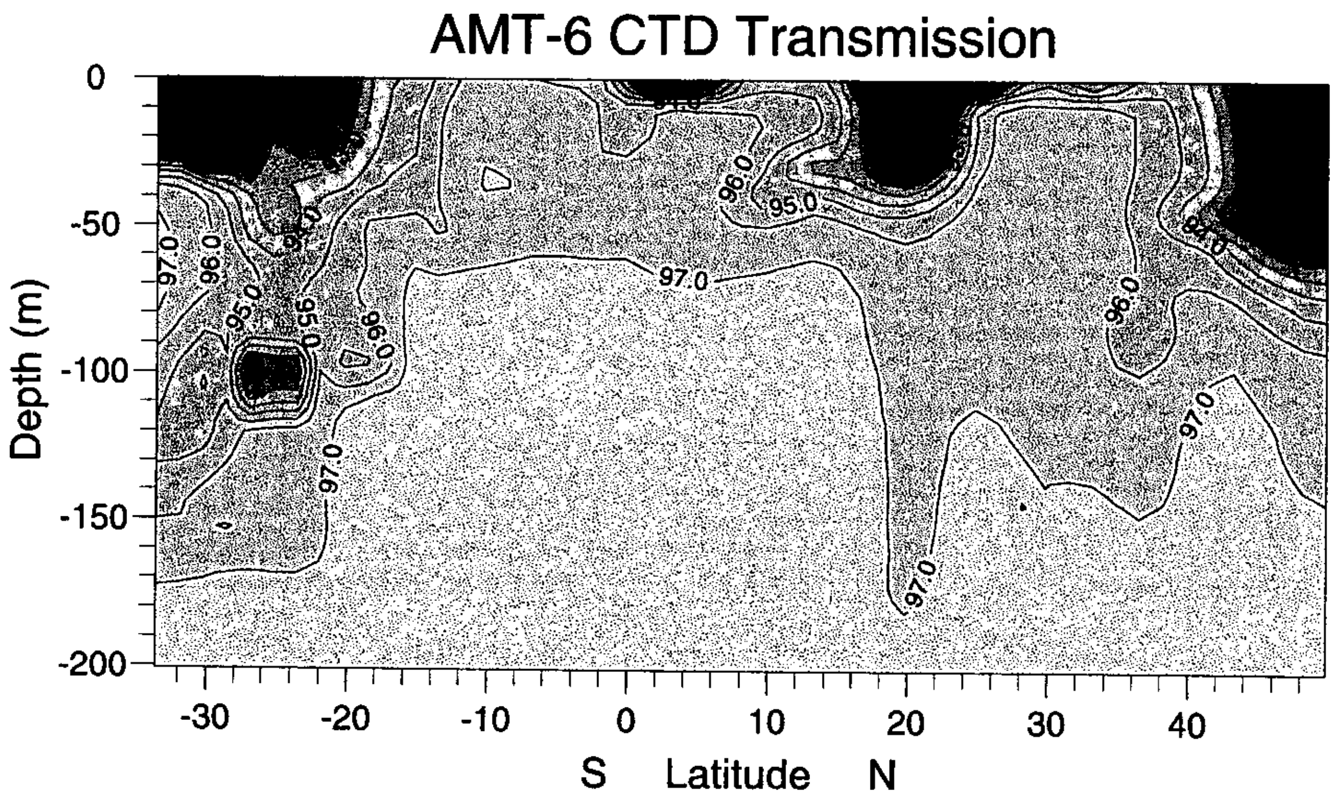
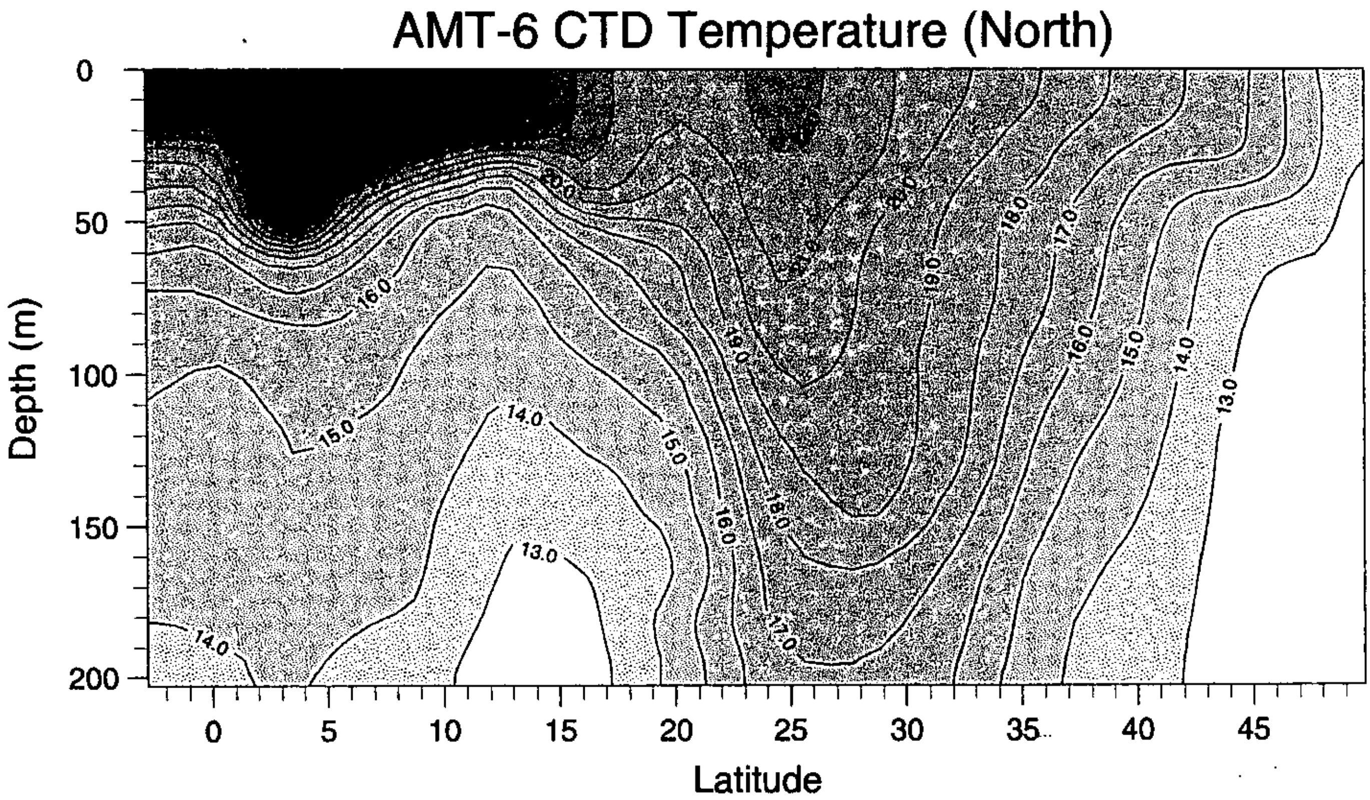


Fig. 4 a, b. Vertical Section of Temperature (top) and Salinity (bottom) from CTD casts for all stations 5 S to 50 N



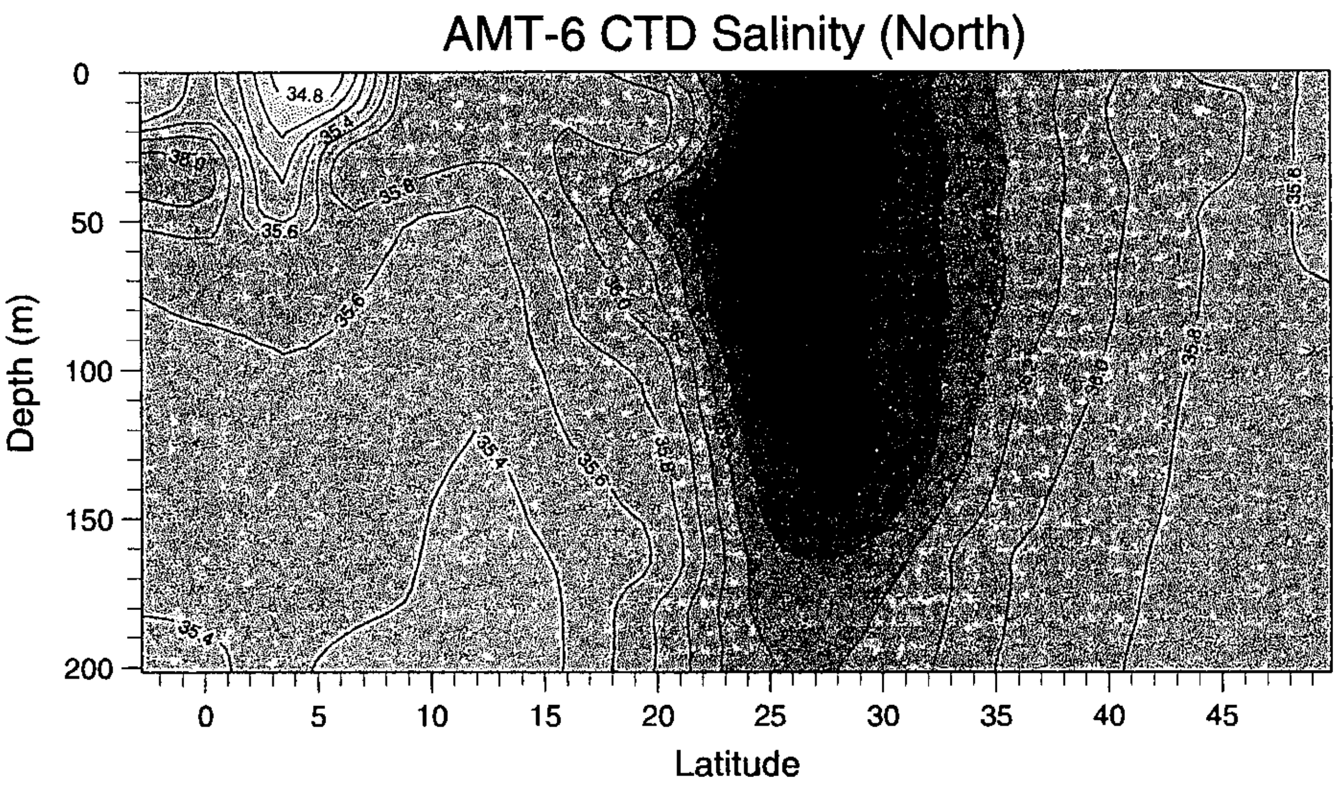
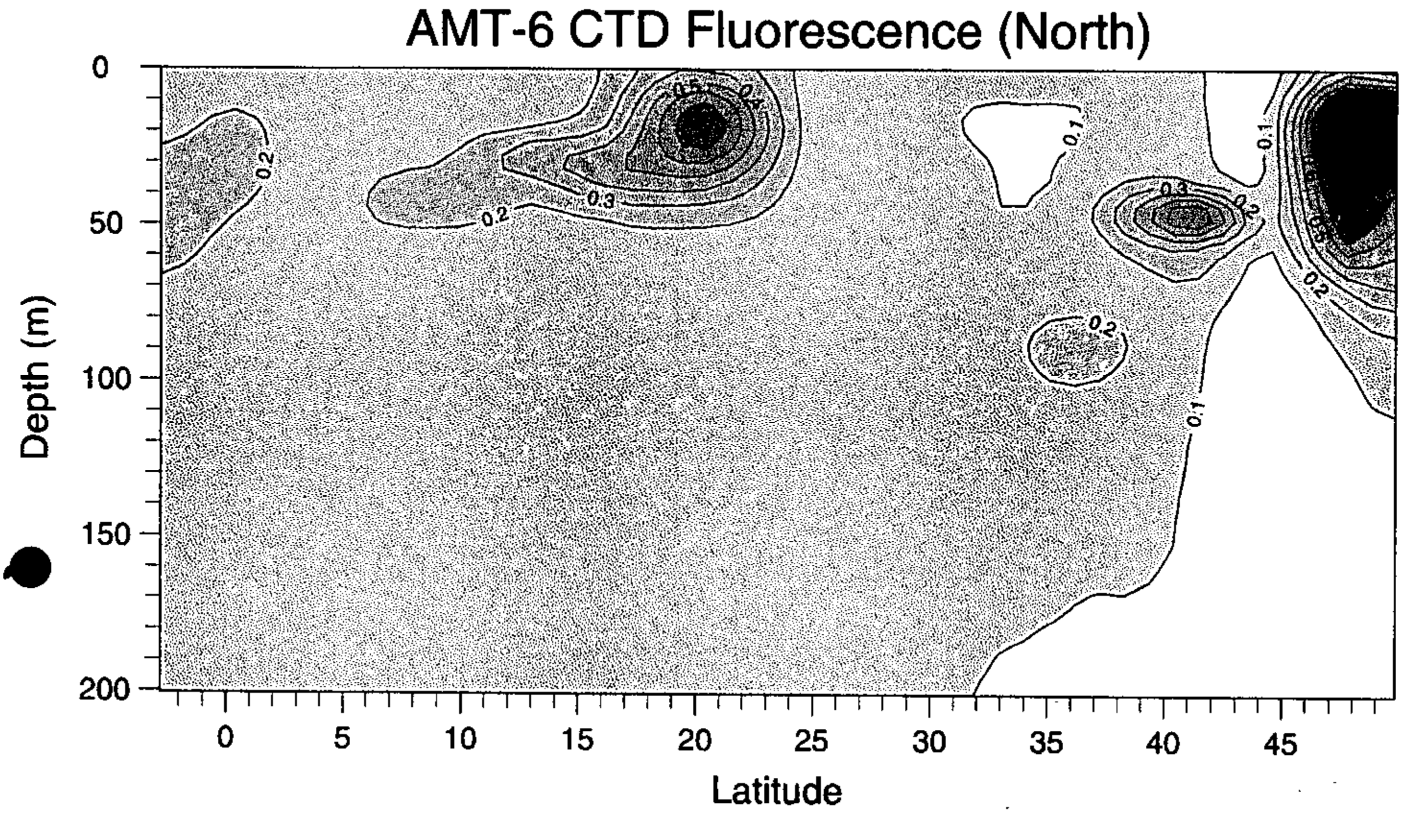


Fig. 4 c, d. Vertical Section of Fluorescence (top) and Transmission (bottom) from CTD casts for all stations 5 S to 50 N



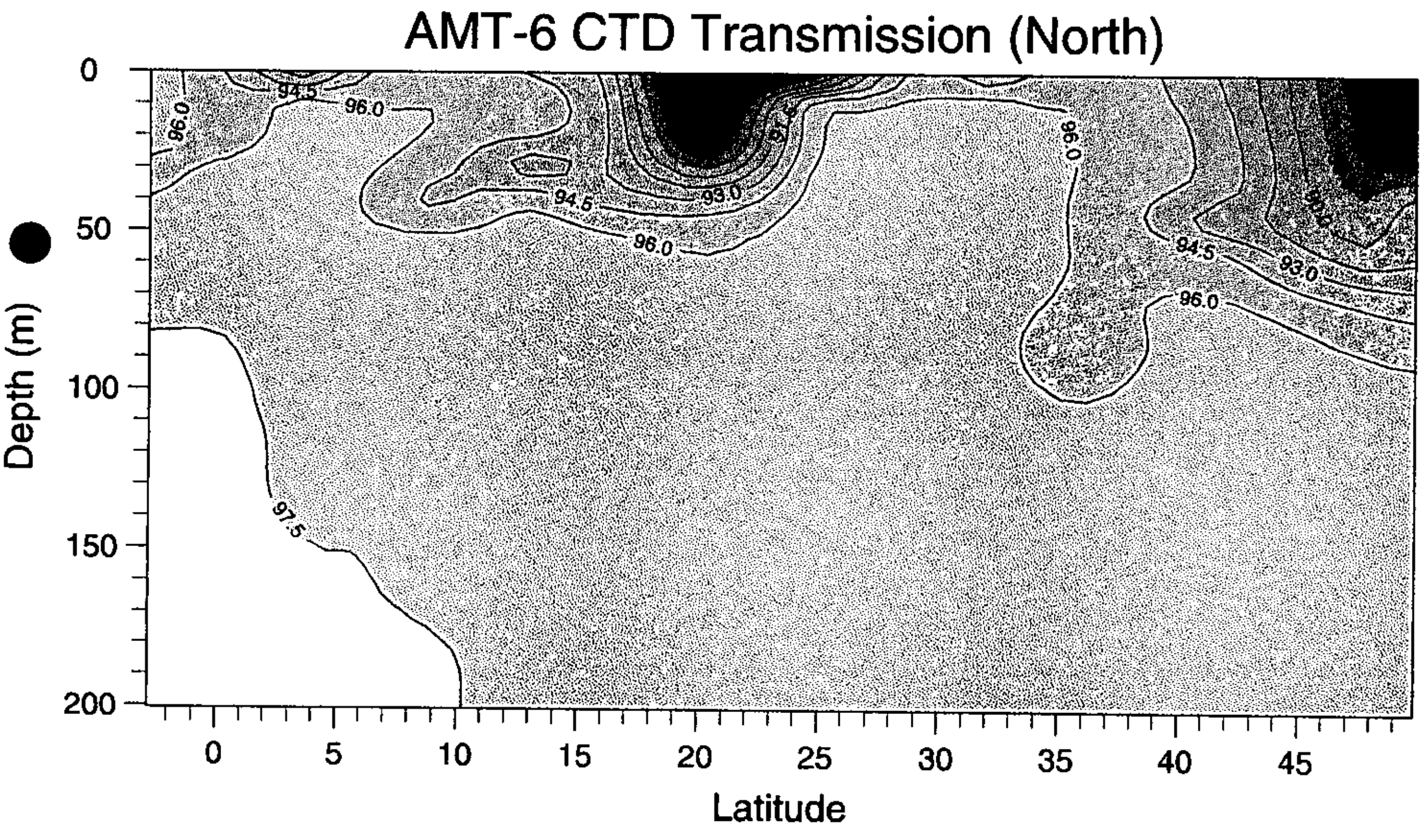
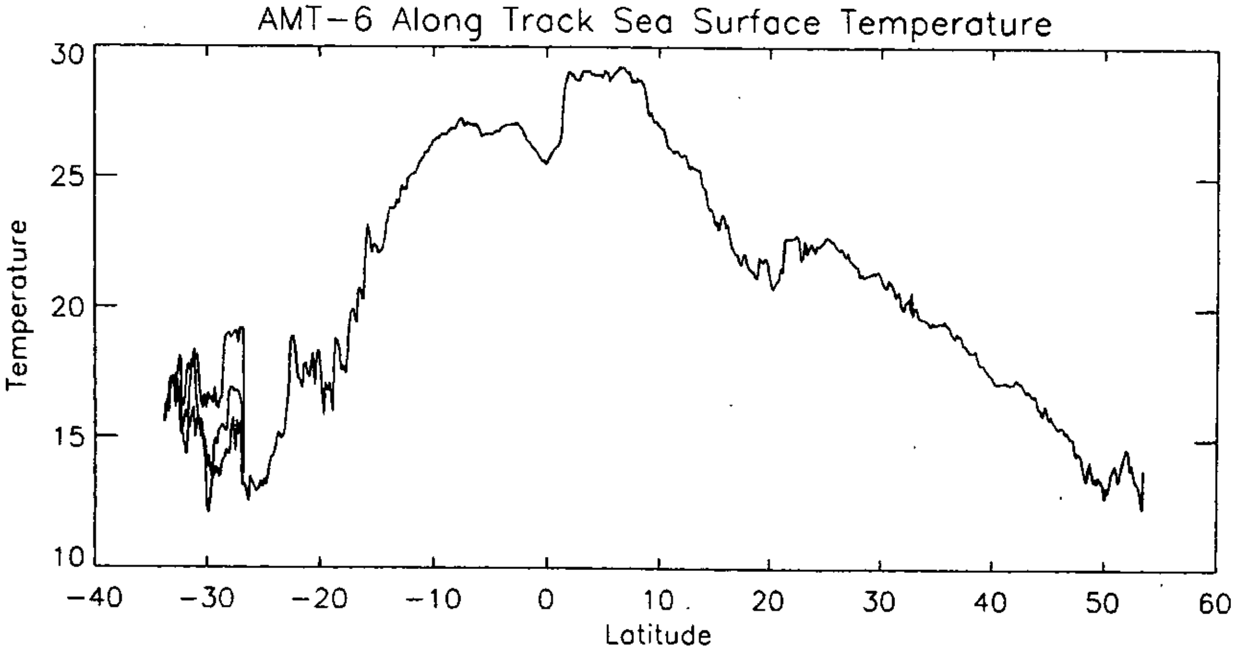
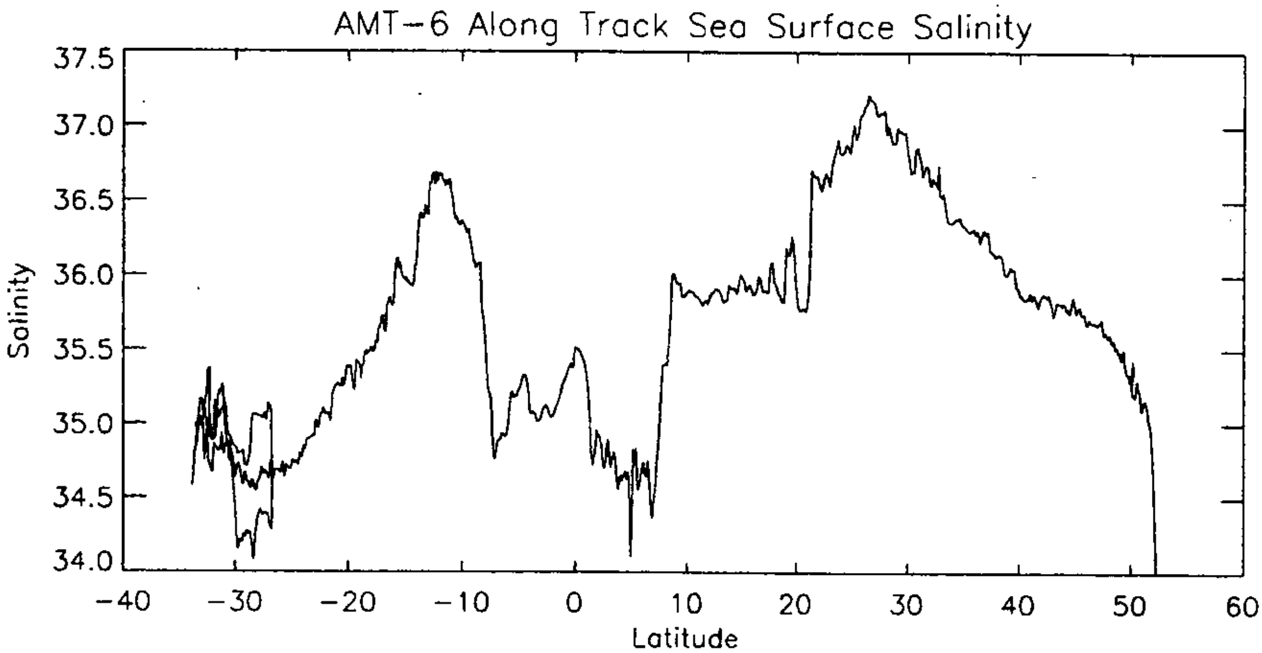


Fig. 5 a, b & c. Along Track Sea Surface Temperature (top), Salinity (middle) and Density (bottom).





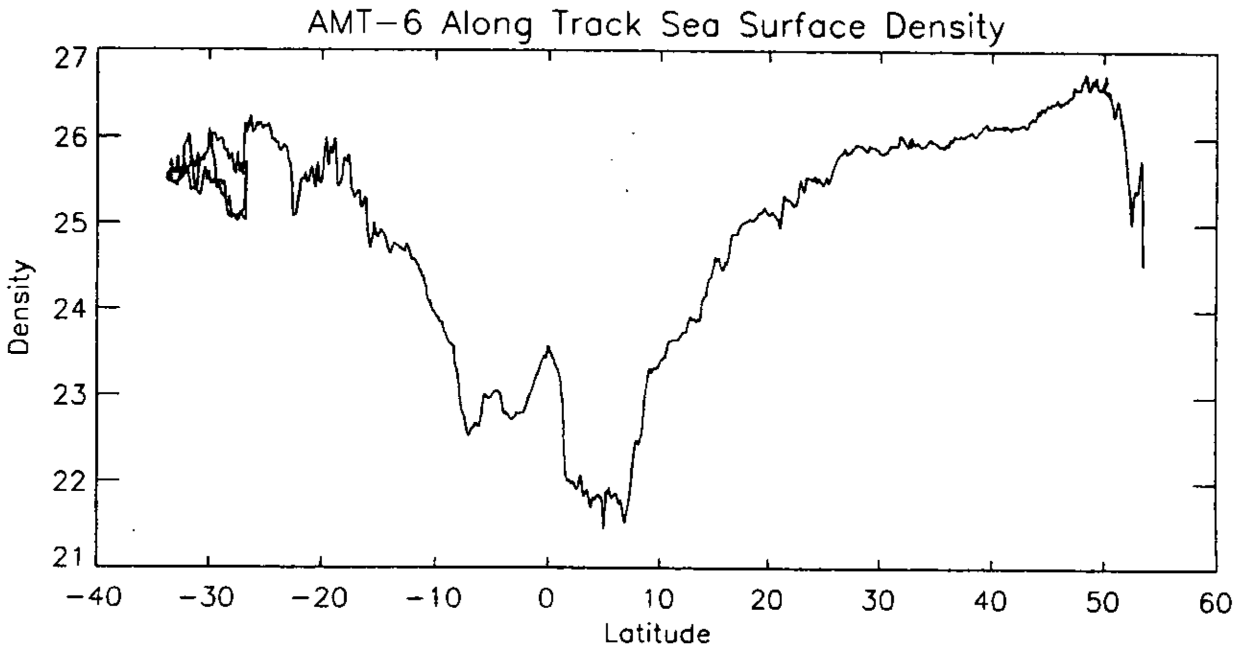
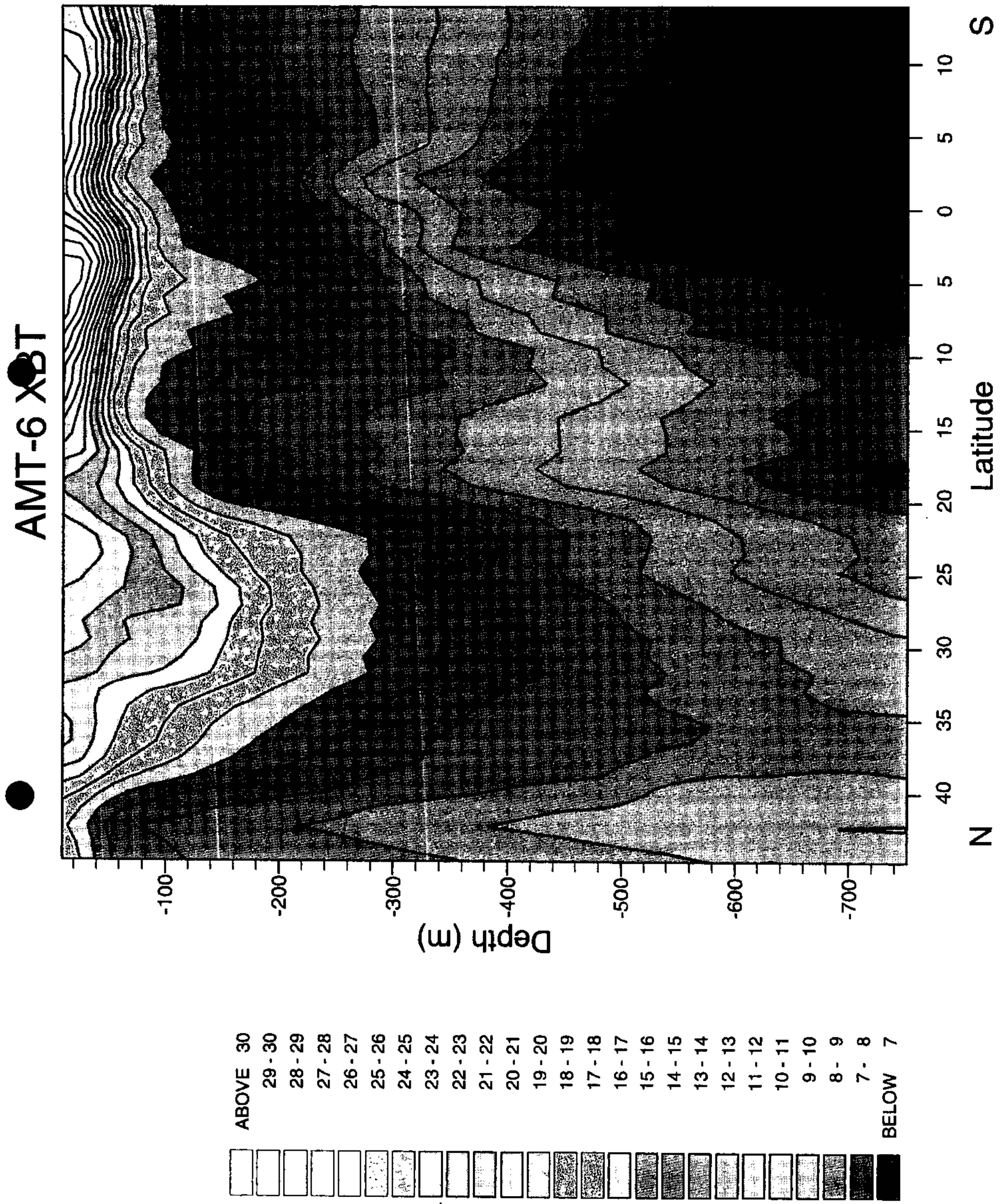


Fig. 6. XBT Section 50 N to 15 S



3.2 Remote Sensed Imagery

Satellite imagery was received daily, throughout the cruise. SeaWiFS data were received from NASA, Goddard and AVHRR imagery of SST from UCT, Cape Town and RSMAS U of Miami. These were used to adjust daily sampling strategy, to take samples in regions of high or low chlorophyll, high or low reflectance (Rrs550) or low or high temperature waters.

Figure 7 shows the SST image for the S. Benguela for 4 May, a few days before sailing from Cape Town. The predominant features are the large mesoscale eddy structures off Cape Columbine (35 S) and to the north of this. The dominant cold water cell stretched from Lamberts Bay (32.5 S) to the Orange River (28.7 S) at the border of RSA and Namibia to the north. The SeaWiFS image (fig. 8) showed complex phytoplankton biomass structures with eddies, jets and streamers extending 100 km offshore. Unusually for this time of year, the biological activity in the S. Benguela was very intense, resulting in very high chlorophyll concentrations (eutrophic, up to and >10 mg.m^{-3}) near shore from 32.5 S to 29 S and mesotrophic concentrations off shore, in the mesoscale structures. The highest concentrations measured (*ca* 30 mg.m^{-3} in a dinoflagellate bloom) were encountered in a streamer only 20-30 km in width at 32.4 S.

The main cold water cell in the mid Benguela stretched from Luderitz (26.7 S) to Conception Bay (24 S), see fig 9. The SeaWiFS image for the area (fig 10) showed very high concentrations (black) and areas where the algorithms failed (white). During the cruise it was thought that these areas had very high pigments, but subsequently it was discovered that desert dust (Kalahari) caused the atmospheric correction algorithm to fail. In these areas the images still showed enough structure, especially the Rrs555 image, to guide the boat through zones of striking contrast and to station positions with maximum variety. At the northern limit of the Benguela the SST imagery showed the extremely sharp front at 15.6 S with the warm tropical water to the north and west. Because of fog, sea mist or atmospheric dust, no good SeaWiFS images of the area were received, and cruise track was set to sample the coldest zones from the SST image.

On leaving the northern Benguela and the mesotrophic area to the northwest, the SST and SeaWiFS images showed less variability as would be expected for the oligotrophic ocean. Unexpectedly there were patches of chlorophyll up to 0.2/0.3 mg.m-3, higher that usual for the equatorial zone. The next significant feature of interest was the Equatorial upwelling, which appeared as a broad (50 km, S to N) band stretching 150 km E to W. At the same time the ITCZ appeared as a cloud covered feature in the AVHRR image composites, from about 3 N to 7 N.

Approaching the West African region there were no notable features in the SeaWiFS or AVHRR and little sign of upwelling off either Senegal or Mauritania. With permission to sample in Senegalese waters, a small excursion to 19 W was possible encountering high phytoplankton concentrations again; see fig 11. The passage in and out of this zone showed high variability in reflectance seen in the Benguela, which were related to 'a' and 'c' measurements by the ac-9.

Finally, SeaWiFS and SST images from PML (received at Dundee) showed phytoplankton blooms and coccolithophores in the western approaches and the English Channel, all of which were sampled; see fig 12.

Satellite images Fig7, 8, 9, 10, 11 & 12 are included as pages 13 a, b, c, d, e & f.

Fig. 7. Southern Benguela SST
Fig. 8. Southern Benguela SeaWiFS Chlorophyll
Fig. 9. Northern Benguela SST
Fig. 10. Northern Benguela SeaWiFS Chlorophyll
Fig. 11. West African Upwelling SeaWiFS Chlorophyll
Fig. 12. Western Approaches SeaWiFS Chlorophyll

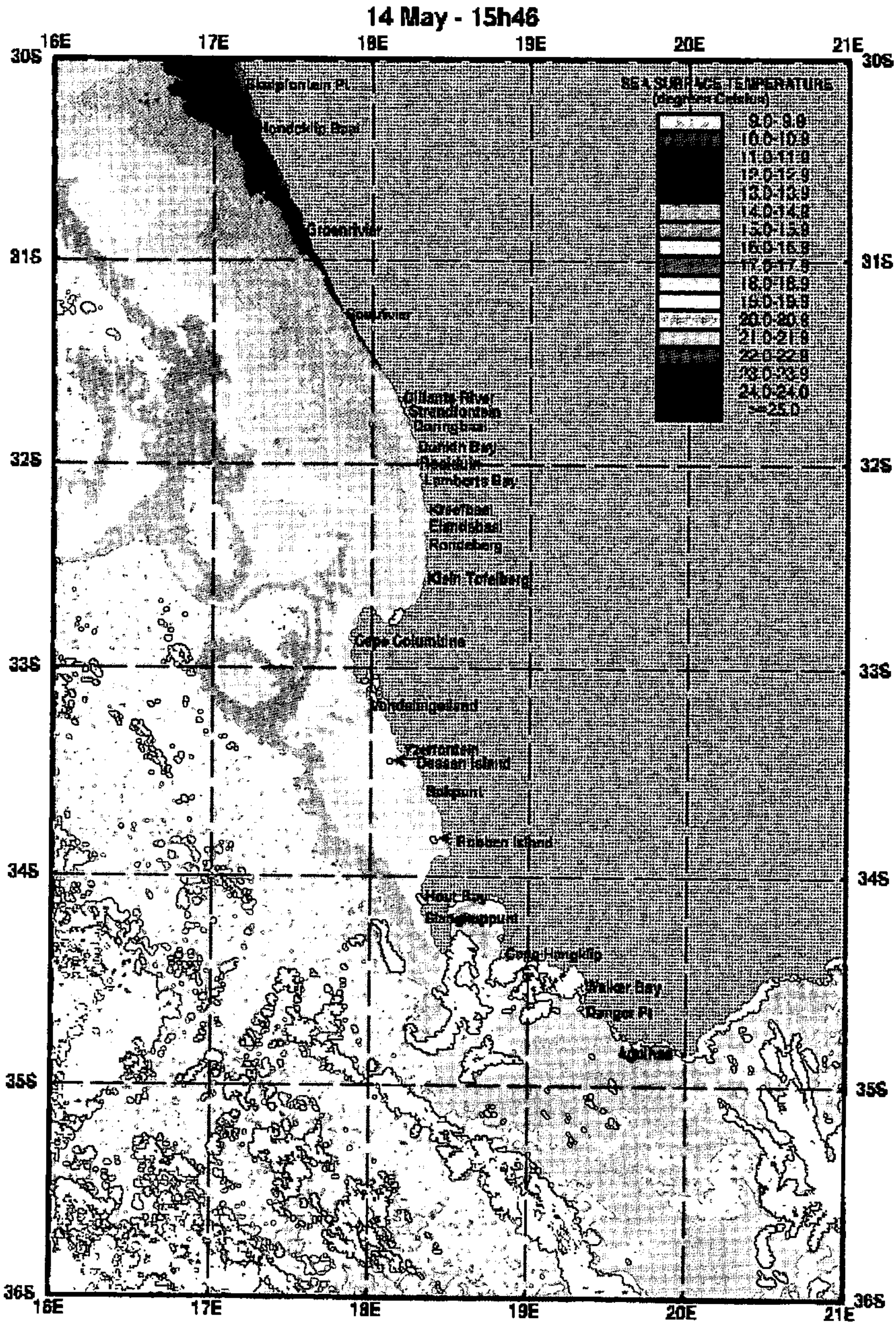


Fig.7 Southern Benguela SST

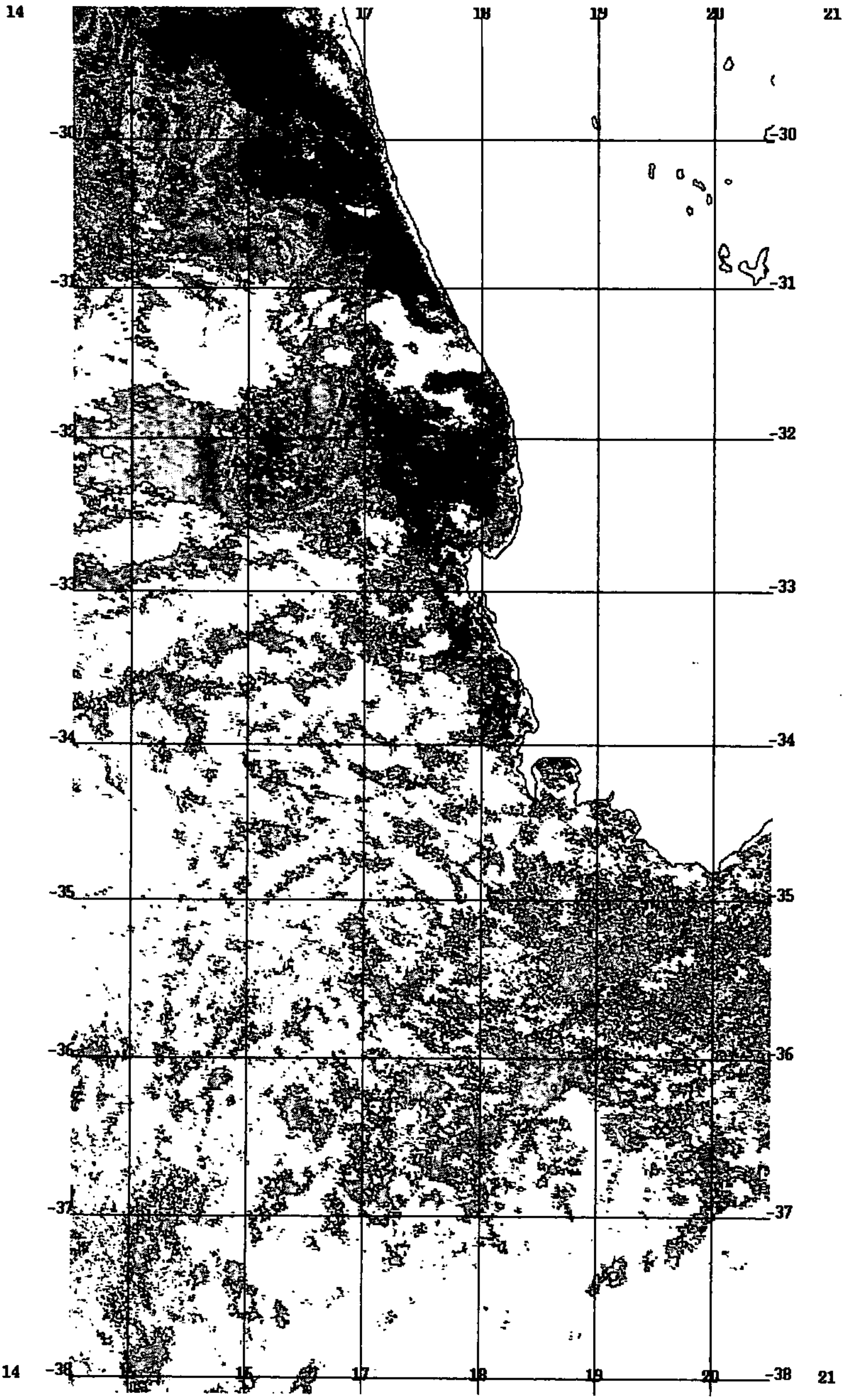


Fig.8 Southern Benguela SeaWiFS Chlorophyll

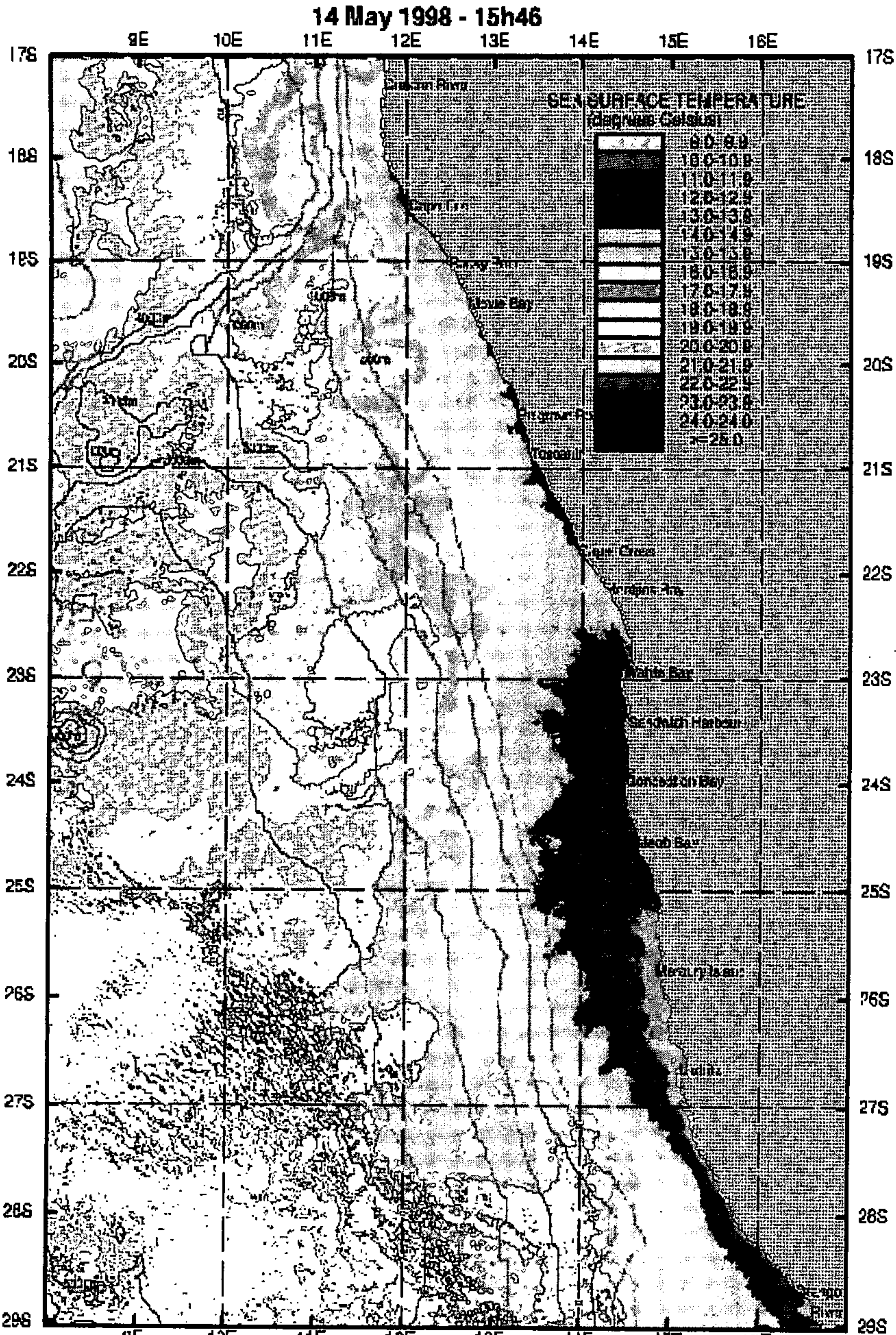


Fig. 9 Northern Benguela SST

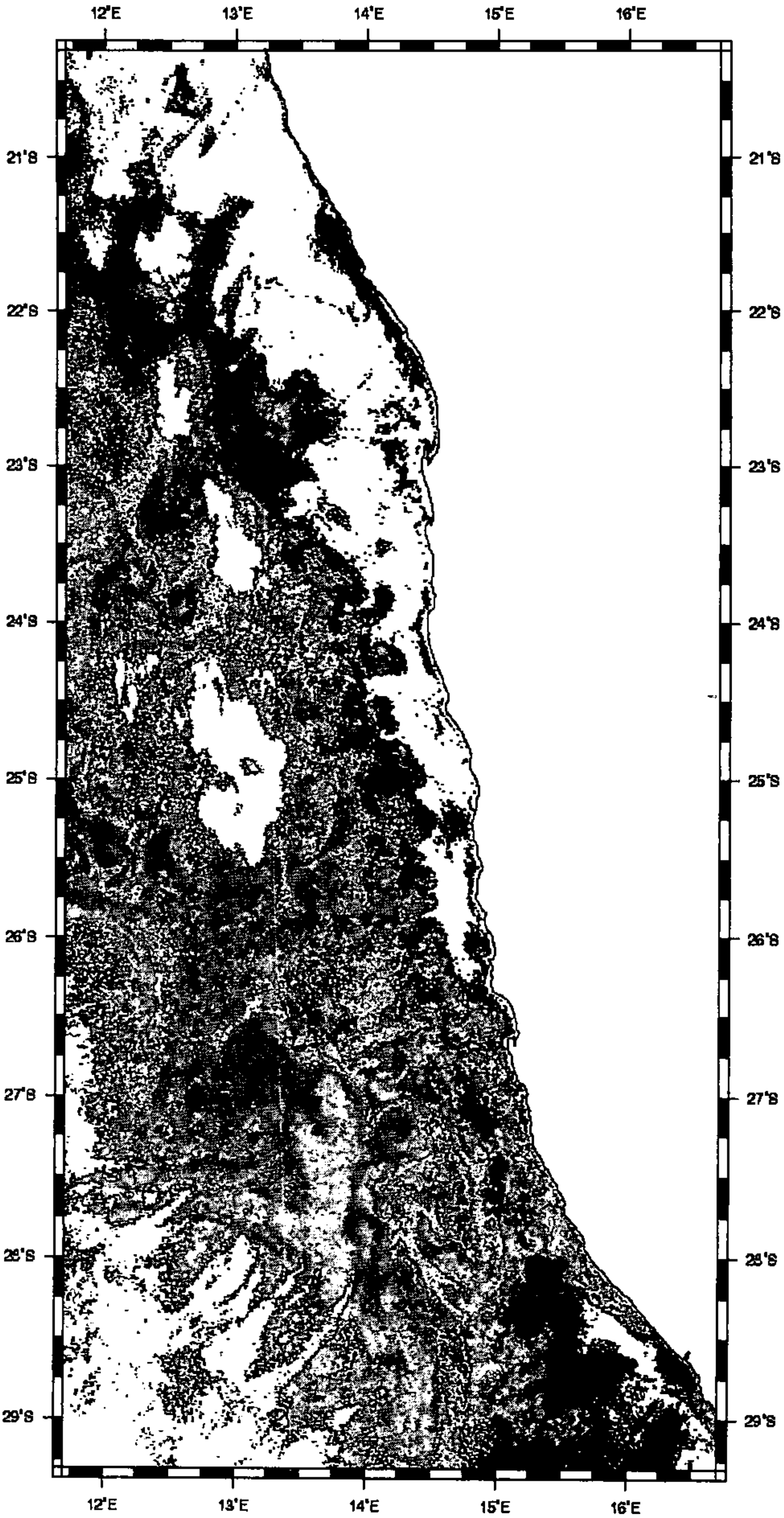


Fig. 10 Northern Benguela SeaWiFS Chlorophyll

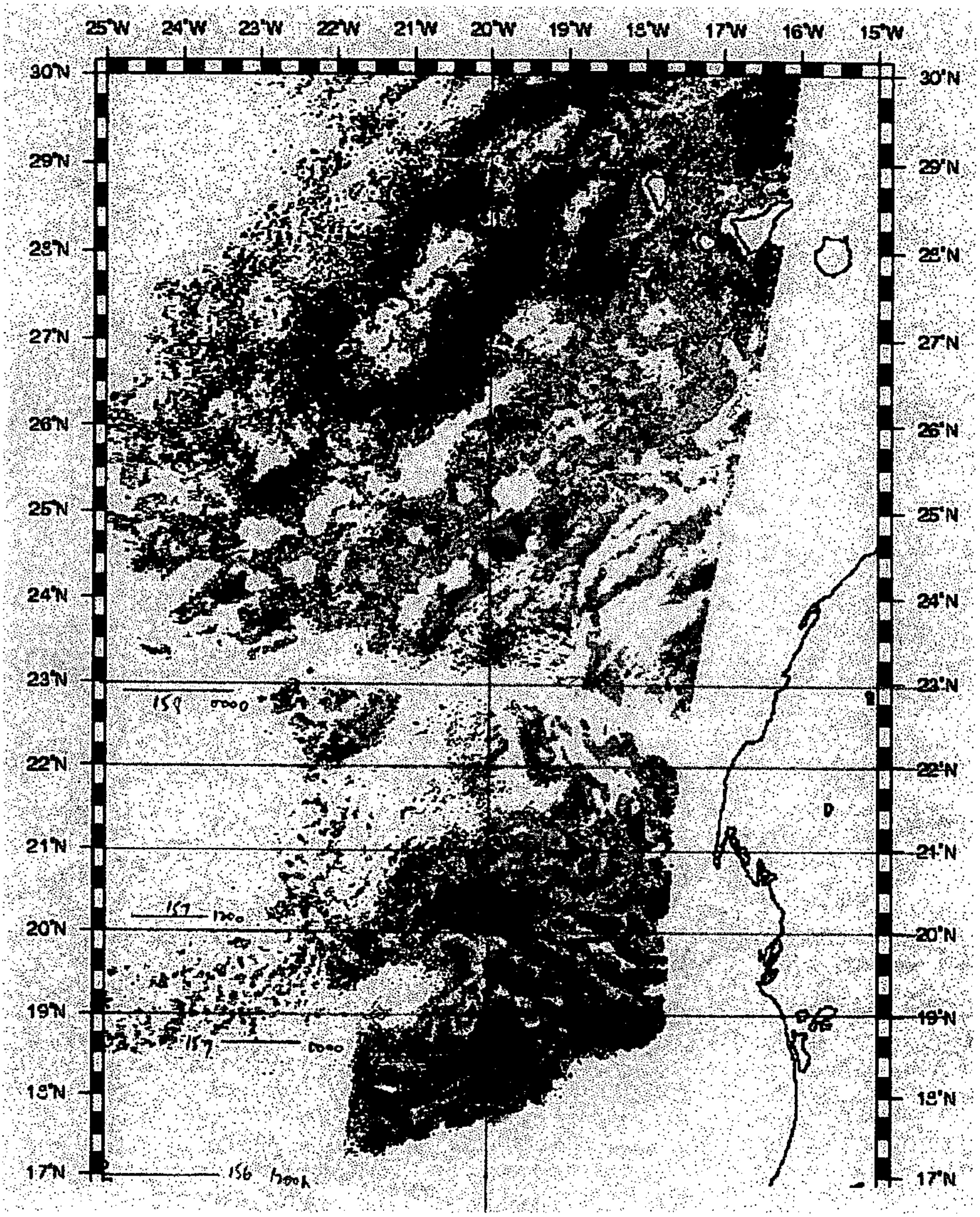


Fig.11 West African Upwelling SeaWiFS Chlorophyll

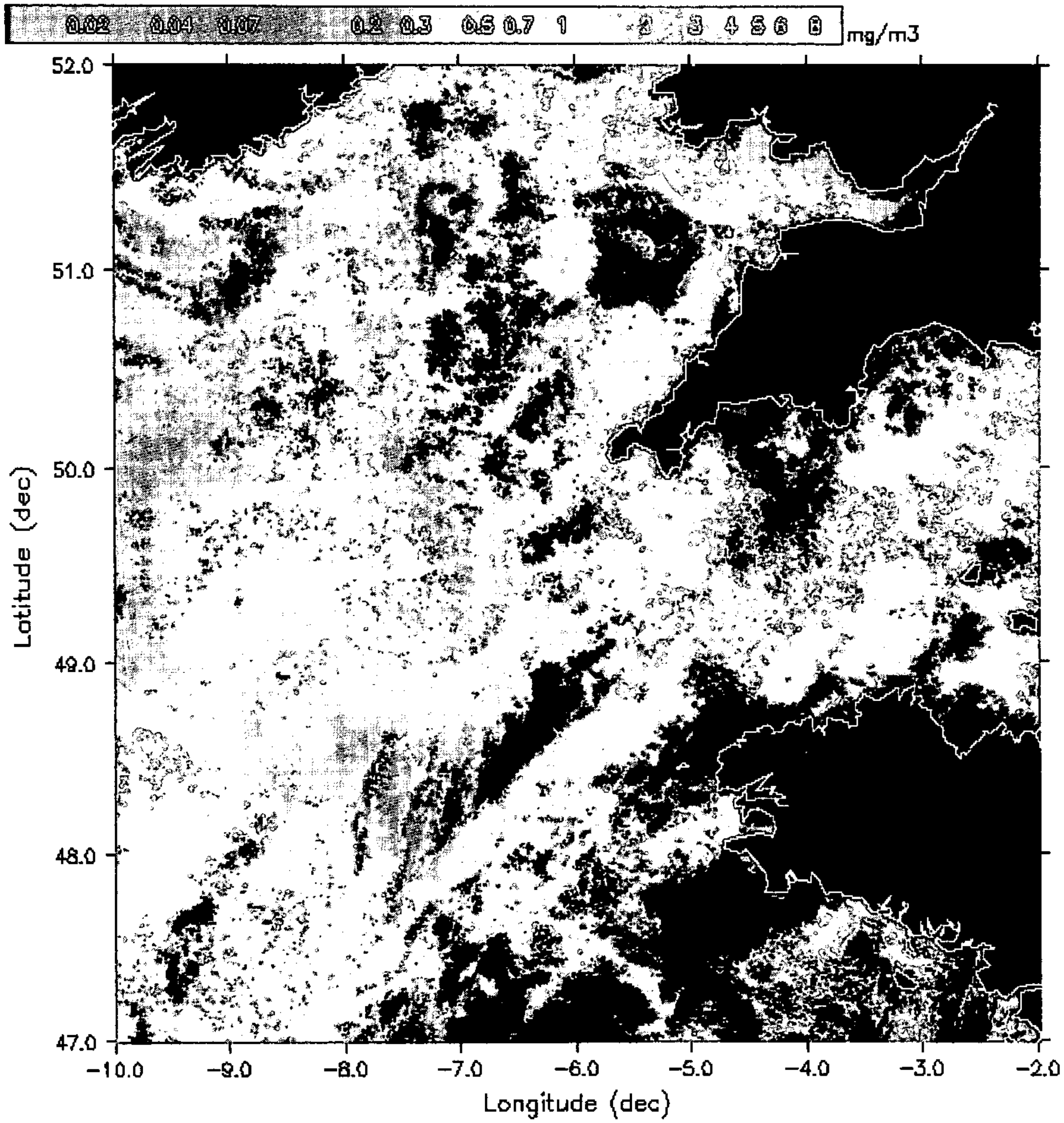


Fig. 12 Western Approaches SeaWiFS Chlorophyll

3.3 In-Water Optics

Stan Hooker, Jim Brown, Cyril Dempsey and Stephane Maritorena, NASA.

During AMT-6, optical data were collected underway with the UOR and an ac-9 and on station by four in-water profiling systems: SeaWiFS Optical Profiling System (SeaOPS), SeaWiFS Free-Falling Advanced Light Level Sensors (SeaFALLS), Low-Cost NASA Environmental Sampling System (LoCNESS), and the miniature NASA Environmental Sampling System (miniNESS). An above-water set of radiometers SeaWiFS Surface Acquisition System (SeaSAS) measured the water leaving radiance on station. SeaOPS was deployed using a winch and crane, whereas, SeaFALLS, LoCNESS, and miniNESS are tethered freefall systems that were deployed by hand. The crane used with SeaOPS had about a 10 m reach over the side of the ship, and the tethered systems were at least 30 m away from the stern of the vessel before any data were collected. All of the in-water profiling instruments collected Ed(z, λ) and Lu(z, λ) data; SeaOPS and LoCNESS also collected Eu(z, λ).

Underway and station surface (solar) irradiance data were measured by an in-air irradiance sensor, $Es(0^+)$, that was mounted on the port trawl post mast, as part of SeaOPS; the SeaWiFS Buoyant Optical Surface Sensor (SeaBOSS), which comprised an in-air irradiance sensor, $Es(0^+)$, fitted inside a buoyant collar, so it can be deployed on a mast or as a tethered buoy; and a photosynthetically available radiation (PAR) sensor (with a deck cell) which was integrated into the CTD system. A complete description of the SeaOPS, LoCNESS, and SeaFALLS systems can be found in Aiken et al. (1998).

The miniNESS profiler was not a new instrument, but had been built up from SeaOPS components: a DATA-100 (S/N 004) and the two light sensors, OCR-200 and OCI-200. Once assembled, miniNESS became a free-falling unit that functioned as LoCNESS, and it was deployed in the same fashion. The data acquisition for miniNESS was the same as used for LoCNESS and SeaOPS. The principle advantage of miniNESS was its low cost, compactness, and flexibility; it was assembled from relatively low cost components, less than one half the size of LoCNESS or SeaFALLS. It was reconfigured quickly, since the radiometers used are not integral to the design. The radiometers were positioned on the edges of the tail fins, so they were at the same depth level when taking data (unlike LoCNESS or SeaFALLS where the sensors were separated by the length of the profiler). In comparison to SeaFALLS (which uses OCR-1000 and OCI-1000 sensors), there was a commensurate loss in sensitivity, so one of the objectives of the AMT-6 cruise was to evaluate the capabilities of miniNESS in comparison to the other proven designs. This was achieved by making simultaneous deployments with the other profilers.

The LoCNESS profiler was used with the Three-Headed Optical Recorder (THOR) option. In this configuration, a special adapter plate, on the nose of the profiler, allowed two heads to be mounted rather than one: the usual Lu sensor plus an Eu sensor. The two nose sensors did not disturb the stability of the profiler during descent. In fact, THOR was shown to have the lowest and most stable tilts of all the profilers. This stability, and the fact that three components of the light field were measured during each profile, made LoCNESS one of the most versatile profilers used.

SeaSAS was used to make above-water radiometric measurements. It consisted of two OCR-200 radiombeters and a DIR-10 directional unit. One radiometer was pointed at the sea surface to measure $Lw(0^+)$ and the other at the sky to measure $Ls(0^+)$. The DIR-10 measured the compass heading of the vessel and its pitch and roll. The measurement procedure followed during AMT-6 was the same as given in Mueller and Austin (1995) with the exception that the surface-viewing angle was 40 degrees up from nadir and the sky-viewing angle was 140 degrees up from nadir (the original protocol was 30 degrees and 150 degrees, respectively). Both radiometers made measurements in the viewing plane perpendicular to the sun. Since the sun was usually on the starboard beam, the measurements were made to the stern. In most cases, simultaneous profiles with one or more of the in-water profilers were made at the same time.

All of the calibrations for above- and in-water radiometers were monitored daily with the SeaWiFS Quality Monitor (Johnson et al. 1998) which has been used on previous AMT cruises for the same purpose (Hooker and Aiken 1998 and Aiken et al. 1998). See Appendices A6-6, 7, 8, 9, 10, and 11.

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3.4 IOPs ac-9 measurements

Derek Pilgrim, Institute of Marine Studies, University of Plymouth

The *ac-9* was operated almost continuously in underway mode from days 141 to 166. The instrument was connected to the ship's non-toxic supply. To maintain the instrument at ambient temperature it was placed in a plastic barrel, on deck, supplied by a constant flow of seawater. A Chelsea Instruments *Alphatracka* transmissometer (25cm, 565nm) was also deployed in the barrel.
The output of the *ac-9* was continuously logged using the PC-based *Wetview* package. On CTD stations (and some optical stations) a 0·2 µm filter was fitted at the input to the *ac-9* to remove all suspended material. Thus measurements of *a* and *c* were obtained for 'total', 'water + dissolved', and, by subtraction, 'particulate' components.
Numerous attempts were made during the cruise to calibrate the *ac-9* using filtered Milli-Q water, but the results were considered unsatisfactory. The instrument is to be calibrated under laboratory conditions ashore. Calibration is not needed to produce 'particulate' values of *a* and *c* (and by subtraction, *b*) since these are obtained by subtraction of filtered from non-filtered measurements.
Figure 13 illustrates typical particle absorption curves from four sample stations, and these clearly show the expected chlorophyll-*a* spectral peaks in the region of 430nm and 662nm

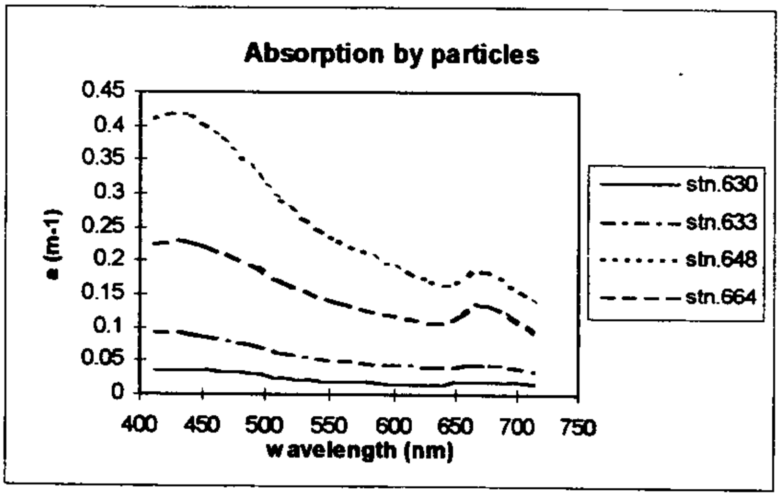


Fig. 13. Particle absorption spectra observed at 4 stations: stn.630 in the Gulf of Guinea, stn.633 at the Equator, stn.648 in the NW African upwelling and stn.664 in the W. Approaches.

Figure 14 illustrates the relationship between particle absorption (in this case total absorption derived from the integration of the spectra in figure 13) and chlorophyll-*a* concentration (from HPLC measurements). The relationship may be expressed as:

$$\text{Absorption} = 27{\cdot}4\,[\text{Chl-}a] + 3{\cdot}21 \quad (n = 27, r^2 = 0.71)$$

Figure 15 shows the relationship between particle scattering (as the scattering ratio, *b/a*) and total absorption a. High values of *a* indicate high concentrations of particles (plankton) whilst high values of *b/a* indicate relatively small-sized plankton. The plankton populations of the six broad geographical areas sampled are clustered into groups of similar scattering ratio and/or absorption. Figure 16 shows the same scattering (*b/a*) data plotted as a function of Chl-*a* concentration.

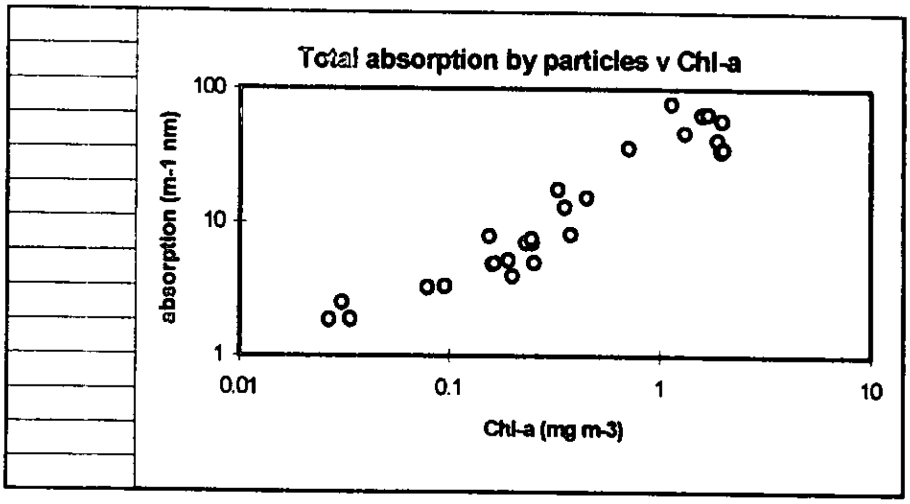


Figure 14. Total absorption vs. chlorophyll-*a* concentration from observations at 27 stations

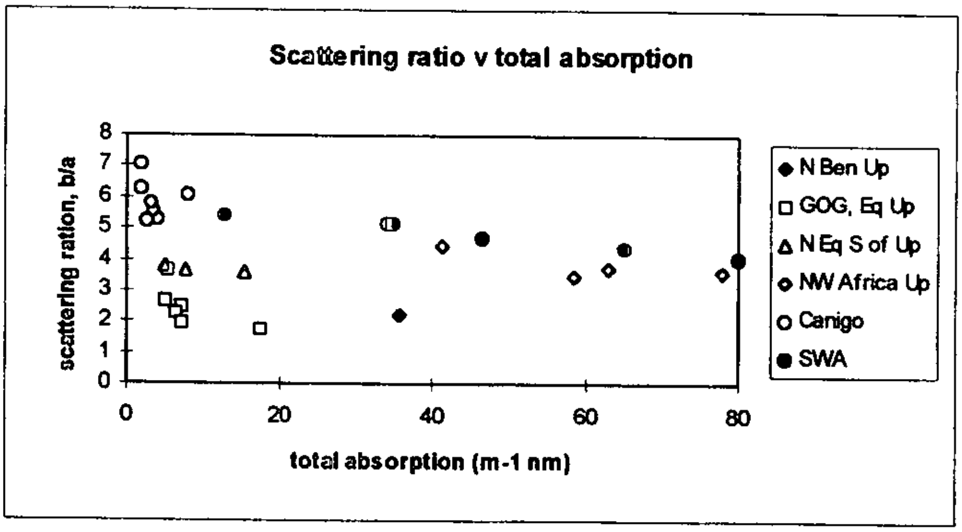
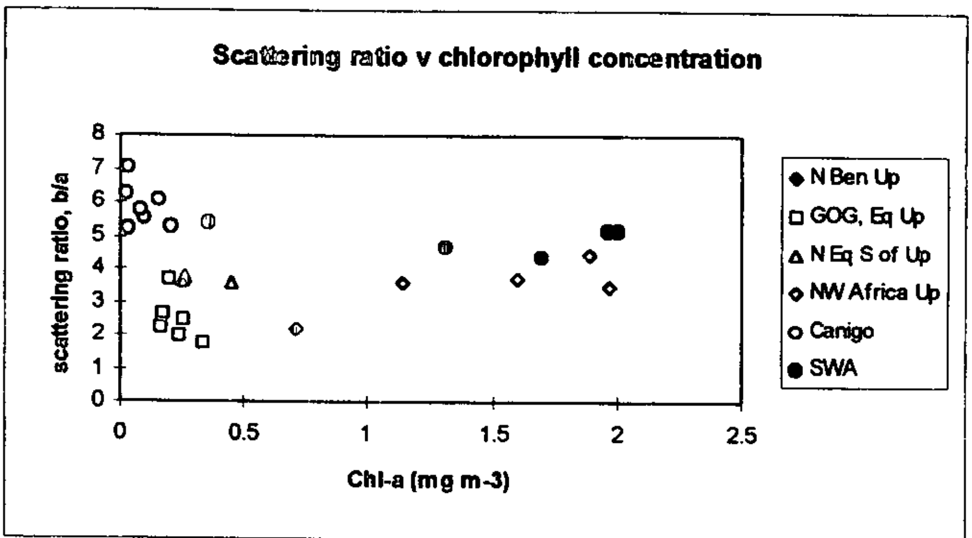


Figure 15. Plot of scattering ratio against total absorption for 6 broad geographical areas



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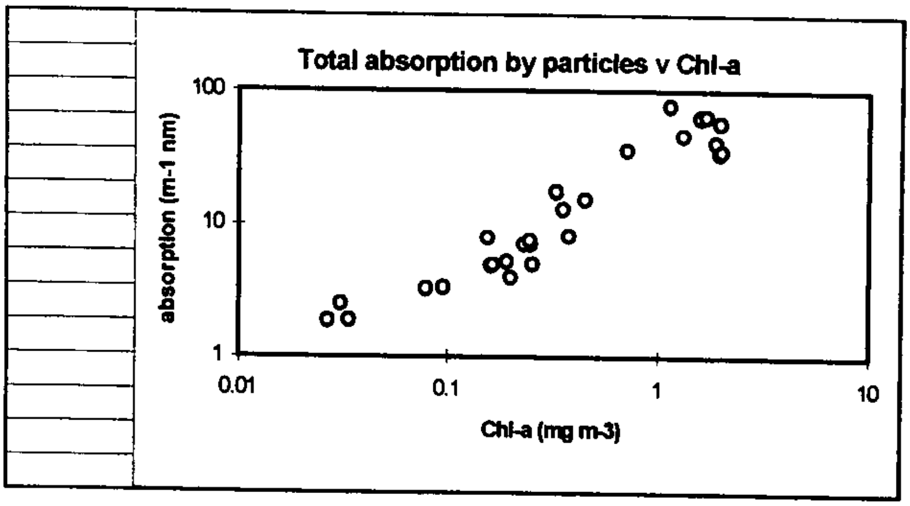

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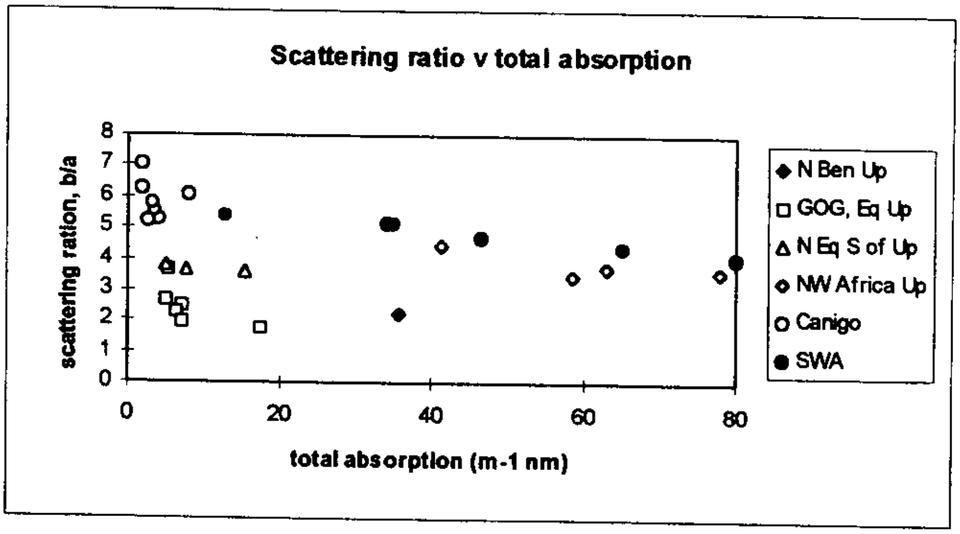

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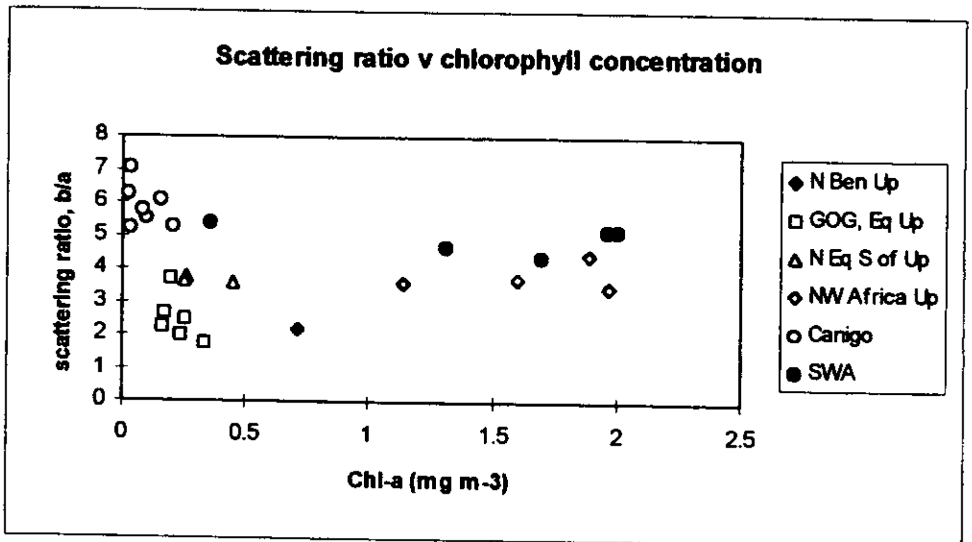

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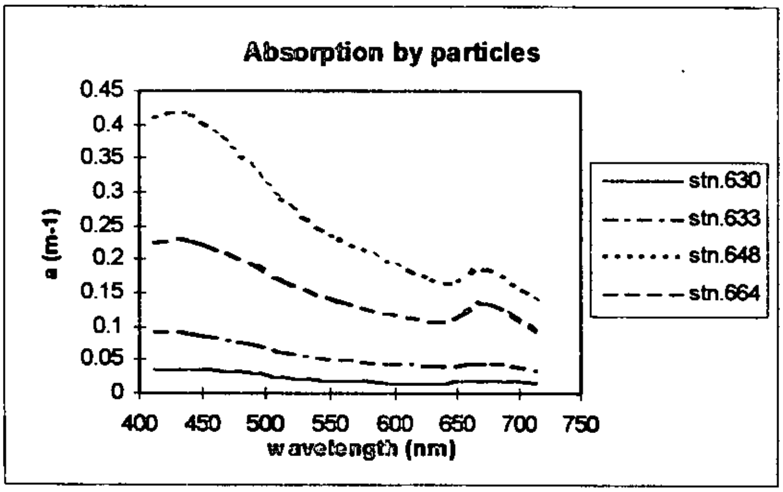

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3.5 FRRF & UOR

Dave Suggett & Jim Aiken, PML & SOC

Fast Repetition Rate Fluorometry:
Fast Repetition Rate (FRR) Fluorometry is an active fluorescence technique, which measures the in vivo fluorescence of chlorophyll (red, 683mm) resulting from a stimulating light source (blue, 450-460mm). FRR fluorometry has evolved from Pump and Probe Fluorometry (both have the same fluorescence-photosynthesis relationships). Both techniques produce an increase and eventual saturation of [PSII] fluorescence yield, via a cumulative closure of reaction centres, as higher light intensities are applied by successive flashes. FRR fluorometry provides about 100 short spaced sub-saturating flashlets. The more efficient design of FRR fluorometry provides an improved signal to noise ratio giving better measurements in low chlorophyll waters.
The Fast Repetition Rate Fluorometer (FRRF) has 2 measurement chambers. One chamber is open to water under ambient light conditions and the other chamber is enclosed forming a 'dark cell'. This cell allows measurements of a dark-adapted sample for comparison. From the concurrent measurements from these 2 chambers, the physiological characteristics of algal cells can be determined. The parameters measured are: Fv/Fm, the photochemical quantum efficiency which is proportional to the maximal change in the quantum yield of fluorescence, $\Delta\phi_{max}$, σ_{PSII} the functional absorption cross section of PSII, τ the minimum turnover time for electron transport. An indirect estimate of production can be derived, based on a theoretical relationship between these parameters and rates of photosynthesis.

Two Chelsea Instruments FAST^{tracka} FRRFs were used on AMT 6, both operating with a flash sequence of 100 saturation flashes (100 1μs flashes each separated by 1μs interval) and 20 relaxation flashes (20 1μs flashes each separated by 50μs intervals) flashes at 200kHz rates.
Underway Flow Through Mode: FRRF #1 was set to acquire data under *discrete* mode. Data were logged by a PC. Water from the underway non-toxic supply and passed through the dark chamber using the standard dark cell or a blackened polycarbonate square vial. The polycarbonate cell had an offset, which needed a calibration factor, obtained by a simultaneous measurement using the 2 cell types, in-line. The windows and the cells were cleaned daily, to prevent fouling.

Periodically, FRRF #2 was attached to the underway flow through water supply for inter-calibration. In this mode, the polycarbonate and the standard dark cells were interchanged, to measure any residual effect of the 2 instruments and the 2 cell types. The measurement of dark-adapted algal samples using this flow through method, means that the ambient light, properties of algae cannot be observed. A range of important biophysical parameters can be derived.

Data acquisition in this underway mode was programmed for 1 data point every 16 flash sequences (=16 flash sequences per acquisition) and recorded in the internal flashcard memory. This was equivalent to a sampling rate of 1 record every 40s. This rate was the lowest possible and was chosen to minimise the noise level and the file size. The gain of the instrument photomultiplier was set manually, and adjusted daily, depending on the chlorophyll concentration for the previous day.

Files were downloaded once per day to the PC. The files were kept small (1.3 MB) to allow easy transfer between machines. All underway files were logged throughout the cruise as UNDWYxx.bin files (see FRRF data acquisition log appendix A6-12). The FRRF's internal clock was set to GMT.

The files were processed through a programme supplied by Z.S. Kolber. This programme provides the biophysical parameters of the algal samples from on the fluorescence measurements taken from the instrument. These are: Fo, background fluorescence; Fm, maximum fluorescence yield; Fv, variable fluorescence yield equated to biomass, Fv/Fm, σ_{PSII}, τ).

CTD Profiling: FRRF #2 was set to acquire data in a remote (*Autoacquire*) mode. The FRRF and appropriate battery pack were attached to the CTD rig and switched on immediately prior to the CTD deployment. Data acquisition in underway mode was 4 flash sequences per acquisition (= 1 data point stored/chamber/10s). For the downcast, data was logged corresponding to a depth average depending on the speed of descent. The upcast was stopped for 2 minutes at chosen depths to improve the signal to noise ratio. A PAR sensor was attached to the FRRF. Additionally, PAR data (for each depth) was taken from the CTD mounted PAR sensor.

The FRRF data were downloaded and processed as above. All CTD files were logged throughout the cruise as CTDPxx.bin files (see FRRF data acquisition log Appendix A6-12). The optical windows and dark cells were cleaned daily to remove any build up of fouling material. Gain was changed manually according to the measurements from the previous day FRRF or Turner fluorometer. The battery voltage was checked daily and changed and recharged as appropriate.

Fig. 17a and b show examples of profile data. Fig. 17a is taken from the Northern Equatorial region (16.22.7 N 20.00.3 W) whilst Fig. 17b is from more oligotrophic waters in the CANIGO region (36.36.9 N 17.30.3 W). Both figures include Fv (fluorescence biomass) and Fv/Fm (Quantum efficiency which is a measure of the 'health' of the algae) for both the dark adapted phytoplankton (D) and phytoplankton under ambient light (L). The scales are the same for both. The oligotrophic region shows a lower (value) deeper maxima of fluorescence and a higher (value) deeper Fv/Fm, compared to that observed in the Northern Equatorial region.

Undulating Oceanographic Recorder (UOR) Tows

The UOR measured the vertical section of the water column (5 to 60 m) whilst towed at the ship's passage speed 11 to 11.5 knots (20km/h). For AMT-6, the UOR carried a FRRF, temperature and salinity sensors, Satlantic downwelling irradiance (OCI-200, S/N 001) and upwelling radiance (OCR-200, S/N 001) sensors. The logger recorded data at a rate of once per 2 seconds from the sensors. The internal logger clock was set to ship's clock GMT and was checked (and readjusted when necessary) daily at time of data download.

This depth range (5 to 60m) captured the fluorescence maxima values for the majority of areas encountered. The UOR was towed from early morning into the main station, between stations or from the afternoon station to early evening, through a wide range of hydrographic areas producing 75 h of tow data. An inventory of the tows for the cruise is given in Appendix A6-13.

The FRRF #2 was programmed to collect data in an identical manner to CTD profiling, although the importance of logging data collected from a section of depth becomes more pronounced under the UOR mode. The number of sequences per acquisition were not changed (reduced so less averaging within a band of depth) to maintain an adequate signal to noise. All data were downloaded and logged as UORPxx.bin files (see FRRF data acquisition log Appendix A6-12).

The files were processed through a programme supplied by Z.S. Kolber. This programme provides the biophysical parameters of the algal samples from on the fluorescence measurements taken from the instrument. These are: Fo, background fluorescence; Fm, maximum fluorescence yield; Fv, variable fluorescence yield equated to biomass, Fv/Fm, σ_{PSII}, τ).

CTD Profiling: FRRF #2 was set to acquire data in a remote (*Autoacquire*) mode. The FRRF and appropriate battery pack were attached to the CTD rig and switched on immediately prior to the CTD deployment. Data acquisition in underway mode was 4 flash sequences per acquisition (= 1 data point stored/chamber/10s). For the downcast, data was logged corresponding to a depth average depending on the speed of descent. The upcast was stopped for 2 minutes at chosen depths to improve the signal to noise ratio. A PAR sensor was attached to the FRRF. Additionally, PAR data (for each depth) was taken from the CTD mounted PAR sensor.

The FRRF data were downloaded and processed as above. All CTD files were logged throughout the cruise as CTDPxx.bin files (see FRRF data acquisition log Appendix A6-12). The optical windows and dark cells were cleaned daily to remove any build up of fouling material. Gain was changed manually according to the measurements from the previous day FRRF or Turner fluorometer. The battery voltage was checked daily and changed and recharged as appropriate.

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3.5 FRRF & UOR

Dave Suggett & Jim Aiken, PML & SOC

Fast Repetition Rate Fluorometry:
Fast Repetition Rate (FRR) Fluorometry is an active fluorescence technique, which measures the in vivo fluorescence of chlorophyll (red, 683mm) resulting from a stimulating light source (blue, 450-460mm). FRR fluorometry has evolved from Pump and Probe Fluorometry (both have the same fluorescence-photosynthesis relationships). Both techniques produce an increase and eventual saturation of [PSII] fluorescence yield, via a cumulative closure of reaction centres, as higher light intensities are applied by successive flashes. FRR fluorometry provides about 100 short spaced sub-saturating flashlets. The more efficient design of FRR fluorometry provides an improved signal to noise ratio giving better measurements in low chlorophyll waters.
The Fast Repetition Rate Fluorometer (FRRF) has 2 measurement chambers. One chamber is open to water under ambient light conditions and the other chamber is enclosed forming a 'dark cell'. This cell allows measurements of a dark-adapted sample for comparison. From the concurrent measurements from these 2 chambers, the physiological characteristics of algal cells can be determined. The parameters measured are: Fv/Fm, the photochemical quantum efficiency which is proportional to the maximal change in the quantum yield of fluorescence, $\Delta\phi_{max}$, σ_{PSII} the functional absorption cross section of PSII, τ the minimum turnover time for electron transport. An indirect estimate of production can be derived, based on a theoretical relationship between these parameters and rates of photosynthesis.

Two Chelsea Instruments FAST^{tracka} FRRFs were used on AMT 6, both operating with a flash sequence of 100 saturation flashes (100 1µs flashes each separated by 1µs interval) and 20 relaxation flashes (20 1µs flashes each separated by 50µs intervals) flashes at 200kHz rates.
Underway Flow Through Mode: FRRF #1 was set to acquire data under *discrete* mode. Data were logged by a PC. Water from the underway non-toxic supply and passed through the dark chamber using the standard dark cell or a blackened polycarbonate square vial. The polycarbonate cell had an offset, which needed a calibration factor, obtained by a simultaneous measurement using the 2 cell types, in-line. The windows and the cells were cleaned daily, to prevent fouling.

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Files were downloaded once per day to the PC. The files were kept small (1.3 MB) to allow easy transfer between machines. All underway files were logged throughout the cruise as UNDWYxx.bin files (see FRRF data acquisition log appendix A6-12). The FRRF's internal clock was set to GMT.

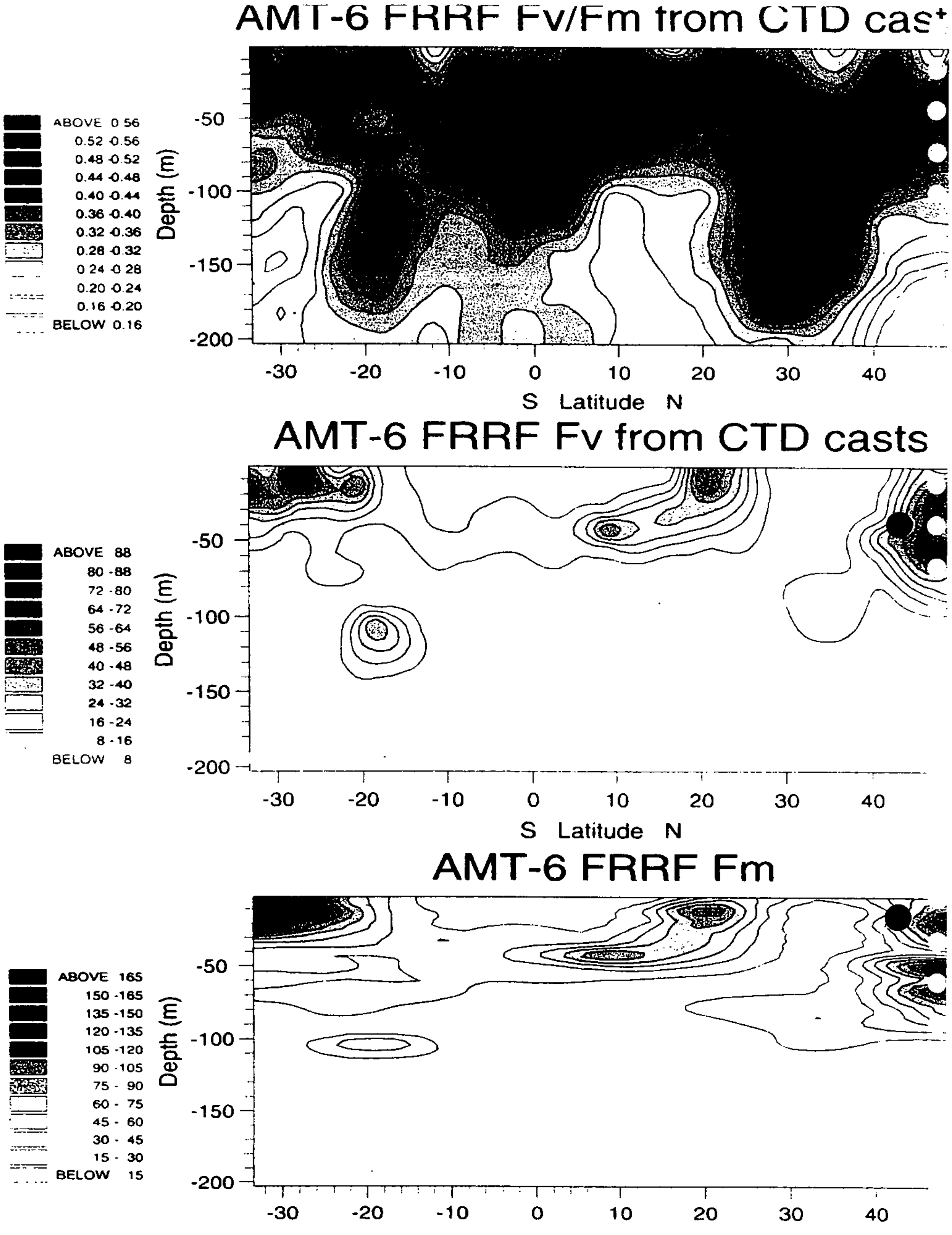


Fig. 18. Vertical section of Fv, Fm, & Fv/Fm from CTD casts from 35 S to 50 N.

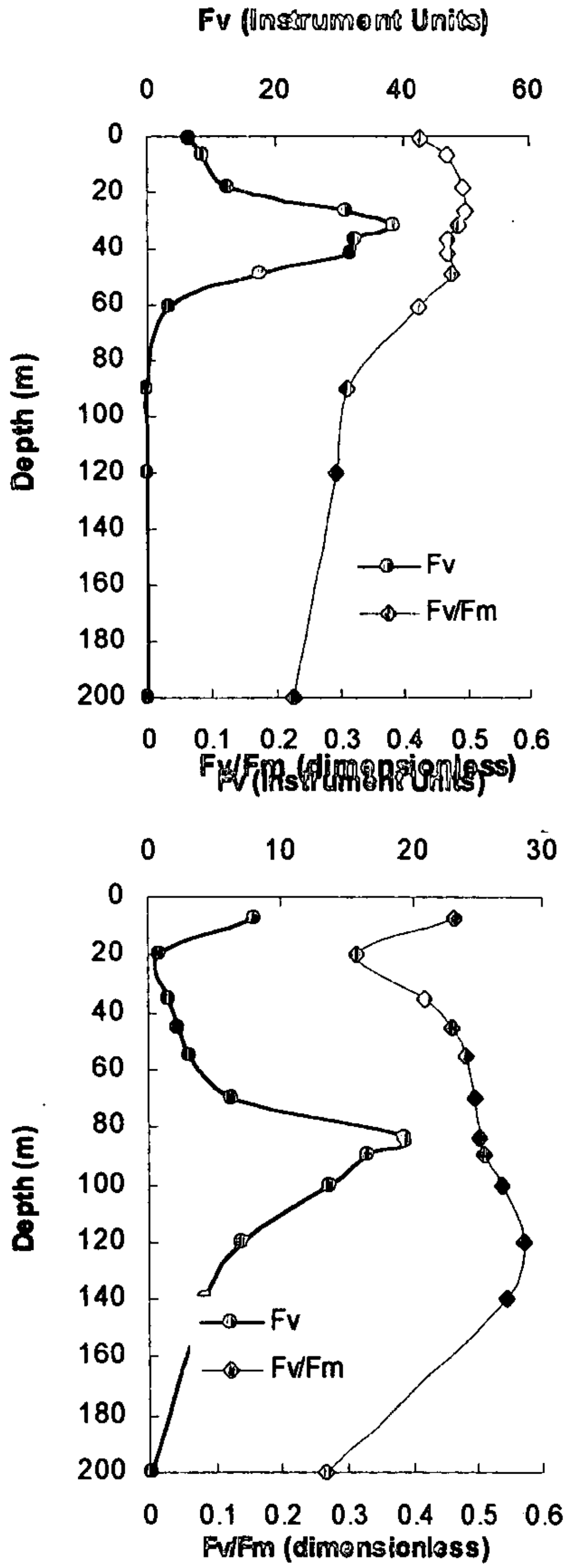


Fig. 17 Vertical profiles of FRRF Fv & Fv/Fm for: a) N Equatorial Region; b) CANIGO

3.6 Water sampling for pigments, phytoplankton and bacteria.

Patrick Holligan, University of Southampton.

Water samples were collected on stations (up to 10 depths between surface and 200 m) and along track (non-toxic supply from ~7 m at approximately 2 h intervals) and filtered for chlorophyll *a* and pigment determinations by fluorescence and HPLC respectively. The chlorophyll *a* measurements were made using the method of Welschmeyer (1994) and gave values that were consistent with but higher than those determined by HPLC. Surface values were in the range >30 mg m^{-3} (Benguela upwelling) to ~0.03 mg m^{-3} (N Atlantic subtropical gyre).
The Chlorophyll and HPLC pigment sampling log (underway & station) is given in Appendix A6-14.

Samples were collected for identification and enumeration of phytoplankton by the following methods:

1. Flow cytometry (fixed in glutaraldehyde, stored at – 80 C) for eukaryotic flagellates, cyanobacteria and heterotrophic bacteria to be analysed by Dr. M. Zubkov (PML)

2. Light microscopy (fixed in Lugols iodine and buffered formalin)
a) Surface fine townet at each daily station, for large cells and colonial forms
b) Surface (7 m) and sub-surface fluorescence maximum depths at each daily station.

3. Additional samples were taken between the daily stations in the upwelling regions where surface fluorescence (chlorophyll) maxima were observed.

During the course of the cruise fresh material from the tow nets was examined. Observations relevant to synoptic optical and biogeochemical measurements included:

1. Dense patches of Ceratium spp in the S. Benguela giving surface chlorophyll *a* values >30 mg m^{-3}.

2. Extensive populations of the very large (cells >250 μm in diameter) diatom Coscinodiscus wailsei in the mid-Benguela region in both surface and deeper waters. Apparently healthy cells were relatively abundant in the anoxic bottom water off Walvis Bay.

3. Trichodesmium/Oscillatoria widespread but not abundant in the eastern tropical S. Atlantic.

4. Exceptionally dense populations of Synechococcus and a small (10 μm) Nitzschia species off N. W. Africa.

5. Blooms of Phaeocystia and Emiliania huxleyi off N.W. European shelf.

3.8 Phytoplankton Pigment Distributions

Ray Barlow, Sea Fisheries Research Institute, Cape Town, RSA.

Objectives

1. Provide accurate pigment data for the calibration and validation of SeaWiFS ocean colour images and the development of SeaWiFS remote sensing algorithms.

2. Investigate the distribution of chlorophyll and carotenoid biomarker pigments along the AMT track to determine the basin scale variations in phytoplankton biomass and community structure.

Methods

Underway surface sampling was conducted every 2 hours from the non-toxic sea water supply and 0.5-4 litres was filtered through 25 mm GFF filters. For vertical profiling, samples were taken from up to 9 depths down to 200 m. Pigment samples were stored at -80°C until analysis by HPLC which was conducted on all underway and station samples on board the James Clark Ross. Pigments were extracted in acetone using ultrasonication, and centrifugation to remove debris, and analysed using the method of Barlow *et al* (*Mar Ecol Prog Ser*, 161, 303-307, 1997) on a Shimadzu HPLC coupled to a Thermo Separations Products autosampler and a UV6000 diode array absorbance detector. Chlorophyll and carotenoid standards were obtained from Sigma Chemical Co, UK, VKI Water Quality Institute, Denmark and Mike Ondrusek, University of Hawaii.

Preliminary results

524 samples were analysed for a range of 15 chlorophylls and carotenoids. Daily main optics stations were processed on board. Concentrations of chlorophyll *a* for underway and station samples are given in Appendix A6-14.

AMT-6 provided a unique opportunity to study a wide variety of water masses and different phytoplankton populations. Some of the data from 4 sections of the underway surface transect are presented as an example of the variations encountered in the Benguela and NW African upwelling regions. High, patchy, chlorophyll *a* concentrations of up to 18.9 $mg.m^{-3}$ were recorded in the southern Benguela between 32 S and 29 S and the accessory pigment data indicated that dinoflagellates (Peridinin - Per) accounted for most of this high biomass (Fig. 19a & b). In the mid-Benguela (28.5 S-25 S), chlorophyll *a* levels ranged from 1 to 4.5 mg m^{-3} with diatoms (Fucoxanthin - Fuc) being the dominant phytoplankton group, although microflagellates in the form of prymnesiophytes (Hexanoyloxyfucoxanthin - Hex) were also significant (Fig. 19c & d).

Similar surface chlorophyll *a* concentrations (1to 4.5 mg m^{-3}) were observed between 22 and 20 S in the N. Benguela with a mixed community of diatoms (Fucoxanthin - Fuc) and microflagellates (Hexanoyloxyfucoxanthin - Hex) accounting for most of the chlorophyll at 22 S to 21 S. Diatoms (Fucoxanthin - Fuc) were the dominant phytoplankton group at 21 to 20 S (Fig. 20a & b). In the NW African Upwelling, chlorophyll *a* ranged from 0.5-4 $mg.m^{-3}$ with diatoms generally being the most prominent group from 15 N to 20 N (Fig. 20c & d). Microflagellates (Hexanoyloxyfucoxanthin - Hex) were also important. At the frontal boundary at 21-21.5 N, chlorophyll *a* concentrations declined markedly to 0.1 mg m^{-3} and the prokaryote organisms *Synechococcus* and *Prochlorococcus* (Zeaxanthin - Zea; Divinyl chlorophyll – DVChla *a*) dominated the community (Fig.21).

Fig. 19 a. Surface Chl a – S Benguela; 19 b. Accessory Pigments; 19 c. Surface Chl a – Mid Benguela; 19 d. Accessory Pigments.

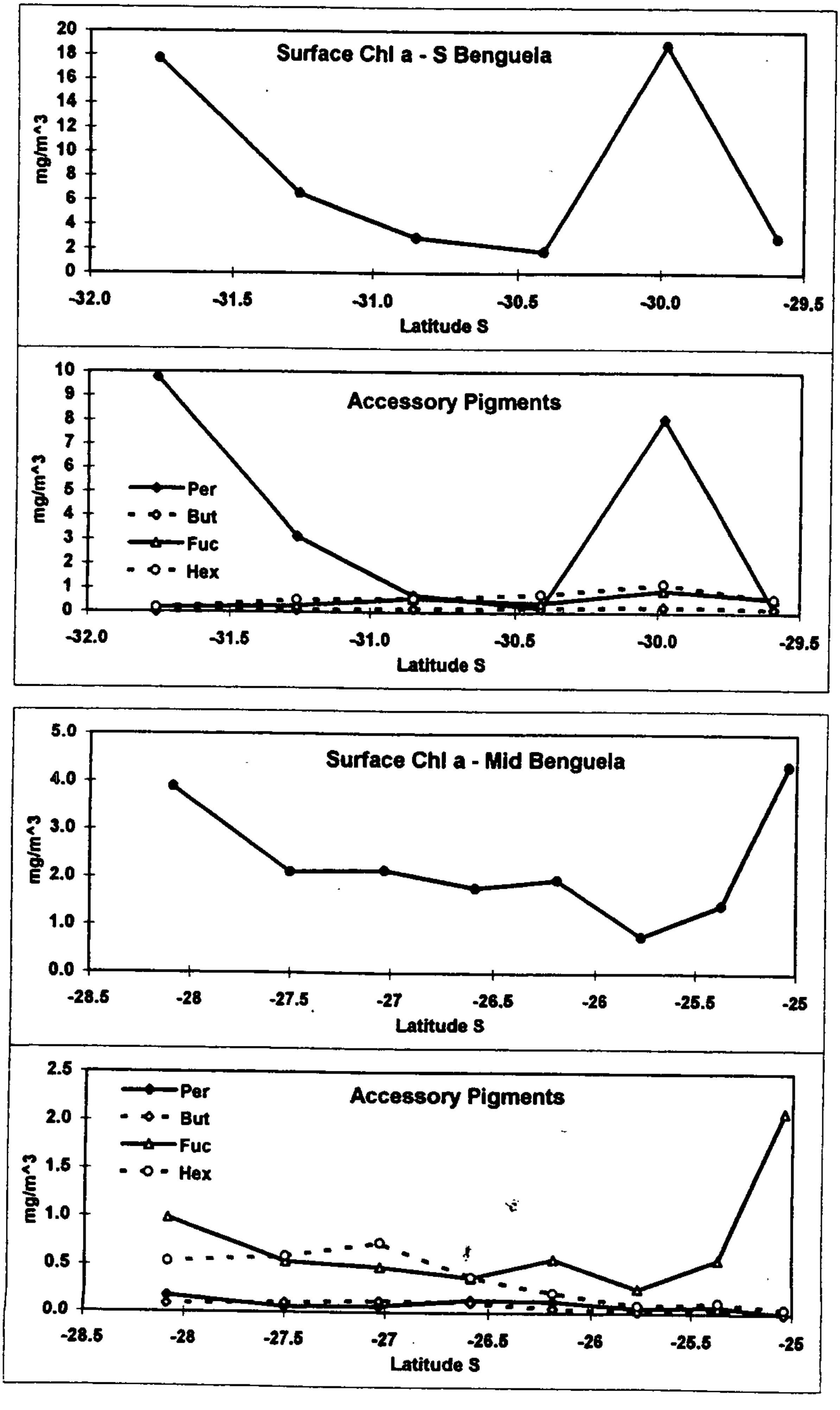
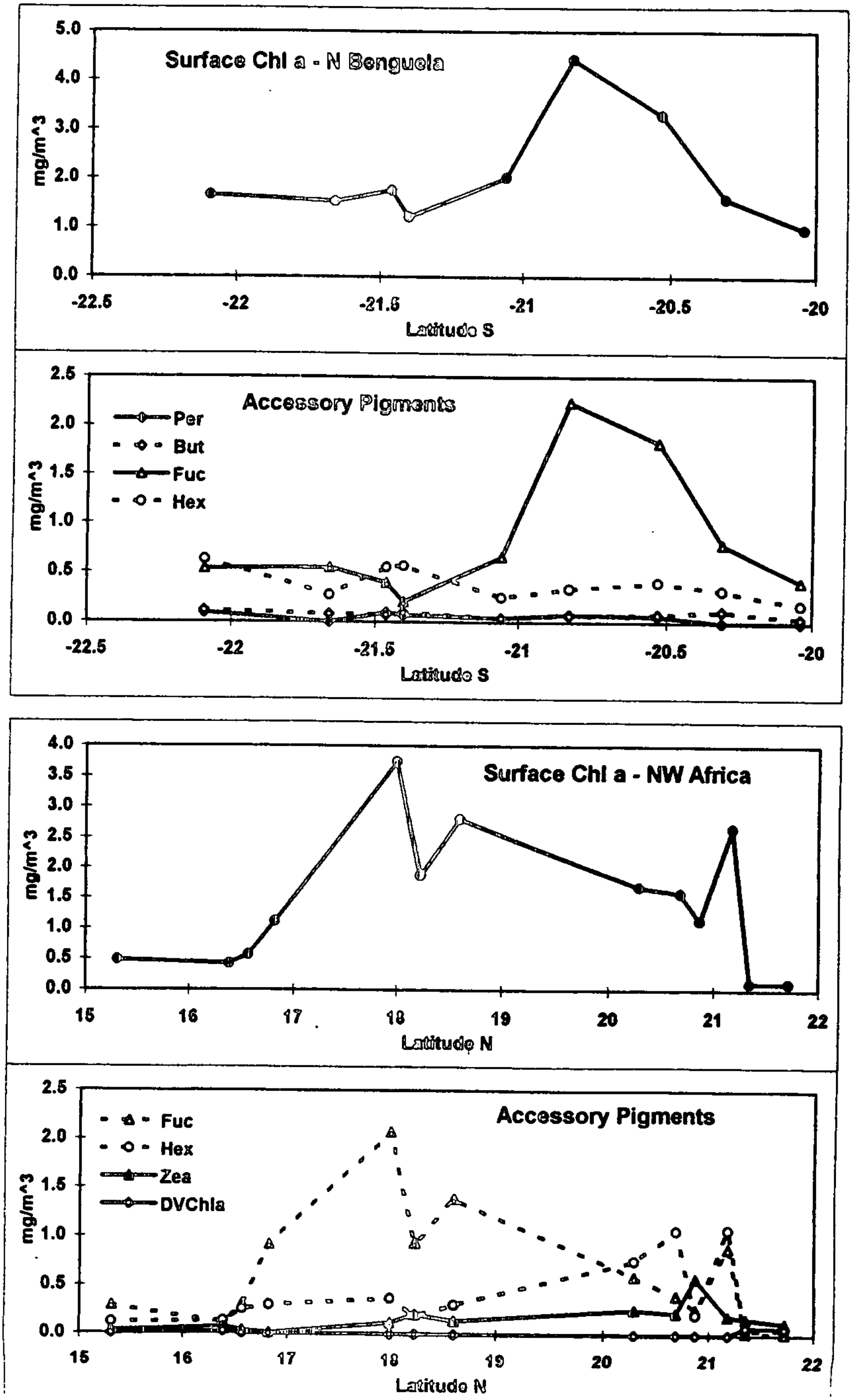


Fig. 20 a. Surface Chl a – N. Benguela; 20 b. Accessory Pigments; 20 c. Surface Chl a – NW Africa; 20 d. Accessory Pigments.



3.8 Photosynthesis parameters and primary production of pico, nano and net-phytoplankton.

Gavin Tilstone and Eva Teira, University of Vigo, Spain

Introduction

The study of phytoplankton photosynthesis is fundamental to understanding the global carbon cycle and to characterising factors that lead to high primary production in the ocean. Phytoplankton photosynthesis has been studied extensively on regional and local scales but less work has been done on the global scale. The Atlantic Meridional Transect using the twice yearly cruise track of RRS James Clark Ross between the Falkland Islands and the United Kingdom (in this case Cape Town and the United Kingdom), provides an opportunity to study basin scale photosynthesis and primary productivity in a number of contrasting biogeochemical regions. The data generated are used to enhance our understanding of phytoplankton photosynthesis and carbon fixation over broad latitudinal scales and to aid the calibration of remotely sensed observations.

Research Objectives

1. The primary objective of this research is to compare spatial and temporal variation of phytoplankton photosynthesis and primary productivity in a range of oligotrophic and eutrophic ecosystems from 35°S to 50°N.

2. To determine primary productivity in the pico (0.2 to 2μ), nano (2 to 20μ) and net-phytoplankton (>20μ) size levels at contrasting longitudinal zones along the AMT6.

3. To correlate phytoplankton photosynthesis parameters derived from photosynthesis - irradiance (P-E) experiments with physical, biological and chemical parameters over broad spatial scales. P-E data will be used to validate FRRF data collected on this cruise.

4. To determine phytoplankton light absorption in different regions along the AMT-6 and to compare primary production values calculated using the photosynthetic action spectrum of phytoplankton against those derived from non - spectral specific measurements.

5. It has been suggested that carbon excreted by phytoplankton can be as much as 40 % of that fixed during photosynthesis. Extracellular release has been identified as an important source of carbon for bacteria. Excreted carbon was determined at stations in the oligotrophic Canaries and Azores region and in upwelling regions to compare carbon excretion by phytoplankton in oligotrophic and eutrophic environments.

6. To study the latitudinal variability in composition and biomass of microzooplankton assemblages, and the potential relationship of these parameters with phytoplankton and environmental variables.

Methodology

Samples were collected between 8:00 and 9:00 GMT each day. The downwelling CTD cast was used to determine irradiance and chlorophyll fluorescence through the water column using the Seabird 911 plus. Between five and eight depths were selected, for a detailed analysis of the water column based on percentage irradiance levels and fluoresence levels.

Fractionated chlorophyll a :

Fractionated chlorophyll a (Chla) was determined at 26 stations along AMT-6. Between 200 & 300 ml of sea water sample from each depth in the water column were sequentially filtered through 0.2, 2 & 20μm polycarbonate filters. Chla was extracted from the filters in 90 % acetone at -20°C for 12 to 24 hrs. The samples were measured on a Turner 10-AU fluorometer calibrated with pure Chla.

Fractionated primary production:
Primary production derived from 6 h incubations was determined at 24 stations and from 24 h incubations at 6 stations. Four discrete samples (3 replicates and 1 dark bottle) were taken from each depth in 75 ml polycarbonate bottles and were inoculated with 5 or 10μ Ci $NaH^{14}CO_3$. The samples were incubated for 6 to 7 h in on-deck cylindrical chambers covered with blue filters to simulate light levels in the water column. The incubators were maintained at sea surface temperature using pumped surface seawater. The samples were filtered through 0.2, 2 & 20μm polycarbonate filters, fumed with acid for 12 h to remove inorganic ^{14}C and suspended in 3.5 ml scintillation liquid. DPMs were counted on a Beckman LS600 Sc scintillation counter using internal quenched-corrected curves. The counting error was 7 %. Counting efficiency was checked every 7 days.
Photosynthesis - Irradiance (P-E) curves:
P-E experiments were conducted at 3 depths in the water column at 23 stations. Fifteen 75 ml sub-samples (14 samples plus one dark bottle) were inoculated with 5 or 10μ Ci $NaH^{14}CO_3$. The samples were illuminated by 100 W tungsten halogen lamp in linear incubators calibrated to give an irradiance range of between 2200 and 5 $\mu E\ m^{-2}\ s^{-1}$. The incubators were maintained at sea surface temperature using the ships non- toxic supply. After 2.5 to 3.5 h, the samples were filtered onto GF/Fs, exposed to HCL acid fumes for 12 h and counted on the scintillation counter as per primary production.

Determination of excreted carbon by phytoplankton:
Dissolved organic carbon, DOC, was determined at 5 stations in the CANIGO region and at 3 stations in the upwelling region. At each station, four sub-samples were taken at 3 depths in 30ml pyrex bottles. Between 30 and 70μ Ci of $NaH^{14}CO_3$ was added and the samples incubated on deck for 2 h at irradiance levels similar to those found in the water column. 10 ml was filtered onto GF/F glass microfibre filters and the residue acidified with HCl to pH 2.0. The samples were bubbled for 24 h to remove inorganic ^{14}C. 14 ml of scintillation liquid was added and DPM's determined on the Beckman LS600 Sc scintillation counter.

Measurement of Total Organic Carbon, TOC.
Samples were collected at 5 stations for the determination of Total Organic Carbon (TOC) in the CANIGO region. Three seawater samples were collected directly from Niskin bottles in 10ml ampoules containing 50μl of phosphoric acid. The ampoules were heat-sealed and preserved in the dark at 4°C. The samples will be analysed by the novel High Temperature Catalytic Oxidation (HTCO) technique, at the Instituto de Investigaciones Marinas (IIM), Vigo, Spain.

Dissolved and particulate organic phosphorus - DOP & POP:
Samples for the measurement of *DOP & POP* were taken from 15 stations. One litre of water was from 5 to 7 depths and filtered through GF/Fs. The residue was collected and frozen in polyethylene bottles. The filter was dried for 12 h using silica gel and stored in aluminium soil. DOP & POP will be determined at IIM.

Light absorption by phytoplankton:
Sub-samples were taken at P-E experimental depths from 16 stations. Between 500 and 2000 ml of sea water was filtered onto GF/F filters which were then frozen at -80 °C. Light absorption by

phytoplankton will be measured on a 600 BU Beckman spectrophotometer at IIM.

Zooplankton samples :
Zooplankton samples were collected for Ignacio Huskin and Mario Quevedo of the Universidad de Oviedo, Oviedo, Spain.

Copepods gut contents
Copepod ingestion rates will be obtained using the gut fluorescence method.
At each station, one WP2 plankton net (200 μm) was deployed to 200 m. The sample was immediately screened to obtain three different size fractions (200-500, 500-1000 and >1000μm). Sub-samples of each fraction were filtered onto paper filters and frozen for further determination of gut contents in each fraction. The gut contents will be measured after extraction in acetone (90%) for 24h, using a Turner Fluorometer before and after acidification.

Microzooplankton composition and biomass
Microzooplankton samples were taken from Niskin bottles at 23 stations. Three depths were sampled; surface, Chl-a maximum and 1% PAR. To obtain estimates of microzooplankton biomass, 500 ml water samples were fixed in 4% (f.c.) pre-added acid Lugol solution and stored at 4°C for subsequent analysis using Uthermol sedimentation technique, an inverted microscope and a video-image analysis system.

Results
A total of 28 stations were sampled in an AMT transect that encompassed four different upwelling systems, three oligotrophic regions and one coastal shelf break environment.

Fractionated chlorophyll a :
516 size fractionated chlorophyll measurements were made. The highest chlorophyll values (>5.2 μg/l) were found in the Southern Benguela (Fig. 21a) where the chla max. resided in the upper 20m. of the water column. The 0.2 - 2 and 2 - 20 μm fractions constituted 98 % of the total (Figs 21d & c). In the Northern Benguela and NW African upwelling system the >20 μm were the most abundant fraction (Fig. 21b). The lowest values (<0.05 μg/l) were found in the CANIGO region where the maximum was found at >80 m and the 0.2 - 2 μm (Fig 21d) comprised 80 % of the total.

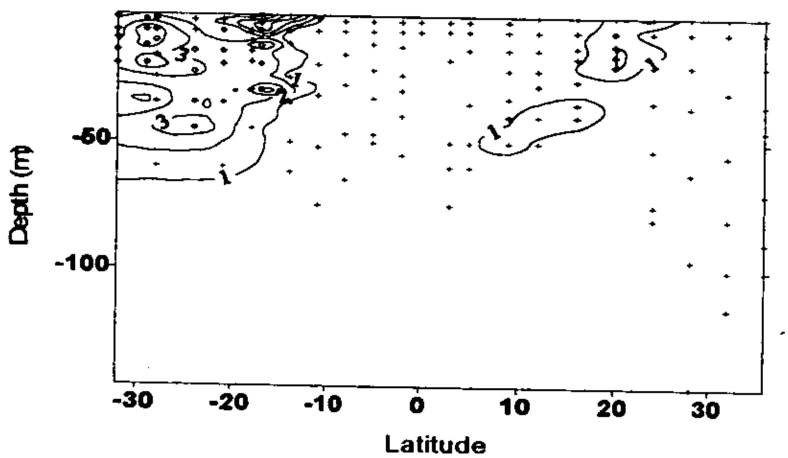


Fig. 21 Chlorophyll-a distributions determined with primary production measurements for AMT-6: a) Total Chla.

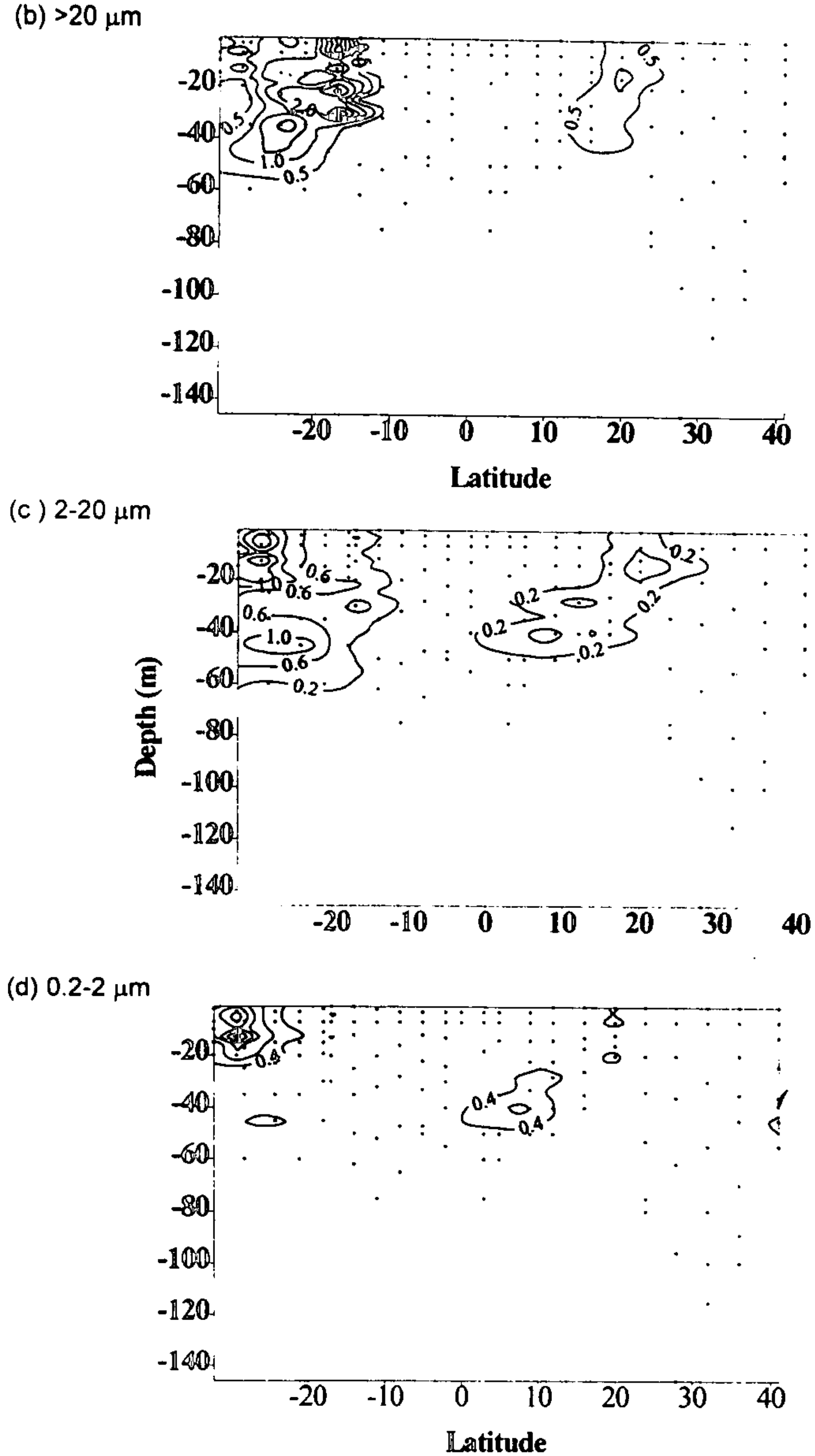


Fig. 21 Chlorophyll-a distributions determined with primary production measurements: b) >20μm fraction; c) 2-20 μm fraction; d) 0.2-2 μm fraction.

Primary production:

1812 primary production measurements using 6 hr incubations were made at 24 stations. 47 P-E measurements were made at 19 of the stations. In addition, 11 P-E parameters were measured in one offshore and one alongshore transect in the Benguela upwelling system to compare FRRF derived photosynthetic parmeters with those derived from radiocarbon measurements.

The highest integrated primary production values (Fig. 22) were measured in the Northern Benguela upwelling system (3340 $mgCm^{-2}day^{-1}$) where *Coscinodiscus* spp. dominated the water column and the >20µm constituted 87 % of primary productivity. In the North West African upwelling system values of upto 3270 mg C m^{-2} day^{-1} were recorded of which 44% was due to the >20µm fraction and 33% to the 0.2 to 2µm fraction.

INT PP ($mgC\ m^{-2}\ d^{-1}$)	S BEN	N BEN	GOG EQ UP	N EQ	NW UP
Total range	428 - 1084	833 - 3360	47 - 395	395 - 420	819 - 3270
Total mean	756	1445	228	408	2045
>20µm range	64 - 140	370 - 2953	9 - 30	28 - 84	425 - 1446
mean	102	987	53	56	936
2-20µm range	222 - 654	146 - 296	11 - 65	128 - 131	166 - 737
mean	438	262	40	129	451
0.2-2µm range	66 - 366	94 - 291	26 - 252	209 - 235	227 - 1088
mean	216	180	133	222	658

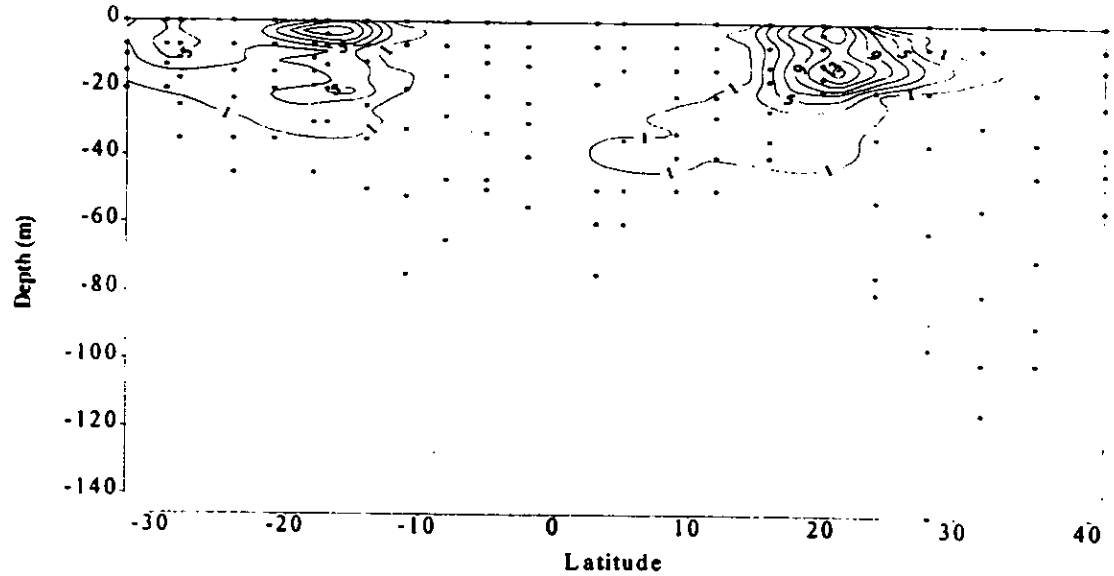


Fig 22. Total primary production (mg C m^{-3} h^{-1}) along AMT-6 track from 32 S to 40 N.

The lowest values were found in the Gulf of Guinea equatorial (47 mg C m^{-2} day^{-1}) and Canaries - Azores regions where the 0.2 to 2 µm fraction contributed 75 % of the total productivity.

There were initial sampling difficulties from 15 to 23 May due to the miss fire of three Niskin bottles at incorrect depths. Two CTD casts were therefore undertaken at each station to collect surface water and then water down to 200m. The problem was resolved on 10 June and sampling continued using one cast.

3.9 Gross Production (GP), Net Community Production (NCP) And Dark Community Respiration (DCR)

Carol Robinson & Pablo Serret Ituarte, Plymouth Marine Laboratory

Objectives

1. To determine the depth and spatial distribution of dissolved oxygen and dissolved inorganic carbon (DIC) concentration

2. To determine the depth and spatial distribution of respiration within and below the euphotic zone and relate this to plankton community structure, particulate organic carbon concentration and nitrogen remineralisation processes

3. To determine the depth and spatial distribution of the balance of gross production and respiration

4. To determine the magnitude and variability of the photosynthetic and respiratory quotients of the plankton community

Methods

Measurements of dissolved oxygen were made with an automated Winkler titration system based on that described in WILLIAMS and JENKINSON (1982), DIC was measured by coulometric titration (ROBINSON and WILLIAMS, 1991; DOE, 1994). Analysis of seawater DIC reference materials throughout the cruise provided quality assessment of the precision and accuracy of the DIC measurements. Oxygen saturation was calculated using the equations for the solubility of oxygen in seawater of BENSON and KRAUSE (1984).

Gross production (GP), net community production (NCP) and dark community respiration (DCR) were determined from *in vitro* changes in dissolved oxygen and DIC. Water was collected each day from depths equivalent to 97%, 33%, and 1% of surface irradiance plus three depths below the euphotic zone and incubated in 60 ml and 125 ml glass bottles in surface water cooled deck incubators or temperature controlled water baths at *in situ* temperature for 24 hours. Five replicate bottles were incubated in the light; five in the dark and five fixed for determination of zero time concentrations. Water was collected from the same CTD casts as that analysed for phytoplankton assimilation of ^{14}C and ^{15}N, and determination of total particulate organic carbon.

Production and respiration rates are calculated from the difference between the means of the replicate light and dark incubated and zero time analyses, and are reported with an associated standard error. The usual standard error associated with a rate determined from a change in dissolved oxygen is 0.2-0.5 mmol $O_2m^{-3}d^{-1}$, and from a change in DIC is 0.5-2 mmol $Cm^{-3}d^{-1}$. Photosynthetic quotients were calculated as GP[O_2]/GP[DIC] and respiratory quotients as DCR[DIC]/DCR[O_2].

Time series measurements of community respiration (DCR[O_2] and DCR[DIC]) were made in conjunction with measurements of nitrate, nitrite and ammonia flux and plankton nitrate and ammonia assimilation, ammonium regeneration and nitrification rates.

Water samples were filtered (47 mm GFC) for later determination of plankton electron transport activity (ETS). The ETS method estimates the maximum activity of the enzymes associated with the respiratory electron transport systems of both eukaryotic and prokaryotic organisms and has a sensitivity of < 0.05 mmol $O_2m^{-3}d^{-1}$. ETS analyses will be carried out according to the KENNER and AHMED (1975) modification of the tetrazolium reduction technique proposed by PACKARD (1971), as described in PACKARD and WILLIAMS (1981).

Preliminary Results

Oxygen, DIC and Respiration samples collected are listed in appendix A6-15.
The depth and latitudinal distribution of the percentage of oxygen saturation, based on preliminary results, is shown in Figure 23. Oxygen saturation distinguishes the different provinces studied and exhibits a spatial pattern related to the temperature distribution. Both the Benguela and NW Africa upwelling regions are characterised by strong vertical oxygen gradients, with high values of oxygen saturation (>105%) near the surface and very low saturation in the subsurface upwelled waters. Some stations in the N Benguela and south of the NW Africa upwelling have extremely low levels of oxygen saturation (< 30%) in subsurface waters. The equatorial upwelling can also be traced by the tilting of the oxyclines towards the surface. In the frontal region between the N Benguela and the Guinea Basin very low oxygen concentrations were measured throughout the water column; this was the only region where oxygen saturation was < 100 % at the surface, and values < 30 % saturation were observed below 60-70 m depth. In both oligotrophic regions sampled (Guinea Basin, and north Atlantic gyre) oxygen supersaturation was measured in the surface mixed layer. While relatively strong vertical oxygen gradients were observed in the Guinea Basin (with <50% saturation below the thermocline), north of ca. 25°N a marked increase in deep oxygen concentration was observed. Near the Ushant front oxygen saturation > 110 % was measured to a depth of 30m.

The high spatial heterogeneity in chlorophyll and plankton community structure observed along the cruise track is highlighted in the range of measured gross production. Surface water gross community oxygen production spans at least two orders of magnitude from 0.5 mmol $O_2m^{-3}d^{-1}$ in the north Atlantic oligotrophic gyre (8 June 1998) to 50 mmol $O_2m^{-3}d^{-1}$ in the northern Benguela upwelling (25 May 1998). Preliminary comparisons confirmed that GP[O_2] corresponded to chlorophyll concentration and ^{14}C assimilation in magnitude and variability.

Dark community respiration was always measurable from the surface to the 1% light depth, and often detectable with the oxygen technique at 200m (0.2-1.0 mmol $O_2m^{-3}d^{-1}$). A respiration maximum was seen below the chlorophyll peak often; this should be better described by the finer scale vertical sampling of ETS samples. Surface community respiration rates varied from 1 mmol O_2 m^{-3} d^{-1} in the north Atlantic gyre to 7 mmol $O_2m^{-3}d^{-1}$ in the NW Africa upwelling region.

Net community production is a direct measurement of the balance between plankton autotrophic and heterotrophic processes. NCP became negative (i.e. the magnitude of plankton respiration was greater than that of photosynthesis) at depths shallower than the 1% light level in the upwelled waters of the northern and southern Benguela and the NW Africa upwelling. NCP was negative throughout the water column at all oligotrophic stations sampled off the Gulf of Guinea and in the north Atlantic gyre. This predominance of respiration supports the recent contentious suggestion of the dominance of heterotrophic processes in the world's oceans (DEL GIORGIO, 1997) and requires careful investigation. Surprisingly NCP was even negative in the sub-surface chlorophyll maxima of the equatorial region (12 - 16°N).

Time course experiments confirmed the linearity of oxygen consumption during the dark community respiration incubations. Concomitant fluxes of DIC and nitrogen nutrients await data analysis.

Preliminary calculations of photosynthetic and respiratory quotients from the Benguela upwelling stations conform to the stochiometry of organic metabolism (i.e. 1.03<PQ>1.4 and 0.97<RQ>0.667) unlike those measured in the coastal upwelling of the Arabian Sea (ROBINSON, C and WILLIAMS, P.J.leB. 1998).

All dissolved oxygen, dissolved inorganic carbon and production and respiration data will be available by August 1998. Particulate organic carbon and ETS analyses will be available by November 1998.

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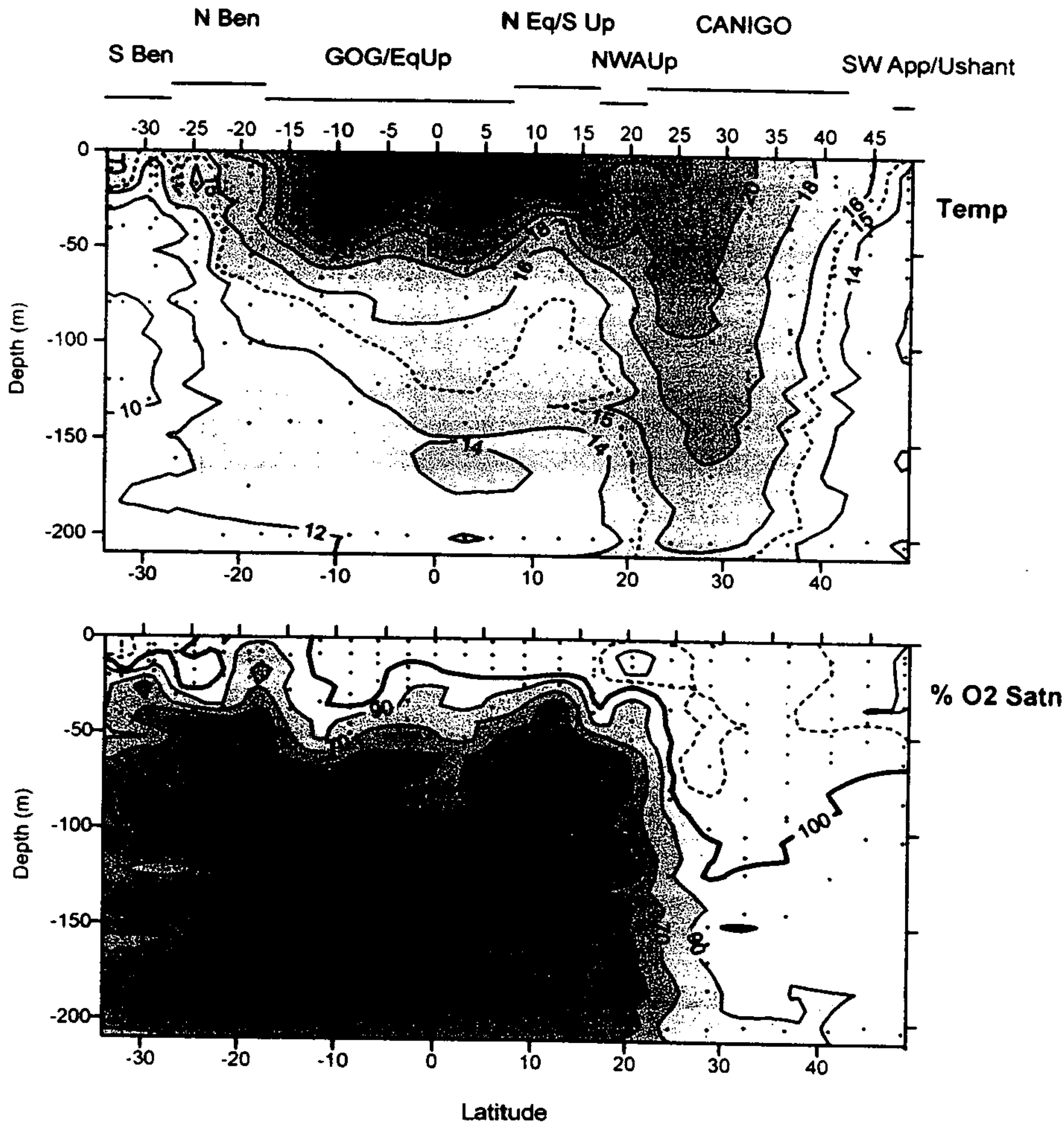
Fig. 23. Spatial distribution of temperature (upper panel) and percentage of oxygen saturation (lower panel) from 35 S to 50 N.



3.10 Basin Scale Estimates of the Planktonic Assimilation and Regeneration of Nitrogen

Andrew Rees, *Plymouth Marine Laboratory*

Rationale

Refinements to the ^{15}N methodology made at PML in combination with nanomolar nutrient analysis have improved the confidence in the technique, so that estimates of new and regenerated production can be made routinely in oligotrophic zones (Joint et al., 1996; Rees et al., in press). The importance of new production in biogeochemical studies is well documented, however its extrapolation to basin scale estimates has previously been restricted to a small number of ship derived determinations. Following Sathyendranath et al (1991) we have, in collaboration with the Remote Sensing Data Analysis Service (RSDAS) combined AVHRR temperature data with ship based analyses to provide temporal and spatial estimates of new production which were unattainable previously (Rees, 1997; Joint et al, in press)

We will continue this work using the AMT to provide estimates of new production for areas of the eastern Atlantic covered by the transect.

Recent measurements of euphotic zone nitrification rates suggest that a substantial fraction of assimilated nitrate is regenerated and not new and hence previous estimates of global new production may be over-estimated. To this end, experiments were conducted to test this hypothesis for a number of marine provinces in the North and South Atlantic Ocean.

Aims

1. To determine the magnitude and variability of ammonium regeneration and nitrification rates and thereby assess the scale of error on estimates of new production.
2. To couple nitrogen regeneration estimates with those made for carbon.
3. To perform uptake experiments to determine the kinetic parameters of nitrate and ammonium assimilation rate at nanomolar concentrations.

Methodology

Nitrate and Ammonium uptake – New Production

Assimilation rates for nitrate and ammonium were determined following the incorporation of the stable isotope ^{15}N. Triplicate samples of water from each depth were distributed into 620 ml clear polycarbonate bottles and $^{15}N\text{-}NO_3$ and $^{15}N\text{-}NH_4$ were added at a final concentration of 10% ambient nitrate or ammonium concentration. Incubations were made in an on-deck incubator maintained at surface seawater temperature. This consisted of a series of tanks with spectrally corrected light screens, which permitted transmission of ambient irradiance in the range 97 – 1%. Incubations were performed for both 24 hours and for shorter time periods of approximately 4 hours to determine mean daily and linear uptake rates respectively. Incubations were then terminated by filtration (< 40 cm Hg vacuum) onto ashed Whatman GF/F filters, which were dried on board and stored over silica gel dessicant until return to the laboratory. These will be analysed by continuous flow nitrogen analysis-mass spectrometry.

Ammonium regeneration

Following inoculation with $^{15}N\text{-}NH_4$ and 24 hour incubation as described above, the filtrate from a number of samples from the base of the euphotic zone were stored in ashed, acid cleaned pyrex bottles with mercuric chloride. Ammonium regeneration will be estimated according to an isotope dilution technique following the extraction of dissolved ammonium in the laboratory.

^{15}N uptake kinetics

In oligotrophic waters, a series of experiments were performed to allow examination of the uptake rate kinetics of nitrate and ammonium. $^{15}N-NO_3$ and $^{15}N-NH_4$ were added at concentrations ranging from 5 – 120 nM to 620 ml samples, which were then incubated for <4 hours in the on-deck incubator. Incubations were terminated by filtration onto GF/F filters and dried prior to analysis in the laboratory.

Nitrification

The bacterial oxidation of ammonium to nitrite and nitrate was estimated by three methods from a number of depths throughout the water column.

(i) The first involved the incorporation of ^{14}C in the dark with and without the prescence of a nitrification inhibitor – allylthiourea (ATU). 6 x 150 ml polycarbonate bottles were filled from a number of depths, 5.0 µCi of ^{14}C bicarbonate was added to each, and to three of the bottles ATU was added to a final concentration of 10 mgl^{-1}. Incubations were in the dark at ambient temperature for approximately 6 hours and were terminated by filtration onto 0.2 µm polycarbonate filters, which were then stored over silica gel dessicant prior to analysis by liquid scintillation counter in the laboratory

(ii) In parallel to the ^{14}C/ATU experiments, the second estimate of nitrification involved the determination of the relative change (ΔDIN) in the concentrations of dissolved nitrate, nitrite and ammonium. A number of samples were collected and incubated under the same conditions without the ^{14}C/ATU additions, with nutrient analysis being made at time of collection and after 24 hours.

(iii) On the samples collected for determination of ammonium regeneration, following extraction of dissolved ammonium, the samples will be further treated with Devarda's alloy to allow extraction of dissolved nitrate, and following isotopic ratio analysis of $^{15}N/^{14}N$ an estimate will be made of ammonium oxidation based on the isotope dilution theory.

Results

Samples for New Production, Ammonium regeneration, 15N Uptake and Nitrification are listed in appendix A6-16.

No data are available at the moment. Analysis of samples by continuous-flow mass spectrometry and liquid scintillation counting will be complete in the order of 4 months after cruise completion.

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3.11 Size-fractionated phytoplankton production based on 15N and 13C dual-labelling tracers.

MIKE LUCAS, UNIVERSITY OF CAPE TOWN & SOUTHAMPTON OCEANOGRAPHIC CENTRE.

INTRODUCTION

The major focus of AMT-6 was to provide, for the first time, optical and biological *in situ* validation of SeaWiFS ocean colour imagery concurrent with SeaWiFS over-passes. The upwelling systems of the southern and northern Benguela, west Africa and the equatorial Atlantic, as well as the oligotrophic sub-tropical Atlantic gyres, provided an extensive range of optical and biological gradients to test both Case I and II algorithms. The extreme spatial and temporal heterogeneity of the high chlorophyll southern Benguela system, evident from the SST and SeaWiFS imagery, contrasts strongly with the homogeneous but low chlorophyll subtropical systems we passed through. This creates problems of scaling up, particularly with respect to daily (24 h) primary productivity measurements within the heterogeneous upwelling systems. Furthermore, it was clear from the received satellite imagery that within the high biomass regions, the SeaWiFS imagery was saturated above ~30µg Chl. L^{-1} and that the 555 band frequently demonstrated high reflectance regions, usually associated with smaller phytoplankton cells and the different species to be found further offshore in the upwelling regions. This relates to the age of the upwelled water and the well-defined species succession that occurs with a shift from "new" to "regenerated" production as initial NO^3 concentrations are reduced. Marked contrasts in the underwater optical depth perceived by SeaWiFS (~33% PAR) add to this scenario where species succession with depth was also observed, governed by light and nutrient availability. There is clearly, therefore, a great deal of complexity involved to resolve the progression from satellite derived ocean colour to phytoplankton biomass and primary production over sensible time and space scales.

Within the context of biogeochemical cycles for carbon and nitrogen, phytoplankton biomass and photosynthesis provide the basis for transporting fixed carbon into the deep ocean by the processes of direct sedimentation of cells and through particle transformation into rapidly sinking fecal pellets as a result mesozooplankton grazing on larger (>20µm) net-phytoplankton cells. This is the "biological pump". The rate at which phytoplankton cells and other particles sink are to some extent size-dependent although physiological fitness considerably influences buoyancy and sedimentation rates. Nevertheless, it is useful to consider phytoplankton biomass and production on a size basis; splitting them into net-plankton (>20µm), nano-plankton (2-20µm) and pico-plankton (<2µm). Small nano- and pico-plankton are not readily consumed by large zooplankton so they enter the micro-zooplankton food web characterised by little sedimentation but considerable regeneration of NH^4 urea and dissolved free amino acids, which is preferred and assimilated rapidly by phytoplankton.

Nitrate assimilation relative to total N assimilation by phytoplankton using ^{15}N tracers provides a useful index, the f-ratio, which indicates what proportion of phytoplankton growth is dependent upon NO^3 assimilation - i.e. "new" net production. Under long term equilibrium conditions, the f-ratio provides a measure of export production available to consumers or for sedimentation and therefore provides a valuable tool for indirectly estimating vertical carbon flux. However, it is becoming apparent that Redfield stochiometry for C:N uptake can no longer be unequivocally taken as 6.6:1 so that dual-labeled tracer studies become an essential component of ^{15}N tracer work if carbon fluxes are to be inferred. Furthermore, size-fractionated ^{15}N tracer studies can provide considerable insight into the structure and functioning of planktonic communities which has implications for planktonic trophodynamics and carbon flux. Size-based production ought also to relate to shifts from strong absorbance to strong refelectance observed in the SeaWiFS imagery.

The dual-labeling and size-fractionated tracer experiments on surface waters carried out on this cruise were undertaken to provide a size-based measure of primary production and nitrogen partitioning designed to complement ^{15}N work and ^{14}C productivity measurements.

Methods

Nitrogen and carbon uptake measurements

Size-fractionated ^{15}N & ^{13}C uptake experiments were carried out on surface communities at each of the daily CTD "production" stations and for a number of "optics" stations. Water was incubated in the simulated *in situ* on deck incubator tubes covered with neutral density filters to give the appropriate light. The incubator bottles were cooled by surface seawater pumped through the tubes. For each nutrient (NO_3, NH_4, urea), 6.0L of sample was measured into a 6.0L polycarbonate bottle and inoculated with ^{15}N label. Bottles (6.0L and 2.0L) were supplemented separately with $Na^{15}NO_3$ (98 atom%), CO $(^{15}NH_2)_2$ (99.1 atom%) and $^{15}NH_4Cl$ (98 atom%) to a final concentration of ~10% of the ambient nutrient concentration. To measure C:N uptake ratios and carbon fixation as a measure of primary production, $NaH^{13}CO_3$ was added to the nitrate bottle (to 5% of the ambient DIC concentration). A dark $^{15}NO_3$ and ^{13}C experiment was also carried out to correct for respiration and dark ^{15}N uptake.

At the end of the 24 h incubation period, the spiked samples for each nutrient (NO_3 & ^{13}C, NH_4, urea) were fractionated into an intact community (2.0L), a <20 µm fraction (2.0L passed through a 20 µm mesh) and a <2 µm fraction (2.0L passed through a 2.0 µm Nuclepore filter). Each separate fraction was filtered onto pre-ashed (450°C for 6 hours) Whatman 47mm GF/F filters which were frozen at -80°C for later determination of particulate ^{15}N and ^{13}C enrichment by mass spectrometry.

Nitrate and urea uptake rates will be calculated according to Dugdale and Goering (1967). Ammonium uptake rates are similarly calculated but corrected for isotopic dilution due to ^{15}N excretion (Glibert *et al.* 1982). A relative preference index (RPI) will be calculated for each nutrient assimilated (McCarthy *et al.* 1977).

Nutrients

Ambient nitrate and ammonium concentrations were determined daily by Malcolm Woodward using a Technicon TA II Autoanalyser. Samples for urea determinations were frozen and subsequently analysed using the methods of Grasshoff *et al.* (1983) scaled down to 5 ml samples (Probyn 1987).

Chlorophyll determinations

At each station for every depth and for all underway samples, chlorophyll concentrations were determined. Samples corresponding to the ^{15}N & ^{13}C uptake experiments were size-fractionated into "total", <20 µm and <2.0 µm fractions. All samples were filtered onto 25 mm Whatman GF/F filters. Pigment was extracted overnight in a -20°C freezer in 90% acetone and measured by a Fluorometer calibrated with pure chlorophyll-*a* (Sigma).

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3.12 Micro and Nano Nutrients

Malcolm Woodward, Plymouth Marine Laboratory

Objectives:
To study the spatial and temporal variations of the micro nutrients Nitrate, Nitrite, Phosphate, Silicate and Ammonia, through differing oceanic regions along the cruise track. Where ambient concentrations were below the detection limits of the colorimetric systems, a nanomolar Ammonia analysis system, and a nanomolar chemiluminescence analysis system for detection of Nitrate and Nitrite were deployed.

Methodology:
Nutrients were measured with a 5 channel Technicon AAII, segmented flow autoanalyser. The chemical methodologies used were:
Nitrate, (Brewer and Riley, 1965); Nitrite, (Grasshoff, 1976); Phosphate (Kirkwood, 1989); Silicate (Kirkwood, 1989), and Ammonia (Mantoura and Woodward, 1983).
Nanomolar Nitrate and Nitrite detection methodology was from Garside (1982), and the nanomolar Ammonia system adapted from Jones, 1991.
Water samples were taken from the 30 litre CTD/Rosette system (SeaBird) and sub-sampled into clean Nalgene bottles. Analysis of the nutrient samples was completed within 3 hours of sampling in every case. Clean handling techniques were employed to avoid any contamination of the samples, particularly by ammonia. No samples were stored. The list of CTD samples analysed for nutrients are given in appendix A6-17.
Underway continuous surface sampling was from the non-toxic water system. The water flow was in-line filtered (Morris *et al*, 1978), by a 0.45um Millipore filter, before analysis for the macro nutrients. For the underway ammonia nanomolar system the Millipore filter was removed and the water was only coarse filtered through a stainless steel mesh. The results for CTD and underway samples from the same approximate depth of 7 metres then agreed. Underway sampling was carried out where possible for the nanomolar ammonia system, and where necessary. Where concentrations exceeded 1 microgram, the 5 channel Technicon analyser was used for the other nutrients. The inventory of Underway Nutrient analysis is given in Appendix A6-18.
All CTD samples were analysed successfully with a negligible sample loss. One CTD section was lost due to poisoning of the Copper/Cadmium Nitrate reducing column by anoxic bottom water samples on one day of the Benguela study.
As usual the Technicon system showed its reliability and reproducibility in the extreme environment of marine research.
The nanomolar nitrate/nitrite chemiluminescent system worked as well as could be expected, although this system was at the limits of its detection for many mixed layer samples from the oligotrophic stations, and the present detector is of insufficient sensitivity to show fine scale changes and variations at less than 10 nanomoles.
The ammonia system performed well following an extensive pre-cruise rebuild, and again it will have produced unique ammonia concentration data from these parts of the world's oceans.

CTD Samples Analysed. The maximum sampling depth was 200 metres for the CTD samples, and was the bottom depth for all CTDs where possible, there was one deep CTD (to 1500m) in the north of the Canigo region, off the Iberian peninsula.

Preliminary Results

Little analysis of the data was carried out on-board, but will be given high priority on return to PML. Details for the nitrate profiles along the transect are presented in preliminary form.
The Southern Benguela region of the coast of Africa had surface nitrate concentrations in the region of 10-13 µmoles./l In the northern Benguela these concentrations were somewhat less in magnitude at 5-8 µmoles/l. There was a very sharp front, shown both by the nutrient profiles, and also the temperature and chlorophyll records. The front was identified in position from SeaWiFS and Ocean temperature satellite images. Offshore of the Benguela and north-west towards the equator, in the oligotrophic region, the nitrate concentrations were 10-20 nanomoles/l. In the equatorial upwelling, these concentrations increased to 30-50 nanomole.

There was a marked nutrient enhancement due to the West African upwelling off the coasts of Mauritania and Senegal, extending out from the coast to the 20^{0}W line. The concentrations here ranged between 0.1 and 3 µmoles/l. To the north of the upwelling there was an area of extreme nutrient depletion, and a truly oligotrophic environment. In the surface waters down to the depth of the thermocline, the nitrate concentrations were less than 5 nanomoles/l, and on many occasions less than the detection limit (3 nanomoles) of the NOx chemiluminescent analyser. On crossing the shelf break entering the Western Approaches, the concentrations increased to 1-2 µmoles/l to the south of Plymouth, and to over 4µmoles/l east of the front off Start Point.

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3.13 Total Dissolvable Iron (TD-Fe) Analyses

Andrew Bowie, Plymouth Marine Laboratory and University of Plymouth

Background

Iron is a major component of the Earth's crust, but like other reactive trace elements, dissolved Fe levels in open-oceanic waters remain very low (<1 nM). The marine biogeochemistry of iron is complicated by its redox speciation, low solubility, and involvement in biological cycles. Improvements to the understanding of the Fe redox cycle are required and chemical nature of iron associated with various operationally defined parameters (e.g., labile, dissolved, colloidal, organically bound, particulate) needs further clarification.

The major sources of iron to the world's oceans are atmospheric, fluvial, hydrothermal, continental shelf regeneration and upwelling of Fe-enriched subsurface waters. In remote areas, the ocean receives the majority of surface water iron from atmospheric dusts, and the true impact of suspended aerosols on trace element levels can only be made by direct measurements. Iron removal in surface waters is thought to be dominated by biological processes. Iron is an essential chemical element for micro-organisms and in HNLC areas of the world's oceans appears to limit phytoplankton growth, which may have important implications for global carbon cycles. The ongoing debate about the effect of iron limitation on phytoplankton communities has highlighted how little is actually known about the marine speciation of iron and its uptake mechanisms by biota.

Fe (III) is the thermodynamically stable form in oxygenated seawater, present predominantly as insoluble oxy-hydroxides or colloidal matter. Fe(II) is a transient species in surface oxic waters, existing via chemical or photochemical reduction or via atmospheric deposition and is oxidised rapidly by O_2 and H_2O_2 species at seawater pH. Recently, organic complexation has been thought to occur to a significant extent in marine systems. Laboratory studies have shown that phytoplankton are able to utilise only dissolved Fe^{2+} or Fe^{3+} species, uptake of the colloidal or particulate forms only possible via a thermal or photochemical dissolution pathway.

AMT-6 Objectives

1. To map underway Fe levels along the complete transect using FI-CL technology for sub-nanomolar determinations
2. To monitor the distribution of Fe in the upper water column through contrasting biogeochemical provinces via daily CTDs
3. To elucidate the Fe input mechanisms along the transect (e.g. atmospheric dusts, sedimentary regeneration, upwelling waters, riverine plumes) from sampling strategy outlined in 1 and 2 and through cross-correlation with hydrographic data and other AMT shipboard measurements (e.g. nutrients, chlorophyll)
4. To correlate Fe with other trace metal profiles (Al, Co, Ni, and Zn) via laboratory analyses on selective asset preserved sub-samples. Such determinations will be performed in a Class 100 clean air laboratory in Plymouth using spectrofluorimetric and cathodic stripping voltammetry techniques.
5. To focus specifically on the extent on Saharan fallout across the Atlantic and investigate the direct contribution of such atmospheric dusts on Fe levels (i.e. solubility, mobility, reactivity). Underway shipboard collection of dust aerosols (see section 2) will enable the dry flux of trace metals to the ocean to be evaluated.
6. To investigate any seasonality in N & S Atlantic Fe levels by comparison with AMT-3 survey.
7. To investigate any changes in the Fe redox content (FeII / FeIII ratio) of surface waters through (i) depths of varying irradiance through the euphotic zone, and (ii) contrasting ecosystems containing varied chlorophyll signatures and organic matter.

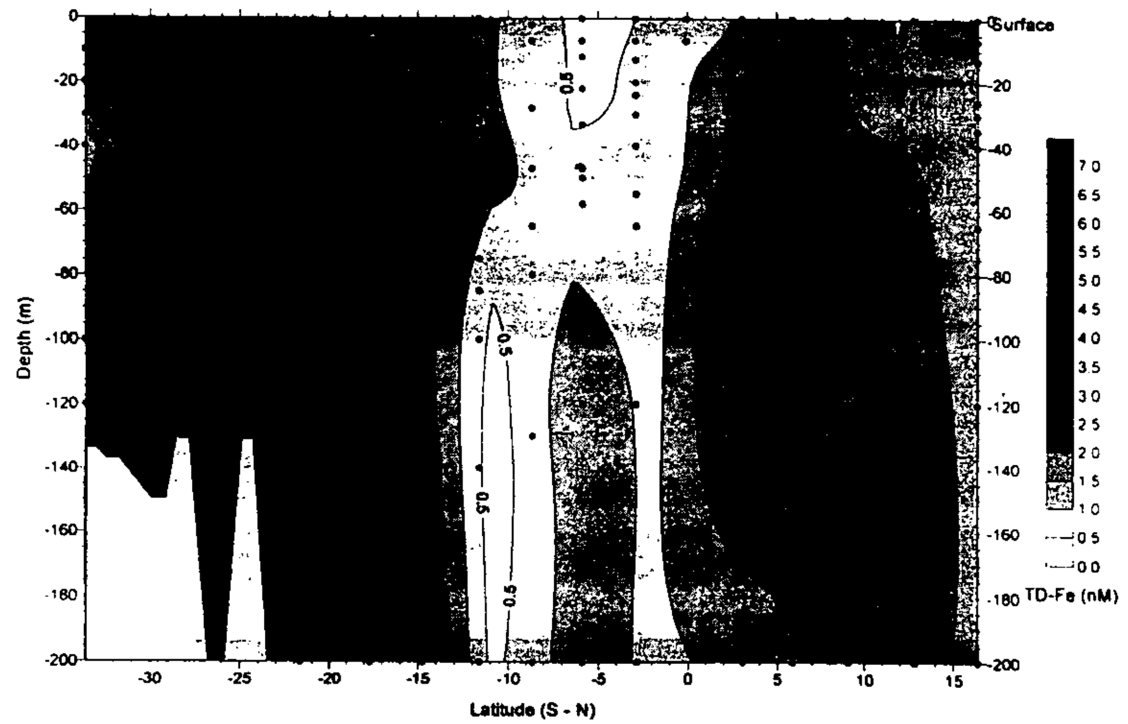
Analytical Methodology

Shipboard determinations were performed using a semi-automated flow injection chemiluminescence (FI-CL) analyser. The technique enables the rapid analysis of total dissolvable Fe(II+III) (TD-Fe) at the sub-nanomolar concentration level. The system is based on the oxidation of luminol, which is catalysed by Fe ions, emitting blue light. The iron is first reduced to Fe(II) and then extracted from its sea-salt matrix and preconcentrated in-line using a micro-column containing the 8-hydroxyquinoline resin. Elution may be performed with a weak acid prior to the detection of the light on mixing with the CL reagent stream. The method requires very little sample handling, the reaction is simple, throughput is high (a 3 min analytical cycle, seawater sample quantified within 25 min). The shipboard limit of detection is 40 pM, below Fe concentrations generally found in open-ocean studies. Unfiltered seawater samples were acidified to ca. pH 2 using 0.01M Q-HCl (quartz sub-boiled distilled) prior to analysis, reduced to the ferrous form using sodium sulfite (100 μM) and the Fe content determined by the method of standard additions. The analysis of unfiltered samples using the FI-CL method is likely to have resulted in the detection of an important fraction of colloidal, particulate and possibly cellular Fe, which dissolved during acidification. Asset preserved sub-samples were collected and stored for subsequent laboratory analysis of other trace metals delivered either via atmospheric deposition (e.g. Al, Pb) or through upwelling systems (e.g. Co, Zn). This will enable the Fe enrichments to be fingerprinted across the south-to-north transect.

Results

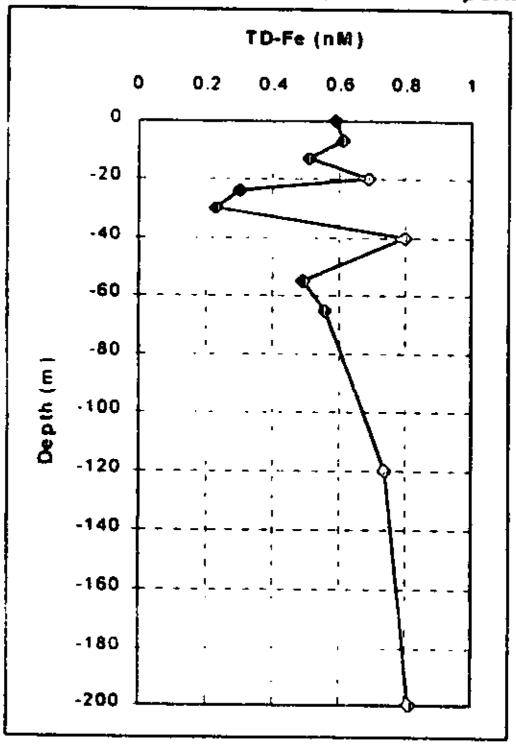
The FI-CL system performed without problem throughout the cruise period. The sampling logs are given in A6-19, A6-20. Surface water (-7m) TD-Fe levels ranged from 0.2 nM measured in the oligotrophic waters, up to levels of 3.3 nM found in the shelf waters of the Benguelan system.
Fig. 24. shows the latitudinal distribution of TD-Fe through the upper water column (0-200 m) in the S & N Atlantic (-35°S to 17°N). Fe enrichments can be seen through the south and north Benguelan upwelling systems due to the input of sub-surface Fe-rich waters. Levels decrease to ca. 0.8 nM in the oligotrophic South Atlantic gyre. Away from continental land masses and upwelling systems, enrichments in TD-Fe levels are dominated by aerosol inputs, particularly from the Saharan dust plume. TD-Fe increases through filaments of the NW African upwelling system are not shown.

Fig. 24. Latitudinal distribution though the upper water column along AMT-6



Wide variations in TD-Fe levels were found through the water column distributions of the Benguelan coastal waters TD-Fe concentrations as high as 16.2 nM were observed in these waters at the lower depth of the CTD cast, a distance of only 25 m above the shelf. Sedimentary regeneration of Fe was thought to be the dominant input mechanism in these samples, but it is also believed that high chlorophyll concentrations through the Benguela, and in particular certain large diatom species (e g cosinodiscus), contributed to large Fe enrichments via the release of cellular iron.

In addition to mapping TD-Fe levels through daily upper water column CTD casts (0-200m), redox speciation experiments were performed to determine FeII and FeII+III concentrations at pH 5.5, in addition to TD-Fe at pH 2.0. Early results indicate higher FeII / FeIII ratios near the surface, decreasing through the euphotic zone, but showing increases towards 200m. Higher FeII concentrations can be attributed to photo-reduction and / or release of FeII species via the breakdown of organic matter at depth. These preliminary measurements indicate that the Fe redox speciation is strongly linked to changes in irradiance and variability in chlorophyll concentrations / signatures through the upper water column, and it is clear that further experiments are necessary in this regard to clarify Fe redox cycling. Fig. 25a shows the distribution of TD-Fe through a typical upper water column (0-200m) of the South Atlantic gyre, whilst Fig. 25b. illustrates the variation in TD-Fe levels in a deeper CTD cast (0-1500m) in the eastern North Atlantic. Both figures are very similar, showing variation through the euphotic zone, but displaying small Fe increases at the chlorophyll maximum, possibly due to the release of cellular iron during sample acidification. TD-Fe levels below the euphotic zone are uniform and consistent throughout different water masses, validating the clean sampling and analytical protocols adopted. Deep water TD-Fe levels average 0.7nM, consistent with the literature data, and indicating that Fe profiles are maintained via a mechanism that reduces the scavenging rate of Fe below this concentration. Such a mechanism may be complexation by strong organic ligands, which have been measured in the Atlantic and Pacific at concentrations near 0.6nM; further experiments are needed to investigate these hypotheses.



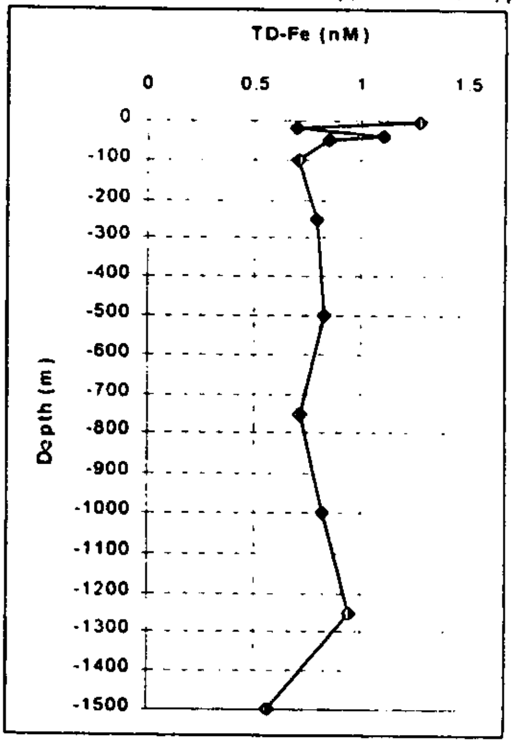


Fig. 25. (a) TD-Fe profile through the upper water column of the South Atlantic gyre (SDY 150, CTD A6-29 / A6-30, 02°48.7'S, 06°09.8'W); (b) TD-Fe distribution through a deep cast in the N. Atlantic (SDY 163, CTD A6-50, 44°40.8.N, 14°00.6'W)

Suspended Particulate Matter, Andrew Bowie, Plymouth Marine Lab. and University of Plymouth

The suspended particulate matter distribution along the transect was investigated via collection of UNCONTAM SW from underway samples and CTD bottles. Seawater (volumes ranged from 500ml to 5l) was filtered through pre-weighed 0.45µm cellulose nitrate (Whatman) membranes. The filters were flushed with UHP (Elgastat) water before storage in petri dishes in the refrigerator (ca. 4°C). The SPM concentrations will be calculated in the laboratory after drying and weighing of the filters. The SPM data will be used to evaluate the contribution of particulate matter to ambient trace metal levels, and distributions correlated with the dry aerosol flux into the eastern Atlantic Ocean.

High Volume Aerosol Sampling

Background

The aims of the sampling are:

1. To assess the concentration of trace metals (e.g. Fe, Al, Pb, Cd, Cu, Zn) in aerosols and hence the dry deposition flux into the eastern Atlantic Ocean
2. To attempt to understand the processes controlling the concentration of these metals.
3. To evaluate the trace metal aerosol solid state speciation and seawater solubilities in selected aerosol populations enabling the prediction of the atmospherically derived trace metals post depositional biogeochemical cycling.

Techniques

Aerosol samples were collected along the AMT-6 cruise track when the sampling was influenced by differing air masses, allowing atmospheric trace metal chemistries of different air masses to be evaluated. Sampling was continuous throughout the cruise period, except whilst on station, during rain events or when the filter head unit was susceptible to sea-spray or precipitation.

The sampling system consisted of: (i) a sampling head on which are attached the filter holder charged with a filter to collect material, (ii) a high volume pump (model Secomak 575), and (iii) a flowmeter.

Analytical Protocols

The filters (Whatman 41, diameter 125 mm) were thoroughly acid washed (10% HCl, 10% HNO_3) prior to use. On-board ship, filters were placed in the filter holders using clean techniques. The loaded filter holder was then transported in a polythene bag to the sampling unit, which was assembled on the "Monkey Island" of the RRS James Clark Ross, facing towards the bow of the ship. The holder was then attached and the pump started. The Aerosol sampling log is given in A6-21.

In order to collect an adequate quantity of aerosol material for chemical analysis, sampling was continuous for intervals of ca. 36h, after which the filter was changed. The flow rate at the start and end of the collection period was noted. When the ship was on station, or during rain, sea-spray or heavy precipitation, aerosol sampling was terminated, the pump was switched off and the filter head covered using a plastic bag. At the end of a sampling period, the filter holders were transported back to a clean area in the ship's laboratory, the filter removed, folded in half with the collection surfaces facing inwards and sealed within labelled clean plastic bags.
Subsequently, a laboratory total hydrofluoric acid digestion of the filters will be carried out within a class 100 laminar flow unit. Analysis for Fe, Al, Pb, Cd, Cu, Zn will be performed using ICP-MS.

3.14 Zooplankton Rachel Woodd-Walker, University of Plymouth

Aims

The objective of the cruise was to measure and characterise the zooplankton community along the AMT 6 transect. The zooplankton community structure was measured in terms of traditional taxonomic composition and size structure (fractionated carbon (JGOFS size classes), and OPC sized biovolume), for both daily stations and surface underway samples.

Method

At each morning station, a double WP2-200 µm was deployed to 200 m (or 100m if the water depth was less than 200m). One net was used for gut analysis, and the other was split in half using a folsum splitter for OPC biovolume and size fractionated CHN biomass estimation. A single WP2 - 200 µm was deployed to 20m, and used for OPC biovolume estimation. In addition, three night nets to 200 m were taken: two in the Southern Benguela and one in the CANIGO region. Each was treated as the day net, except total rather than size fractionated CHN samples were taken.

Biomass. The half 200 m net was stored at 4 °C until it could be processed (generally 1-2 h). The zooplankton were washed through 2000, 1000, 500 and 200 µm meshes to produce four size fractions: >2000, 1000-2000, 500-1000 and 200-500 µm (JGOFs size classes). These were made up to an appropriate volume using filtered sea water, usually 500 or 1000 ml depending on the density of zooplankton. Three replicate 50 ml aliquots were filtered onto three pre-ashed Whatman GF/C filters from each size fraction. The filters were placed in a 60 °C oven for 48 hours, before being encapsulated in pre-ashed aluminium foil and frozen for subsequent CHN analysis. The remaining portion of each fraction was preserved in 4 % borax buffered formalin for future taxonomic analysis.

OPC net sample. On station, the non-toxic sea water supply was switched off, and net samples processed. The OPC had a container of pre-screened sea water (130 µm) pumped through it at approximately 15 l min^{-1}. The water was recycled via a 130 µm mesh collection tube. The net sample was added slowly to the body of water and the file left to run until the counts returned to zero. The sample was retrieved from the collection tube, and preserved in 4 % borax buffered formalin. The system was rinsed with fresh water, before starting the non-toxic sea water supply. The files were downloaded, and processed into JGOF's size classes.

Underway sampling. A bench top OPC-l was run in underway mode from the non-toxic sea water supply continuously, apart from file changes at sunrise, sunset and on station when the net samples were processed and routine maintenance carried out. The OPC could not be used when the ship's speed exceeded approximately 13 knots and the probe was retracted due to bubbles in the system. Some data was therefore lost from day 140 and 141, recovering the track from Cape Town to Northern Benguela. To reduce problems with bubbles, a debubbler system was used proceeding the OPC. A flow rate of approximately 20 l min^{-1} was used through the OPC. The volume of water passing through the OPC was measured using a flowmeter, and recorded for each file. Latitude and longitude were logged directly from the ship's differential GPS to the OPC computer. Each day the files were downloaded, and processed to produce averaged biovolumes for the four JGOFS size classes, total biovolume, and mean equivalent spherical diameter (ESD).

"In line" samples were taken periodically for validation of the OPC counts and taxonomy; see

Mesozooplankton sample log A6-22. The samples were collected from the outflow of the OPC using a 200 μm mesh tube, and preserved in 4 % formalin. Occasional biomass (total carbon) samples were taken from these before preservation. The sample was made up to 50 or 1000 ml, and three replicated aliquots of 50 ml were filtered on to GF/C filters and treated as the net CHN samples.

Particulates. At each morning station, samples of particulates for CHN analyses were obtained from CTD water bottles at two different depths: surface (7m) and chlorophyll maximum, as determined by *in situ* fluorescence. Water samples from the two depths were filtered through 5 μm membrane filter, and a 200 μm gauze. The filtrate from each size fraction was filtered in triplicate onto pre-ashed Whatman GF/F filters to produce a series of replicate samples of the two size fractions (<2,<200μm). Filters were dried for 24 hours in the oven (60 °C) and then compacted in pre-ashed aluminium foil and frozen for subsequent CHN analysis. Particulates CHN analyses log A6-23.

Preliminary results

The biovolume showed huge variation both between the upwelling areas (North & South Benguela, Equatorial and North West African) and the gyres, and within these regions. This is seen in the net data (Fig. 26.) and the surface underway data (Fig. 27). The underway data also shows evidence suggesting an increase in biovolume at night, although the signal is partially masked by the high spatial variation. At night the underway data clearly shows the mean equivalent spherical diameter, a measure of zooplankton size, is higher at night than at other times of the day, suggesting that larger zooplankton are migrating towards the surface at night.

Fig. 26. OPC total biovolume for 20 m and 200 m nets.

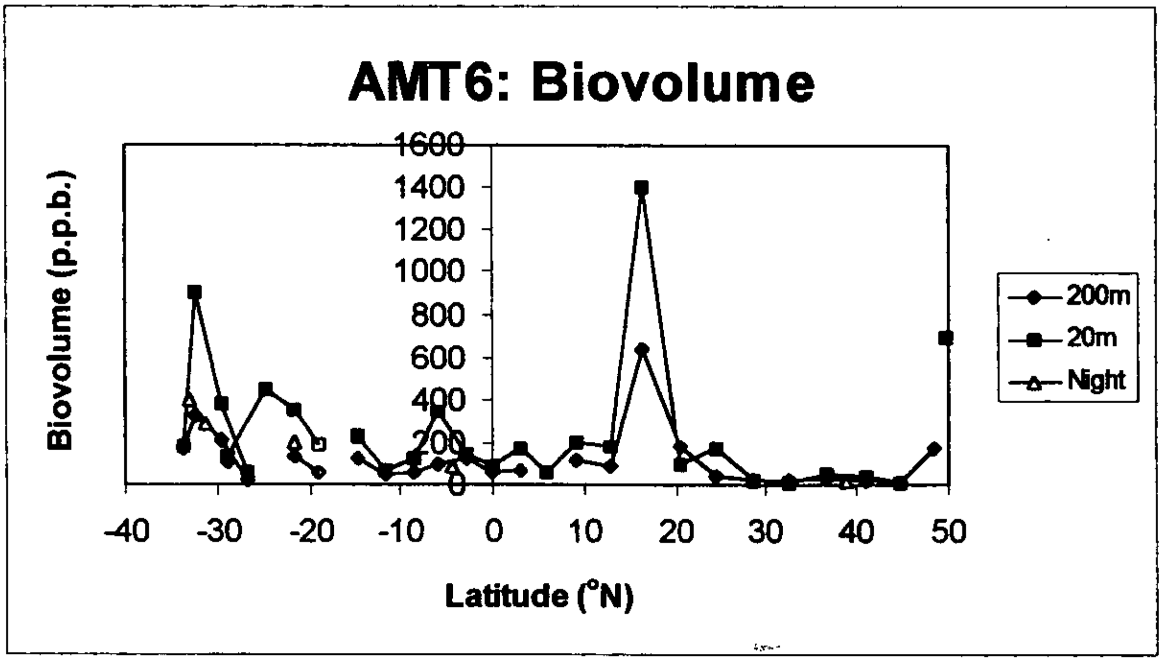


Fig. 27. OPC total biovolume for underway (7m non-toxic sea water supply), integrated over morning, afternoon and night time periods.

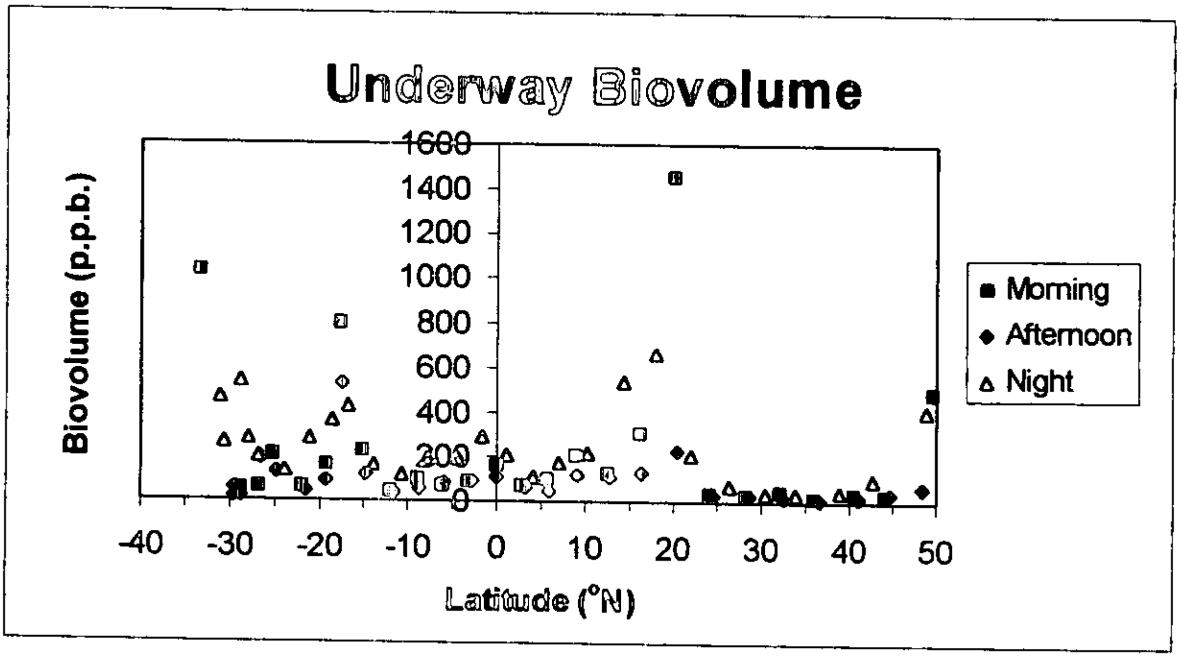
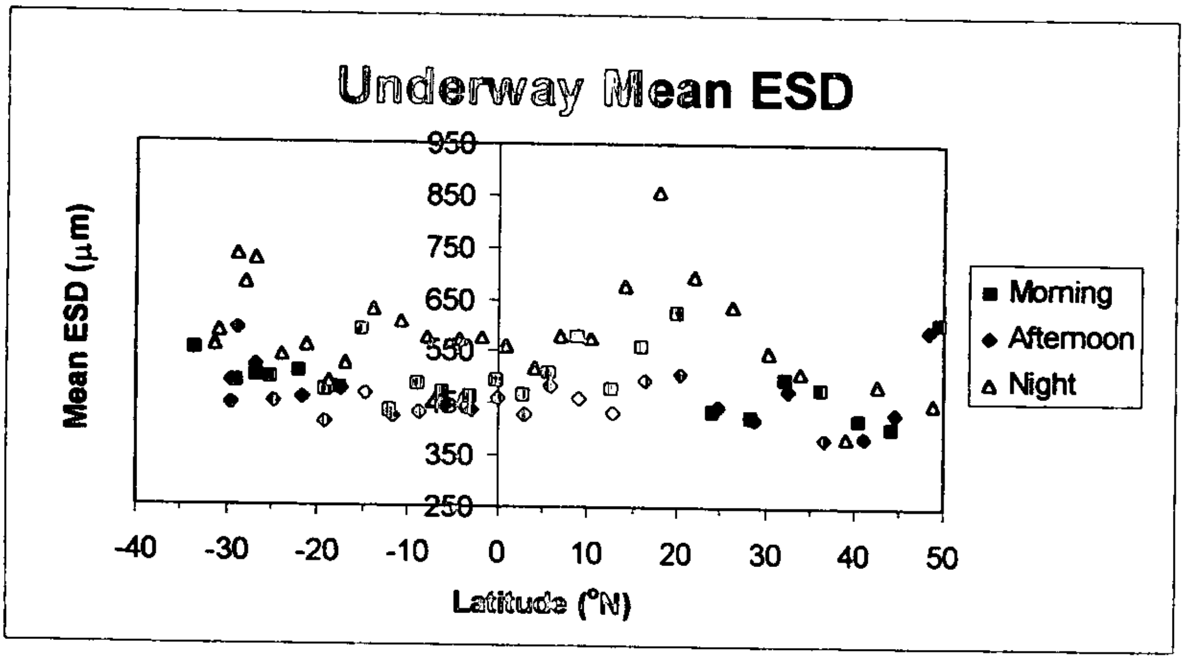


Fig. 28. Surface underway mean equivalent spherical diameter (ESD) of zooplankton, integrated over morning, afternoon and night.



4. SYNTHESIS and CONCLUSIONS

Satellite imagery was received daily, throughout the cruise. SeaWiFS data were received from NASA, Goddard and AVHRR imagery of SST from UCT, Cape Town and RSMAS U of Miami. Both AVHRR and SeaWiFS delivered remarkable imagery, unique in the active pursuit of biological oceanographic research in a heterogeneous area such as the Benguela, in a way that was only ever speculated on previously. These were used to adjust daily sampling strategy, to take samples in regions of high or low chlorophyll, high or low reflectance (Rrs550) or low or high temperature waters. The success of the cruise in sampling such a wide diversity of phytoplankton assemblages and low to high range of biomass can be attributed to the availability of these data in such a timely and convenient manner.

AMT-6 was designated a study of upwelling and high productivity ecosystems.
From a physical and biological oceanographic perspective, the cruise partitioned into 7 main regions, with distinctive ecosystem characteristics:

1. The S. Benguela Upwelling (S BEN UP);
2. The N. Benguela Upwelling (N BEN UP);
3. The Gulf of Guinea and the Equatorial Upwelling (GOG & EQ UP);
4. Equatorial North Atlantic (ENA);
5. N. W. African Upwelling (NWA UP);
6. CANIGO region;
7. Biscay, S. W. Approaches and western English Channel (SWA & WEC).

Of these 7 areas, 3 were upwelling, highly productive (S BEN UP, N BEN UP & NWA UP), 2 were mesotrophic (ENA & SWA) and 2 were oligotrophic (GOG & CANIGO).
The basic physical (SST, MLD), biological (CHL, Phytoplankton) and optical (Kd490, R555) characteristic properties of these 7 regions are summarised in appendix A6-24a. An extended data matrix for all the stations is given in appendix A6-24b.

Within the Benguela, the diversity of phytoplankton assemblages was exceptionally great. In the southern area, small diatoms were abundant, but there were major populations of dinoflagellates. Chlorophyll concentrations were typically over 5 $mg.m^{-3}$. At ca 32 19'S, a "red tide" of Ceratium spp was encountered, with chlorophyll concentrations over 30 $mg.m^{-3}$, extending over a broad area 20 km in width.

In the Northern, Benguela diatoms were dominant, small (Nitzschia spp), colonial forms and the large Coscinodicus wailsei, with single cells > 250um in diameter. Chlorophyll concentrations throughout the northern Benguela ranged from 1 to 4 $mg.m^{-3}$. In many respects the two sectors of the Benguela were different from expectations for the time of year, which normally has the northern area the most intense in biological activity.

The Gulf of Guinea ecosystem was unusual for several features, notably that nowhere was it truly oligotrophic; surface chlorophyll concentrations were typically 0.2 (range 0.1 to 0.36) $mg.m^{-3}$. Sub-surface, the region was highly heterotrophic and oxygen was under-saturated. All these 'unusual' observations may be normal for an oligotrophic ocean gyre near mid-winter, given that these conditions have been studied rarely and reported less.
The equatorial upwelling feature was a much broader feature (>100 km S to N) as observed by SeaWiFS, than encountered on the usual AMT track further west (23 W), where it is normally

only 20 km S to N. Surface chlorophyll concentrations were 0.3 to 0.4 much higher than observed on previous AMT cruises at 23 W.

North of the EQ UP, the ITCZ was the most evident feature in the satellite imagery (AVHRR), shown as a broad band of cloud from 2 to 8 N. This was the only area that provided poor optical sampling conditions, but for only 2 days, so little was lost. In the ENA, south of the NWA UP, observing and sampling conditions were exceptionally good. Surface chlorophyll values were 0.3 to 0.5 mg.m^{-3}, but in the thermocline at 40 m a sub-surface maximum, up to 2 mg.m^{-3}, was measured at all stations. Surprisingly at the time, there were no useful SeaWiFS images available, despite the sunny, cloudless skies; in retrospect it was explained by the occurrence of a Saharan dust storm affecting the area, which produced a dust-laden atmosphere, which the SeaWiFS atmospheric correction procedures could not process.

Only when north of this area, off the coast of Senegal and Mauritania, were good images obtained which showed areas of high biomass and high reflectance, not always co-incident, indicating different phytoplankton assemblages. These included dense populations of Synechococcus and a small (10 um) Nitzchia species. The SeaWiFS images showed the upwelling system extending further offshore (beyond the 20W line) and at seemingly much higher concentrations than usual, compared to the distributions shown in the NASA, CZCS May and June monthly composites.

The front to the north of the WA UP, at the southern limit of the CANIGO region, was the sharpest encountered since the Benguela; there was a salinity change of 0.6 PSU in < 20 km and the chlorophyll concentrations dropped to < 0.05(HPLC) the lowest encountered anywhere. Satellite imagery was sparse for the area, due to patchy cloud cover, but in the cloud-free patches biomass exceeded 0.2 mg.m^{-3} in places. These conditions were typical for the whole of the CANIGO region.

North of the CANIGO there was a significant increase in biological activity, though surface chlorophyll concentrations were low, above a sub-surface maximum in the thermocline again reaching 0.5 mg. m^{-3}.

Good imagery for the WAP and the WEC showed a major phytoplankton bloom at the shelf break, a coccolithophore bloom on the shelf and a large bloom in the WEC south of Plymouth. As it turned out the shelf edge bloom was identified to be Phaeocystis and the bloom south of Plymouth was composed mainly of small diatoms.
The wide diversity and concentration range (0.03 to 8.5 mg.m^{-3} chlorophyll-*a*) made AMT-6 notable for the range of biomass and bio-optical data used for SeaWiFS algorithm.
Post cruise, the SeaWiFS operational algorithm was modified by the high concentration data (> 1.5 mg.m^{-3}), reducing the modeled (retrieved) values from satellite imagery by a factor of 2 at values greater than 2 mg.m^{-3}. These data and their residual outliers provide a test set for new bio-optical models, which have been developed to explain biological diversity occurring in widespread ecosystems. The study of high productivity, upwelling systems has been part of this, as well as being important studies in their own right. These ecosystems are among the most sensitive to the effects of climate change. Although regular AMT cruises from Cape Town are unlikely, the study of high productivity systems on AMT should always be a consideration to fulfill its objectives, which are related to climate change.

APPENDICIES

A6-0	Pre-cruise Provisional station positions, Re-cast station dates after Cape Town Return and achieved station positions.
A6-1	Combined CTD and Optical Station list
A6-2	Scientific Bridge Log.
A6-3	XBT deployment log
A6-4	CTD water bottle depths, T and S for each cast
A6-5	CTD Salinity calibration bottles
A6-6	SeaOPS log
A6-7	SeaFALLS log
A6-8	LoCNESS log
A6-9	Mini NESS log
A6-10	SeaSPEC log
A6-11	SeaSAS log
A6-12	FRRF Data acquisition log
A6-13	UOR tow log
A6-14	HPLC pigments
A6-15	Oxygen, DIC and Respiration Samples Collected
A6-16	Samples taken for New Production, Ammonium regeneration, ^{15}N Uptake and Nitrification
A6-17	Discrete CTD nutrient samples analysed
A6-18	Underway Nutrient Analysis
A6-19	TD-Fe and SPM, CTD sampling log.
A6-20	TD-Fe and SPM, underway sampling log.
A6-21	High volume aerosol sampling log.
A6-22	Mesozooplankton log.
A6-23	Particulates CHN analyses log.
A6-24	AMT-6 Cape Town to Grimsby, Data Matrix.

Appendix A6-0; Pre-cruise Provisional station positions, Re-cast station dates after Cape Town Return and achieved station positions.

ANNEX 1

Provisional daily, main, pre-noon station positions by latitude, and approx. longitude.

Leg 1. @ 2.2 deg/day; 14 to 21 May 98;		Recast C. Tn/2 (20 - 25May);	Actual achieved
1. 33.6 S, 17.7 E	(135, 33.6 S)	20/5 140	
2. 31.4 S, 17.5 E	(136, 32.3 S)		
3. 29.2 S, 16.0 E	(137, 29.5 S)	21/5 141	28.54 S, 15.8 E
4. 27.0 S, 14.7 E	(138, 26.7 S)		
5. 24.8 S, 14.2 E	(139, 29.5 S)	22/5 142	24.75 S, 14.3 E
6. 22.6 S, 13.4 E		23/5 143	21.52 S, 12.2 E
7. 20.4 S, 12.4 E		24/5 144	19.00 S, 12.0 E
8. 18.2 S, 11.2 E		25/5 145	17.66 S, 11.3 E
Leg 2. @ 3.5 deg/day; 22 to 31 May 98;		26 May to 3 June	
9. 14.5 S, 6.0 E		26/5 146	14.74 S, 07.9 E
10. 11.0 S, 3.0 E		27/5 147	11.61 S, 04.1 E
11. 7.5 S, 0.7 W		28/5 148	08.63 S, 00.6 E
12. 4.0 S, 4.2 W		29/5 149	05.86 S, 02.6 W
13. 0.5 S, 8.2 W		30/5 150	02.80 S, 06.2 W
14. 3.0 N, 11.7 W		31/5 151	00.02 S, 08.9 W
15. 6.5 N, 15.4 W		1/6 152	03.07 N, 12.8 W
16. 10.0 N, 19.0 W		2/6 153	05.85 N, 16.1 W
17. 13.5 N, 20. W		3/6 154	09.06 N, 19.1 W
Leg 3, 3 @ deg/day; 31 May 4 June 98;		4 June to 7June	
18. 16.0 N, 20. W		4/6 155	12.80 N, 19.2 W
19. 19.0 N, 20. W		5/6 156	16.38 N, 20.0 W
20. 22.0 N, 20. W		6/6 157	20.41 N, 20.0 W
21. 25.5 N, 20. W		7/6 158	24.51 N, 20.0 W
Leg 4, @ 3.5 deg/day; 5 to 10 June 98;		8 June to 13 June	
22. 28.5 N, 20. W		8/6 159	28.70 N, 19.9 W
23. 32.0 N, 20. W; Madeira.		9/6 160	32.43 N, 17.1 W
24. 35.5 N, 20. W		10/6 161	36.74 N, 17.5 W
25. 39.0 N, 20. W		11/6 162	41.08 N, 17.4 W
26. 41.5 N, 13.5 W		12/6 163	44.68 N, 14.0 W
27. 43.5 N, 9.5 W;		13/6 164 Shelf Break	48.45 N, 09.7 W
Leg 5; 11 to 13 June 98		14 June to 16 June	
28. 48.5 N, 5.5 W Ushant		14/6 165 Eng. Chan S of Ply.	49.84 N, 03.5 W
29. English Channel/N. Sea.		15/6 166 S, North Sea	no station
30. Dock Grimsby.		16/6 167 Dock 10.30 BST	

Appendix A6-1
CTD/OPTICS Station List for AMT-6, Cape Town to Grimsby, 14 May to 16 June 1998.

Sta.	Time GMT	Date	(SDY)	Lat (N,S), Lon (E,W)	CTD	SOPS	SFAL	MiNS	LoNS	HPLC
A601	12.25-15.10	15/5	135	33 37.1'S, 18 00.2'E	A6-01	01-05	01-05	nil	N	5.48
A602	08.05-09.30	16/5	136	32 20.2'S, 17 52.6'E	A6-02	06-07	06-08	nil	N	2.58
A603	11.07-12.21	16/5	136	32 03.4'S, 17 51.9'E	A6-03	08-09	09-11	nil	N	5.03
A604	07.55-09.50	17/5	137	29 31.2'S, 16 27.2'E	A6-04	10	12-18	01-09	N	4.34
A605	11.06-12.02	17/5	137	29 21.7'S, 16 14.9'E	A6-05	11-12	19	nil	N	2.83
A606	04.15-05.38	18/5	138	26 42.6'S, 14 47.9'E	A6-06	nil	nil	nil	N	3.49
A607	08.36-09.48	18/5	138	26 41.8'S, 14 14.8'E	A6-07	13-16	20-21	nil	N	2.23
A608	11.23-12.28	18/5	138	26 42.4'S, 13 57.5'E	A6-08	17	22	nil	N	1.11
A609	14.57-15.28	18/5	138	26 41.8'S, 13 30.1'E	A6-09	nil	nil	nil	N	1.60
A610	08.56-09.52	19/5	139	29 30.7'S, 15 12.5'E	nil	18	23-27	10-12	N	1.04
A611	08.00-09.00	21/5	141	28 55.8'S, 16 11.3'E	A6-10	19-20	nil	13	N	8.30
A612	11.43-12.56	21/5	141	28 32.5'S, 15 48.3'E	A6-11	21-22	28-37	14-17	N	6.00
A613	08.00-09.32	22/5	142	24 45.0'S, 14 19.5'E	A6-12	23	38-52	18-25	N	2.44
A614	12.03-13.11	22/5	142	24 16.5'S, 14 06.4'E	A6-13	24	53-64	26-31	N	1.85
A615	04.05-05.00	23/5	143	22 05.5'S, 12 36.7'E	A6-14	NIL	NIL	N	N	1.73
A616	08.02-11.06	23/5	143	21 39.3'S, 12 24.4'E	A6-15	25-29	N	N		1.66
A617	12.18-13.27	23/5	143	21 31.5'S, 12.12.6'E	NIL	NIL	65-67	N		
A618	13.34-14.55	23/5	143	21 23.9'S, 12 06.1'E	A6-16	30-31	68-75	32-35		1.79
TEST	07.30-08.15	24/5	144	19 00.0'S, 12 00.0'E	TEST	NIL	N	N		
A619	08.15-08.52	24/5	144	18 59.8'S, 12 00.0'E	A6-17	32	76-90	N		1.86
A619	09.15-09.50	24/5	144	" "	A6-18					
TEST	11.20-11.50	24/5	144	18 54.6'S, 12 09.3'E	TEST	NIL	N	N		
A620	11.52-12.30	24/5	144	18 54.6'S, 12 09.3'E	A6-19	N	N	36-39		1.62
A621	13.10-13.44	24/5	144	18 52.6'S, 12 02.1'E	NIL	NIL	91-93	40-44		3.97
TEST	06.30-07.07	25/5	145	17 40.0'S, 11 20.0'E	TEST	NIL	N	N		
A622	08.20-09.30	25/5	145	17 40.0'S, 11 20.1'E	A6-20	33-34	94-98	45-48		2.43
A623	11.33-12.25	25/5	145	17 26.5'S, 11 04.5'E	A6-21	35	99-102	49-51		0.82
A624	08.30-09.42	26/5	146	14 44.6'S, 07 51.6'E	A6-22	36-37	-105	52-54		0.466
A625	11.32-11.47	26/5	146	14 29.6'S, 07 33.5'E	NIL	NIL	-108	55-57		0.37
A626	08.32-09.00	27/5	147	11 37.2'S, 04 08.3'E	A6-23	N	N	N		
A626	09.08-10.05	27/5	147	" "	A6-24	38	N	58-59		0.12
A627	13.10-13.36	27/5	147	11 11.7'S, 03 38.2'E	NIL	N	-110	60-61		0.08
A628	08.30	28/5	148	08 37.6'S, 00 36.5'E	A6-25	N	-112	N		0.22
A628	09.00-09.58	28/5	148	" "	A6-26	N	N	N		
A629	14.22-14.56	28/5	148	08 09.8'S, 00 03.3'W	NIL	N	-116	62-65		0.15
A630	08.30-	29/5	149	05 51.9'S, 02 37.1'W	A6-27	Y	117	N		0.24
A630	09.20-10.20	29/5	149	" "	A6-28	39	-119	66-67		
A631	08.30-	30/5	150	02 48.7'S, 06 09.8'W	A6-29	40	N	L		0.17
A631	09.14-10.58	30/5	150	" "	A6-30	SS	-125	L		
A632	12.06-12.31	30/5	150	02 38.8'S, 06 35.3'W	NIL	N	-127	L	1-3	0.16
A633	07.55-10.12	31/5	151	00 01.7'S, 08 51.0'W	A6-31	N	N	L	4-7	0.33
A633	-10.12	31/5	151	" "	A6-32	N	-131	L	N	
A634	11.49-12.17	31/5	151	00 10.1'N, 09 08.2'W	NIL	N	-133	L	8-10	0.27
A635	09.08-	1/6	152	03 04.3'N, 12 46.2'W	A6-33	SS	N	N	N	0.16
A635	09.46-10.32	1/6	152	" "	A6-34					
A636	11.22-11.43	1/6	152	03 10.4'N, 12 53.7'W	NIL	N	134	N	N	
A637	08.50-	2/6	153	05 51.7'N, 16 04.9'W	A6-35	SS	N	N	N	0.24
A637	09.35-10.21	2/6	153	" "	A6-36	SS	N	N	N	
A638	13.58-14.11	2/6	153	06 21.7'N, 16 32.9'W	NIL	N	Y	-136	N	0.20

A639	09.02-	3/6	154	09 03.7'N, 19 07.2'W	A6-37	SS	-138	68-71	N	0.23
A639	09.44-10.30	3/6	154	" "	A6-38	N	N	N	N	
A640	13.00-13.28	3/6	154	09 24.6'N, 19 25.7'W	NIL	N	-141	72-74	N	0.18
A641	09.05	4/6	155	12 47.1'N, 19 14.7'W	A6-39	SS	N	N	11	0.27
A641	09.53-10.46	4/6	155	" "	A6-40	N	-144	N	12-14	
A642	13.34-13.56	4/6	155	13 17.8'N, 19 08.7'W	NIL	N	-146	N	15-17	0.18
A643	09.12-	5/6	156	16 22.5'N, 20 00.0'W	A6-41	SS	N	N	N	0.47
A643	09-52-10.36	5/6	156	" "	A6-42		-149	N	18-21	
A644	11.43-12.01	5/6	156	16 33.5'N, 19 59.9'W	NIL	N	-151	N	22-23	0.88
A645	13.35-13.53	5/6	156	16 49.2'N, 20 00.2'W	NIL	N	-155	N	24-27	1.12
A646	09.00-10.36	6/6	157	20 24.3'N, 20 00.1'W	A6-43	SS	-161	75-83	28-30	1.87
A647	12.08-12.23	6/6	157	20 40.7'N, 19 59.7'W	NIL	N	-164	N	31-33	1.60
A648	13.29-13.43	6/6	157	20 52.1'N, 20 00.0'W	NIL	N	-167	N	34-36	1.14
A649	08.58-09.58	7/6	158	24 30.3'N, 20 00.0'W	A6-44	SS	-169	N	N	0.19
A650	12.26-12.43	7/6	158	24 59.4'N, 20 00.1'W	NIL	N	170	N	37-38	0.086
A651	13.16-13.34	7/6	158	25 05.1'N, 19 59.8'W	NIL	N	-172	84	39-40	0.095
A652	09.02-09.55	8/6	159	28 41.0'N, 19 52.2'W	A6-45	N	173	N	N	0.034
A653	12.22-12.42	8/6	159	29 05.2'N, 19 33.7'W	NIL	N	-175	N	41-42	0.027
A654	08.00-08.42	9/6	160	32 25.6'N, 17 02.9'W	A6-46	N	176	N	N	0.032
A655	12.40-13.18	9/6	160	32 39.4'N, 17 09.7'W	NIL	N	-179	85	43-45	0.027
A656	09.00-	10/6	161	36 36.8'N, 17 30.2'W	A6-47	N	-182	N	46-48	0.065
A656	09.47-10.35	10/6	161	" "	A6-48	N	-185	86-88	N	
A657	12.30-12.56	10/6	161	36 59.4'N, 17 29.5'W	NIL	N	-188	N	49-51	0.111
A658	09.01-10.11	11/6	162	41 04.7'N, 17 29.9'W	A6-49	N	-191	N	52-55	0.158
A659	11.46-12.12	11/6	162	41 19.0'N, 17 12.2'W	NIL	N	-194	N	56-58	0.163
A660	08.28-09.50	12/6	163	44 40.8'N, 14 00.6'W	A6-50	N	-197	N	N	0.357
A661	15.03-15.19	12/6	163	45 29.5'N, 13 07.5'W	NIL	N	-200	N	N	0.70
A662	09.50-10.28	13/6	164	48 27.0'N, 09 41.8'W	A6-51	N	-207	N	N	1.82
A663	14.30-15.55	13/6	164	48 43.1'N, 08 37.4'W	NIL	N	-219	N	N	3.75
A664	17.00-17.27	13/6	164	48 47.0'N, 08 16.6'W	NIL	N	-221	N	N	1.69
A665	08.57-10.42	14/6	165	49 50.2'N, 04 09.5'W	A6-52	N	-224	N	N	2.03
A666	13.06-13.17	14/6	165	50 00.2'N, 03 28.0'W	NIL	N	-227	N	N	1.34

NOTES:
Stations are numbered sequentially.
CTD casts are numbered sequentially.
SeaOPS, SeaFALLS & MiniNESS are each numbered sequentially.
Zooplankton nets are not included on this table and night time nets are numbered separately.
1. All times are for start and end of stations in GMT.
2. There were no CTD casts for stations: A610, A617, A621, A625, A627, A629, A632, A634, A636, A638, A640, A642, A644, A645, A647, A648, A650, A651, A653, A655, A657, A659, A661, A663, A664, A666.
3. There were no OPT casts for stations: A606, A609, A615.
4. There were 2 CTD casts for station A619, A626, A628, A630, A631, A633, A635, A637, A639, A641, A643, A656
5. There was no water sampled from any TEST CTD casts.
6. Data for CTD cast A6-20, station A622 was not stored on disk.
7. Data only for CTD cast A6-33; no water bottles, due to cable failure at 120 m.
8. Bottles 10,12 did not fire on CTD1, bottle 3 did not fire on CTD A6-34, A6-36.
9. CTD cast A6-50 (Sta. A660) was to 1500m.

ver 14/6/98

Appendix A6-2 Scientific Bridge Log (all times are in GMT)

Date	SDY	Latitude	Longitude	Time	Activity
15/05/98	135	S 33°37.1	E 18° 00.2	1110	V/L on station #1
				1120	Deploying 'F' Net forward starboard
				1124	Sea ops deployed Aft starboard
				1134	'F' Net recovered on board
				1141	'F' Net re-deployed
				1144	'F' Net recovered, Rocket in the water
				1146	'F' Net re-deployed
				1157	Rocket recovered, sea ops on the surface
				1158	Sea ops going down
				1208	'F' Net recovered
				1246	Sea ops recovered on board
				1308	Deploying AC9 stationboard Aft
				1318	Recovered AC9
				1338	Commence deploying CTD
				1344	CTD in the water, veering
				1358	CTD at 120m
				1425	CTD recovered
				1510	V/L proceeding to survey area
				1955	V/L coming into station
		S 32°55.4	E 17°05.4	2010	V/L on station NON 1 (Night Only Net). Depth 350m
				2022	Commence deploying plankton net
				2038	Plankton net retrieved
				2045	Crane stowed, V/L moves off station
16/05/98	136	S 32°20.25	E 17°52.59	0800	V/L coming into station #2
				0805	Depth 137m
				0809	Deploying CTD
				0811	Deploying plankton nets
				0815	Sea ops deployed
				0820	Plankton nets recovered
				0824	CTD at 120m
				0827	Plankton net deployed –20m
				0830	Plankton net recovered
				0834	Hauling on CTD –80m
				0835	Plankton net deployed
				0837	CTD at 80m
				0838	Hauling CTD to 40m
				0840	CTD at 40m
				0841	Hauling CTD –20m
				0844	CTD at 20m, sea ops recovered
				0900	Recovering CTD
				0901	Recovering plankton net
				0904	CTD and nets recovered
				0909	Rocket in water off the stern
				0926	Rocket on deck and recovered
				0930	V/L moves off station
				1103	V/L coming onto station
		S 32°03.36	E 17°51.94	1107	V/L on station #3, depth 126m
				1110	Commence deploying CTD
				1114	CTD in the water, 100m
				1119	Sea ops deployed
				1121	CTD at 100m
				1137	Commence recovery CTD
				1140	CTD recovered on deck, recovered sea ops
				1148	Deploying rockets off stern
				1205	Rocket recovered
				1210	AC9 deployed, starboard Aft
				1213	AC9 recovered
				1221	V/L off station
				2000	V/L coming onto station
		S 31°17.3	E 16°20.8	2007	V/L on station NON 2
				2008	Deploying plankton nets
				2022	Plankton nets recovered
				2029	V/L moves station
17/05/98	137	S 29°31.2	E 16°27.2	0755	V/L coming onto station #4, depth 150m
				0809	Plankton net deployed
				0811	CTD deployed

				0816	Plankton net recovered, bomb in water
				0821	CTD at 130m, plankton net deployed
				0826	Plankton net recovered
				0830	Plankton net deployed
				0852	CTD recovered
				0907	Sea ops deployed, C4 deployed
				0908	Plankton net recovered
				0924	Sea ops recovered
				0925	C4 recovered
				0929	AC9 deployed
				0944	AC9 recovered
				0950	V/L moves off station
		S 29°21.68	E 16° 14.85	1106	V/L on station #5, depth 155m
				1113	Commence deploying CTD
				1116	Sea ops and CTD deployed
				1124	CTD at 120m
				1141	Sea ops recovered, commence CTD recovery
				1148	AC9 deployed
				1159	AC9 recovered
				1202	V/L off station, speed at 4kts for UOR deployment
		S 29°21.7	E 16° 15.4	1210	Deploying UOR
				1216	UOR deployed, increasing to 11kts
				1744	Slowing to 6kts for UOR recovery
				1755	UOR recovered
				1800	V/L increase to 2250 KW
18/05/98	138	S 26° 42.6	E 14° 47.9	0415	V/L stopped on station #6 for CTD
				0420	CTD deployed
				0430	Plankton net deployed
				0432	CTD at 160m
				0442	Plankton net recovered
				0454	CTD recovered
		S 26° 42.3	E 14° 47.6	0538	UOR deployed
				0545	V/L at 11kts
				0825	UOR recovered
		S 26° 41.8	E 14° 14.8	0830	V/L on station#7, depth 365m
				0835	Plankton nets deployed
				0836	CTD deployed
				0840	Sea ops deployed
				0853	CTD at 300m
				0921	CTD recovered
				0925	Sea ops and plankton nets recovered
				0930	C4 deployed
				0942	C4 recovered
				0948	UOR deployed
				1111	Commence recovery of UOR
				1117	UOR recovered
		S 26° 42.44	E 13° 57.54	1123	V/L on station #8, depth 418m
				1129	Sea ops deployed, deploying 'F' Net, commence CTD deployment
				1131	CTD deployed
				1134	Rocket deployed
				1147	'F' Net recovered, Sea ops recovered, rocket recovered, CTD at 300m
				1204	CTD recovered
				1215	AC9 deployed
				1228	V/L off station
				1231	Commence deploying UOR
				1238	UOR deployed, increase speed to 11kts
				1450	UOR recovered
		S 26° 41.80	E 13° 30.07	1457	V/L on station #9, depth 1100m
				1501	CTD and 'F' Net deployed
				1513	CTD at 200m
				1518	'F' Net recovered
				1528	CTD recovered
19/05/98	139			0608	Seawater probe to mid position
		S 29° 21.68	E 16° 14.85	0856	V/L on station #10, depth 170m
				0858	Sea ops deployed
				0920	Sea ops recovered
				0925	Mini-ness deployed
				0928	C4 deployed
				0944	Mini-ness recovered
				0950	C4 recovered

				0952	V/L moves off station
21/05/98	141				
				0755	V/L coming onto station
		S 28°55.8	E 16°11.3	0800	V/L on station #11, depth 130m
				0805	Plankton nets deployed
				0806	Sea ops deployed
				0807	CTD deployed
				0820	CTD at 110m
				0832	Sea ops recovered
				0845	CTD recovered
				0849	Plankton nets recovered
				0852	Mini net deployed
				0855	Mini net recovered
				0900	V/L moves off station
		S 28°38.86	E 15°54.85	1049	V/L on station #12, depth 130m
				1054	V/L off station resuming course for 30 mins
				1138	V/L coming on station
		S 28°32.5	E 15°48.3	1143	V/L on station, depth 131m
				1146	Sea ops deployed, commence deploying CTD
				1148	CTD deployed
				1151	Sea-falls deployed aft
				1220	Sea ops and sea-falls recovered
				1221	Commence CTD recovery
				1224	CTD recovered
				1226	Lauching mini-net and rocket
				1254	Recovered mini-net and rocket, all secure
				1256	V/L off station
22/05/98	142				
				0755	V/L coming onto station
		S 24°45.0	E 14°19.5	0800	V/L on station #13, depth 120m
				0804	Plankton nets deployed
				0807	Sea ops deployed
				0809	CTD deployed
				0815	Rocket launched port off
				0820	CTD at 110m
				0829	Sea ops recovered
				0840	Mini-net deployed
				0857	CTD recovered
				0900	Plankton net recovered
				0930	Min-net and C4 recovered
				0932	V/L moves off station, half power
				1200	V/L approaching station
		S 24°16.5	E 14°06.4'	1203	V/L on station #14, depth 150m
				1206	Sea-ops deployed, commence deployed CTD
				1209	CTD deployed
				1213	Sea-falls deployed
				1224	Sea-ops recovered
				1230	Rockets deployed aft
				1242	Commence recovering CTD
				1247	CTD recovered on deck
				1311	All gear recovered, V/L moving off station
				1317	UOR deployed @ 4 knots
				1334	Increasing to 11.0 knots
				1745	V/L reducing speed for UOR recovery
				1755	UOR recovered, increasing to 2250 kW
23/05/98	143	S 22°05.5'	E 12°36.7'	0405	V/L on station #15 for CTD, depth 666m
				0408	CTD deployed
				0416	Bongo net deployed
				0426	CTD @ 200m
				0434	Bongo net recovered
				0450	CTD recovered
				0500	V/L proceeding to next waypoint
		S 22°02.9'	E 12°35.5'	0525	UOR deployed @ 6 knots
				0750	V/L slows to recover CTD
				0755	UOR recovered, V/L coming onto station
		S 21°39.3'	E 12°24.4'	0802	V/L on station #16, depth 964m
				0803	Plankton nets deployed
				0903	Plankton nets recovered
				0908	Sea-ops deployed
				0918	Sea-ops recovered
				0923	Sea-ops redeployed
				1017	Commence deploying CTD
				1020	CTD deployed in water

				1050	Sea-ops recovered
				1104	Commence CTD recovery
		S 21°39.2'	E 12°24.3'	1106	CTD recovered on deck, off station
		S 21°31.5'	E 12°12.6	1218	V/L on station #17, depth 1235m
				1219	Deploying rockets aft
				1234	Rockets recovered, V/L off station
				1327	V/L coming on station
		S 21°23.9'	E 12°06.1'	1334	V/L on station #18, depth 1257m
				1336	Sea-ops deployed
				1340	Commence deploying CTD
				1342	CTD deployed, rocket deployed aft
				1401	Sea-ops recovered
				1408	Deploying mini-ness, commence recovering CTD
				1413	CTD on-board, gantry secured
				1415	Sea-falls deployed
				1423	Mini-ness recovered
				1427	Mini-ness re-deployed
				1438	Sea-falls recovered
				1446	Mini-ness recovered
				1449	Mini-ness re-deployed
				1454	Mini-ness recovered
		S 21°24.2'	E 12°06.2'	1455	V/L moves off station, UOR deployed @ 4 knots
		S 20°44.1'	E 11°36.1'	1947	UOR recovered
24/05/98	144	S 18°59.8'	E 12°00.0'	0655	V/L comes onto station #19 for test CTD, depth 206m
				0735	CTD deployed for testing
				0750	Plankton net deployed, CTD recovered
				0758	CTD re-deployed for testing
				0815	CTD recovered
				0822	CTD deployed
				0824	Sea-ops deployed
				0838	CTD @ 180m
				0849	Plankton net recovered
				0851	Sea-ops recovered
				0852	CTD recovered
				0902	Plankton net deployed
				0917	CTD deployed
				0920	Plankton net recovered
				0924	CTD @ 55m
				0942	CTD recovered
				0950	V/L moves off station
		S 18°54.6'	E 12°09.3'	1120	V/L on station #20, depth 115m
				1123	Commence deploying CTD
				1126	CTD deployed in water
				1138	CTD recovered on deck, no sampling
				1150	Commence re-deploying CTD
				1152	CTD in water
				1156	Deploying mini-ness
				1203	Mini-ness recovered
				1205	Mini-ness re-deployed
				1216	Commence recovering CTD
				1219	CTD recovered
				1222	Mini-ness re-deployed
				1230	Mini-ness recovered, set course 290°T
		S 18°52.6'	E 12°02.1'	1310	On station #21, depth 144m, heading 180°T
				1311	Sea-falls deployed
				1325	Sea-falls recovered
				1327	Mini-ness deployed
				1344	Mini-ness recovered, course 290°T @ 4 knots for UOR deployment
				1403	UOR deployed, increasing to 11 knots
				1550	UOR recovered
25/05/98	145	S 17°40.0'	E 11°20.1'	0600	V/L stopped on station #22
				0635	CTD deployed for testing
				0645	CTD recovered
				0655	CTD deployed for testing
				0707	CTD recovered
				0742	Plankton nets deployed
				0805	Plankton nets recovered
				0812	CTD and plankton nets deployed
				0819	Sea-ops deployed
				0829	CTD @ 200m
				0853	Sea-ops recovered

				0856	Plankton nets recovered
				0900	CTD recovered
				0905	Mini-ness deployed
				0910	C4 deployed
				0928	C 4 and mini-ness recovered
				0930	V/L moves off station and deploys UOR
				0935	UOR deployed
				1125	Commence UOR recovery
				1129	UOR recovered
		S 17°26.5'	E 11°04.5'	1133	On station #23, depth 1306m
				1136	Sea-ops deployed
				1142	CTD deployed
				1143	F-net deployed fwd
				1156	F-net recovered
				1159	Sea-ops recovered
				1202	CTD recovered
				1204	Sea-falls deployed aft
				1207	Mini-ness deployed aft
				1225	All equipment recovered, set course 313°T @ 4 knots for UOR
				1238	UOR deployed
				1752	UOR recovered
26/05/98	166 6			0824	V/L coming onto station
		S 14°44.6'	E 07°51.6'	0834	V/L on station #24, depth 4860m
				0838	Sea-ops and plankton nets deployed
				0840	CTD deployed
				0850	CTD @ 200m
				0912	Sea-ops recovered
				0920	CTD recovered
				0923	Plankton net recovered
				0925	C4 deployed
				0926	Mini-ness deployed
				0941	C4 and mini-ness recovered
				0942	V/L moves off station
		S 14°29.6'	E 07°33.5'	1132	V/L on station #25
				1134	Deploying rockets sea-falls and mini-ness
				1146	All gear recovered
				1147	V/L proceeding off station
		S 13°18.5'	E 06°08.6'	2020	XBT launched #2
27/05/98	147 167	S 11°53.0'	E 04°26.8'	0630	XBT launched #3
		S 11°37.2'	E 04°08.3'	0832	V/L comes onto station #26, depth 5523m
				0840	Plankton nets deployed
				0902	Sea-ops deployed
				0908	CTD deployed
				0918	CTD @ 200m
				0926	Sea-ops recovered
				0945	Plankton nets recovered
				0949	CTD recovered
				0951	Mini-ness deployed
				1000	Mini-ness recovered
		S 11°36.9'	E 04°08.0'	1005	XBT launched #4
		S 11°11.7'	E 03°38.2'	1312	V/L on station #27
				1314	Sea-falls deployed
				1315	Mini-ness deployed
				1336	All equipment recovered, V/L off station
		S11°11.3'	E 03°37.1'	1345	XBT launched #5
		S 10°49.6'	E 03°12.8'	1715	XBT launched #6
		S 10°30.0'	E 02°49.6'	1837	XBT launched #7
28/05/98	148	S 08°55.8'	E 00°57.2	0613	XBT launched #8
				0825	V/L coming onto station
		S 08°57.6'	E 00°36.5'	0830	V/L on station #28, depth 4932m
				0833	Plankton net deployed
				0835	CTD deployed for tests
				0848	CTD recovered
				0850	C4 deployed
				0910	C4 recovered
				0914	CTD deployed, Sea-spec deployed
				0923	CTD @ 200m
				0940	Sea-spec recovered
				0945	Plankton net recovered
				0952	CTD recovered

				0954	V/L moves off station @ 8 knots, UOR deployed
		S 08°37.2'	E 00°35.7'	0958	XBT launched #9
				1112	Commence slowing to 4 knots for UOR recovery
				1122	UOR recovered, V/L coming on station, rocket deployed
		S 08°28.8'	E 00°25.8'	1126	Rocket recovered, V/L on station
				1131	V/L off station, resume course
		S 08°11.9'	W 00°00.7'	1408	XBT launched #10
		S 08°09.8'	E 00°03.3'	1422	Commence slowing to come on station #29
				1428	Sea-falls deployed aft
				1429	Mini-ness deployed aft
				1453	Mini-ness recovered on-board
				1456	Sea-falls recovered on-board, V/L off station
				1500	Course 315°T @ 4 knots for UOR deployment
		S 08°09.9'	W 00°03.7'	1502	UOR deployed
				1506	Increasing to 11 @ knots
		S 07°41.5'	W 00°29.6'	1836	XBT launched #11
		S 07°25.9'	W 00°47.2'	2050	UOR recovered
		S 07°08.3'	W 01°07.4'	2257	XBT deployed #12
29/05/98	149	S 06°13.0'	W 02°11.9'	0542	XBT launched #13
		S 05°51.9'	W 02°57.1'	0830	V/L on station #30, depth 4389m
				0830	Plankton net deployed
				0904	Rocket deployed
				0910	Rocket recovered
				0920	CTD deployed
				0930	CTD @ 200m
				0945	Sea-ops deployed
				0955	Plankton net recovered
				1000	CTD recovered
				1003	Sea-ops recovered
				1004	C4 deployed
				1008	Mini-ness deployed
				1016	Mini-ness recovered
				1018	C4 recovered
		S 05°51.0'	W 02°39.0'	1020	V/L moves off station @ 1250 kW, XBT launched #14
		S 05°20.7'	W 03°12.7'	1403	XBT launched #15
		S 04°42.9'	W 03°56.8'	1830	XBT launched #16
				1103	V/L on station
		S 04°22.2'	W 04°20.7'	2104	Plankton nets deployed
				2122	Plankton nets recovered
				2124	V/L moves off station
		S 04°08.7'	W 04°35.9'	2300	XBT launched #17
30/05/98	150	S 03°06.6'	W 05°48.7'	0618	XBT launcjed #18
		S 02°48.7'	W 06°09.8'	0830	V/L on station #31
				0834	Plankton net deployed
				0836	Sea-ops deployed
				0900	Sea-ops recovered
				0914	CTD deployed
				0924	CTD @ 200m
				0926	Sea-spec deployed
				0950	Plankton net recovered
				0959	CTD recovered
				1001	Sea-spec recovered
				1005	C4 deployed
				1016	Loch-ness deployed
				1040	Loch-ness recovered
				1052	Loch-ness re-deployed
				1055	Loch-ness and C4 recovered
				1058	V/L moves off station @ 4 knots
		S 02°47.5'	W 06°11.7'	1100	XBT launched #19
				1107	XBT complete, V/L moves up to 2250 kW
		S 02°38.8'	W 06°21.1'	1206	On station, Loch-ness deployed
				1210	Sea-falls on starboard quarter
				1227	Sea-falls recovered
				1231	Loch-ness recovered, resume cruising speed
		S 02°22.7'	W 06°35.3'	1410	XBT launched #20
		S 01°37.2'	W 07°06.1'	1820	XBT maunched #21
				2058	V/L slows to 6 knots
		S 01°06.9'	W 07°26.0'	2105	UOR deployed
				2110	V/L increases speed to 11 knots
31/05/98	151			0250	Commence reducing speed for UOR recovery

		S 00°13.9'	W 08°02.0'	0300	UOR recovered
				0304	UOR recovered to deck
		S 00°13.4'	W 08°03.5'	0316	XBT launched #22
		S 00°13.2'	W 08°04.6'	0324	XBT launched
		S 00°12.9'	W 08°05.4'	0331	UOR re-deployed
				0341	V/L at 11 knots
		S 00°06.0'	W 08°35.5'	0626	XBT launched #23
				0750	V/L slows to recover UOR
		S 00°02.1'	W 08°51.0'	0755	UOR recovered
		S 00°01.7'	W 08°51.4'	0811	V/L on station, depth 4530m
				0815	Plankton net deployed
				0833	Plankton net recovered
				0834	Loch-ness deployed
				0835	C4 deployed
				0856	C4 and Loch-ness recovered
				0901	Plankton net deployed
				0904	CTD and sea-spec deployed
				0929	CTD recovered (no communications)
				0939	Sea-spec recovered
				0942	Plankton net recovered
				0950	Loch-ness and C4 deployed
				1010	Loch-ness and C4 recovered
				1012	V/L resumes passage
		S 00°00.5'	W 08°52.8'	1020	XBT launched
				1022	V/L moves up to 2250 kW
		N 00°10.1'	W 09°08.2'	1149	On station
				1151	Rocket deployed port quarter
				1156	Sea-falls deployed starboard quarter
				1217	V/L off station, resume cruising speed
01/06/98	152	N 02°42.8'	W 12°20.6'	0614	XBT launched
				0850	V/L slows for station #35
		N 03°04.3'	W 12°46.2'	0908	V/L on station
				0909	Plankton net deployed
				0911	CTD deployed
				0915	Sea-spec deployed
				0921	CTD recovered
				0946	CTD deployed
				0950	Sea-spec recovered
				0957	CTD @ 100m
				1015	Plankton net recovered
				1029	CTD recovered
				1032	V/L moves off station
		N 03°09.2'	W 12°46.8'	1043	XBT launched
				1045	V/L moves up to 2250 kW
				1122	Commence slowing down to come on station
		N 03°10.4'	W 12°53.7'	1130	V/L on station #36
				1132	Sea-falls deployed
				1135	Loch-ness deployed
				1141	Sea-falls recovered
				1143	V/L off station, set course 270°T
		N 03°26.2'	W 13°15.2'	1400	XBT launched
		N 03°57.2'	W 13°53.2'	1806	XBT launched
		N 04°36.9'	W 14°42.5'	2328	XBT launched
02/06/98	153	N 05°29.3'	W 15°43.7'	0613	XBT launched
				0850	V/L slows for station #37
		N 05°51.7'	W 16°04.9'	0905	V/L on station, depth 4945m
				0910	Plankton net deployed
				0911	CTD deployed
				0913	Sea-spec deployed
				0919	CTD recovered
				0935	CTD deployed
				0940	Sea-spec recovered
				0945	CTD @ 200m
				1008	Plankton net recovered
				1019	CTD recovered
				1021	V/L moves off station @ 8 knots
		N 05°51.7'	W 16°04.9'	1024	XBT launched
				1028	V/L moves up to 2250 kW
		N 06°21.7'	W 16°32.9'	1458	V/L on station #38
				1500	Rockets deployed aft
				1511	Rockets recovered, resume course and speed
		N 06°56.3'	W 17°06.6'	1812	XBT deployed

03/06/98	154	N 07°52.5'	W 17°58.1'	0021	XBT deployed
		N 08°42.2'	W 18°47.1'	0618	XBT deployed
				0850	V/L slows for station #39
		N 09°03.7'	W 19°07.2'	0902	V/L on station
				0904	Plankton net deployed
				0912	Sea-spec deployed
				0923	Mini-ness deployed
				0928	C4 deployed
				0936	Mini-ness and C4 recovered
				0940	Sea-spec recovered
				0944	CTD deployed
				0956	CTD @ 200m
				1012	Plankton net recovered
				1030	CTD recovered
				1031	V/L moves off station @ 8 knots
		N 09°04.2'	W 19°07.6'	1035	XBT launched
				1038	V/L moves up to 2250 kW
		N 09°24.6'	W 19°25.7'	1300	V/L slowing down to come on station #40
				1307	Mini-ness deployed aft
				1309	Sea-falls deployed aft
				1320	Rockets recovered aft
				1328	V/L @ 4 knots for UOR deployment
				1330	UOR deployed, V/L increasing to 8 knots
				1337	V/L increasing to 11 knots
		N 09°28.6'	W 19°29.5'	1403	XBT deployed
		N 10°07.7'	W 19°48.2'	1807	XBT deployed
				1844	Reduce speed for UOR recovery
		N 10°08.7'	W 19°46.8'	1851	UOR recovered
04/06/98	155	N 12°19.1'	W 19°20.4'	0606	UOR deployed
		N 12°20.6'	W 19°20.1'	0617	XBT launched
				0845	V/L slows to 8 knots
		N 12°47.1'	W 19°14.7'	0855	UOR recovered
		N 12°47.3'	W 19°14.6'	0905	V/L on station #41
				0906	Plankton net deployed
				0908	CTD deployed
				0912	Sea-spec deployed
				0916	CTD recovered
				0934	Loch-ness deployed
				0950	Loch-ness recovered
				1002	CTD @ 200m
				1004	Sea-spec recovered
				1015	Plankton net recovered
				1025	Loch-ness deployed
				1030	C4 deployed
				1040	CTD recovered
				1044	Loch-ness and C4 recovered
				1046	V/L moves off station
		N 12°47.8'	W 19°14.6'	1048	XBT launched
				1050	V/L moves up to 2250 kW
		N 12°59.9'	W 19°12.4'	1153	XBT deployed
		N 13°12.3'	W 19°09.6'	1300	XBT deployed
				1333	V/L coming on station
		N 13°17.8'	W 19°08.7'	1334	V/L on station #42
				1336	Loch-ness deployed aft
				1338	C4 deployed starboard quarter
				1356	Off station, rockets recovered, increasing to 4 knots
		N 13°18.3'	W 19°08.7'	1403	UOR deployed
		N 13°18.7'	W 19°08.6'	1408	XBT deployed
		N 14°01.8'	W 19°00.1'	1812	XBT deployed
		N 14°08.4'	W 19°01.2'	1852	UOR recovered
		N 14°52.1'	W 19°18.1'	2300	XBT launched
05/06/98	156	N 15°53.5'	W 19°58.3'	0600	UOR deployed
		N 15°56.3'	W 19°58.5'	0620	XBT deployed
		N 15°57.0'	W 19°58.5'	0625	UOR recovered, sensor not switched on
		N 15°57.3'	W 19°58.6'	0628	UOR redeployed
		N 15°59.3'	W 19°58.6'	0640	XBT deployed
				0847	V/L slows for UOR recovery
		N 16°22.5'	W 20°00.0'	0852	UOR on-board
				0912	V/L on station #43
		N 16°22.7'	W 20°00.0'	0913	Plankton net deployed
				0915	CTD deployed

				0916	Sea-spec deployed
				0928	CTD recovered
				0944	Sea-spec recovered
				0952	CTD deployed
				0959	Loch-ness deployed
				1004	C4 deployed
				1005	CTD @ 200m
				1018	Plankton net recovered
				1023	C4 and loch-ness recovered
				1034	CTD recovered
				1036	V/L moves off station @ 6 knots
		N 16°22.7'	W 20°00.2'	1039	XBT launched
				1045	V/L moves up to 2250 kW
				1143	V/L coming on station
		N 16°33.5'	W 19°59.9'	1148	V/L on station #44
				1149	Loch-ness deployed aft port
				1150	Sea-falls deployed aft starboard
				1201	Sea-falls recovered
				1202	Loch-ness recovered, V/L moves off station
		N 16°49.2'	W 20°00.2'	1335	V/L on station #45
				1337	Loch-ness deployed
				1338	Sea-falls deployed
				1352	Sea-falls recovered
				1353	Loch-ness recovered, V/L moves off station
		N 17°40.6'	W 19°59.9'	1829	XBT launched
06/06/98	157	N 19°57.8'	W 20°00.1'	0623	XBT launched
		N 19°58.3'	W 20°00.2'	0628	UOR deployed
				0845	V/L slows to recover UOR
		N 20°23.9'	W 20°00.0'	0850	UOR on-board
				0853	V/L coming on station
		N 20°24.3'	W 20°00.1'	0900	V/L on station #46
				0901	C4 deployed
				0906	C4 recovered
				0910	Plankton net deployed
				0914	CTD deployed
				0920	Sea-spec deployed
				0924	CTD @ 200m
				0944	Sea-spec recovered
				0953	Mini-ness deployed
				0959	CTD recovered
				1007	C4 deployed
				1010	Plankton net recovered
				1017	Loch-ness deployed
				1034	Loch-ness, mini-ness and C4 recovered
				1036	V/L moves off station
		N 20°24.7'	W 20°00.2'	1037	XBT launched
				1043	V/L moves up to 2250 kW
		N 20°40.7'	W 19°59.7'	1208	V/L on station #47
				1209	Loch-ness deployed
				1212	Sea-falls deployed
				1221	Sea-falls recovered
				1223	Loch-ness recovered, off station, resuming normal speed
		N 20°52.1'	W 19°60.0'	1329	V/L on station #48
				1331	Rocket in water
				1332	Sea-falls deployed
				1342	Sea-falls recovered
				1343	Off station
				1347	Deploying UOR
		N 20°52.4'	W 20°00.0'	1348	UOR deployed
				1354	Increasing to 11 knots
		N 21°16.8'	W 20°00.6'	1606	XBT launched
		N 21°41.8'	W 20°00.4'	1825	XBT launched
		N 21°45.7'	W 20°00.3'	1849	UOR recovered
0706/98	158	N 23°59.0'	W 20°00.0'	0613	XBT launched
		N 24°30.3'	W 20°00.0'	0858	V/L on station #49
				0905	Plankton nets deployed
				0906	CTD deployed
				0907	Sea-spec deployed
				0917	CTD @ 200m
				0933	Sea-spec recovered
				0939	C4 deployed

				0950	CTD recovered
				0955	C4 recovered
				0956	Plankton net recovered
				0958	V/L moves off station
		N 24°30.5'	W 20°00.1'	1000	XBT launched
				1005	V/L moves up to 2250 kW
				1226	V/L coming on station
		N 24°59.4'	W 20°00.1'	1232	V/L on station #50
				1233	Loch-ness deployed aft port
				1234	Sea-falls deployed aft starboard
				1241	Sea-falls recovered
				1243	Loch-ness recovered, resuming course, offstation
				1316	V/L coming on station
		N 25°05.4'	W 19°59.6'	1318	V/L on station #51
				1319	Loch-ness deployed aft port
				1320	Sea-falls deployed aft starboard
				1330	Mini-ness deployed aft port
				1333	Loch-ness recovered
				1334	Sea-falls and mini-ness recovered, V/L off station
		N 25°10.3'	W 19°59.7'	1405	XBT launched
		N 25°11.8'	W 19°59.7'	1412	XBT launched
		N 26°03.2'	W 19°59.8'	1840	XBT launched
08/06/98	159	N 28°14.2'	W 19°59.9'	0620	XBT launched
				0850	V/L slows for station
		N 28°41.0'	W 19°52.2'	0902	V/L on station #52
				0903	Plankton net deployed
				0906	CTD deployed
				0916	CTD @ 200m
				0940	C4 deployed
				0950	C4 recovered
				0953	CTD recovered
				0955	V/L moves off station
				0957	V/L @ 2250 kW
		N 28°41.3'	W 19°52.0'	0959	XBT launched
		N 29°05.2'	W 19°33.7'	1217	V/L coming on station
				1222	V/L on station #53
				1223	Loch-ness deployed aft port
				1225	Sea-falls deployed aft satrboard
				1242	Rockets recovered, V/L off station, resume course
		N 29°19.2'	W 19°23.7'	1407	XBT launched
		N 30°00.7'	W 18°52.2'	1804	XBT launched
		N 30°50.9'	W 18°14.6'	2244	XBT launched
09/06/98	160	N 32°08.5'	W 17°15.7'	0611	XBT launched
				0750	V/L slows for station
		N 32°25.6'	W 17°02.9'	0800	V/L on station #54
				0803	CTD deployed
				0804	Plankton nets deployed
				0816	CTD @ 200m
				0828	CTD and plankton nets recovered
				0833	C4 deployed
				0842	C4 recovered
				1239	V/L coming on station
		N 32°39.4'	W 17°09.7'	1240	V/L on station #55
				1249	Loch-ness deployed aft port
				1250	Sea-falls deployed aft starboard
				1306	Mini-ness deployed
				1316	Sea-falls recovered
				1318	Rockets recovered, V/L proceeding off station
		N 33°29.8'	W 17°30.0'	1814	XBT launched
10/06/98	161			0850	V/L slows for station
		N 36°36.8'	W 17°30.2'	0900	V/L on station #56
				0903	Plankton nets deployed
				0905	CTD deployed
				0912	Loch-ness deployed
				0914	C4 deployed
				0920	CTD recovered
				0946	Loch-ness recovered
				0947	CTD deployed
				0948	Mini-ness deployed
				0958	CTD @ 200m
				1006	Mini-ness recovered

				1008	C4 recovered
				1018	Plankton net recovered
				1035	CTD recovered
		N 36°37.0'	W 17°30.3'	1037	XBT launched
				1040	V/L moves up to 3000 kW
				1224	V/L coming on station
		N 36°59.4'	W 17°29.5'	1230	V/L on station #57
				1231	Loch-ness deployed aft port
				1234	Sea-falls deployed aft starboard
				1255	Sea-falls recovered
				1256	Loch-ness recovered, V/L off station
		N 37°12.4'	W 17°29.3'	1400	XBT launched
		N 38°07.6'	W 17°30.2'	1820	XBT launched
				2150	V/L slows for station
		N 38°52.8'	W 17°30.0'	2200	V/L on station #58
				2201	Plankton net deployed
				2220	Plankton net recovered
				2222	V/L moves off station
11/06/98	162 ~~152~~	N 40°32.8'	W 17°29.9'	0618	XBT launched
				0850	V/L slows for station
		N 32°25.6'	W 17°02.9'	0901	V/L on station
				0904	Plankton nets deployed
				0906	CTD deployed
				0909	Loch-ness deployed
				0910	C4 deployed
				0920	CTD @ 200m
				0928	C4 and loch-ness recovered
				0952	CTD recovered
				0955	Loch-ness deployed
				0956	C4 deployed
				1001	Plankton net recovered
				1007	C4 recovered
				1009	Loch-ness recovered
				1011	V/L moves off station, XBT launched
				1014	V/L moves up to 2250 kW
		N 41°19.0'	W 17°12.2'	1146	V/L on station #59
				1148	Loch-ness deployed port quarter
				1149	Sea-falls deployed starboard quarter
				1211	Sea-falls recovered
				1212	Loch-ness recovered, off station @ 2250 kW
		N 41°35.3'	W 16°56.5'	1400	XBT launched
		N 42°17.3'	W 16°16.8'	1825	XBT launched
12/06/98	163	N 44°19.0'	W 14°23.5'	0614	XBT launched
				0820	V/L slows for station
		N 44°40.8'	W 14°00.6'	0828	V/L on station #60, depth 4240m
				0835	CTD deployed
				0840	Plankton nets deployed
				0910	CTD @ 1500m
				0920	C4 deployed
				0930	C4 recovered
				0945	Plankton net recovered
				0950	CTD recovered
		N 44°40.6'	W 14°00.7'	0955	XBT launched, off station
				1455	V/L coming on station
		N 45°29.5'	W 13°07.5'	1503	V/L on station #61
				1514	Sea-falls deployed aft starboard
				1519	Sea-falls recovered, V/L off station
		N 45°59.1'	W 12°34.9'	1819	XBT launched
		N 46°48.8'	W 11°37.6'	2314	XBT launched
13/06/98	164	N 47°57.9'	W 10°18.0'	0605	UOR deployed
		N 47°59.3'	W 10°16.3'	0617	XBT launched
				0858	V/L slows to recover UOR
		N 48°22.4'	W 09°48.8'	0904	UOR recovered
				0935	V/L slows for station
		N 48°27.0'	W 09°41.8'	0950	V/L on station #62
				0953	Plankton net and CTD deployed
				0955	C4 deployed
				1003	CTD @ 200m
				1026	Plankton net and CTD recovered
				1028	C4 recovered
		N 48°27.2'	W 09°41.4'	1044	XBT launched

		N 48°42.2'	W 08°42.3	1404	XBT launched
		N 48°43.1'	W 08°37.4'	1430	V/L drfiting on station #63 in manual D.P.
				1448	Sea-falls deployed aft port
				1453	Sea-falls recovered
				1500	Sea-falls re-deployed aft port
				1555	Sea-falls recovered
				1700	V/L reducing speed for station #64
		N 48°47.0'	W 08°16.6'	1715	Sea-falls deployed
				1727	Sea-falls recovered
		N 48°52.3'	W 07°50.8'	1848	UOR deployed
		N 49°08.3'	W 06°49.5'	2253	UOR recovered
14/06/98	165	N 49°50.2'	W 04°09.5'	0857	V/L on station #65, depth 79m
				0901	Plankton net deployed
				0903	CTD deployed
				0908	CTD @ 60m
				0932	CTD recovered
				0934	Plankton net recovered
				1006	C4 deployed
				1016	C4 recovered
				1042	V/L moves off station
				1302	V/L coming on station
		N 50°00.2'	W 03°28.0'	1306	V/L on station for rockets
				1307	Rockets deployed aft
				1317	Sea-falls recovered, resume course, off station

Prepared by: Andrew R. Bowie, 01/07/98

Appendix A6-3
XBT deployment log

Cast	Date	Time	Lat, Long	Type	File No.	OK
1	26/5	15.43		T7	T-7$54	OK
2	26/5	20.17	13 20.8'S, 06 11.3'E	T7	T-7$55	OK
3	27/5	06.37	11 52.7'S, 04 26.4'E	T7	T-7$56	OK
4	27/5	10.05	11 37.1'S, 04 08.3'E	T5	T-5$57	1200
5	27/5	13.40	11 11.8'S, 03 37.7'E	T7	T-7$58	OK
6	27/5	16.10	10 50.7'S, 03 14.1'E	T7	T-7$59	OK
7	27/5	18.37	10 31.0'S, 02 50.7'E	T7	T-7$60	OK
	27/5	23.17		T7		?
	27/5	23.		T7		?
8	28/5	06.11	08 56.6'S, 00 58.2'E	T7	T-7$63	OK
9	28/5	09.58	08 37.4'S, 00 35.9'E	T5	T-5$64	OK
10	28/5	14.04	08 12.4'S, 00 00.0'	T7	T-7$65	OK
11	28/5	18.29	07 42.2'S, 00 28.7'W	T7	T-7$66	OK
11X	28/5	22.00	07 08.4'S, 01 07.5'W	T7	T-7$67 -71	?
12	29/5	01.56	07 00.0'S, 01 17.3'W	T7	T-7$72-73	OK
13	29/5	05 49	06 12.2'S, 02 12.8'W	T7	T-7$74	OK
14	29/5		05 51.5'S, 02 37.7'W	T5	T-5$75	200
15	29/5	14.01	05 21.7'S, 03 11.6'W	T7	T-7$76	OK
16	29/5	18.29	04 43.5'S, 03 11.6'W	T7	T-7$77	OK
17	29/5	23.00	04 09.6'S, 04 35.0'W	T7	T-7$78	OK
18	30/5	06.15	03 07.2'S, 05 48.0'W	T7	T-7$79	OK
19	30/5	11.00	02 48.5'S, 06 10.5'W	T5	T-5$80	OK
20	30/5	14.06	02 28.3'S, 06 34.6'W	T7	T-7$81	OK
21	30/5	18.25	01 36.6'S, 07 06.5'W	T7	T-7$82	OK
22	30/5	23.05		T7	T-7$83	OK
23	31/5	03.15	00 13.6'S, 08 02.9'W	T5	T-5$84	OK
24	31/5	03.25	" "	T5	T-5$85	OK
25	31/5	03.35	" "	T7	T-7$86	OK
26	31/5	06.40	00 06.2'S, 08 34.8'W	T5	T-5$87	OK
27	31/5	10.53	00 01.7'N, 08 51.0'W	T5	T-5$88	700
28	31/5	23.00	01 40.7'N, 11 04.6'W	T5	T-5$89	
29	1/6	06.10	02 42.2'N, 12 19.9'W	T7	T-7$90	OK
30	1/6		03 04.4'N, 12 46.3'W	T5	T-5$91	OK
31	1/6	14.00	03 24.7'N, 13 14.6'W	T7	T-7$92	OK
32	1/6	18.10	03 56.6'N, 13 52.5'W	T7	T-7$93	OK
33	1/6	23.25	04 36.3'N, 14 41.7'W	T7	T-7$94	OK
34	2/6	06.10	05 28.7'N, 15 43.1'W	T7	T-7$95	OK
35	2/6	11.	05 51.8'N, 16 04.9'W	T5	T-5$96	OK
36	2/6	18.10	06 56.4'N, 17 06.1'W	T7	T-7$97	OK
37	3/6	00.17	07 52.0'N, 17 58.4'W	T7	T-7$98	OK
38	3/6	06.15	08 41.6'N, 18 46.6'W	T7	T-7$99	OK
39	3/6	10.30	09 03.8'N, 19 07.3'W	T5	T-5$	OK
40	3/6	14.00	09 28.3'N, 19 29.2'W	T7	T-7$	OK
41	3/7	18.05	10 01.1'N, 19 48.2'W	T7	T-7$	OK

42	4/6	06.15	12 20.0'N, 19 20.2'W	T7	T-7$	OK
43	4/6	10.48	12 47.8'N, 19 14.6'W	T5	T-5$	NIL
44	4/6	10.55	" "	T7	T-7$	OK
45	4/6	11.53	12 59.9'N, 19 12.4'W	T7	T-7$	OK
46	4/6	13.00	13 12.3'N, 19 09.6'W	T7	T-7$	OK
47	4/6	14.08	13 18.7'N, 19 08.6'W	T7	T-7$	OK
48	4/6	18.10	14 01.2'N, 19 00.0'W	T7	T-7$10	OK
49	4/6	22.57	14 51.3'N, 19 17.8'W	T7	T-7$11	OK
50	5/6	06.20	15 55.7'N, 19 58.4'W	T7	T-7$12	200m
51	5/6	06.40	15 59.5'N, 19 58.6'W	T7	T-7$13	700m
52	5/6	10.39	16 22.7'N, 20 00.3'W	T5	T-5$14	OK
53	5/6	14.00	16 49.1'N, 20 00.2'W	T7	T-7$15	OK
54	5/6	18.25	17 41.0'N, 19 59.9'W	T7	T-7$16	OK
55	6/6	06.20	19 56.9'N, 20 00.1'W	T7	T-7$17	OK
56	6/6	10.35	20 24.3'N, 20 00.2'W	T5	T-5$18	OK
57	6/6	14.00	20 54.2'N, 20 00.0'W	T7	T-5$19	OK But T7
58	6/6	16.05	21 16.3'N, 20 00.6'W	T7	T-7$20	OK
59	6/6	18.20	21 41.3'N, 20 00.4'W	T7	T-7$21	OK
60	7/6	06.10	23 58.4'N, 20 00.0'W	T7	T-7$22	OK
61	7/6	10.0?	24 30.4'N, 20 00.1'W	T5	T-5$23	OK
62	7/6	14.00	25 09.5'N, 19 59.6'W	T7	T-7$24	X
63	7/6	14.10	25 11.2'N, 19 59.7'W	T7	T-7$25	OK
64	7/6	18.35	26 02.7'N, 19 59.8'W	T7	T-7$26	OK
65	8/6	06.20	28 13.5'N, 19 59.9'W	T7	T-7$27	OK
66	8/6	10.55	28 41.1'N, 19 52.2'W	T5	T-5$28	X
67	8/6	10.57	" "	T7	T-7$29	OK
68	8/6	14.05	29 18.4'N, 19 24.2'W	T7	T-7$30	OK
69	8/6	18.00	29 59.8'N, 18 52.8'W	T7	T-7$31	OK
70	8/6	22.45	30 50.1'N, 18 15.3'W	T7	T-7$32	OK
71	9/6	06.10	32 07.9'N, 17 16.1'W	T7	T-7$33	OK
72	9/6	14.00	32 43.2'N, 17 17.7'W	T7	T-7$34	OK
73	9/6	18.20	33 29.1'N, 17 30.0'W	T7	T-7$35	OK
74	10/6	06.20	36 03.6'N, 17 30.0'W	T7	T-7$36	OK
75	10/6	10.37	36 36.8'N, 17 30.3'W	T5	T-5$37	500m
76	10/6	14.00	37 11.4'N, 17 29.3'W	T7	T-7$38	As T5
77	10/6	18.20	38 07.0'N, 17 30.1'W	T7	T-7$39	OK
78	10/6	23.15	39 03.6'N, 17 30.1'W	T7	T-7$40	500m
79	11/6	06.15	40 32.0'N, 17 29.9'W	T7	T-7$41	OK
80	11/6	11.15	41 04.8'N, 17 25.9'W	T7	T-7$42	OK
81	11/6	14.00	41 34.9'N, 16 56.8'W	T7	T-7$43	OK
[illegible]	11/6	18.20	42 16.7'N, 16 17.3'W	T7	T-7$44	OK
83	12/6	00.02	43 01.8'N, 15 33.2'W	T7	T-7$45	OK
84	12/6	06.15	44 18.3'N, 14 24.1'W	T7	T-7$46	OK
85	12/6	09.57	44 40.6'N, 14 00.6'W	T5	T5-$47	OK 1500m CTD
86	12/6	14.00	45 19.7'N, 13 18.1'W	T7	T-7$48	OK
87	12/6	18.15	45 58.5'N, 12 35.4'W	T7	T-7$49	OK
88	12/6	23.10	46 47.7'N, 11 38.9'W	T7	T-7$50	OK
89	13/6	06.15	47 58.7'N, 10 16.7'W	T7	T-7$51	OK
90	13/6	10.42	48 26.9'N, 09 41.9'W	T7	T-7$52	OK T7 on T5
91	13/6	14.00	48 42.1'N, 08 43.0'W	T7	T-7$53	OK

Appendix A6-4 CTD water bottle depths, T and S for each cast

CTD Cast	Start Date	Time	Bottle	Time	Depth	Temp	Salinity
AMT6-01	15/05/98	13:51	1	13:58	120.7	9.32	37.723
			2	13:59	100.7	9.62	34.753
			3	14:01	80.7	9.81	34.772
			4	14:05	60.6	10.18	34.814
			5	14:07	41.1	10.97	34.883
			6	14:08	41.0	10.98	34.885
			7	14:10	30.6	11.84	34.912
			8	14:11	30.9	11.83	34.923
			9	14:13	21.2	13.08	34.953
			10	14:14	20.6	14.31	34.972
			11	14:16	11.0	15.69	34.987
			12	14:16	10.6	15.74	34.981
AMT6-02	16/5/98	08:15	1	08:34	120.7	7.92	34.585
			2	08.36	80.8	9.87	34.779
			3	08:39	40.3	11.78	34.993
			4	08:42	20.8	15.87	35.017
			5	08:43	21.2	15.13	34.988
			6	08:45	16.3	16.19	35.047
			7	08:48	11.3	16.23	35.054
			8	08:51	8.5	16.18	35.049
			9	08:52	8.4	16.29	35.057
			10	08:54	5.5	16.10	35.048
			11	08:56	3.6	15.82	35.030
			12	08:57	3.6	15.75	35.026
AMT6-03	16/5/98	11.13	1	11.29	41.2	10.26	34.824
			2	11:30	41.3	10.27	34.826
			3	11:30	41.5	10.27	34.826
			4	11:31	41.1	10.27	34.826
			5	11:32	16.6	11.83	34.956
			6	11:33	16.5	11.60	34.906
			7	11:33	11.2	13.83	34.891
			8	11:34	11.3	12.95	34.903
			9	11:35	8.2	13.28	34.900
			10	11:35	8.6	13.23	34.899
			11	11:36	3.4	13.84	34.900
			12	11:37	3.7	13.93	34.900
AMT6-04	17/5/98	08:10	1	08:23	130.8	9.33	34.723
			2	08:27	81.0	9.62	34.756
			3	08:30	41.2	10.52	34.829
			4	08:32	26.9	11.42	34.876
			5	08:35	21.6	12.67	34.861
			6	08:36	21.3	12.77	34.860
			7	08:37	13.4	12.94	34.860
			8	08:42	13.7	12.94	34.860
			9	08:44	8.3	13.36	34.864
			10	08:46	4.6	13.14	34.861
			11	08:47	4.7	13.09	34.861
			12	08:48	4.7	13.08	34.861
AMT6-05	17/5/98	11:15	1	11:31	16.4	13.81	34.904
			2	11:32	16.5	13.92	34.909
			3	11:33	16.3	13.92	34.910
			4	11:33	16.3	13.92	34.910
			5	11:34	8.6	14.30	34.909
			6	11:35	8.7	14.30	34.909
			7	11:35	8.7	14.31	34.909
			8	11:36	8.8	14.32	34.909
			9	11.37	4.5	14.61	34.911
			10	11:38	4.4	14.67	34.913
			11	11:38	4.4	14.71	34.913
			12	11:39	4.7	14.71	34.913
AMT6-06	18/5/98	04:18	1	04:34	160.8	10.32	34.878
			2	04:37	80.8	11.50	34.970
			3	04:40	41.2	12.18	35.970
			4	04:44	5.3	13.22	35.950
			5	04:45	5.3	13.20	35.952
AMT6-07	18/5/98	08:35	1	09:02	251.5	9.04	34.799
			2	09:05	161.5	11.33	34.939
			3	09:09	80.6	13.54	35.027
			4	09:11	46.2	14.23	34.903
			5	09:12	30.8	15.02	34.894
			6	09:13	30.6	15.08	34.897
			7	09:14	20.9	15.47	34.866
			8	09:14	18.3	15.70	34.882
			9	09:15	14.2	15.67	34.878
			10	09:17	8.1	15.78	34.897
			11	09:18	5.0	16.15	34.938
			12	09:18	4.7	15.94	34.911
AMT6-08	18/5/98	11:28	1	11:59	17.4	14.92	34.999
			2	12:00	9.3	14.95	34.989
			3	12:01	5.2	15.04	34.987
AMT6-09	18/5/98	15:00	1	15:12	201.7	12.05	35.047
			2	15:19	17.9	16.67	35.007
			3	15:20	11.9	17.52	35.140
			4	15:21	8.4	18.29	35.268
			5	15:22	5.5	19.03	35.391

AMT6-10	21/5/98	08:08	1	08:19	111.6	9.63	34.758
			2	08:22	61.7	10.13	34.811
			3	08:24	37.0	11.71	34.908
			4	08:27	27.0	11.81	34.910
			5	08:28	27.0	11.86	34.907
			6	08:30	18.8	13.06	34.874
			7	08:34	13.0	13.05	34.862
			8	08:36	8.7	13.31	34.835
			9	08:37	9.3	13.31	34.836
			10	08:39	4.6	13.33	34.836
			11	08:40	5.1	13.33	34.836
			12	08:41	4.3	13.33	34.836
AMT6-11	21/5/98	11:49	1	11:57	101.0	9.68	34.770
			2	11:57	101.2	9.67	34.769
			3	12:01	61.6	10.48	34.854
			4	12:07	31.2	11.80	34.946
			5	12:07	31.3	11.74	34.946
			6	12:10	21.6	13.38	34.902
			7	12:11	21.4	13.26	34.914
			8	12:13	13.4	13.79	34.840
			9	12:14	13.2	13.83	34.844
			10	12:16	8.8	13.93	34.844
			11	12:18	5.9	13.97	34.844
			12	12:19	5.8	13.99	34.844
AMT6-12	22/5/98	08:06	1	08:27	100.9	11.84	35.095
			2	08:31	80.4	11.91	35.098
			3	08:34	59.4	11.99	35.052
			4	08:38	46.5	12.39	35.035
			5	08:41	37.6	12.62	35.005
			6	08:42	37.3	12.65	35.002
			7	08:45	24.3	12.85	34.999
			8	08:48	17.2	12.91	35.001
			9	08:51	8.6	13.05	35.010
			10	08:52	8.5	13.04	35.009
			11	08:55	4.8	13.12	35.015
			12	08:56	5.0	13.12	35.015
AMT6-13	22/5/98	12:09	1	12:24	71.8	12.46	35.079
			2	12:27	51.6	12.94	35.044
			3	12:31	31.7	13.84	35.036
			4	12:34	16.3	14.02	35.040
			5	12:37	8.4	14.17	35.039
			6	12:39	4.2	14.29	35.039
AMT6-14	23/5/98	04:15	1	04:31	41.0	16.74	35.278
			2	04:34	21.5	17.87	35.275
			3	04:38	8.7	17.91	35.283
			4	04:40	4.2	17.91	35.282
AMT6-15	23/5/98	10:20	1	10:35	201.4	11.58	35.065
			2	10:39	101.9	14.08	35.330
			3	10:43	61.6	16.03	35.309
			4	10:43	61.5	16.02	35.310
			5	10:46	41.7	16.49	35.305
			6	10:49	36.6	16.76	35.297
			7	10:52	20.8	16.97	35.290
			8	10:55	16.1	17.02	35.291
			9	10:58	8.8	17.10	35.293
			10	10:59	8.4	17.12	35.293
			11	11:01	3.8	17.12	35.292
			12	11:01	3.8	17.13	35.293
AMT6-16	23/5/98	13:39	1	13:49	202.2	11.42	35.034
			2	13:54	41.5	14.42	35.278
			3	13:57	26.4	16.63	35.320
			4	14:00	16.6	17.52	35.340
			5	14:01	16.3	17.52	35.340
			6	14:03	8.5	17.74	35.342
			7	14:05	3.7	17.63	35.341
AMT6-17	24/5/98	08:22	1	08:39	176.0	13.35	35.317
			2	08:43	142.4	13.74	35.364
			3	08:45	101.7	14.40	35.437
			4	08:46	101.3	14.40	35.438
			5	08:46	101.4	14.40	35.438
			6	08:48	81.6	14.87	35.472
			7	08:49	61.7	15.42	35.487
AMT6-18	24/5/98	09.16	1	09:23	55.7	15.74	35.504
			2	09:26	46.4	15.78	35.506
			3	09:26	46.2	15.78	35.506
			4	09:29	31.2	16.20	35.489
			5	09:29	31.0	16.20	35.489
			6	09:30	31.4	16.20	35.490
			7	09:32	21.2	16.23	35.488
			8	09:35	16.4	16.31	35.493
			9	09:36	16.3	16.45	35.498
			10	09;37	12.1	16.25	35.490
			11	09:38	12.6	16.30	35.493
			12	09:40	8.0	16.47	35.500
AMT6-19	24/5/98	11:54	1	12:02	101.0	14.43	35.398
			2	12:05	31.9	15.18	35.388
			3	12:08	16.9	15.54	35.397
			4	12:08	16.9	15.52	35.397
			5	12:09	16.8	15.50	35.396
			6	12:11	8.1	15.61	35.401
			7	12:14	4.8	15.96	35.400

AMT6-21	25/5/98	11:42	8	11:56	31.5	18.49	35.708
			6	11.58	18.8	18.77	35.703
			2	11:59	8.5	18.87	35.703
AMT6-22	26/5/98	08:40	12	08:52	201.8	11.65	35.117
			11	08:55	142.0	12.81	35.246
			10	08:59	81.6	14.41	35.442
			8	09:02	64.4	15.37	35.542
			7	09:06	51.8	17.48	35.737
			9	09:06	51.5	17.58	35.747
			3	09:09	37.4	22.09	36.043
			6	09:11	26.9	22.13	36.046
			2	09:14	14.1	22.16	36.046
			5	09:16	14.3	22.15	36.046
			1	09:17	9.6	22.15	36.046
			4	09:18	9.4	22.16	36.046
AMT6-23	27/5/98	08:36	12	08:38	8.1	25.18	36.709
			11	08:39	8.1	25.18	36.709
			10	08:40	7.9	25.18	36.709
			8	08:41	1.5	25.18	36.709
			7	08:42	1.6	25.18	36.708
			9	08:43	1.4	25.18	36.709
			3	08:43	1.4	25.17	36.709
			6	08:45	1.0	25.18	36.709
			2	08:46	1.1	25.18	36.709
			4	08:46	0.8	25.18	36.709
			1	08:47	1.3	25.18	36.709
AMT6-24	27/5/98	09:08	12	09:20	201.9	11.69	35.122
			11	09:23	141.7	12.56	35.224
			10	09:27	102.1	13.85	35.382
			8	09:30	86.3	14.71	35.483
			9	09:33	76.6	15.59	35.594
			7	09:34	76.3	15.55	35.591
			6	09:35	66.9	17.45	35.830
			5	09:39	53.6	20.27	36.113
			2	09:39	53.6	20.40	36.126
			3	09:42	33.6	25.16	36.704
			4	09:45	21.6	25.17	36.707
			1	09:45	21.6	25.17	36.707
AMT6-25	28/5/98	08:33	12	08:37	8.3	26.79	36.145
			11	08:38	8.9	26.79	36.145
			10	08:39	8.4	26.79	36.247
			8	08:41	0.6	26.79	36.247
			7	08:42	1.3	26.79	36.247
			9	08:42	1.3	26.79	36.247
			3	08:43	1.5	26.78	36.245
			6	08:44	1.2	26.79	36.144
			2	08:45	1.1	26.78	36.142
			1	08:46	0.7	26.78	36.143
AMT6-26	28/5/98	09:13	12	09:23	201.0	12.13	35.166
			11	09:28	131.5	13.6 2	35.346
			10	09:31	81.9	15.56	35.542
			9	09:34	66.4	16.13	35.590
			8	09:35	66.9	16.10	35.588
			5	09:37	48.4	20.50	35.834
			2	09:38	49.2	20.94	35.927
			7	09:40	44.5	23.94	36.280
			6	09:43	36.2	26.73	36.375
			3	09:46	29.3	26.84	36.255
			4	09:48	18.0	26.80	36.145
			1	09:49	18.3	26.80	36.146
AMT6-27	29/5/98	08:42	12	08:46	7.7	26.67	35.125
			11	08:47	7.7	26.67	35.126
			10	08:48	7.9	26.67	35.126
			9	08:49	1.3	26.68	35.122
			8	08:50	1.6	26.67	35.123
			5	08:50	1.2	26.68	35.123
			7	08:51	1.3	26.68	35.123
			6	08:52	1.9	26.68	35.122
			3	08:52	1.8	26.68	35.122
			4	08:53	1.3	26.68	35.122
			1	08:54	1.2	26.68	35.120
AMT6-28	29/5/98	09:19	12	09:32	199.2	12.47	35.209
			11	09:35	120.9	14.59	35.451
			10	09:40	58.1	17.94	35.751
			9	09:42	50.7	18.53	35.724
			8	09:43	51.9	18.32	35.722
			5	09:45	48.3	19.22	35.759
			2	09:46	47.8	19.43	35.767
			7	09:48	40.7	21.16	35.826
			6	09:50	34.0	23.99	36.083
			3	09:53	22.8	26.53	35.187
			4	09:56	13.4	26.71	35.115
			1	09:57	13.4	26.70	35.115
AMT6-29	30/5/98	08:35	12	08:37	8.8	27.02	35.166
			11	08:37	8.9	27.02	35.166
			10	08:38	9.0	27.01	35.167
			9	08:40	1.8	27.02	35.166
			8	08:41	1.4	27.02	35.166
			5	08:41	1.9	27.02	35.166
			7	08:42	1.1	27.02	35.166
			6	08:42	1.8	27.02	35.167
			6	08:43	0.6	27.02	35.166
			3	08:44	1.7	27.02	35.167

			4	08:45	1.5	27.02	35.167
			1	08:45	1.6	27.01	35.168
AMT6-30	30/5/98	09:14					
			12	09:24	200.2	13.43	35.326
			11	09:28	122.2	14.96	35.526
			10	09:38	66.9	15.95	35.589
			9	09:40	56.9	17.36	35.708
			8	09:41	57.2	17.36	35.710
			5	09:44	42.7	19.13	35.937
			2	09:44	42.2	19.10	35.932
			7	09:47	32.2	20.64	36.026
			6	09:50	25.3	21.19	36.040
			3	09:52	21.8	21.31	36.044
			4	09:55	15.3	27.01	35.168
			1	09:56	15.0	27.01	35.174
AMT6-31	31/5/98	08:17					
			12	08:20	8.1	25.52	35.563
			11	08:21	8.0	25.51	35.564
			10	08:21	7.9	25.52	35.564
			9	08:22	1.1	25.52	35.563
			8	08:23	1.2	25.53	35.560
			5	08:24	1.1	25.53	35.560
			7	08:24	0.4	25.53	35.561
			6	08:25	0.6	25.53	35.562
			3	08:26	1.0	25.52	35.563
			4	08:26	1.0	25.51	35.564
			1	08:27	0.9	25.50	35.565
AMT6-33	01/6/98	09:11					
			12	09:14	8.5	28.98	34.743
			11	09:14	8.7	28.98	34.743
			10	09:15	8.5	28.98	34.743
			9	09:16	1.0	28.97	34.743
			8	09:17	1.0	28.97	34.742
			5	09:18	1.1	28.97	34.742
			7	09:18	1.5	28.97	34.743
			6	09:19	1.4	28.97	34.743
			3	09:19	1.0	28.97	34.744
			4	09:20	1.3	28.97	34.744
			1	09:21	0.9	28.97	34.744
AMT6-34	01/6/98	09:46					
			12	09:58	201.3	14.19	35.423
			11	10:02	141.6	14.90	35.520
			10	10:08	91.4	15.64	35.605
			9	10:11	76.4	17.08	35.689
			8	10:12	76.4	17.09	35.690
			5	10:14	61.9	18.36	35.684
			2	10:15	61.6	18.48	35.689
			7	10:16	57.0	19.61	35.690
			6	10:19	51.5	23.73	35.787
			3	10:22	33.3	28.89	34.945
			4	10:25	19.7	28.98	34.747
			1	10:26	19.7	28.99	34.748
AMT6-35	02/6/98	09:11					
			12	09:12	8.3	28.94	34.723
			11	09:13	8.4	28.93	34.701
			10	09:14	8.4	28.92	34.695
			9	09:15	1.5	28.92	34.690
			8	09:15	1.7	28.92	34.687
			5	09:16	1.5	28.92	34.686
AMT6-36	02/6/98	09:35					
			12	09:46	201.1	13.72	35.371
			11	09:50	121.1	14.98	35.515
			10	09:56	81.0	16.15	35.620
			9	09:59	61.0	17.71	35.698
			8	10:00	60.7	17.52	35.688
			5	10:03	50.2	18.99	35.789
			2	10:04	50.1	19.67	35.815
			7	10:06	41.3	23.05	35.963
			6	10:09	35.3	23.97	36.000
			3	10:11	27.3	26.82	36.027
			4	10:14	15.0	28.88	35.063
			1	10:15	15.1	28.88	35.097
AMT6-37	03/6/98	09:06					
			12	09:08	8.3	27.32	35.992
			11	09:09	8.2	27.32	35.992
			10	09:10	8.3	27.32	35.992
			3	09:11	1.5	27.31	35.992
			9	09:11	1.5	27.31	35.992
			8	09:12	1.7	27.31	35.991
			7	09:13	15.3	27.32	35.993
			6	09:14	15.2	27.32	35.993
			5	09:15	1.6	27.32	35.992
			4	09:16	1.4	27.31	35.993
			1	09:17	1.1	27.32	35.992
AMT6-38	03/6/98	09:44					
			12	09:55	201.2	13.44	35.347
			11	09:59	121.5	14.62	35.463
			10	10:06	81.3	15.14	35.511
			3	10:09	61.4	15.70	35.554
			9	10:11	51.5	16.10	35.565
			8	10:13	51.2	16.19	35.574
			7	10:15	45.4	17.95	35.696
			6	10:19	40.3	18.48	35.716
			5	10:19	41.0	18.79	35.737
			2	10:20	40.7	20.03	35.794
			4	10:22	34.1	22.04	35.864
			1	10:24	23.6	27.31	35.987
AMT6-39	04/6/98	09:08					
			12	09:10	15.8	25.35	35.943
			11	09:10	15.7	25.03	35.930
			10	09:11	15.5	25.34	35.944

			3	09:12	9.2	25.37	35.945
			9	09:13	9.0	25.37	35.946
			8	09:13	9.2	25.37	35.946
			5	09:14	1.5	25.37	35.946
			4	09:15	1.6	25.37	35.945
			1	09:16	1.7	25.37	35.945
AMT6-40	04/6/98	09:52					
			12	10:01	201.1	12.35	35.277
			11	10:06	101.8	13.94	35.406
			10	10:12	61.8	14.89	35.508
			3	10:15	51.5	15.30	35.540
			9	10:16	51.9	15.30	35.541
			8	10:17	41.3	15.87	35.603
			7	10:20	36.3	16.20	35.634
			6	10:24	28.7	18.46	35.759
			5	10:24	28.9	18.69	35.762
			2	10:25	28.9	22.00	35.816
			4	10:26	27.9	22.67	35.850
			1	10:28	23.9	24.92	35.923
AMT6-41	05/06/98	09:15					
			12	09:19	.....15.3	22.64	36.002
			11	09:19	15.1	22.64	36.001
			10	09:20	15.2	22.63	36.001
			3	09:21	9.5	22.64	36.002
			9	09:22	9.4	22.63	36.001
			8	09:23	9.5	22.63	36.002
			5	09:24	1.4	22.64	36.000
			2	09:25	0.5	22.63	36.000
			4	09:25	1.0	22.64	35.996
			1	09:26	0.9	22.63	35.993
AMT6-42	05/6/98	09:52					
			12	10:05	201.6	12.61	35.429
			11	10:09	121.9	14.08	35.623
			10	10:15	61.9	16.90	35.903
			3	10:18	49.9	21.17	36.010
			9	10:21	42.1	22.42	36.066
			8	10:22	42.2	22.39	36.066
			7	10:23	37.2	22.42	36.066
			5	10:24	37.3	22.39	36.065
			2	10:25	37.1	22.42	36.067
			6	10:26	32.0	22.44	36.066
			4	10:28	27.8	22.46	36.064
			1	10:30	18.9	22.61	36.011
AMT6-43	06/6/98	09:13					
			12	09:24	201.5	14.47	35.843
			11	09:27	162.2	14.03	35.602
			10	09:36	81.8	16.45	35.966
			3	09:39	51.9	18.26	36.325
			9	09:42	41.9	19.37	36.506
			8	09:45	31.9	19.77	36.044
			7	09:47	21.8	20.46	35.899
			6	09:48	21.8	20.63	35.872
			4	09:50	17.9	20.65	35.867
			1	09:53	14.0	20.64	35.868
			5	09:55	8.7	20.81	35.858
			2	09:56	8.8	20.81	35.859
AMT6-44	07/6/98	09:06					
			12	09:20	202.2	16.81	36.390
			11	09:23	122.3	19.13	36.803
			10	09:26	92.5	20.86	37.076
			3	09:29	82.2	21.11	37.122
			9	09:30	81.9	21.16	37.129
			8	09:32	77.2	21.27	37.079
			7	09:34	67.0	21.59	37.119
			6	09:37	55.4	21.79	37.154
			4	09:40	35.3	22.11	37.194
			5	09:43	22.2	22.25	37.017
			2	09:44	22.1	22.25	37.017
			1	09:46	9.5	22.46	36.909
AMT6-45	08/6/98	09:06					
			12	09:16	202.6	16.78	36.371
			11	09:22	182.5	17.18	36.429
			10	09:28	167.6	17.54	36.473
			3	09:31	157.9	18.24	36.614
			9	09:33	148.4	18.81	36.705
			8	09:34	148.8	18.84	36.712
			7	09:37	97.9	19.52	36.822
			6	09:40	64.4	19.65	36.774
			..5	09:43	38.3	20.77	36.896
			2	09:44	38.3	20.77	36.897
			4	09:46	22.7	21.29	36.927
			1	09:49	9.3	21.29	36.927
AMT6-46	09/6/98	08:04					
			12	03:16	201.1	16.04	36.216
			11	03:18	141.7	17.70	36.489
			10	03:20	121.8	18.53	36.673
			3	03:21	116.7	18.57	36.682
			9	03:22	112.1	18.58	36.686
			8	03:23	101.5	18.60	36.685
			7	03:24	81.3	18.71	36.682
			6	03:25	56.6	18.78	36.638
			4	03:26	46.1	18.87	36.641
			5	03:27	31.9	19.27	36.677
			2	03:27	32.0	19.37	36.683
			1	03:28	8.8	20.23	36.605
AMT6-46	10/6/98	09:06					
			1	09:06	1.9	18.84	36.312
			5	09:07	1.8	18.84	36.312
			7	09:07	2.0	18.84	36.312
			4	09:09	22.2	18.14	36.352
			9	09:10	22.1	18.15	36.352

	11	09:11	22.0	18.15	36.351	
	2	09:14	9.1	18.84	36.312	
	6	09:14	9.1	18.83	36.312	
	8	09:15	8.7	18.84	36.312	
	3	09:16	2.0	18.84	36.312	
	10	09:17	2.3	18.84	36.311	
	12	09:18	1.5	18.84	36.311	
AMT6-47 10/6/98 09:47						
	12	09:57	202.3	14.03	35.925	
	11	10:01	142.3	15.10	36.053	
	10	10:07	102.2	16.18	36.188	
	9	10:09	92.2	16.47	36.225	
	6	10:14	91.0	16.59	36.242	
	7	10:14	90.9	16.54	36.234	
	8	10:15	91.1	16.54	36.234	
	5	10:17	72.1	17.12	36.347	
	3	10:20	57.1	17.21	36.325	
	4	10:21	57.0	17.22	36.326	
	2	10:22	47.0	17.51	36.332	
	1	10:26	37.3	18.01	36.345	
AMT6-49 11/6/98 09:06						
	12	09:17	202.4	13.21	35.781	
	11	09:22	122.3	13.91	35.864	
	10	09:28	82.0	14.42	35.918	
	9	09:31	61.9	14.79	35.938	
	8	09:33	56.9	14.84	35.942	
	7	09:37	47.9	15.05	35.959	
	6	09:38	47.9	15.05	35.960	
	5	09:40	38.2	15.40	35.961	
	4	09:44	26.3	16.60	35.896	
	3	09:45	14.3	17.17	35.864	
	2	09:46	14.6	17.17	35.865	
	1	09:48	9.6	17.19	35.865	
AMT6-50 12/6/98 08:36						
	12	09:11	1508.0	4.83	35.076	
	11	09:19	1249.1	6.93	35.360	
	10	09:24	999.0	8.81	35.561	
	9	09:28	749.2	9.52	35.435	
	8	09:33	500.1	10.69	35.472	
	7	09:38	248.2	11.88	35.632	
	6	09:41	101.1	12.58	35.727	
	5	09:42	50.1	13.21	35.784	
	4	09:43	40.4	13.64	35.726	
	3	09:44	35.0	14.13	35.756	
	2	09:45	21.3	16.28	35.892	
	1	09:46	8.7	16.29	35.894	
AMT6-51 13/6/98 09:53						
	12	10:04	203.5	11.48	35.604	
	11	10:09	103.4	11.64	35.607	
	10	10:10	83.3	11.81	35.611	
	9	10:11	63.0	12.19	35.614	
	8	10:13	52.9	12.81	35.604	
	7	10:15	32.3	13.40	35.583	
	6	10:17	32.6	13.40	35.585	
	5	10:19	22.7	13.48	35.578	
	4	10:21	15.5	13.50	35.579	
	3	10:23	9.9	13.50	35.579	
	2	10:24	10.0	13.48	35.578	
	1	10:26	6.7	13.49	35.578	
AMT6-52 14/6/98 09:04						
	12	09:12	61.5	12.18	35.310	
	11	09:14	42.0	12.20	35.310	
	10	09:17	31.8	12.23	35.309	
	9	09:18	31.8	12.24	35.309	
	8	09:20	21.6	13.16	35.315	
	7	09:21	21.5	13.17	35.315	
	6	09:23	14.6	13.18	35.315	
	5	09:24	14.7	13.18	35.316	
	4	09:26	8.5	13.22	35.316	
	3	09:26	8.6	13.21	35.316	
	2	09:28	2.8	13.24	35.316	1
	09:29	2.7	13.24	35.315		

Appendix A6-5 CTD SALINITIES

date	*day*	*station*	*depth (m)*	*sample no*	*salinity*
15 May	135	601	10	1.1	35.079
16 May	136	602	7	1.2	35.226
17 May	137	604	7	1.3	35.023
		605	7	1.4	35.060
18 May	138	606	4	1.5	35.153
		607	4	1.6	35.100
			7	1.7	35.061
		608	4	1.8	35.249
		609	10	1.9	35.228
21 May	141	611	7	1.10	34.985
		612	7	1.11	35.029
22 May	142	613	7	1.12	35.114
		614	7	1.13	35.158
23 May	143	615	7	1.14	35.397
		616	7	1.15	35.430
		617	7	1.16	35.455
24 May	144	618	7	1.17	35.995
		619	7	1.18	35.620
		620	7	1.19	35.553
25 May	145	622	7	1.20	35.810
		623	7	1.21	35.842
26 May	146	624	7	1.22	36.169
27 May	147	626	7	1.23	36.861
			52	1.24	36.181
28 May	148	628	7	2.1	36.216
			47	2.2	35.967
29 May	149	630	7	2.3	35.207
			47	2.4	35.885
30 May	150	631	7	2.5	35.271
			40	2.6	36.021
31 May	151	633	7	2.7	35.683
1 June	152	635	7	2.8	34.834
			60	2.9	35.782
2 June	153	637	7	2.11	34.780
			51	2.12	34.812
3 June	154	639	7	2.13	36.079
			40	2.14	35.784
4 June	155	641	7	2.15	36.012
			16	2.16	35.833

date	day	station	depth (m)	sample no	salinity
5 June	156	643	7	2.17	36.081
			35	2.18	36.118
6 June	157	646	7	2.19	35.967
7 June	158	649	7	2.20	36.919
			80	2.21	37.136
8 June	159	652	7	2.22	37.001
			46	2.23	36.800
9 June	160	654	115	3.1	36.630
10 June	161	656	89	3.3	36.283
11 June	162	658	7	3.2	35.916
			45	3.4	36.042
12 June	163	660	7	3.5	35.928
			35	3.6	35.806
13 June	164	664	7	3.7	35.675
			20	3.8	35.612
14 June	165	665	7	3.9	35.383

dap/dox/amt6/a6_salt

Appendix A6-6 SeaOPS log.

AMT-6 SeaOPS Log for the Sequential Day of the Year (SDY) with all times reported in GMT (SDY 135 is 15 May and SDY 152 is 1 June).

Cast No.	SDY	Position Longitude	Latitude	Darks Es	Lu/Ed/Eu	Data Logger	Radiometers Port1	Port2	Port3	Measurement Port1	Port2	Port3	Down Cast Beg.	End	CCD Pic.	Up Cast Beg.	End	Depth [m]	Comments
1	135	18.0158	-33.6324	1107	1107	OCP-004	OCI-100	OCR-068	OCI-048	Ed	Lu	Eu	1129	1133		1135	1140	50	High cirrus.
2	135	18.0146	-33.6326			OCP-004	OCI-100	OCR-068	OCI-048	Ed	Lu	Eu	1146	1150		1152	1156	50	Clear.
3	135	18.0135	-33.6328			OCP-004	OCI-100	OCR-068	OCI-048	Ed	Lu	Eu	1203	1207		1208	1213	50	Clear.
4	135	18.0125	-33.6330			OCP-004	OCI-100	OCR-068	OCI-048	Ed	Lu	Eu	1215	1219		1227	1231	50	Clear.
5	135	18.0116	-33.6326			OCP-004	OCI-100	OCR-068	OCI-048	Ed	Lu	Eu	1232	1237		1240	1244	50	Clear.
6	136	17.8765	-32.3394	0741	0741	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0818	0822	0823	0824	0829	50	Clear.
7	136	17.8767	-32.3399			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0831	0835		0837	0841	50	Clear.
8	136	17.8661	-32.0579	1108	1108	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1121	1125	1127	1126	1131	50	Clear, High haze.
9	136	17.8667	-32.0580			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1132	1137		1137	1142	50	Clear, High haze.
10	137	16.4446	-29.5272	0741	0741	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0910	0914	0855	0916	0920	50	Clear, High cirrus.
11	137	16.2495	-29.3641		1100	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1118	1122	1126	1123	1128	50	Cloudy, Heavy cirrus.
12	137	16.2511	-29.3645			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1131	1135		1136	1140	50	Cloudy, Heavy cirrus.
13	138	14.2456	-26.6976	0802	0802	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0840	0845	0850	0846	0850	50	Thin high cirrus.
14	138	14.2441	-26.6973			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0852	0856		0856	0901	50	Thin high cirrus.
15	138	14.2436	-26.6971			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0902	0906		0907	0912	50	Thin high cirrus.
16	138	14.2431	-26.6972			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0913	0917		0918	0922	50	Thin high cirrus.
17	138	13.9559	-26.7094		1115	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1132	1138	1141	1138	1144	75	Clear down, High cirrus up.
18	139	15.2091	-29.5129	0830	0830	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0904	0911	0913	0912	0918	75	Clear.
19	141	16.1879	-28.9295	0730	0730	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0810	0814		0815	0819	50	Partly cloudy w/high cirrus.
20	141	16.1873	-28.9290			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0820	0824	0815	0825	0829	50	Partly cloudy w/high cirrus.
21	141	15.8032	-28.5431		1047	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1149	1153		1154	1159	50	Clear.
22	141	15.8012	-28.5437			OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1201	1209		1209	1218	90	Clear.
23	142	14.3242	-24.7504	0742	0742	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	0812	0819	0821	0819	0825	75	Clear, thin high cirrus.
24	142	14.1058	-24.2753		1157	OCP-004	OCI-040	OCR-035	OCI-048	Ed	Lu	Eu	1210	1215	1244	1216	1221	60	Cloudy, high cirrus.
25	143	12.4044	-21.6534	0743	0743	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0910	0914		0914	0919	50	Clear, high light haze.
26	143	12.4039	-21.6526			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0924	0931	0925	0931	0937	78	Clear, high light haze.
27	143	12.4035	-21.6519			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0946	0953		0954	1001	80	Clear, high light haze.
28	143	12.4042	-21.6520			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	1022	1028		1029	1036	75	Clear, high light haze.
29	143	12.4042	-21.6529			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	1036	1043		1043	1050	75	Clear, high light haze.
30	143	12.1015	-21.3989		1319	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	1340	1344		1344	1349	50	Clear.
31	143	12.1011	-21.3984			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	1349	1354		1354	1358	50	Clear.
32	144	11.9995	-18.9960	0737	0737	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0825	0834	0841	0840	0850	100	Clear.
33	145	11.3314	-17.6599	0737	0737	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0819	0826		0827	0835	85	Clear, high haze.
34	145	11.3315	-17.6601			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0835	0842	0901	0843	0849	75	Clear, high haze.
35	145	11.0733	-17.4396			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	1143	1150	1214	1151	1157	75	Clear, light haze.
36	146	7.8609	-14.7433	0710	0710	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0841	0847		0848	0854	75	Clear.
37	146	7.8604	-14.7433			OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0855	0902	0930	0902	0909	75	Clear.
38	147	4.1392	-11.6210	0832	0832	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0905	0913	0959	0915	0925	100	Cloudy.
39	149	-2.6308	-5.8635	0835	0835	OCP-004	OCI-040	OCR-037	OCI-048	Ed	Lu	Eu	0946	0953	0951	0954	1002	75	Clear [dn], Small clouds [up].
40	150	-6.1659	-2.8111	0823	0823	OCP-009	OCI-100	OCR-035		Ed	Lu		0838	0845	0848	0846	0901	75	Clear.

Appendix A6-7 SeaFALLS log.

AMT-6 SeaFALLS Log for the Sequential Day of the Year (SDY) with all times reported in GMT (SDY 135 is 15 May and SDY 152 is 1 June).

Cast No.	SDY	Position Longitude	Latitude	Darks Ea	Ew	Lu/Ed	Down Cast Beg.	End	CCD Pic.	Depth [m]	Comments
1	135	18.0121	-33.6327	1108	1108	1108	1230	1231		55	Clear.
2	135	18.0120	-33.6326				1232	1233		55	Clear.
3	135	18.0116	-33.6324				1239	1239		40	Clear.
4	135	18.0115	-33.6326				1240	1241		38	Clear.
5	135	18.0111	-33.6329				1243	1244		38	Clear.
6	136	17.8749	-32.3430	0809	0809	0809	0911	0912		75	Clear.
7	136	17.8735	-32.3447				0916	0918	0919	80	Clear.
8	136	17.8732	-32.3455				0920	0921		80	Clear.
9	136	17.8673	-32.0591		1146	1146	1152	1154		75	Clear, High haze.
10	136	17.8667	-32.0600				1156	1157		75	Clear, High haze.
11	136	17.8663	-32.0609				1200	1201		75	Clear, High haze.
12	137	16.4479	-29.5251	0741	0741	0741	0854	0855	0855	50	Clear.
13	137	16.4471	-29.5255				0858	0859		45	Clear.
14	137	16.4467	-29.5258				0900	0901		75	Clear, High cirrus.
15	137	16.4450	-29.5269				0910	0912		75	Clear, High cirrus.
16	137	16.4447	-29.5271				0913	0914		75	Clear, High cirrus.
17	137	16.4445	-29.5273				0916	0918		75	Clear, High cirrus.
18	137	16.4443	-29.5274				0920	0921		75	Clear, High cirrus.
19	137	16.2484	-29.3640		1100	1100	1118	1120	1126	75	Cloudy, Heavy cirrus.
20	138	14.2412	-26.6978	0815	0815	0815	0931	0933		75	Thin high cirrus.
21	138	14.2391	-26.6983				0935	0937		75	High cirrus thinned a lot.
22	138	13.9552	-26.7096		1115	1115	1140	1142	1141	100	High cirrus moving through.
23	139	15.2066	-29.5118	0837	0837	0837	0928	0930	0913	75	Clear.
24	139	15.2060	-29.5113				0932	0933		75	Clear.
25	139	15.2049	-29.5107				0936	0938		75	Clear.
26	139	15.2044	-29.5105				0941	0943		75	Clear.
27	139	15.2031	-29.5099				0945	0947		100	Clear.
28	141	15.8032	-28.5430	0730	1047	1047	1153	1154		75	Clear.
29	141	15.8030	-28.5431				1156	1158		75	Clear.
30	141	15.8026	-28.5434				1201	1201		75	Clear.
31	141	15.8019	-28.5436				1206	1207		75	Clear.
[illegible]	141	15.8012	-28.5436				1209	1211		75	Clear.
33	141	15.8004	-28.5438				1213	1214		75	Clear.
34	141	15.7996	-28.5438				1216	1218		75	Clear.
35	141	15.7970	-28.5447				1227	1228		75	Clear.
36	141	15.7958	-28.5455				1231	1232		75	Clear.
37	141	15.7944	-28.5466				1235	1237		75	Clear.
38	142	14.3243	-24.7504	0724	0724	0724	0817	0819	0821	100	Clear, thin high cirrus.
39	142	14.3237	-24.7500				0821	0823		100	Clear, thin high cirrus.
40	142	14.3233	-24.7499				0826	0827		100	Clear, thin high cirrus.
41	142	14.3226	-24.7496				0830	0832		100	Clear, thin high cirrus.
42	142	14.3218	-24.7493				0835	0837		100	Clear, thin high cirrus.
43	142	14.3212	-24.7487				0840	0842		100	Clear, thin high cirrus.
44	142	14.3211	-24.7485				0844	0846		100	Clear, thin high cirrus.
45	142	14.3204	-24.7479				0852	0853		100	Clear, thin high cirrus.
46	142	14.3189	-24.7470				0857	0859		100	Clear, thin high cirrus.
47	142	14.3175	-24.7460				0902	0904		100	Clear, thin high cirrus.
48	142	14.3152	-24.7446				0909	0911		100	Clear, thin high cirrus.
49	142	14.3133	-24.7438				0915	0917		80	Clear, thin high cirrus.
50	142	14.3121	-24.7434				0920	0921		50	Clear, thin high cirrus.
51	142	14.3115	-24.7431				0922	0924		60	Clear, thin high cirrus.
52	142	14.3106	-24.7427				0926	0927		60	Clear, thin high cirrus.

53	142	14.1059	-24.2752			1200	1200	1213	1215	75	Cloudy, high cirrus.
54	142	14.1054	-24.2754					1220	1221	75	Cloudy, high cirrus.
55	142	14.1051	-24.2756					1223	1224	75	Cloudy, high cirrus.
56	142	14.1048	-24.2757					1228	1230	75	Cloudy, high cirrus.
57	142	14.1046	-24.2757					1233	1234	75	Cloudy, high cirrus.
58	142	14.1041	-24.2760					1239	1241	75	Cloudy, high cirrus.
59	142	14.1038	-24.2761				1242	1244	1244	75	Cloudy, high cirrus.
60	142	14.1032	-24.2764					1248	1249	75	Thin high cirrus.
61	142	14.1027	-24.2767					1252	1254	75	Thin high cirrus.
62	142	14.1020	-24.2773					1257	1258	75	Thin high cirrus.
63	142	14.1015	-24.2775					1300	1301	75	Thin high cirrus.
64	142	14.1007	-24.2780					1305	1306	75	Thicker high cirrus.
65	143	12.2093	-21.5257		0743	1215	1215	1221	1222	75	Clear.
66	143	12.2091	-21.5262				1225	1227	1227	75	Clear.
67	143	12.2090	-21.5268					1228	1230	75	Clear.
68	143	12.1012	-21.3976			1319	1319	1416	1417	60	Clear.
69	143	12.1014	-21.3984					1419	1420	50	Clear.
70	143	12.1018	-21.3992					1422	1423	60	Clear.
71	143	12.1021	-21.3997					1424	1426	60	Clear.
72	143	12.1025	-21.4006					1428	1429	55	Clear.
73	143	12.1027	-21.4010					1430	1431	60	Clear.
74	143	12.1029	-21.4014					1433	1434	60	Clear.
75	143	12.1031	-21.4016					1435	1436	60	Clear.
76	144	11.9993	-18.9956	0737	0737	0737	0838	0840	0841	100	Clear.
77	144	11.9993	-18.9956					0843	0844	100	Clear.
78	144	11.9993	-18.9956					0843	0844	100	Clear.
79	144	11.9993	-18.9956					0843	0844	100	Clear.
80	144	11.9993	-18.9956					0843	0844	100	Clear.
81	144	11.9993	-18.9956					0843	0844	100	Clear.
82	144	11.9993	-18.9956					0843	0844	115	Clear.
83	144	11.9993	-18.9956					0843	0844	110	Clear.
84	144	11.9993	-18.9956					0843	0844	105	Clear.
85	144	11.9993	-18.9956					0843	0844	100	Clear.
86	144	11.9993	-18.9956					0843	0844	100	Clear.
87	144	11.9993	-18.9956					0843	0844	100	Clear.
88	144	11.9993	-18.9956					0843	0844	100	Clear.
89	144	11.9993	-18.9956					0843	0844	100	Clear.
90	144	11.9993	-18.9956					0843	0844	110	Clear.
91	144	12.0345	-18.8775					1312	1313	75	Clear.
92	144	12.0343	-18.8782					1315	1317	75	Clear.
93	144	12.0340	-18.8788			1325	1325	1319	1321	75	Clear.
94	145	11.3306	-17.6583	0743	0743	0743	0909	0911	0901	60	Clear, high haze.
95	145	11.3301	-17.6576					0913	0914	50	Clear, high haze.
96	145	11.3297	-17.6572					0915	0917	75	Clear, high haze.
97	145	11.3290	-17.6567					0921	0922	60	Clear, high haze.
98	145	11.3287	-17.6564					0924	0925	60	Clear, high haze.
99	145	11.0711	-17.4384					1207	1208	55	Clear, light haze.
100	145	11.0696	-17.4383				1211	1213	1214	100	Clear, light haze.
101	145	11.0680	-17.4382					1217	1217	55	Clear, light haze.
102	145	11.0667	-17.4381					1220	1221	55	Clear, light haze.
103	146	7.8596	-14.7425	0639	0639	0639	0925	0927	0930	75	Clear.
104	146	7.8589	-14.7413					0929	0931	75	Clear.
105	146	7.8590	-14.7404					0934	0936	100	Clear.
106	146	7.5574	-14.4937					1135	1137	75	Clear.
107	146	7.5564	-14.4942					1139	1140	75	Clear.
108	146	7.5558	-14.4943					1143	1145	75	Clear.
109	147	3.6353	-11.1959	0830	0830	0830	1316	1317	1318	75	Partly cloudy w/sun breaks.
110	147	3.6314	-11.1972					1331	1332	50	Partly cloudy w/sun breaks; cloudy at end.
111	148	0.6054	-8.6261		0750	0750	0750	0852	0854	100	Clear (w/scattered clouds).
112	148	0.6030	-8.6247					0858	0900	80	Clear (w/scattered clouds).

113	148	-0.0533	-8.1620				1428	1430	1439	75	Clear (w/scattered clouds).
114	148	-0.0560	-8.1637				1443	1444		65	Clear (w/scattered clouds).
115	148	-0.0562	-8.1640				1446	1447		65	Clear (w/scattered clouds).
116	148	-0.0567	-8.1644				1450	1451		100	Clear (w/scattered clouds).
117	149	-2.6256	-5.8646	0836	0836	0836	0904	0905	0951	75	Clear, little high cirrus.
118	149	-2.6317	-5.8643				1007	1009		85	Clear.
119	149	-2.6331	-5.8634				1013	1014		75	Clear, small cloud moved through.
120	150	-6.1728	-2.8104	0830	0830	0830	1006	1008	0848	100	Clear.
121	150	-6.1742	-2.8097				1011	1013		100	Clear.
122	150	-6.1754	-2.8088				1015	1017		100	Clear.
123	150	-6.1865	-2.8002				1040	1041		50	Clear, aborted due to cloud at end.
124	150	-6.1876	-2.7994				1042	1044		100	Clear.
125	150	-6.1908	-2.7971				1049	1051		100	Clear.
126	150	-6.3551	-2.6492				1214	1216		100	Clear.
127	150	-6.3563	-2.6497		1227	1227	1219	1222		125	Clear.
128	151	-8.8586	-0.0281	0809	0809	0809	0837	0839		100	Clear, light high haze.
129	151	-8.8609	-0.0250				0849	0850	0911	75	Clear, light high haze.
130	151	-8.8664	-0.0189				0955	0956		80	Clear, light high haze.
131	151	-8.8681	-0.0167				1000	1002		85	Clear, light high haze.
132	151	-9.1376	0.1684				1152	1154		90	Clear.
133	151	-9.1389	0.1698				1202	1203	1217	60	Clear.
134	152	-12.8960	3.1727	0836	0836	0836	1132	1134		100	Clear, thin high cirrus.
135	153	-16.5499	6.3614	0902			1401	1403		75	Clear, high cirrus.
136	153	-16.5505	6.3616		1411	1411	1405	1407		100	Clear, high cirrus.
137	154	-19.1210	9.0632	0804	0901	0901	0928	0930	0935	75	Completely overcast w/some brightening.
138	154	-19.1210	9.0633				0932	0933		75	Completely overcast w/some brightening.
139	154	-19.4284	9.4100				1308	1309	1324	75	Clear w/high haze.
140	154	-19.4281	9.4103				1312	1314		75	Clear w/high haze.
141	154	-19.4281	9.4102				1316	1317		75	Clear w/high haze.
142	155	-19.2449	12.7933	0854	0854	0854	1033	1034	0955	75	Clear w/light haze.
143	155	-19.2451	12.7939				1037	1038		90	Clear w/light haze.
144	155	-19.1462	13.2978				1339	1340		90	Clear w/light haze.
145	155	-19.1466	13.2984				1343	1344	1345	90	Clear w/light haze.
146	155	-19.1468	13.2993				1348	1350		100	Clear w/light haze.
147	156	-20.0049	16.3776	0837	0837	0837	1009	1010	1014	80	Clear.
148	156	-20.0048	16.3777				1012	1014		90	Clear w/small cloud ~2/3 down.
149	156	-20.0047	16.3778				1017	1019		95	Clear.
150	156	-19.9983	16.5593				1152	1153	1158	90	Clear.
151	156	-19.9980	16.5595				1156	1158		90	Clear.
152	156	-20.0035	16.8204				1339	1340		70	Clear.
153	156	-20.0036	16.8204				1341	1342		75	Clear.
154	156	-20.0037	16.8205				1345	1346		30	Clear, abort on cloud encroachment.
155	156	-20.0040	16.8204				1348	1349		90	Clear.
156	157	-20.0027	20.4058	0841	0841	0841	0901	0903	1032	100	Clear.
157	157	-20.0035	20.4071				1011	1012		50	Clear.
158	157	-20.0035	20.4077				1014	1015		50	Clear.
159	157	-20.0033	20.4089				1019	1020		50	Clear.
160	157	-20.0032	20.4099				1023	1024		50	Clear.
161	157	-20.0032	20.4109				1027	1028		50	Clear.
162	157	-19.9954	20.6784				1212	1213		50	Clear.
163	157	-19.9954	20.6787				1214	1215		50	Clear.
164	157	-19.9956	20.6791				1218	1219		50	Clear.
165	157	-20.0000	20.8690				1333	1334		50	Clear.
166	157	-19.9998	20.8692				1336	1337		50	Clear.
167	157	-19.9998	20.8693				1338	1339		50	Clear.
168	158	-20.0017	24.5062	0829	0829	0829	0942	0943	0939	100	Cloudy, diffuse lighting.
169	158	-20.0012	24.5061				0947	0949		100	Cloudy, diffuse lighting.
170	158	-20.0010	24.9912				1235	1237		100	Clear.
171	158	-19.9963	25.0855				1321	1323		100	Clear.
172	158	-19.9959	25.0859				1326	1328		100	Clear.

173	159	-19.8706	28.6844	0848	0848	0848	0939	0942	0943	150	Cloudy, pretty diffuse.
174	159	-19.5624	29.0873				1226	1229	1239	170	Clear.
175	159	-19.5621	29.0875				1233	1236		175	Clear.
176	160	-17.0497	32.4282	0727	0727	0727	0833	0836	0834	150	Clear, thin high cirrus.
177	160	-17.1639	32.6540				1251	1253		125	Clear.
178	160	-17.1657	32.6529				1258	1301		140	Clear.
179	160	-17.1673	32.6517				1307	1310		140	Clear.
180	161	-17.5049	36.6139	0824	0824	0824	0916	0917		135	Clear.
181	161	-17.5050	36.6140				0926	0928		120	Clear.
182	161	-17.5051	36.6141				0939	0941	0944	120	Clear.
183	161	-17.5049	36.6141				0948	0951		120	Clear.
184	161	-17.5050	36.6140				0955	0957		120	Clear.
185	161	-17.5051	36.6140				1001	1004		125	Clear.
186	161	-17.4917	36.9897				1235	1237		150	Clear.
187	161	-17.4914	36.9908				1241	1244	1244	150	Clear.
188	161	-17.4912	36.9918				1248	1251		150	Clear.
189	162	-17.4316	41.0801	0837	0837	0837	0918	0920		100	Clear, cloud at end.
190	162	-17.4317	41.0808				0956	0958		115	Clear.
191	162	-17.4313	41.0819				1001	1003		115	Clear.
192	162	-17.2021	41.3170				1151	1153		120	Clear.
193	162	-17.2009	41.3173				1157	1159		120	Clear.
194	162	-17.1991	41.3179				1204	1206	1210	120	Clear.
195	163	-14.0099	44.6780	0822	0822	0822	0917	0918		80	Completely overcast.
196	163	-14.0099	44.6780				0922	0924		75	Completely overcast.
197	163	-14.0102	44.6779				0925	0927	0928	75	Completely overcast.
198	163	-13.1258	45.4918				1505	1506		75	Foggy, completely overcast.
199	163	-13.1261	45.4907				1508	1510		85	Foggy, completely overcast.
200	163	-13.1277	45.4891				1513	1515		75	Foggy, completely overcast.
201	164	-9.6972	48.4493	0832	0832	0832	0958	0959		55	Clear.
202	164	-9.6978	48.4486				1009	1009		60	Clear.
203	164	-9.6979	48.4485				1011	1012		50	Clear.
204	164	-9.6978	48.4483				1013	1014		50	Clear.
205	164	-9.6978	48.4481				1015	1016		50	Clear.
206	164	-9.6983	48.4481				1019	1020		50	Clear.
207	164	-9.6983	48.4480				1021	1023	1025	100	Clear.
208	164	-8.6240	48.7190				1449	1450		40	Clear, cloudy at end.
209	164	-8.6155	48.7234				1503	1504		50	Clear.
210	164	-8.6143	48.7241				1505	1506		35	Clear, cloudy at end.
211	164	-8.6130	48.7248				1507	1508		50	Partly cloudy.
212	164	-8.6084	48.7275				1514	1516	1520	100	Completely cloudy, diffuse light.
213	164	-8.6045	48.7297				1521	1522		50	Clear.
214	164	-8.6025	48.7309				1524	1525		30	Clear.
215	164	-8.5994	48.7328				1529	1530		50	Completely cloudy, diffuse light.
216	164	-8.5905	48.7379				1542	1543		60	Clear.
217	164	-8.5884	48.7389				1545	1546		50	Clear.
218	164	-8.5861	48.7401				1548	1549		25	Clear, abort due to cloud.
219	164	-8.5845	48.7409				1550	1551		50	Clear, small cloud in middle of cast.
220	164	-8.2751	48.7834				1716	1717		40	Cloudy, diffuse light.
221	164	-8.2707	48.7840				1719	1720		50	Cloudy, diffuse light.
222	165	-4.1469	49.8391	0749	0749	0749	1006	1007		50	Completely cloudy, diffuse light.
223	165	-4.1477	49.8390				1009	1010		50	Completely cloudy, diffuse light.
224	165	-4.1484	49.8388				1012	1013	1019	50	Completely cloudy, diffuse light.
225	165	-3.4685	50.0025				1307	1308		50	Clear.
226	165	-3.4676	50.0026				1309	1310		50	Clear.
225	165	-3.4662	50.0028				1312	1313		50	Clear.

Appendix A6-8 LoCNESS log.

AMT-6 LoCNESS Log for the Sequential Day of the Year (SDY) with all times reported in GMT (SDY 258 is 15 September and SDY 152 is 1 June).

Cast No.	SDY	Position Longitude	Latitude	Darks Es	Lu/Ed	Down Cast Beg.	End	CCD Pic.	Depth [m]	Comments
1	150	-6.3530	-2.6485	0823	1232	1207	1209		100	Clear.
2	150	-6.3551	-2.6492			1214	1216		80	Clear.
3	150	-6.3563	-2.6497			1219	1222		125	Clear.
4	151	-8.8586	-0.0281	0809	0809	0837	0839		95	Clear, light high haze.
5	151	-8.8611	-0.0249			0849	0851	0911	75	Clear, light high haze.
6	151	-8.8664	-0.0189			0955	0956		75	Clear, light high haze.
7	151	-8.8681	-0.0167			1000	1002		75	Clear, light high haze.
8	151	-9.1376	0.1684			1152	1154		75	Clear.
9	151	-9.1389	0.1698			1202	1203		50	Clear.
10	151	-9.1401	0.1704			1208	1209	1217	80	Clear.
11	155	-19.2442	12.7915	0854	0854	0944	0946		100	Clear w/light haze.
12	155	-19.2446	12.7923			1027	1028	0955	45	Clear w/high cirrus.
[illegible]	155	-19.2448	12.7929			1030	1032		75	Clear w/high cirrus.
14	155	-19.2451	12.7939			1037	1038		80	Clear w/high cirrus.
15	155	-19.1462	13.2978			1339	1340		75	High cirrus.
16	155	-19.1466	13.2984			1343	1344	1345	75	High cirrus.
17	155	-19.1468	13.2993			1348	1350		85	High cirrus.
18	156	-20.0048	16.3777	0837	0837	0959	1000	1014	75	Clear.
19	156	-20.0049	16.3776			1009	1010		70	Clear.
20	156	-20.0048	16.3777			1012	1014		75	Clear w/small cloud ~2/3 way down.
21	156	-20.0047	16.3778			1017	1019		75	Clear.
22	156	-19.9983	16.5593			1152	1153	1158	75	Clear.
23	156	-19.9980	16.5595			1156	1158		75	Clear.
24	156	-20.0035	16.8204			1339	1340		75	Clear.
25	156	-20.0036	16.8204			1341	1342		75	Clear.
26	156	-20.0037	16.8205			1345	1346		75	Clear, abort on cloud encroachment.
27	156	-20.0040	16.8204			1348	1349		75	Clear.
28	157	-20.0033	20.4089	0841	0841	1019	1020	1032	50	Clear.
29	157	-20.0032	20.4099			1023	1024		50	Clear.
30	157	-20.0032	20.4109			1027	1028		50	Clear.
31	157	-19.9954	20.6784			1212	1213		50	Clear.
[illegible]	157	-19.9954	20.6787			1214	1215		50	Clear.
[illegible]	157	-19.9956	20.6791			1218	1219		50	Clear.
34	157	-20.0000	20.8690			1333	1334		50	Clear.
35	157	-19.9998	20.8692			1336	1337		50	Clear.
36	157	-19.9998	20.8693			1338	1339		50	Clear.
37	158	-20.0010	24.9911	0829	0829	1234	1236		100	Clear.
38	158	-20.0011	24.9915			1239	1240		50	Clear.
39	158	-19.9964	25.0854			1320	1322	1325	100	Clear.
40	158	-19.9959	25.0859			1326	1328		100	Clear.
41	159	-19.5624	29.0873	0848	0848	1226	1229		150	Clear.
42	159	-19.5621	29.0875			1233	1236	1239	150	Clear.
43	160	-17.1639	32.6540		1245	1251	1253		115	Clear.
44	160	-17.1657	32.6529			1258	1301		125	Clear.
45	160	-17.1673	32.6517			1307	1310		125	Clear.
46	161	-17.5049	36.6139	0831	0831	0916	0917		105	Clear.
47	161	-17.5050	36.6140			0926	0928		110	Clear.
48	161	-17.5051	36.6141			0939	0941	0944	105	Clear.
49	161	-17.4917	36.9897			1235	1237		125	Clear.
50	161	-17.4914	36.9908			1241	1244	1244	125	Clear.
51	161	-17.4912	36.9918			1248	1251		130	Clear.
52	162	-17.4316	41.0801	0837	0837	0918	0920		90	Clear, cloud at end.

53	162	-17.4316	41.0802	0924	0926		55	Clear (ended early).
54	162	-17.4317	41.0808	0956	0958		100	Clear.
55	162	-17.4313	41.0819	1001	1003	1005	100	Clear.
56	162	-17.2021	41.3170	1151	1153		100	Clear.
57	162	-17.2009	41.3173	1157	1159		100	Clear.
58	162	-17.1991	41.3179	1204	1206	1210	100	Clear.

Appendix A6-9 miniNESS log.

AMT-6 miniNESS Log for the Sequential Day of the Year (SDY) with all times reported in GMT (SDY 135 is 15 May and SDY 152 is 1 June).

Cast No.	SDY	Position Longitude	Position Latitude	Darks Es	Darks Lu/Ed	Data Logger	Radiometers Port1	Radiometers Port2	Measurement Port1	Measurement Port2	Down Cast Beg.	Down Cast End	CCD Pic.	Depth [m]	Comments
1	137	16.4519	-29.5229	0752		OCP-008	OCI-100	OCR-068	Ed	Lu	0837	0838		50	Clear.
2	137	16.4497	-29.5241			OCP-008	OCI-100	OCR-068	Ed	Lu	0841	0843		40	Clear.
3	137	16.4493	-29.5243			OCP-008	OCI-100	OCR-068	Ed	Lu	0843	0843		40	Clear.
4	137	16.4489	-29.5246			OCP-008	OCI-100	OCR-068	Ed	Lu	0845	0845		50	Clear.
5	137	16.4486	-29.5249			OCP-008	OCI-100	OCR-068	Ed	Lu	0847	0848		40	Clear.
6	137	16.4484	-29.5250			OCP-008	OCI-100	OCR-068	Ed	Lu	0849	0850		50	Clear.
7	137	16.4480	-29.5250			OCP-008	OCI-100	OCR-068	Ed	Lu	0854	0854	0855	50	Clear.
8	137	16.4472	-29.5254			OCP-008	OCI-100	OCR-068	Ed	Lu	0858	0858		45	Clear.
9	137	16.4468	-29.5257			OCP-008	OCI-100	OCR-068	Ed	Lu	0900	0900		45	Clear.
10	139	15.2067	-29.5119	0922		OCP-008	OCI-100	OCR-068	Ed	Lu	0928	0929	0913	50	Clear.
11	139	15.2060	-29.5113			OCP-008	OCI-100	OCR-068	Ed	Lu	0932	0933		50	Clear.
12	139	15.2049	-29.5107			OCP-008	OCI-100	OCR-068	Ed	Lu	0936	0937		50	Clear.
13	141	16.1870	-28.9287	0844		OCP-008	OCI-100	OCR-068	Ed	Lu	0852	0852	0815	50	Ptly cldy high cirrus
14	141	15.7970	-28.5447	1047		OCP-008	OCI-100	OCR-068	Ed	Lu	1227	1228		50	Clear.
15	141	15.7944	-28.5466			OCP-008	OCI-100	OCR-068	Ed	Lu	1235	1237		50	Clear.
16	141	15.7924	-28.5476			OCP-008	OCI-100	OCR-068	Ed	Lu	1243	1244		50	Clear.
17	141	15.7911	-28.5486			OCP-008	OCI-100	OCR-068	Ed	Lu	1249	1249		50	Clear.
18	142	14.3213	-24.7488	0832		OCP-008	OCI-100	OCR-068	Ed	Lu	0840	0841	0821	50	Clear, thin high cirrus.
19	142	14.3205	-24.7480			OCP-008	OCI-100	OCR-068	Ed	Lu	0852	0852		50	Clear, thin high cirrus.
20	142	14.3185	-24.7467			OCP-008	OCI-100	OCR-068	Ed	Lu	0859	0900		50	Clear, thin high cirrus.
21	142	14.3153	-24.7447			OCP-008	OCI-100	OCR-068	Ed	Lu	0909	0910		50	Clear, thin high cirrus.
22	142	14.3134	-24.7439			OCP-008	OCI-100	OCR-068	Ed	Lu	0915	0916		50	Clear, thin high cirrus.
23	142	14.3121	-24.7434			OCP-008	OCI-100	OCR-068	Ed	Lu	0920	0921		50	Clear, thin high cirrus.
24	142	14.3115	-24.7431			OCP-008	OCI-100	OCR-068	Ed	Lu	0922	0924		50	Clear, thin high cirrus.
25	142	14.3106	-24.7427			OCP-008	OCI-100	OCR-068	Ed	Lu	0926	0927		50	Clear, thin high cirrus.
26	142	14.1042	-24.2759	1226		OCP-008	OCI-100	OCR-068	Ed	Lu	1239	1240	1244	65	Cloudy, high cirrus.
27	142	14.1032	-24.2764			OCP-008	OCI-100	OCR-068	Ed	Lu	1248	1249		65	Thin high cirrus.
28	142	14.1027	-24.2767			OCP-008	OCI-100	OCR-068	Ed	Lu	1252	1254		50	Thin high cirrus.
29	142	14.1020	-24.2773			OCP-008	OCI-100	OCR-068	Ed	Lu	1257	1258		65	Thin high cirrus.
30	142	14.1015	-24.2775			OCP-008	OCI-100	OCR-068	Ed	Lu	1300	1301		60	Thin high cirrus.
31	142	14.1007	-24.2780			OCP-008	OCI-100	OCR-068	Ed	Lu	1305	1306		60	Thicker high cirrus.
32	143	12.1012	-21.3976	1403		OCP-008	OCI-100	OCR-035	Ed	Lu	1416	1417		60	Clear.
33	143	12.1014	-21.3984			OCP-008	OCI-100	OCR-035	Ed	Lu	1419	1420		50	Clear.
34	143	12.1025	-21.4006			OCP-008	OCI-100	OCR-035	Ed	Lu	1428	1429		55	Clear.
35	143	12.1031	-21.4016			OCP-008	OCI-100	OCR-035	Ed	Lu	1435	1436		60	Clear.
36	144	12.1521	-18.9076	1146		OCP-008	OCI-100	OCR-035	Ed	Lu	1200	1201		50	Mostly cloudy.
37	144	12.1517	-18.9078			OCP-008	OCI-100	OCR-035	Ed	Lu	1206	1207		50	Mostly cloudy.
38	144	12.1508	-18.9086			OCP-008	OCI-100	OCR-035	Ed	Lu	1215	1216		50	Mostly cloudy.
39	144	12.1502	-18.9094			OCP-008	OCI-100	OCR-035	Ed	Lu	1222	1223		50	Mostly cloudy.
40	144	12.0336	-18.8801			OCP-008	OCI-100	OCR-035	Ed	Lu	1328	1329		50	Clear.
41	144	12.0332	-18.8809			OCP-008	OCI-100	OCR-035	Ed	Lu	1335	1336		50	Clear.
42	144	12.0331	-18.8814			OCP-008	OCI-100	OCR-035	Ed	Lu	1339	1339		50	Clear.
43	144	12.0330	-18.8818			OCP-008	OCI-100	OCR-035	Ed	Lu	1342	1342		50	Clear.
44	144	12.0328	-18.8824	1351		OCP-008	OCI-100	OCR-035	Ed	Lu	1346	1346		50	Clear.
45	145	11.3306	-17.6583	0756		OCP-008	OCI-100	OCR-035	Ed	Lu	0909	0911	0901	60	Clear, high haze.
46	145	11.3301	-17.6576			OCP-008	OCI-100	OCR-035	Ed	Lu	0913	0914		50	Clear, high haze.
47	145	11.3290	-17.6567			OCP-008	OCI-100	OCR-035	Ed	Lu	0921	0922		60	Clear, high haze.
48	145	11.3287	-17.6564			OCP-008	OCI-100	OCR-035	Ed	Lu	0924	0925		60	Clear, high haze.
49	145	11.0711	-17.4384			OCP-008	OCI-100	OCR-035	Ed	Lu	1207	1208	1214	55	Clear, light haze.
50	145	11.0680	-17.4382			OCP-008	OCI-100	OCR-035	Ed	Lu	1217	1217		55	Clear, light haze.
51	145	11.0667	-17.4381			OCP-008	OCI-100	OCR-035	Ed	Lu	1220	1221		55	Clear, light haze.
52	146	7.8598	-14.7428	0918		OCP-008	OCI-100	OCR-035	Ed	Lu	0925	0925	0930	55	Clear.

53	146	7.8589	-14.7414		OCP-008	OCI-100	OCR-035	Ed	Lu	0929 0930	60	Clear.
54	146	7.8591	-14.7405		OCP-008	OCI-100	OCR-035	Ed	Lu	0934 0935	60	Clear.
55	146	7.5576	-14.4937		OCP-008	OCI-100	OCR-035	Ed	Lu	1135 1136 1136	45	Clear.
56	146	7.5564	-14.4942		OCP-008	OCI-100	OCR-035	Ed	Lu	1139 1140	60	Clear.
57	146	7.5559	-14.4943		OCP-008	OCI-100	OCR-035	Ed	Lu	1143 1144	55	Clear.
58	147	4.1391	-11.6207	0837	OCP-008	OCI-100	OCR-035	Ed	Lu	0952 0953 0959	55	Clear, cloud at end.
59	147	4.1385	-11.6195		OCP-008	OCI-100	OCR-035	Ed	Lu	0956 0957	60	Cloudy.
60	147	3.6353	-11.1959		OCP-008	OCI-100	OCR-035	Ed	Lu	1316 1317	55	Partly cloudy w/sun breaks.
61	147	3.6314	-11.1972		OCP-008	OCI-100	OCR-035	Ed	Lu	1331 1332	50	Partly cloudy w/sun breaks.
62	148	-0.0542	-8.1624	0750 1122	OCP-008	OCI-100	OCR-035	Ed	Lu	1431 1432 1439	50	Clear.
63	148	-0.0560	-8.1637		OCP-008	OCI-100	OCR-035	Ed	Lu	1443 1444	60	Clear.
64	148	-0.0562	-8.1640		OCP-008	OCI-100	OCR-035	Ed	Lu	1446 1447	60	Clear.
65	148	-0.0567	-8.1644		OCP-008	OCI-100	OCR-035	Ed	Lu	1450 1451	60	Clear.
66	149	-2.6318	-5.8643	0841	OCP-008	OCI-100	OCR-035	Ed	Lu	1008 1009 0951	50	Clear.
67	149	-2.6331	-5.8634		OCP-008	OCI-100	OCR-035	Ed	Lu	1013 1014	50	Clear, small cloud moved through.
68	154	-19.1209	9.0631	0900	OCP-008	OCI-100	OCR-035	Ed	Lu	0923 0924 0935	55	Completely overcast w/some brightening.
69	154	-19.1210	9.0631		OCP-008	OCI-100	OCR-035	Ed	Lu	0926 0926	50	Completely overcast w/some brightening.
70	154	-19.1210	9.0632		OCP-008	OCI-100	OCR-035	Ed	Lu	0928 0929	50	Completely overcast w/some brightening.
71	154	-19.1210	9.0633		OCP-008	OCI-100	OCR-035	Ed	Lu	0932 0933	50	Completely overcast w/some brightening.
72	154	-19.4284	9.4100		OCP-008	OCI-100	OCR-035	Ed	Lu	1308 1308 1324	55	Clear w/high haze.
73	154	-19.4281	9.4103		OCP-008	OCI-100	OCR-035	Ed	Lu	1312 1313	55	Clear w/high haze.
74	154	-19.4281	9.4102		OCP-008	OCI-100	OCR-035	Ed	Lu	1316 1317	55	Clear w/high haze.
75	157	-20.0025	20.4056	0841 0929	OCP-008	OCI-100	OCR-035	Ed	Lu	0955 0956	50	Clear.
76	157	-20.0025	20.4056		OCP-008	OCI-100	OCR-035	Ed	Lu	0959 1000	50	Clear.
77	157	-20.0027	20.4061		OCP-008	OCI-100	OCR-035	Ed	Lu	1002 1003	50	Clear.
78	157	-20.0031	20.4067		OCP-008	OCI-100	OCR-035	Ed	Lu	1005 1006	50	Clear.
79	157	-20.0035	20.4071		OCP-008	OCI-100	OCR-035	Ed	Lu	1011 1012	50	Clear.
80	157	-20.0035	20.4077		OCP-008	OCI-100	OCR-035	Ed	Lu	1014 1015	50	Clear.
81	157	-20.0033	20.4089		OCP-008	OCI-100	OCR-035	Ed	Lu	1019 1020	50	Clear.
82	157	-20.0032	20.4099		OCP-008	OCI-100	OCR-035	Ed	Lu	1023 1024	50	Clear.
83	157	-20.0032	20.4109		OCP-008	OCI-100	OCR-035	Ed	Lu	1027 1028 1032	50	Clear.
84	158	-19.9956	25.0863	0829	OCP-008	OCI-100	OCR-035	Ed	Lu	1331 1332 1325	60	Clear.
85	160	-17.1673	32.6517		OCP-008	OCI-100	OCR-035	Ed	Lu	1308 1309	65	Clear.
86	161	-17.5050	36.6141	0828	OCP-008	OCI-100	OCR-035	Ed	Lu	0948 0948 0944	50	Clear.
87	161	-17.5050	36.6140		OCP-008	OCI-100	OCR-035	Ed	Lu	0955 0955	65	Clear.
88	161	-17.5051	36.6139		OCP-008	OCI-100	OCR-035	Ed	Lu	1001 1001	50	Clear.

Appendix A6-10 SeaSPEC log.

AMT-6 SeaSPEC Log. All times reported in GMT (SDY 135 is 15 May and SDY 152 is 1 June).

Cast		Position		Collectors		Cables		Measurement		Down Cast		CCD	Up Cast		Depth	
No.	SDY	Longitude	Latitude	Port1	Port2	Port1	Port2	Port1	Port2	Beg.	End	Pic.	Beg.	End	[m]	Comments
0	148	0.5983	-8.6225	C	A	C	2 m	Ed	Lu	0912	0930		0934	0938	50	Cloudy.
1	150	-6.1703	-2.8111	C	A	C	2 m	Ed	Lu	0928	0939	0848	0952	0959	70	Scattered clouds [down], Clear [up].
2	151	-8.8637	-0.0221	C	A	C	2 m	Ed	Lu	0900	0924	0911	0930	0938	70	Mostly cloudy w/sun breaks.
3	152	-12.7718	3.0734	C	A	C	2 m	Ed	Lu	0917	0934	0932	0941	0948	70	Sunny w/high cirrus.
4	153	-16.0816	5.8623	C	A	C	2 m	Ed	Lu	0916	0932		0934	0939	50	Completely cloudy.
5	154	-19.1210	9.0632	C	A	C	2 m	Ed	Lu	0913	0927	0935	0930	0935	60	Completely overcast w/some brightening over time.
6	155	-19.2441	12.7903	C	A	C	2 m	Ed	Lu	0912	0930	0955	0953	1000	70	Partly cloudy w/high haze.
7	156	-20.0042	16.3781	C	A	C	2 m	Ed	Lu	0917	0933	1014	0936	0942	70	Partly cloudy, clear w/occasional cloud.
8	157	-20.0025	20.4054	C	A	C	2 m	Ed	Lu	0920	0936	1032	0939	0942	40	Clear.
9	158	-20.0004	24.5058	C	A	C	2 m	Ed	Lu	0908	0921	0939	0925	0931	70	Cloudy, diffuse lighting.

113	156	-20.0048	16.3778			OCP-019	OCR-064	OCR-028	Ls	Lw	1021	1024		Clear w/occasional cloud.
114	157	-20.0025	20.4055	0841	0841	OCP-019	OCR-064	OCR-028	Ls	Lw	0920	0923		Clear.
115	157	-20.0025	20.4055			OCP-019	OCR-064	OCR-028	Ls	Lw	0923	0926		Clear.
116	157	-20.0025	20.4053			OCP-019	OCR-064	OCR-028	Ls	Lw	0926	0929		Clear.
117	157	-20.0025	20.4053			OCP-019	OCR-064	OCR-028	Ls	Lw	0929	0932		Clear.
118	157	-20.0025	20.4054			OCP-019	OCR-064	OCR-028	Ls	Lw	0932	0935		Clear.
119	157	-20.0024	20.4054			OCP-019	OCR-064	OCR-028	Ls	Lw	0935	0938		Clear.
120	157	-20.0024	20.4055			OCP-019	OCR-064	OCR-028	Ls	Lw	0939	0942		Clear.
121	157	-20.0026	20.4056			OCP-019	OCR-064	OCR-028	Ls	Lw	0942	0945		Clear.
122	157	-20.0034	20.4070			OCP-019	OCR-064	OCR-028	Ls	Lw	1009	1012		Clear.
123	157	-20.0035	20.4074			OCP-019	OCR-064	OCR-028	Ls	Lw	1012	1015		Clear.
124	157	-20.0034	20.4082			OCP-019	OCR-064	OCR-028	Ls	Lw	1015	1018		Clear.
125	157	-20.0033	20.4089			OCP-019	OCR-064	OCR-028	Ls	Lw	1018	1021		Clear.
126	157	-20.0032	20.4099			OCP-019	OCR-064	OCR-028	Ls	Lw	1022	1025		Clear.
127	157	-20.0032	20.4107			OCP-019	OCR-064	OCR-028	Ls	Lw	1025	1028		Clear.
128	157	-20.0034	20.4114			OCP-019	OCR-064	OCR-028	Ls	Lw	1028	1031		Clear.
129	157	-20.0038	20.4116			OCP-019	OCR-064	OCR-028	Ls	Lw	1031	1034	1032	Clear.
130	157	-19.9954	20.6784			OCP-019	OCR-064	OCR-028	Ls	Lw	1211	1214		Clear.
131	157	-19.9954	20.6788			OCP-019	OCR-064	OCR-028	Ls	Lw	1214	1217		Clear.
132	157	-19.9955	20.6791			OCP-019	OCR-064	OCR-028	Ls	Lw	1217	1220		Clear.
133	157	-20.0010	20.8687			OCP-019	OCR-064	OCR-028	Ls	Lw	1328	1331		Clear.
134	157	-20.0001	20.8689			OCP-019	OCR-064	OCR-028	Ls	Lw	1331	1334		Clear.
135	157	-19.9998	20.8692			OCP-019	OCR-064	OCR-028	Ls	Lw	1335	1338		Clear.
136	157	-19.9998	20.8693			OCP-019	OCR-064	OCR-028	Ls	Lw	1338	1341		Clear.
137	158	-20.0003	24.5057	0829	0829	OCP-019	OCR-064	OCR-028	Ls	Lw	0907	0910		Cloudy, diffuse lighting.
138	158	-20.0003	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0910	0913		Cloudy, diffuse lighting.
139	158	-20.0004	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0914	0917		Cloudy, diffuse lighting.
140	158	-20.0004	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0917	0920		Cloudy, diffuse lighting.
141	158	-20.0005	24.5057			OCP-019	OCR-064	OCR-028	Ls	Lw	0920	0923		Cloudy, diffuse lighting.
142	158	-20.0005	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0923	0926		Cloudy, diffuse lighting.
143	158	-20.0004	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0926	0929		Cloudy, diffuse lighting.
144	158	-20.0003	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0929	0932		Cloudy, diffuse lighting.
145	158	-20.0002	24.5058			OCP-019	OCR-064	OCR-028	Ls	Lw	0938	0941	0939	Cloudy, diffuse lighting.
146	158	-20.0018	24.5062			OCP-019	OCR-064	OCR-028	Ls	Lw	0941	0944		Cloudy, diffuse lighting.
147	158	-20.0014	24.5062			OCP-019	OCR-064	OCR-028	Ls	Lw	0944	0947		Cloudy, diffuse lighting.
148	158	-20.0012	24.5062			OCP-019	OCR-064	OCR-028	Ls	Lw	0947	0950		Cloudy, diffuse lighting.
149	158	-20.0011	24.9910			OCP-019	OCR-064	OCR-028	Ls	Lw	1232	1235		Clear.
150	158	-20.0010	24.9913			OCP-019	OCR-064	OCR-028	Ls	Lw	1236	1239		Clear.
151	158	-20.0012	24.9916			OCP-019	OCR-064	OCR-028	Ls	Lw	1239	1242	1325	Clear.
152	159	-19.5623	29.0874	0848	0848	OCP-019	OCR-064	OCR-028	Ls	Lw	1229	1232		Clear.
153	159	-19.5621	29.0875			OCP-019	OCR-064	OCR-028	Ls	Lw	1233	1236		Clear.
154	159	-19.5620	29.0875			OCP-019	OCR-064	OCR-028	Ls	Lw	1236	1239	1239	Clear.
155	159	-19.5620	29.0874			OCP-019	OCR-064	OCR-028	Ls	Lw	1239	1242		Clear.
156	160	-17.1651	32.6533	0727	0727	OCP-019	OCR-064	OCR-028	Ls	Lw	1255	1258		Clear.
157	160	-17.1657	32.6529			OCP-019	OCR-064	OCR-028	Ls	Lw	1258	1301		Clear.
158	160	-17.1664	32.6525			OCP-019	OCR-064	OCR-028	Ls	Lw	1301	1305		Clear.
159	160	-17.1669	32.6520			OCP-019	OCR-064	OCR-028	Ls	Lw	1305	1308		Clear.
160	160	-17.1674	32.6516			OCP-019	OCR-064	OCR-028	Ls	Lw	1308	1311		Clear.
161	160	-17.1681	32.6511			OCP-019	OCR-064	OCR-028	Ls	Lw	1311	1314		Clear.

Appendix AMT 6-12: FRRF Data Acquisition Log

Date	Time Start		Position		Gain	File Name	Notes
	GMT	Ship	Lat	Lon			
15.5.98	11:15:05	13:15:05			16	UNDWY01	
15.5.98	12:25:19	14:25:19	33.37.15 S	18.00.27 E	16	CTDP01	No PAR data using new prog
15.5.98	15:30:18	17:30:18			16	UNDWY02	Periodic air in flow-through
15.5.98	23:04:57	01:04:57			16	UNDWY03	Periodic air in flow-through
16.5.98	08:05:23	10:05:23	32.20.21 S	17.52.67	16	CTDP02	
16.5.98	09:32:32	11:32:32			4	UNDWY04	Outflow tube not in place
16.5.98	12:25:02	14:25:02	32.03.75 S	17.51.81 E	4	UNDWY05	
16.5.98	20:32:10	22:32:10	31.17.10 S	16.20.56 E	4	UNDWY06	
16.5.98	22:05:11	22:05:11	31.03.88 S	16.34.74 E	4	UNDWY07	Periodic air in flow-through
17.5.98	05:25:04	07:25:04	29.50.11 S	16.49.73 E	4	UNDWY08	
17.5.98	07:55:47	09:55:47	29.31.24 S	16.27.21 E	16	CTDP03	
17.5.98	09:58:16	11:58:16	29.29.67 S	16.23.88 E	4	UNDWY09	FRRF submerged to avoid air
17.5.98	11:06:18	13:06:18	29.21.85 S	16.14.92 E	16	CTDP04	
17.5.98	12:16:00	14:16:00	29.21.12 S	16.15.82 E	4	UNDWY10	
17.5.98	14:27:00	16:27:00	29.02.05 S	16.02.29 E	4	UNDWY11	
17.5.98	22:34:17	00:34:17	27.45.63 S	15.08.34 E	4	UNDWY12	
18.5.98	05:38:12	07:38:12	26.42.31 S	14.47.22 E	4	UORP01	Flashing on recovery (= logger file Tow603.dat)
18.5.98	09:55:00	11:55:00	26.42.05 S	14.13.36 E	4	UORP02	Flashing on recovery (= logger file Tow604.dat)
18.5.98	12:39:24	14:39:24	26.42.62 S	13.55.75 E	4	UORP03	Flashing on recovery (= logger file Tow605.dat)
20.5.98	09:34:04	11:34:04	33.43.74 S	18.11.39 E	4	UNDWY13	
20.5.98	16:13:47	18:13:47	32.23.96 S	17.22.20 E	4	UNDWY14	Inflow hose detached few mins
21.5.98	23:59:27	01:59:27	30.37.67 S	16.42.39 E	4	UNDWY15	
21.5.98	08:09:29	10:09:29	28.55.80 S	16.11.29 E	4	CTDP05	PAR sensor #14 used
21.5.98	09:07:20	11:07:20	28.54.49 S	16.10.13 E	4	UNDWY16	
21.5.98	11:50:00	13:50:00	28.32.59 S	15.48.25 E	4	CTDP06	PAR sensor #14 used
21.5.98	12:32:22	14:32:22	28.32.77 S	15.47.69 E	4	UNDWY17	
21.5.98	20:16:32	22:16:32	27.11.27 S	14.54.18 E	4	UNDWY18	
22.5.98	04:03:57	06:03:57	25.33.77 S	14.23.89 E	4	UNDWY19	
22.5.98	08:20:11	10:20:11	24.45.07 S	14.19.49 E	4	CTDP07	PAR sensor #14 used
22.5.98	10:04:49	12:04:49	24.38.67 S	14.15.78 E	4	UNDWY20	Alt. dark cell; contd. file through stn 12:02 to 13:24 GMT; contd. file through UOR
22.5.98	12:10:27	14:10:27	24.16.52 S	14.06.38 E	4	CTDP08	PAR sensor #14 used
22.5.98	13:29:44	15:29:44	24.14.70 S	14.05.34 E	4	UORP04	NOT Flashing on recovery (= logger file Tow606.dat)
22.5.98	18:03:47	20:03:47	23.35.81 S	13.36.34 E	4	UNDWY21	Out of stn.
23.5.98	01:49:00	03:49:00	22.22.64 S	12.23.23 E	4	UNDWY22	Alt. dark cell; contd. file through stns; contd. file through UOR
23.5.98	04:05:15	06:05:15	22.05.51 S	12.36.72 E	4	CTDP09	PAR sensor #14 used
23.5.98	05.23.33	07.23.33	22.02.76 S	12.35.52 E	4	UORP05	NOT Flashing on recovery (= logger file Tow607.dat)
23.5.98	09:32:42	11:32:42	21.39.15 S	12.24.23 E	4	UNDWY23	Alt. dark cell; started file on stn; contd. file through UOR
23.5.98	10:19:14	12:19:14	21.39.10 S	12.24.24 E	4	CTDP10	PAR sensor #14 used
23.5.98	13:41:00	15:41:00	21.23.90 S	12.06.07 E	4	CTDP11	PAR sensor #14 used
23.5.98	15:04:50	17:04:50	21.23.88 S	12.06.12 E	4	UORP06	NOT Flashing on recovery (= logger file Tow608.dat)
23.5.98	16:12:43	18:12:43	21.14.15 S	11.58.97 E	4	UNDWY24	Alt. dark cell
23.5.98	22:51:08	00:51:08	20.19.53 S	11.53.56 E	4	UNDWY25	Alt. dark cell
24.5.98	05:22:57	07:22:57	19.16.33 S	12.02.40 E	4	UNDWY26	Alt. dark cell
24.5.98	08:00:12	10:00:12	18.59.85 S	12.00.09 E	4	CTDP12	PAR sensor #14 used
24.5.98	09:15:34	11:15:34	18.59.85 S	12.00.09 E	4	CTDP13	PAR sensor #14 used
24.5.98	09:18:48	11:18:48	18.59.85 S	12.00.09 E	4	UNDWY27	Alt. dark cell; started file on stn; contd. file through UOR
24.5.98	11:50:40	13:50:40	18.54.45 S	12.09.17 E	4	CTDP14	PAR sensor #14 used
24.5.98	13:58:47	15:58:47	18.52.52 S	12.00.62 E	4	UORP07	Flashing on recovery (= logger file Tow609.dat)
24.5.98	17:06:21	19:06:21	18.42.14 S	11.32.49 E	4	UNDWY28	Alt. dark cell
25.5.98	01:20:00	03:20:00	18.10.97 S	10.51.52 E	4	UNDWY29	Alt. dark cell
25.5.98	08:11:13	10:11:13	17.39.68 S	11.19.93 E	4	CTDP15	PAR sensor #14 used
25.5.98	08:42:08	10:42:08	17.39.68 S	11.19.93 E	4	UNDWY30	Alt. dark cell; started file on stn; contd. file through UOR

25.5.98	09:36:35	11:36:35	17.39.01 S	11.19.27 E	4	UORP08	Flashing on recovery (= logger file Tow61011.dat)
25.5.98	12:29:54	14:29:54	17.26.08 S	11.03.57 E	4	UORP09	Flashing on recovery (= logger file Tow61011.dat)
25.5.98	16:06:23	18:06:23	16.58.64 S	10.32.90 E	4	UNDWY31	Alt. dark cell
25.5.98	23:50:14	01:50:14	15.56.81 S	09.18.29 E	4	UNDWY32	Alt. dark cell
26.5.98	07:32:48	09:32:48	14.51.92 S	08.00.46 E	4	UNDWY33	Alt. dark cell
26.5.98	08:39:22	10:39:22	14.44.62 S	07.51.66 E	4	CTDP16	PAR sensor #14 used
26.5.98	10:13:02	12:13:02	14.40.00 S	07.46.34 E	4	UNDWY34	Alt. dark cell; noisy data from insensitive gain
26.5.98	16:53:33	18:53:33	13.46.78 S	06.43.08 E	4	UNDWY35	Alt. dark cell; noisy data from insensitive gain
26.5.98	20:22:08	22:22:08	13.17.65 S	06.07.60 E	4	UNDWY36	Alt. dark cell; noisy data from insensitive gain
27.5.98	03:57:55	04:57:55	12.13.02 S	04.51.11 E	4	UNDWY37	Alt. dark cell; noisy data from insensitive gain
27.5.98	08:36:18	09:36:18	11.37.26 S	04.08.35 E	4	CTDP17	PAR sensor #14 used
27.5.98	09:06:43	10:06:43	11.37.26 S	04.08.35 E	4	CTDP18	PAR sensor #14 used; battery died at end of 1st depth acqn.
27.5.98	10:27:17	11:27:17	11.33.84 S	04.04.47 E	16	UNDWY38	Gain test
27.5.98	10:41:14	11:41:14	11.31.93 S	04.02.20 E	64	UNDWY39	Gain test
27.5.98	10:58:20	11:58:20	11.29.58 S	03.59.33 E	64	UNDWY40	
27.5.98	18:30:42	19:30:42	10.30.52 S	02.50.11 E	64	UNDWY41	
28.5.98	02:10:30	03:10:30	09.28.00 S	01.35.90 E	64	UNDWY42	
28.5.98	08:35:57	09:35:57	08.37.50 S	00.36.22 E	16	CTDP19	PAR sensor #14 used
28.5.98	09:11:27	10:11:27	08.37.50 S	00.36.22 E	16	CTDP20	PAR sensor #14 used
28.5.98	10:16:07	11:16:07	08.37.50 S	00.36.22 E	16	UORP10	Flashing on recovery (= logger file Tow61213.dat)
28.5.98	10:25:51	11:25:51	08.35.02 S	00.34.04 E	64	UNDWY43	Alt. dark cell
28.5.98	15:02:22	16:02:22	08.09.79 S	00.03.79 W	16	UORP11	NOT Flashing on recovery (= logger file Tow61213.dat)
28.5.98	18:12:07	19:12:07	07.44.13 S	00.26.22 W	64	UNDWY44	Alt. dark cell
29.5.98	02:01:47	03:01:47	06.43.19 S	01.36.78 W	64	UNDWY45	Alt. dark cell
29.5.98	08:32:08	09:32:08	05.51.91 S	02.37.50 W	16	CTDP21	PAR sensor #14 used
29.5.98	09:21:37	10:21:37	05.51.91 S	02.37.50 W	16	CTDP22	PAR sensor #14 used
29.5.98	10:14:02	11:14:02	05.51.80 S	02.37.99 W	64	UNDWY46	
29.5.98	17:50:25	18:50:25	04.48.36 S	03.50.37 W	64	UNDWY47	
30.5.98	01:31:20	02:31:20	03.47.28 S	05.01.49 W	64	UNDWY48	
30.5.98	08:30:14	09:30:14	02.48.68 S	06.09.97 W	16	CTDP23	PAR sensor #14 used
30.5.98	09:14:22	10:14:22	02.48.68 S	06.09.97 W	16	CTDP24	PAR sensor #14 used
30.5.98	10:10:03	11:10:03	02.48.59 S	06.10.44 W	64	UNDWY49	Start file on stn.; change gain
30.5.98	17:48:29	18:48:29	01.43.83 S	07.02.08 W	64	UNDWY50	
30.5.98	20:55:03	21:55:03	01.08.15 S	07.25.20 W	16	UNDWY51	Alt. dark cell
30.5.98	21:06:52	22:06:52	01.06.92 S	07.26.02 W	16	UORP12	NOT Flashing on recovery (= logger file Tow61415.dat)
31.5.98	03:31:08	04:31:08	00.12.93 S	08.05.63 W	16	UNDWY52	Alt. dark cell
31.5.98	03:31:32	04:31:32	00.12.98 S	08.05.63 W	16	UORP13	Flashing on recovery (= logger file Tow61415.dat)
31.5.98	10:32:03	11:32:03	00.00.27 S	08.55.34 W	16	UNDWY53	*Part* noisy data from insensitive gain
31.5.98	18:38:09	19:38:09	01.03.02 N	10.17.83 W	16	UNDWY54	*Part* noisy data from insensitive gain
31.5.98	23:15:01	00:15:01	01.43.06 N	11.07.58 W	16	UNDWY55	*Part* noisy data from insensitive gain
1.6.98	06:59:00	07:59:00	02.49.19 N	12.28.11 W	64	UNDWY56	Change gain
1.6.98	09:10:11	10:10:11	03.04.40 N	12.46.31 W	16	CTDP25	PAR sensor #14 used
1.6.98	09:52:46	10:52:46	03.04.40 N	12.46.31 W	16	CTDP26	PAR sensor #14 used
1.6.98	10:58:30	11:58:30	03.06.38 N	12.40.32 W	64	UNDWY57	
1.6.98	18:30:53	19:30:53	04.00.26 N	13.57.04 W	64	UNDWY58	
2.6.98	02:10:15	03:10:15	04.57.29 N	15.07.85 W	64	UNDWY59	
2.6.98	09:08:56	10:08:56	05.51.74 N	16.04.90 W	16	CTDP27	PAR sensor #14 used
2.6.98	09:35:11	10:35:11	05.51.74 N	16.04.90 W	16	CTDP28	PAR sensor #14 used; FRRF not flashing on recovery.
2.6.98	10:35:08	11:35:08	05.53.20 N	16.06.34 W	64	UNDWY60	
2.6.98	18:43:52	19:43:52	07.01.00 N	17.11.12 W	64	UNDWY61	
3.6.98	02:26:00	03:26:00	08.10.44 N	18.15.87 W	64	UNDWY62	
3.6.98	09:11:12	10:11:12	09.03.80 N	19.07.26 W	16	CTDP29	PAR sensor #14 used
3.6.98	09:47:52	10:47:52	09.03.80 N	19.07.26 W	16	CTDP30	PAR sensor #14 used
3.6.98	10:38:19	11:38:19	09.04.28 N	19.07.72 W	64	UNDWY63	
3.6.98	12:20:39	13:20:39	09.18.84 N	19.20.91 W	64	UNDWY64	Alt. dark cell
3.6.98	13:30:03	14:30:03	09.25.01 N	19.26.13 W	16	UORP14	Flashing on recovery (= logger

								file Tow616.dat)
3.6.98	19:06:13	20:06:13	10.11.63 N	19.46.22 W	64	UNDWY65	Alt. dark cell
4.6.98	02:52:28	03:52:28	11.41.15 N	19.28.19 W	64	UNDWY66	Alt. dark cell
4.6.98	06:06:18	07:06:18	12.19.23 N	19.20.45 W	16	UORP15	Flashing on recovery (= logger file Tow617.dat)
4.6.98	10:49:29	11:49:29	12.47.92 N	19.14.68 W	64	UNDWY67	Alt. dark cell
4.6.98	13:33:39	14:33:39	13.17.84 N	19.08.74 W	64	UNDWY68	Alt. dark cell
4.6.98	14:03:18	15:03:18	13.18.31 N	19.08.75 W	4	UORP16	Flashing on recovery (= logger file Tow618.dat)
4.6.98	20:12:13	21:12:13	14.22.63 N	19.06.32 W	64	UNDWY69	Alt. dark cell
5.6.98	01:32:42	02:32:42	15.19.45 N	19.28.65 W	16	UNDWY70	Alt. dark cell
5.6.98	06:28:45	08:28:45	15.57.63 N	19.58.67 W	4	UORP17	Flashing on recovery (= logger file Tow62021.dat)
5.6.98	09:21:32	10:21:32	16.22.66 N	20.00.28 W	4	CTDP31	PAR sensor #14 used
5.6.98	09:53:46	10:53:46	16.22.66 N	20.00.28 W	4	CTDP32	PAR sensor #14 used
5.6.98	11:26:05	12:26:05	16.30.62 N	20.00.03 W	16	UNDWY71	Alt. dark cell
5.6.98	19:09:03	20:09:03	17.47.47 N	20.00.00 W	16	UNDWY72	
6.6.98	02:41:42	03:41:42	19.15.63 N	19.59.86 W	16	UNDWY73	
6.6.98	06:28:15	07:28:15	19.58.39 N	20.00.16 W	4	UORP18	Flashing on recovery (= logger file Tow62021.dat)
6.6.98	06:28:13	07:28:13	19.58.39 N	20.00.16 W	16	UNDWY74	Alt. dark cell
6.6.98	09:13:28	10:13:28	20.24.32 N	20.00.14 W	4	CTDP33	PAR sensor #14 used
6.6.98	10:41:05	11:41:05	20.25.08 N	20.00.27 W	16	UNDWY75	Alt. dark cell
[illegible].98	13:48:27	14:48:27	20.52.49 N	20.00.00 W	4	UORP19	Flashing on recovery (= logger file Tow622.dat)
6.6.98	18:01:22	19:01:22	21.37.62 N	20.00.49 W	16	UNDWY76	Alt. dark cell
7.6.98	01:54:97	02:54:97	23.09.35 N	20.00.12 W	16	UNDWY77	Alt. dark cell
7.6.98	10:41:42	11:41:42	24.38.32 N	20.00.14 W	64	UNDWY78a UNDWY78b	Flow through both FRR's in series: a= alum; b=titan
7.6.98	18:11:56	19:11:56	25.58.06 N	19.59.90 W	64	UNDWY79	
8.6.98	01:54:00	02:54:00	27.23.24 N	19.59.90 W	64	UNDWY80	
8.6.98	09:04:06	10:04:06	28.41.07 N	19.52.24 W	64	CTDP34	PAR sensor #14 used
8.6.98	10:03:12	11:03:12	28.42.21 N	19.51.40 W		UNDWY81	
8.6.98	13:51:48	14:51:48	29.16.50 N	19.25.58 W	64	UNDWY82a UNDWY82b	Flow through both FRR's in series: a= alum; b=titan
8.6.98	20:22:00	21:22:00	30.28.68 N	18.33.53 W	64	UNDWY83	Flow through both FRR's in series: a= alum; b=titan
9.6.98	03:09:51	04:09:51	31.36.61 N	17.40.14 W	64	UNDWY84	
9.6.98	08:02:11	09:02:11	32.25.69 N	17.02.91 W	16	CTDP35	PAR sensor #14 used; no 2 minute depth stops; battery fail
9.6.98	09:53:22	10:53:22	32.30.42 N	17.09.20 W	64	UNDWY85	
9.6.98	17:10:24	18:10:24	33.16.63 N	17.29.79 W	64	UNDWY86	
10.6.98	01:31:16	02:31:16	35.02.14 N	17.30.03 W	64	UNDWY87	
10.6.98	09:47:09	10:47:09	36.36.85 N	17.30.30 W	16	CTDP36	PAR sensor #14 used
10.6.98	10:42:58	11:42:58	36.37.43 N	17.30.35 W	64	UNDWY88	
10.6.98	18:14:21	19:14:21	38.06.61 N	17.30.21 W	64	UNDWY89	
[illegible]98	09:06:22	10:06:22	41.04.80 N	17.25.93 W	16	CTDP37	PAR sensor #14 used
11.6.98	09:54:55	10:54:55	41.04.83 N	17.25.90 W	64	UNDWY90	
11.6.98	18:50:32	19:50:32	42.21.56 N	16.12.66 W	64	UNDWY91	
12.6.98	02:31:20	03:31:20	43.40.12 N	15.01.86 W	64	UNDWY92	
12.6.98	10:02:01	11:02:01	44.40.53 N	14.01.27 W	16	UNDWY93a UNDWY 93b	Flow through both FRR's in series: a= alum; b=titan
12.6.98	17:60:48	18:60:48	45.48.52 N	12.46.53 W	16	UNDWY94a UNDWY 94b	Flow through both FRR's in series: a= alum; b=titan
13.6.98	01:32:00	02:32:00	47.12.04 N	11.10.09 W	16	UNDWY95a UNDWY 95b	Flow through both FRR's in series: a= alum; b=titan
13.6.98	06:06:16	08:06:16	47.58.05 N	10.17.85 W	4	UORP20	Flashing on recovery (= logger file Tow62324.dat); av. Aqn=16
13.6.98	09:46:35	10:46:35	48.27.02 N	09.41.01 W	4	CTDP38	PAR sensor #14 used; av. aqn=16
13.6.98	10:31:32	11:31:32	48.26.91 N	09.41.92 W	4	UNDWY96	Alt. dark cell
13.6.98	12:49:05	13:49:05	48.37.21 N	09.04.00 W	16	UNDWY97	Alt. dark cell
13.6.98	14:58:14	15:58:14	48.43.30 N	08.37.16 W	4	UNDWY98	Alt. dark cell
13.6.98	18:48:26	19:48:26	48.52.33 N	07.50.49 W	4	UORP21	Flashing on recovery (= logger file Tow62324.dat)
13.6.98	22:45:06	23:45:06	49.07.92 N	06.51.15 W	4	UNDWY99	Alt. dark cell
14.6.98	06:19:22	07:19:22	49.48.34 N	04.47.79 W	4	UNDWY100	Alt. dark cell
14.6.98	09:01:04	10:01:04	49.50.28 N	04.09.54 W	4	CTDP39	PAR sensor #14 used
14.6.98	10:16:07	11:16:07	49.50.32 N	04.08.93 W	4	UNDWY101a UNDWY101b	Flow through both FRR's in series: a= alum; b=titan
14.6.98	16:29:06	17:29:06	50.12.93 N	02.36.47 W	4	UNDWY102	Flow thro both FRR's in series:

Appendix AMT 6-13: UOR Tow Log

Date	Tow Number	Time Start (GMT)	Position		Time Stop (GMT)	Position		File Name	Notes
			Lat	Lon		Lat	Lon		
17.5.98	TowA601	07:30			07:55			Towtest.dat	Stopped on station test: LOG JA8 and CTDF JA
17.5.98	TowA602	12:12	29.20.1 S	16.14.4 E	17:55	28.33.5 S	15.40.8 E	n/a	Logger failed to record (no data)
18.5.98	TowA603	05:38	26.42.3 S	14.47.2 E	08:24	26.41.8 S	14.14.8 E	Tow603.dat	Removed SSDL JA3, FRRF added 08:00: 26.41.8 S 14. ,9.4 E)
18.5.98	TowA604	09:48	26.42.0 S	14.13.3 E	11:18	26.42.3 S	13.58.4 E	Tow604.dat	
18.5.98	TowA605	12:32	26.42.6 S	13.55.7 E	14:44	26.42.5 S	13.31.2 E	Tow605.dat	Battery to FRR flooded; no damage to data acqn.
22.5.98	TowA606	13.19	24.14.7 S	14.05.3 E	17.43	23.38.4 S	13.38.8 E	Tow606.dat	FRRF not flashing on recovery
23.5.98	TowA607	05:29	22.02.7 S	12.35.5 E	07:45	21.39.1 S	12.24.2 E	Tow607.dat	Und 9 (07:03, 21.47.6 S 12.28.5 E); FRRF n flashing on recovery
23.5.98	TowA608	15:05	21.23.9 S	12.06.1 E	19:45	20.44.4 S	11.36.3 E	Tow608.dat	FRRF not flashing on recovery
24.5.98	TowA609	13:59	18.52.5 S	12.00.6 E	16:02			Tow609.dat	Und 5, 14:55, 18.49.6 S 12.52.3 E.
25.5.98	TowA610	09:36	17.39.0 S	11.19.3 E	11:28	17.26.5 S	11.04.5 E	Tow61011.dat	
25.5.98	TowA611	12:29	17.26.1 S	11.03.6 E	17:55			Tow61011.dat	Und 31, 17:24, 16.49.6 S 10.21.6 E; 18 05, 16.44.8 S 10.16.0 E
28.5.98	TowA612	10:16	08.35.9 S	00.34.1 E	11:25			Tow61213.dat	
28.5.98	TowA613	15:02	08.09.8 S	00.03.7 W	20:50	07.25.7 S	00.47.4 W	Tow61213.dat	FRRF not flashing on recovery
30.5.98	TowA614	21:06	01.06.9 S	07.26.0 W	03:05	00.13.6 S	08.02.9 W	Tow61415.dat	FRRF not flashing on recovery
31.5.98	TowA615	03:31	00.12.9 S	08.05.6 W	08:00	00.01.7 S	08.51.0 W	Tow61415.dat	
03.6.98	TowA616	14:30	09.25.0 N	19.26.1 W	18:48	10.08.9 N	19.46.8 W	Tow616.dat	
04.6.98	TowA617	06:06	12.19.2 N	19.20.4 W	08:52	12.47.1 N	19.14.7 W	Tow617.dat	
04.6.98	TowA618	14:03	13.18.3 N	19.08.8 W	18:54	14.09.8 N	19.01.5 W	Tow618.dat	
05.6.98	TowA619	06:02	15:38:8 N	19:58:3 W	06:26			Tow62021.dat	FRRF not switched on: UOR out for switch on & re-deploy
05.6.98	TowA620	06:28	15:57.6 N	19.58.6 W	08:55	16.22.7 N	20.00.0 W	Tow62021.dat	
06.6.98	TowA621	06:28	19.58.4 N	20.00.2 W	08:55	20.24.3 N	20.00.1 W	Tow62021.dat	
06.6.98	TowA622	13:48	20.52.5 N	20.00.20W	18:49	21.46.2 N	20.00.3 W	Tow622.dat	
13.6.98	TowA623	06:06	47.58.1 N	10.17.9 W	09:02	48.22.2 N	09.49.5 W	Tow62324.dat	
13.6.98	TowA624	18:48	48.52.3 N	07.50.5 W	22:54			Tow62324.dat	

Appendix A6-14 Chlorophyll and HPLC pigments sampling log.

Date	Time-GMT	Lat.	Long.	JD:Stn:Sample	Depth	Bottle	Chl.a	HPLC	Dom. Pig.	Fluor.
15/5	11.50			135-1-1	NT		4.64	4.589	Hex/Fuc	
	13.13			135-1-2	NT		4.05	5.567	Hex/Fuc	
15/5-Stn. 1	12.25-15.10	33 37.1 S	18 00.2 E	135-1-3	100	2	0.07			
				135-1-4	80	3	0.07			
				135-1-5	40(?100)	5,6	0.06			
				135-1-6	30	7,8	4.25			
				135-1-7	20	9,10	0.28			
				135-1-8	10	11,12	0.28	5.401	Hex/Fuc	
15/5	18.57	33 03.0 S	17 14.6 E	135-UW-9	NT		2.42			10.1
	21.00	32 53.0 S	17 03.0 E	135-UW-10	NT		1.81			8.5
	23.05	32 36.0 S	16 40.0 E	135-UW-11	NT		1.30			8.1
16/5	01.00	32 19.0 S	16 20.0 E	136-UW-12	NT		0.95			7.1
	03.00	32 20.2 S	16 47.6 E	136-UW-13	NT		1.32			11.1
	05.02	32 20.6 S	17 14.8 E	136-UW-14	NT		7.69			16.6
	07.06	32 20.4 S	17 41.6 E	136-UW-15	NT		3.18			12.7
16/5-Stn. 2	08.05-09.30	32 20.2 S	17 52.6 E	136-2-16	80	2	0.07			
				136-2-17	20	4,5	2.23	1.877	Hex/Fuc	
				136-2-18	15	6	3.02	2.704	Hex/Fuc	
				136-2-22	10	7	3.12	2.799	Hex/Fuc	
				136-2-23	7	8,9	3.09	2.591	Hex/Fuc	
				136-2-24	4	10	3.34	2.519	Hex/Fuc	
				136-2-19	0-Tot.		4.20			
				136-2-20	0-<20		2.58			
				136-2-21	0-<2		3.88			
16/5-Stn. 3	11.07-12.21	32 03.4 S	17 51.9 E	136-3-25	15(?80)	5,6	1.18	0.590	Per(Hex/Fuc)	
				136-3-26	7(?10)	9,10	5.84	4.425	Per(Hex/Fuc)	
				136-3-27	2	11,12	7.00	5.643	Per(Hex/Fuc)	
16/5	18.06	31 28.2 S	16 44.6 E	136-UW-28	NT		1.00			9.3
	20.01	31 17.4 S	16 20.9 E	136-UW-29	NT		0.92			9.8
	21.57	31 03.9 S	16 21.4 E	136-UW-30	NT		1.19			10.5
17/5	00.02	30 42.9 S	16 34.7 E	137-UW-31	NT		2.78			17.8
	02.00	30 22.8 S	16 46.7 E	137-UW-32	NT		2.65			23.3
	04.00	30 01.1 S	16 59.4 E	137-UW-33	NT		2.92			9.8
	05.57	29 45.6 S	16 44.3 E	137-UW-34	NT		3.68			12.6
	07.06	29 31.2 S	16 27.2 E	137-UW-35	NT		4.86			14.5
17/5-Stn. 4	07.55-09.50	29 31.2 S	16 27.2 E	137-4-36	80(?25)	2	0.79	0.035	Fuc	
				137-4-37	40	3	0.19	0.335	Fuc	
				137-4-38	25(?130)	4	0.11			
				137-4-39	20	5,6	2.37	2.236	Fuc(Hex)	
				137-4-40	13	7,8	4.88	4.202	Fuc(Hex)	
				137-4-41	7(?13)	9	4.85	4.233	Fuc(Hex)	
				137-4-42	3	10,11, 12	5.34	4.613	Fuc(Hex)	
				137-4-43	0-Tot.		4.14			
				137-4-44	0-<20		4.30			
				137-4-45	0-<2		1.95			
17/5-Stn. 5	11.06-12.02	29 21.7 S	16 14.9 E	137-5-46	15	10	1.94	1.721	Fuc/Hex	
				137-5-47	7	11	3.81	2.708	Fuc/Hex	16.1
				137-5-48	3	12	3.23	2.952	Fuc/Diadino	
17/5	14.49	28 59.2 S	15 59.8 E	137-UW-49	NT		2.16			16.4
	18.45	28 24.2 S	15 33.5 E	137-UW-50	NT		1.99			10.7
	21.01	28 03.2 S	15 19.2 E	137-UW-51	NT		1.67			16.9
	23.08	27 39.2 S	15 05.2 E	138-UW-52	NT		0.47			8.5
18/5	01.00	27 21.2 S	14 55.4 E	138-UW-53	NT		0.61			8.0
	03.04	26 54.5 S	14 49.6 E	138-UW-54	NT		3.29			15.9
18/5-Stn. 6	04.15-05.38	26 42.6 S	14 47.9 E	138-6-55	160	1	0.20			
				138-6-56	80	2	0.03			
				138-6-57	40	3	0.05	1.205	Fuc(Hex)	
				138-6-58	4	4	4.38			

				138-6-59	4	5	3.28			
				138-6-60	NT		3.96	3.486	Fuc/Hex	13.7
				138-6-61	4-Tot(160)	4	0.20			
				138-6-62	4-<20(160)	4	0.16			
				138-6-63	4-<2(160)	4	0.04			
18/5	07.02	26 41.7 S	14 30.4 E	138-UW-64	NT-PI		2.12	1.859	Hex	14.1
18/5-Stn. 7	08.36-09.48	26 41.8 S	14 14.8 E	138-7-65	80	3	1.37	1.210	Per/Fuc	
				138-7-66	30	5,6	3.20	2.899	Hex/Fuc/Per	
				138-7-67	20	7	2.22	2.402	Hex/Fuc	
				138-7-68	13(?20)	9	1.97	1.989	Hex/Fuc	
				138-7-69	7	10	2.18	2.113	Hex(Fuc/Diad)	
				138-7-70	4	11,12	2.48	2.171	Hex(Fuc/Diad)	
				138-7-71	4-Tot	11	2.60			
				138-7-72	4-<20	11	2.42			
				138-7-73	4-<2	11	1.69			
				138-7-74	NT		1.94	1.699	Hex(Fuc/Diad)	
18/5-Stn. 8	11.23-12.28	26 42.4 S	13 57.5 E	138-8-75	16	10	1.21	1.042	Hex/Per/Fuc	
				138-8-76	8	11	1.34	1.103	Hex/Per/Fuc	
				138-8-77	4	12	1.26	1.145	Hex/Per/Fuc	
				138-8-78	NT		1.36	1.095	Hex/Per/Fuc	
18/5	13.49	26 42.3 S	13 41.7 E	138-UW/PI-79	NT		1.21	1.209	Diadino/Per	7.5
18/5-Stn. 9	14.57-15.28	26 41.8 S	13 30.1 E	138-9-85	200	1	0.02			
				138-9-80	16	2	1.72	1.566	Hex(Fuc/Per)	
				138-9-81	10	3	1.05	0.978	Hex(Fuc/Per)	
				138-9-82	7(?200)	4	0.02			
				138-9-83	4(?16)	5	1.74	1.617	Hex(Fuc/Per)	
				138-9-84	NT		0.40	0.237	Hex	
19/5-Stn. 10	08.56-09.52 (10.00)	29 30.7 S	15 12.5 E	139-Optics-86	NT		1.19	1.102	Hex(Dia/But/Fuc)	
				139-Optics-87	NT		1.15	1.119	Hex(Dia/But/Fuc)	
				139-Optics-88	NT		1.09	0.918	Hex(Dia/But/Fuc)	
				139-Optics-89	NT		1.13	1.084	Hex(Dia/But/Fuc)	
				139-Optics-90	NT		1.13	1.002	Hex(Dia/But/Fuc)	
				139-Optics-91	NT		1.07	1.012	Hex(Dia/But/Fuc)	
20/5	12.37	33 12.7 S	17 41.6 E	140-UW-92	NT		1.21			12.0
	14.49	32 42.5 S	17 30.0 E	140-UW-93	NT		0.62			10.0
	16.29			140-UW-94	NT		27.12			33.6
	16.35	32 19.0 S	17 20.2 E	140-UW-95	NT-replicate		49.59			~50
	16.35	32 19.0 S	17 20.2 E	140-UW-96	NT-replicate		48.39			~50
	16.35	32 19.0 S	17 20.2 E	140-UW-97	NT-replicate		45.89			~50
	16.35	32 19.0 S	17 20.2 E	140-UW-98	NT-replicate		45.89			~50
	16.35	32 19.0 S	17 20.2 E	140-UW-99	NT-replicate		47.09			~50
	16.35	32 19.0 S	17 20.2 E	140-UW-100	NT-replicate		47.39			~50
20/5	19.01	31 45.4 S	17 07.9 E	140-UW-101	NT		8.16	17.739?	Per(Diadino)	17.6
	21.06	31 15.8 S	16 56.9 E	140-UW-102	NT		2.98	6.564?	Per(Dia/Hex)	14.5
	23.02	30 50.7 S	16 47.7 E	140-UW-103	NT		2.96	2.906	Per/Hex/Fuc	19.5
21/5	01.02	30 24.4 S	16 36.5 E	141-UW-104	NT		2.22	1.790	Hex/Fuc(Per/But)	20.4
	03.01	29 58.9 S	16 27.3 E	141-UW-105	NT		5.00	18.888?	Per(Hex/Fuc)	25.2
	05.01	29 33.2 S	16 17.8 E	141-UW-106	NT		3.58	2.937	Fuc/Hex(Per)	20.9
21/5-Stn. 11	08.00-09.00	28 55.8 S	16 11.3 E	141-11-107	60	2	0.14	0.767	Per	
				141-11-108	25(?60)	4,5	0.16			
				141-11-109	17	6	2.85	6.537	Per	
				141-11-110	11	7	4.72	4.450	Fuc	
				141-11-111	7	8,9	5.64	4.458	Fuc	
				141-11-112	3	10,11.12	6.08	8.299	Per/Fuc	
				141-11-113	3-Tot	11	5.98			
				141-11-114	3-<20	11	5.02			

				141-11-115	3-<2	11	1.85			
21/5-Stn. 12	11.43-12.56	28 32.5 S	15 48.3 E	141-12-116	4-Tot	11	6.66			
				141-12-117	4-<20	11	6.32			
				141-12-118	4-<2	11	2.55			
				141-12-119	12	8	6.58	5.969	Fuc/Hex	
				141-12-120	7	10	6.50	6.084	Fuc/Hex	
				141-12-121	4	12	6.26	5.966	Fuc/Hex	
21/5	15.34	28 05.6 S	15 25.3 E	141-UW-122	NT		4.40	3.896	Fuc/Hex	23.0
	18.42	27 30.0 S	15 04.7 E	141-UW-123	NT		2.54	2.102	Fuc/Hex	21.8
	21.03	27 01.9 S	14 48.7 E	141-UW-124	NT		3.04	2.146	Fuc/Hex	22.2
	23.09	26 35.1 S	14 40.0 E	141-UW-125	NT		2.52	1.775	Fuc/Hex	21.1
22/5	01.03	26 11.2 S	14 33.3 E	142-UW-126	NT		2.70	1.954	Fuc/Hex	22.8
	03.03	25 45.9 S	14 27.1 E	142-UW-127	NT		1.30	0.772	Fuc/DVb	19.5
	05.00	25 22.1 S	14 20.8 E	142-UW-128	NT		2.20	1.435	Fuc(Hex/DVb)	21.3
	06.34	25 02.4 S	14 19.6 E	142-UW-129	NT		8.00	4.334	Fuc(Dia/DVb)	30.2
	07.40			142-UW-130	NT		9.28			38.0
22/5-Stn. 13	08.00-09.32	24 45.0 S	14 19.5 E	142-13-131	100	1	4.02	2.680	Fuc	
				142-13-132	80	2	2.77	2.008	Fuc	
				142-13-133	58	3	1.82	0.782	Fuc	
				142-13-134	45	4	8.00	2.898	Fuc	
				142-13-135	35	5,6	8.96.	3.680	Fuc	
				142-13-136	23	7	6.30	3.020	Fuc	
				142-13-137	15	8	3.12	2.252	Fuc	
				142-13-138	7	9,10	3.77	2.620	Fuc	
				142-13-139	3	11,12	2.16	1.651	Fuc	27.7
				142-13-140	3-Tot	11	2.12			
				142-13-141	3-<20	11	1.94			
				142-13-142	3-<2	11	1.05			
				142-13-143	3-Tot rpt	11	2.12			
				142-13-144	3-<20 rpt	11	2.00			
				142-13-145	3-<2 rpt	11	0.86			
22/5-Stn. 14	12.03-13.11	24 16.5 S	14 06.4 E	142-14-157	70	1	5.64			
				142-14-156	50	2	2.93			
				142-14-155	30	3	1.58			
				142-14-154	15(?70)	4	4.27			
				142-14-146	15(?70)	4	5.27	3.293	Fuc	
				142-14-147	7(?50)	5	2.88	2.014	Fuc	
				142-14-148	3	6	2.91	1.676	Fuc	
				142-14-149	7-Tot		3.13			
				142-14-150	7-<20		0.35			
				142-14-151	7-<2		0.22			
				142-14-158	15-Cosc.		3919.70			
				142-14-159	70-Cosc		4059.70			
22/5	16.01	23 86.8 S	13 86.3 E	142-UW-152	NT		4.08			41.0
	18.03	23 60.2 S	13 61.1 E	142-UW-153	NT		1.45			31.5
	19.59	23 30.2 S	13 29.6 E	142-UW-160	NT		18.80			34.6
	22.00	22 58.7 S	12 58.4 E	142-UW-161	NT		0.04			35.7
23/5	00.01	22 39.8 S	12 39.4 E	143-UW-162	NT		1.60			36.3
	02.00	22 20.3 S	12 21.0 E	143-UW-163	NT		0.73			33.4
	04.00	22 05.4 S	12 36.6 E	143-UW-164	NT		2.36			37.0
23/5-Stn. 15	04.05-05.00	22 05.5 S	12 36.7 E	143-15-165	40	1	0.31			
				143-15-166	20	2	1.47	1.789	Fuc(Hex)	
				143-15-167	7	3	1.71	1.663	Hex/Fuc	
				143-15-168	3	5	1.21	1.020	Hex(Fuc)	
				143-15-169	NT/PI		1.26			
23/5	06.50	21 49.4 S	12 29.3 E	143-UW-170	NT/PI		1.30			39.8
23/5-Stn. 16	9.14	21 39.3 S	12 24.4 E	143-16-171	NT/PI		2.20			42.5
	8.02-11.06			143-16-172	100	2	0.20	0.131	Fuc	
				143-16-173	60	3,4	0.81	0.630	Fuc(Hex)	
				143-16-174	40	5	0.95	0.683	Fuc(Hex)	
				143-16-175	20	7	2.43	1.676	Fuc/Hex(Zea/Dia)	
				143-16-176	7	9,10	1.95	1.532	Fuc/Hex(Zea/Dia)	

				143-16-177	3	11,12	1.86	1.783	Fuc/Hex(Zea/Dia)	
				143-16-179	3-Tot		2.06			
				143-16-180	3-<20		1.21			
				143-16-181	3-<2		0.64			
23/5-Stn. 17	12.18-13.27 (13.09)	21 31.5 S	12 12.6 E	143-17-182	NT/PI		2.34	1.761	Hex/Fuc(Dia)	39.0
23/5-Stn. 18	13.34-14.55	21 23.9 S	12 06.1 E	143-18-186	15(?40)	4	0.09	0.361	Fuc	
				143-18-183	15(?5)	5	0.68			
				143-18-184	7	6	2.09	1.684	Hex(Fuc)	
				143-18-178	3	7	2.56	1.904	Hex(Fuc)	
23/5	15.01	21 24.0 S	12 06.1 E	143-UW-185	NT/PI		1.83	1.216	Hex(Fuc)	45.4
	17.25	21 03.8 S	11 51.0 E	143-UW-187	NT		2.26	2.024	Fuc(Hex)	40.3
	19.11			143-UW-188	NT		4.92	4.430	Fuc(Hex/Dia)	44.0
	20.37			143-UW-189	A/C 1		1.89			
	20.37			143-UW-190	A/C 2		6.36			
	20.37			143-UW-191	A/C 3		1.57			
	21.10	20 31.7 S	11 36.2 E	143-UW-192	NT		4.08	3.295	Fuc(Hex/Dia)	48.0
	23.10	20 18.7 S	11 54.7 E	143-UW-193	NT		2.55	1.601	Fuc(Hex/But)	44.9
24/5	01.10	20 02.5 S	12 18.6 E	144-UW-194	NT		1.44	0.985	Fuc(Hex)	39.0
	03.00	19 42.6 S	12 13.8 E	144-UW-195	NT		2.05			40.5
	05.00	19 20.4 S	12 04.3 E	144-UW-196	NT		2.90			58.2
	07.00			144-UW-197	A/C 4		2.01			
24/5-Stn. 19	8.15-08.52	18 59.8 S	12 00.0 E	144-19-201	180	1	1.18	0.759	Fuc(Diadino)	
				144-19-202	100	3	2.53	0.935	Fuc(Diadino)	
				144-19-203	60	7	1.13	0.348	Fuc(Diadino)	
				144-19-204	30	6	1.34	1.149	Fuc(Diadino)	
				144-19-205	20	7	1.87	1.992	Fuc(Diadino)	
				144-19-206	7	12	1.72	1.722	Fuc(Diadino)	57.1
				144-19-198	0-Tot		1.28			
				144-19-199	0-<20		0.51			
				144-19-200	0-<2		0.32			
24/5-Stn. 20	11.52-12.30	18 54.6 S	12 09.3 E	144-20-207	100a	1	19.20			
				144-20-207	100b	1	21.30			
				144-20-208	30a	2	10.02			
				144-20-208	30b	2	11.90			
				144-20-209	15	3	2.88	1.505	Fuc(Hex/Diadino)	
				144-20-210	7	6	3.18	2.016	Fuc(Hex/Diadino)	
				144-20-211	3	7	1.73	1.251	Fuc(Hex/Diadino)	
24/5-Stn. 21	13.10-13.44 (13.50)	18 52.6 S	12 02.1 E	144-21-212	Surf./Optics		3.32	3.971	Fuc(Hex/Diadino)	52.0
24/5	15.58			144-UW-213	NT		3.76			
	18.40	18 37.6 S	11 18.8 E	144-UW-214	NT		0.87			
	20.34	18 32.0 S	11 03.8 E	144-UW-215	NT		0.77			
	22.39	18 26.1 S	10 46.2 E	145-UW-216	NT		0.92			
25/5	00.37	18 16.5 S	10 46.6 E	145-UW-217	NT		0.78			
	02.40	18 01.4 S	11 00.9 E	145-UW-218	NT		1.82			
	04.20	17 50.1 S	11 10.9 E	145-UW-219	NT		3.50			
25/5-Stn. 22	08.20-09.30	17 40.0 S	11 20.1 E	145-22-225	100		0.09	0.117	Fuc	
				145-22-226	40		1.26	0.815	Fuc(Hex/Diadino)	
				145-22-227	20		3.18	1.946	Fuc(Hex/Diadino)	
				145-22-228	13		3.85	2.390	Fuc(Hex/Diadino)	
				145-22-229	7		4.00	2.522	Fuc(Hex/Diadino)	
				145-22-230	3		3.81	2.396	Fuc(Hex/Diadino)	
				145-22-220	0-Tot		4.40			
				145-22-221	0-Tot		5.15			
				145-22-222	0-Tot		5.00			
				145-22-223	0-<20		0.94			
				145-22-224	0-<2		0.51			
25/5-Stn. 23	11.33-12.25	17 26.5 S	11 04.5 E	145-23-234	30		0.90	0.565	Fuc(Hex/Diadino)	
				145-23-235	17		1.18	0.926	Fuc/Hex(Diadino)	
				145-23-236	7		1.14	0.712	Fuc/Hex(Diadino)	
				145-23-231	0-Tot		1.13			

				145-23-232	0-<20	0.83			
				145-23-233	0-<2	0.64			
25/5	14.30			145-UW-237	NT	2.00			
	16.30	16 54.9 S	10 28.2 E	145-UW-238	NT	3.59			37.2
	18.30	16 41.0 S	10 11.5 E	145-UW-239	NT	5.22			42.7
	20.32	16 24.0 S	09 50.8 E	145-UW-240	NT	1.35			79.7
	22.37	16 06.9 S	09 30.2 E	145-UW-241	NT	1.87			32.6
26/5	00.32	15 50.9 S	09 11.2 E	146-UW-242	NT	4.49			32.9
	03.09	15 28.6 S	08 43.9 E	146-UW-243	NT	0.77			44.0
	05.05	15 12.5 S	08 25.9 E	146-UW-244	NT	0.47			23.9
	07.18	14 53.8 S	08 02.8 E	146-UW-245	NT	0.81			51.9
26/5-Stn. 24	08.30-09.42	14 44.6 S	07 51.6 E	146-24-249	80	0.16	0.106	Hex	
				146-24-250	50	0.48	0.514	Hex/DVa/Zea	
				146-24-251	35	0.74	0.482	Hex/DVa/Zea	
				146-24-252	25	0.57	0.390	Hex/DVa/Zea	
				146-24-253	12	0.52	0.464	Hex/DVa/Zea	
				146-24-254	7	0.54	0.378	Hex/DVa/Zea	
				146-24-246	0-Tot	0.52			
				146-24-247	0-<20	0.47			
				146-24-248	0-<2	0.36			
				146-24-255	NT	0.66	0.556	Hex/DVa/Zea	
[illegible]/5-Stn. 25	11.32-11.47 (11.36)	14 29.6 S	07 33.5 E	146-25-256	NT/Optics	0.42	0.371	Hex/Zea/Fuc	
26/5	13.33	14 15.0 S	07 16.0 E	146-UW-257	NT	0.41			59.2
	15.45	13 55.9 S	06 54.7 E	146-UW-258	NT	0.17			48.2
	17.29	13 41.8 S	06 36.7 E	146-UW-09	NT	0.23			50.1
	19.32	13 24.6 S	06 15.9 E	146-UW-10	NT	0.17			37.6
	21.32	13 07.8 S	05 55.6 E	146-UW-11	NT	0.18			33.2
	23.32	12 08.5 S	05 59.3 E	146-UW-12	NT	0.17			40.7
	01.31	12 56.6 S	05 26.6 E	147-UW-13	NT	0.21			35.6
27/5	03.32	12 17.3 S	04 55.4 E	147-UW-14	NT	0.16			30.8
	05.30	12 00.6 S	04 36.0 E	147-UW-15	NT	0.18			30.4
	07.28	11 44.6 S	04 16.6 E	147-UW-16	NT	0.20			31.8
27/5-Stn. 26	08.32-09.00	11 37.2 S	04 08.3 E	147-26-20	140	0.02			
				147-26-21	85	0.22	0.163	Zea/DVa(Hex)	
				147-26-22	65	0.31	0.136	Zea/DVa(Hex)	
				147-26-23	52	0.49	0.350	Zea/DVa(Hex)	
				147-26-24	32	0.21	0.123	Zea/DVa(Hex)	
				147-26-25	20	0.21	0.121	Zea/DVa(Hex)	
				147-26-26	7	0.19	0.132	Zea/DVa(Hex)	30.9
				147-26-27	0	0.19	0.109	Zea/DVa(Hex)	
				147-26-17	1-Tot	0.20			
				147-26-18	1-<20	0.19			
				147-26-19	1-<2	0.14			
27/5	12.02	11 20.3 S	03 48.1 E	147-UW-28	NT	0.17			30.1
27/5-Stn. 27	13.10-13.36 (13.20)	11 11.7 S	03 38.2 E	147-27-29	NT	0.17	0.082	Zea/DVa(Hex)	29.2
27/5	15.20	10 57.2 S	03 21.2 E	147-UW-30	NT	0.19			30.2
	17.20	10 40.2 S	03 01.8 E	147-UW-31	NT	0.16			30.2
	19.20	10 24.1 S	02 42.3 E	147-UW-32	NT	0.22			31.6
	21.20	10 07.2 S	02 22.4 E	147-UW-33	NT	0.31			42.6
	23.20	09 50.8 S	02 02.6 E	147-UW-34	NT	0.14			30.0
28/5	01.20	09 34.1 S	01 43.1 E	148-UW-35	NT	0.13			27.8
	03.20	09 19.0 S	01 25.2 E	148-UW-36	NT	0.14			25.8
	05.20	09 02.9 S	01 05.9 E	148-UW-37	NT	0.15			25.5
	06.25	08 53.5 S	00 54.5 E	148-UW-39	NT	0.39			40.0
	07.28	08 45.0 S	00 44.8 E	148-UW-38	NT	0.38			45.5
28/5-Stn. 28	08.30-09.58	08 37.6 S	00 36.5 E	148-28-43	130	0.04			
				148-28-44	65	0.26	0.169	Hex/But/DVa	
				148-28-45	47	0.44	0.343	Hex/DVa	
				148-28-46	43	0.38	0.313	Hex/DVa	

				148-28-47	35	0.24	0.172	DVa(Zea/Hex)	
				148-28-48	28	0.26	0.191	DVa(Zea/Hex)	
				148-28-49	16	0.28	0.222	DVa(Zea/Hex)	
				148-28-50	7	0.28	0.193	DVa(Zea/Hex)	32.9
				148-28-51	0	0.29	0.229	DVa(Zea/Hex)	
				148-28-40	surf-Tot	0.28			
				148-28-41	surf-<20	0.27			
				148-28-42	surf-<2	0.24			
28/5	12.13	08 23.2 S	00 19.4 E	148-UW-52	NT	0.17			26.8
28/5-Stn. 29	14.22-14.56 (14.30)	08 09.8 S	00 03.3 W	148-29-53	NT/Optics	0.17	0.148	Zea/DVa(Hex)	25.5
28/5	16.39	07 55.8 S	00 13.9 W	148-UW-54	NT	0.21			26.7
	18.20	07 43.1 S	00 27.6 W	148-UW-55	NT	0.48			40.0
	20.08	07 30.3 S	00 42.3 W	148-UW-56	NT	0.74			50.9
	21.54	07 17.1 S	00 57.4 W	148-UW-57	NT	0.26			34.0
	23.53	07 00.9 S	01 16.3 W	148-UW-58	NT	0.21			33.0
29/5	01.50	06 44.5 S	01 35.2 W	149-UW-59	NT	0.26			34.0
	04.00	06 26.1 S	01 56.7 W	149-UW-60	NT	0.24			32.0
	06.01	06 10.5 S	02 14.9 W	149-UW-61	NT	0.25			31.0
29/5-Stn. 30	08.30-10.20	05 51.9 S	02 37.1 W	149-30-65	120	0.08	0.043	Hex/DVa(Zea/But)	
				149-30-66	58	0.34	0.228	Hex/DVa(Zea/But)	
				149-30-67	50	0.42	0.311	Hex/DVa(Zea/But)	
				149-30-68	47	0.44	0.297	Hex/DVa(Zea/But)	
				149-30-69	40	0.50	0.388	Hex/DVa(Zea/But)	
				149-30-70	33	0.41	0.348	Hex/DVa(Zea/But)	
				149-30-71	22	0.32	0.265	DVa/Zea(Hex)	
				149-30-72	7	0.29	0.250	DVa/Zea(Hex)	31.4
				149-30-73	0	0.30	0.214	DVa/Zea(Hex)	
				149-30-62	surf-Tot	0.26			
				149-30-63	surf-<20	0.24			
				149-30-64	surf-<2	0.20			
29/5	12.12	05 35.0 S	02 54.3 W	149-UW-74	NT	0.22			19.1
	14.07	05 20.1 S	03 13.5 W	149-UW-75	NT	0.22			30.2
	16.08	05 02.9 S	03 33.2 W	149-UW-76	NT	0.25			31.1
	18.09	04 46.2 S	03 52.9 W	149-UW-77	NT	0.21			30.2
	20.07	04 28.6 S	04 13.6 W	149-UW-78	NT	0.22			30.0
	22.06	04 15.7 S	04 28.0 W	149-UW-79	NT	0.18			30.4
	23.57	04 00.6 S	04 45.6 W	149-UW-80	NT	0.19			30.2
30/5	01.58	03 43.5 S	05 05.9 W	150-UW-81	NT	0.22			30.6
	04.01	03 25.9 S	05 25.9 W	150-UW-82	NT	0.22			30.5
	06.02	03 08.7 S	05 46.2 W	150-UW-83	NT	0.31			30.3
30/5-Stn. 31	08.30-10.58	02 48.7 S	06 09.8 W	150-31-87	120	0.03	0.017		
				150-31-88	65	0.31	0.250	Hex(DVa/But)	
				150-31-89	55	0.38	0.255	Hex(DVa/But)	
				150-31-90	40	0.41	0.318	Hex(DVa/But)	
				150-31-91	30	0.44	0.336	Hex/Zea(DVa)	
				150-31-92	20	0.31	0.244	Zea/DVa(Hex)	
				150-31-93	13	0.20	0.165	Zea/DVa(Hex)	
				150-32-94	7	0.21	0.160	Zea/DVa(Hex)	28.6
				150-33-95	0	0.22	0.172	Zea/DVa(Hex)	
				150-31-84	surf-tot	0.19			
				150-31-85	surf-<20	0.16			
				150-31-86	surf-<2	0.15			
30/5-Stn. 32	12.06-12.31 (12.12)	02 38.8 S	06 35.3 W	150-32-96	NT/Optics	0.18	0.161	Zea(DVa)	28.9
30/5	14.32	02 19.0 S	06 37.8 W	150-UW-97	NT	0.17			29.2
	16.25	01 57.9 S	06 52.1 W	150-UW-98	NT	0.24			33.6
	18.31	01 34.6 S	07 07.9 W	150-UW-99	NT	0.17			36.6
	20.30	01 12.6 S	07 22.4 W	150-UW-100	NT	0.18			44.5
	22.38	00 52.8 S	07 35.1 W	150-UW-101	NT	0.20			55.9
31/5	00.33	00 35.5 S	07 46.4 W	151-UW-102	NT	0.24			60.4

	02.34	00 17.2 S	07 58.5 W	151-UW-103	NT	0.25			60.2
	04.30	00 10.7 S	08 15.6 W	151-UW-104	NT	0.29			63.2
	06.27	00 06.0 S	08 35.8 W	151-UW-105	NT	0.36			62.6
31/5-Stn. 33	07.55-10.12	00 01.7 S	08 51.0 W	151-33-106	7	0.42	0.330	Zea/DVa/Hex	65.2
	(CTD	Broke	Down)	151-33-107	0	0.42	0.320	Zea/DVa/Hex	
				151-33-109	surf-tot	0.41			
				151-33-110	surf-<20	0.39			
				151-33-111	surf-<2	0.29			
31/5-Stn. 34	11.49-12.17	00 10.1 N	09 08.2 W	151-34-108	NT/Optic s	0.38	0.265	Zea/DVa	64.7
	(11.54)								
31/5	14.48	00 32.1 N	09 34.7 W	151-UW-112	NT	0.19			63.3
	17.01	00 50.4 N	09 59.8 W	151-UW-113	NT	0.21			65.2
	18.50	01 04.8 N	10 20.2 W	151-UW-114	NT	0.23			61.5
	20.58	01 23.1 N	10 43.2 W	151-UW-115	NT	0.22			55.6
	22.50	01 39.5 N	11 03.1 W	151-UW-116	NT	0.17			53.5
1/6	00.40	01 56.2 N	11 23.5 W	152-UW-117	NT	0.15			50.3
	02.40	02 12.6 N	11 44.1 W	152-UW-118	NT	0.19			49.3
	04.11	02 25.5 N	12 00.1 W	152-UW-119	NT	0.23			49.9
	06.08	02 42.6 N	12 20.4 W	152-UW-120	NT	0.19			47.5
	08.09	02 58.3 N	12 39.3 W	152-UW-121	NT	0.19			45.9
1/6-Stn. 35	09.08-10.32	03 04.3 N	12 46.2 W	152-35-122	140	0.05	0.010	Hex	
				152-35-123	90	0.21	0.160	Hex(But/DVa)	
				152-35-124	75	0.49	0.196	Hex(But/DVa)	
				152-35-125	60	0.33	0.251	Hex(But/DVa)	
				152-35-126	55	0.42	0.320	Hex(But/DVa)	
				152-35-127	50	0.43	0.332	Hex(But/DVa)	
				152-35-128	18	0.24	0.151	DVa/Zea(Hex)	
				152-35-129	7	0.23	0.164	DVa/Zea(Hex)	45.0
				152-35-130	0	0.26	0.168	DVa/Zea(Hex)	
				152-35-132	surf-Tot	0.23			
				152-35-133	surf-<20	0.21			
				152-35-134	surf-<2	0.18			
1/6-Stn. 36	11.22-11:43	03 10.4 N	12 53.7 W	Optics/NIL ?					
1/6	12.25	03 15.2 N	13 00.9 W	152-UW-131	NT	0.22			43.7
	14.25	03 29.4 N	13 19.4 W	152-UW-135	NT	0.29			45.9
	16.22	03 44.4 N	13 37.3 W	152-UW-136	NT	0.35			48.1
	18.30	04 00.2 N	13 57.0 W	152-UW-137	NT	0.38			48.7
	20.32	04 15.1 N	14 15.6 W	152-UW-138	NT	0.30			49.5
	22.26	04 29.3 N	14 33.2 W	152-UW-139	NT	0.30			50.0
/6	00.33	04 45.0 N	14 52.4 W	153-UW-140	NT	0.31			49.8
	02.30	04 59.0 N	15 10.0 W	153-UW-141	NT	0.33			50.0
	04.32	05 14.1 N	15 29.7 W	153-UW-142	NT	0.24			48.6
	06.27	05 31.3 N	15 45.4 W	153-UW-143	NT	0.23			48.4
2/6-Stn. 37	08.50-10.21	05 51.7 N	16 04.9 W	153-37-144	120	0.06	0.032	Hex/DVa(But)	
				153-37-145	80	0.24	0.098	Hex/DVa(But)	
				153-37-146	60	0.14	0.103	Hex/DVa(But)	
				153-37-147	51	0.40	0.297	Hex/DVa	
				153-37-148	40	0.50	0.384	Hex/DVa	
				153-37-149	34	0.48	0.407	DVa(Zea/Hex)	
				153-37-150	14	0.36	0.281	DVa(Zea/Hex)	
				153-37-151	7	0.28	0.233	DVa(Zea/Hex)	58.1x31.6
				153-37-152	0	0.27	0.215	DVa(Zea/Hex)	
2/6	12.06	06 06.1 N	16 18.3 W	153-UW-153	NT	0.28			49.5x31.6
2/6-Stn. 38	14.58-15.11	06 21.7 N	16 32.9 W	153-38-154	NT	0.24	0.201	DVa/Zea(Hex)	47.9x31.6
	(14.01)								
2/6	16.10	06 39.1 N	16 49.5 W	153-UW-155	NT	0.27			50.3x31.6
	18.24	06 58.1 N	17 07.7 W	153-UW-156	NT	0.25			53.8
	20.29	07 17.5 N	17 25.3 W	153-UW-157	NT	0.25			52.2
	22.20	07 34.9 N	17 42.0 W	153-UW-158	NT	0.25			51.8

3/6	00.03	07 49.8 N	17 56.2 W	154-UW-159	NT		0.19			49.9
	02.04	08 07.4 N	18 13.0 W	154-UW-160	NT		0.21			49.5
	03.58	08 23.0 N	18 28.4 W	154-UW-161	NT		0.23			51.9
	06.03	08 40.4 N	18 45.4 W	154-UW-162	NT		0.28			34.4
	08.08	08 57.9 N	19 01.6 W	154-UW-163	NT		0.28			50.7
3/6-Stn.39	09.02-10.30	09 03.7 N	19 07.2 W	154-39-169	120		0.03			
				154-39-170	80		0.09	0.060	DVa/Hex/Fuc	
				154-39-171	60		0.22	0.153	DVa/Hex/Fuc	
				154-39-172	50		0.33	0.273	DVa/Hex/Fuc	
				154-39-167	40	2	2.28			
				154-39-168	40	6	2.12			
				154-39-173	40		2.07	1.831	Hex/Fuc/Per/But	
				154-39-174	33		0.58	0.521	Hex/DVa/Zea	
				154-39-175	14		0.29	0.228	Zea/DVa(Hex)	
				154-39-176	7		0.29	0.254	Zea/DVa(Hex)	52.5x31.6
				154-39-177	0		0.27	0.220	Zea/DVa(Hex)	
				154-39-164	surf-tot		0.26			
				154-39-165	surf-<20		0.25			
				154-39-166	surf-<2		0.20			
3/6-Stn. 40	13.00-13.28 (13.10)	09 24.6 N	19 25.7 W	154-40-184	NT/Optic s		0.15	0.183	Zea(DVa)	49.7x31.6
3/6	15.40	09 40.2 N	19 40.9 W	154-UW-185	NT		0.15			49.6x31.6
	17.33	09 55.5 N	19 49.3 W	154-UW-186	NT		0.16			52.3
	19.38	10 17.6 N	19 45.1 W	154-UW-187	NT		0.13			49.5
	21.31	10 38.9 N	19 40.9 W	154-UW-188	NT		0.17			50.3
	23.34	11 02.3 N	19 36.1 W	154-UW-189	NT		0.17			50.0
4/6	01.38	11 26.6 N	19 31.3 W	155-UW-190	NT		0.18			51.7
	03.33	11 49.3 N	19 26.5 W	155-UW-191	NT		0.17			50.9
	05.39	12 14.2 N	19 21.3 W	155-UW-192	NT		0.22			52.8
	08.37	12 46.4 N	19 14.9 W	155-UW-193	NT		0.30			58.1
4/6-Stn. 41	09.04-10.46	12 47.1 N	19 14.7 W	155-41-194	60		0.08	0.024	DVb(Fuc/Hex)	
				155-41-195	50		0.24	0.193	DVb(Fuc/Hex)	
				155-41-196	40		0.34	0.250	DVb(Fuc/Hex)	
				155-41-197	30	5	1.93			
				155-41-206	30	6	1.44	1.762	Hex/Fuc(But/Per)	
				155-41-198	26		0.63	0.539	DVa/Zea(Hex)	
				155-41-199	22		0.84	0.712	DVa/Zea(Hex)	
				155-41-200	14		0.37	0.306	Zea/DVa(Hex)	
				155-41-201	7		0.30	0.247	Zea/DVa(Hex)	56.4x31.6
				155-41-202	0		0.30	0.266	Zea/DVa(Hex)	
				155-41-203	surf-tot		0.30			
				155-41-204	surf-<20		0.27			
				155-41-205	surf-<2		0.22			
4/6-Stn. 42	13.34-13.56 (13.40)	13 17.8 N	19 08.7 W	155-42-207	NT		0.21	0.178	Zea(Hex/DVa)	56.0x31.6
4/6	15.32	13 33.0 N	19 05.5 W	155-UW-208	NT		0.21			57.2x31.6
	17.37	13 55.4 N	19 00.7 W	155-UW-209	NT		0.27			71.1x31.6
	19.34	14 26.8 N	19 06.2 W	155-UW-210	NT		0.18			5.7x3.61
	21.25	14 35.7 N	19 11.6 W	155-UW-211	NT		0.29			7.8x3.61
	23.26	14 56.7 N	19 19.9 W	155-UW-212	NT		0.36			8.4
5/6	01.28	15 18.7 N	19 28.4 W	156-UW-213	NT		0.80	0.484	Fuc(Hex)	17.7
	03.30	15 40.9 N	19 36.9 W	156-UW-214	NT		0.31			8.4
	05.30	15 53.3 N	19 53.2 W	156-UW-215	NT		0.39			9.8
	07.31	16 08.6 N	19 59.1 W	156-UW-216	NT		0.55			10.4
5/6-Stn. 43	09.12-10.36	16 22.5 N	20 00.0 W	156-43-217	60		0.21	0.156	Fuc(Hex)	
				156-43-218	48		0.66	0.582	Fuc(Hex)	
				156-43-219	40		1.80	1.058	Fuc(Hex)	
				156-43-220	35		1.81	1.056	Fuc(Hex)	
				156-43-221	30		1.86	1.047	Fuc(Hex)	
				156-43-222	26		1.26	1.112	Fuc(Hex)	
				156-43-223	13		0.49	0.452	Hex/Fuc(Zea)	
				156-43-224	7		0.50	0.450	Hex/Fuc(Zea)	11.0x3.16
				156-43-225	0		0.49	0.496	Hex/Fuc(Zea)	

5/6-Stn. 44	11.43-12.01 (11.53)	16 33.5 N	19 59.9 W	156-44-226	NT/Optics	0.94	0.882	Fuc/Hex(But)	18.3x3.16
5/6-Stn. 45	13.42 13.35-13.53	16 49.2 N	20 00.2 W	156-45-227	NT/Optics	1.55	1.115	Fuc(Hex)	35.0x3.16
				156-45-228	0-Tot	2.41			
				156-45-229	0-<20	0.91			
				156-45-230	0-<2	0.34			
5/6	15.40	17 02.2 N	20 00.1 W	156-UW-231	NT	1.41			23.8
	18.21	17 39.4 N	20 00.0 W	156-UW-232	NT	0.56			15.3
	20.07	17 59.6 N	20 00.0 W	156-UW-233	NT	4.04	3.747	Fuc(Hex/Dia)	56.0
	21.19	18 13.9 N	19 59.9 W	156-UW-234	NT	1.89	1.887	Fuc(Hex/Dia)	52.9
	23.16	18 36.2 N	20 00.0 W	156-UW-235	NT	3.41	2.812	Fuc(Hex/Dia)	58.8
6/6	00.20	18 48.3 N	19 59.9 W	157-UW-236	NT	2.34			50.9
	01.20	18 59.9 N	20 00.0 W	157-UW-237	NT	0.58			17.4
	03.37	19 26.1 N	20 00.0 W	157-UW-238	NT	0.46			17.7
	05.20	19 45.8 N	19 59.9 W	157-UW-239	NT	0.56			19.4
	05.55	19 52.5 N	20 00.1 W	157-UW-240	NT	1.25			33.2
	07.02	20 04.4 N	20 00.2 W	157-UW-241	NT	1.74			45.0
	08.11	20 17.2 N	20 00.1 W	157-UW-242	NT	1.71	1.696	Hex/Fuc(Zea)	50.2
6/6-Stn. 46	09.00-10.36	20 24.3 N	20 00.1 W	157-46-246	80	0.06			
				157-46-247	50	0.24	0.157	Fuc	
				157-46-248	40	0.45	0.273	Fuc	
				157-46-249	30	1.79	1.683	Fuc(Hex)	
				157-46-250	20	2.03	1.985	Fuc(Hex)	
				157-46-251	12	2.29	1.834	Hex/Fuc(Zea/Dia)	
				157-46-252	7	2.20	1.972	Hex/Fuc(Zea/ Dia)	~56
				157-46-253	0	1.97	1.770	Hex/Fuc(Zea/Dia)	
				157-46-243	0-tot	1.92			
				157-46-244	0-<20	1.38			
				157-46-245	0-<2	0.48			
6/6	11.30	20 34.3 N	20 00.0 W	157-UW-254	NT	1.91			42.9
6/6-Stn. 47	12.08-12.23 (12.17)	20 40.7 N	19 59.7 W	157-47-255	NT/Optics	1.82	1.598	Hex(Fuc)	~50
				157-47-256	0-tot	1.86			
				Rpt. Extraction	0-tot	0.24			
				157-47-257	0-<20	1.55			
				Rpt. Extraction	0-<20	0.21			
				157-47-258	0-<2	0.47			
				Rpt. Extraction	0-<2	0.08			
6/6-Stn. 48	13.29-13.43 (13.35)	20 52.1 N	20 00.0 W	157-48-259	NT/Optics	0.89	1.138	Fuc/Hex	38.7x3.16
				Rpt. Extraction	NT(48)	0.30			
6/6	15.30	21 10.7 N	20 00.4 W	157-UW-260	NT	3.36	2.662	Hex/Fuc(Dia)	56.9
	16.29	21 21.2 N	20 00.6 W	157-UW-261	NT	0.24	0.112	Zea(DVa)	25.0
	18.32	21 43.4 N	20 00.4 W	157-UW-262	NT	0.22	0.117	Zea(DVa)	18.4
	20.29	22 05.1 N	20 00.3 W	157-UW-263	NT	0.21			15.4
	22.25	22 28.0 N	19 59.9 W	157-UW-264	NT	0.14			13.5
7/6	00.31	22 53.0 N	19 59.9 W	158-UW-265	NT	0.30			14.5
	02.37	23 17.6 N	20 00.1 W	158-UW-266	NT	0.26			13.6
	04.35	23 40.5 N	19 59.8 W	158-UW-267	NT	0.29			13.3
	06.24	24 01.4 N	20 00.0 W	158-UW-268	NT	0.22			12.0
7/6-Stn. 49	08.58-09.58	24 30.3 N	20 00.0 W	158-49-278	0-tot	0.22			
				158-49-279	0-<20	0.20			
				158-49-280	0-<2	0.13			
				158-49-269	0	0.20	0.180	Hex/Zea/DVa	
				158-49-270	7	0.20	0.200	Hex/Zea/DVa	32.4x10
				158-49-271	20	0.20	0.339	Hex/Zea/DVa	
				158-49-272	34	0.21	0.151	Hex/Zea/DVa	
				158-49-273	65	0.34	0.256	Hex/Zea/DVa	
				158-49-274	75	0.47	0.381	Hex/Zea/DVa/But	

				158-49-275	80	0.54	0.427	Hex/Zea/DVa/But	
				158-49-276	120	0.20	0.154	Hex/Zea/DVa/But	
7/6-Stn. 50	12.26-12.43 (12.34)	24 59.4 N	20 00.1 W	158-50-277	NT/Optics	0.13	0.086	Zea/DVa(Hex)	21.5
7/6-Stn. 51	13.16-13.34 (13.24)	25 05.1 N	19 59.8 W	158-51-281	NT/Optics	0.14	0.095	Zea/DVa(Hex)	14.5
7/6	15.23	25 25.8 N	20 00.2 W	158-UW-282	NT	0.18			15.3x10
	17.30	25 50.3 N	19 59.9 W	158-UW-283	NT	0.10			14.3
	19.30	26 12.6 N	19 59.7 W	158-UW-284	NT	0.08			14.2
	21.32	26 34.8 N	19 59.9 W	158-UW-285	NT	0.08			16.9
	23.34	26 57.5 N	20 00.0 W	158-UW-286	NT	0.09			18.2
8/6	01.31	27 19.1 N	20 00.0 W	159-UW-287	NT	0.08			17.4
	03.31	27 42.1 N	20 00.0 W	159-UW-288	NT	0.08			17.2
	05.38	28 06.2 N	19 59.8 W	159-UW-289	NT	0.06			17.2
8/6-Stn. 52	09.02-09.55	28 41.0 N	19 52.2 W	159-52-293	200	0.04	0.026	Hex/Zea	
				159-52-294	165	0.16	0.117	Hex/Zea	
				159-52-295	146	0.30	0.214	DVa/DVb/Hex/But	
				159-52-296	98	0.13	0.105	Hex/Zea	
				159-52-297	62	0.08	0.068	Hex/Zea	
				159-52-298	36	0.06	0.040	Hex/Zea	
				159-52-299	20	0.06	0.031	Hex/Zea	
				159-52-300	7	0.06	0.034	Hex/Zea	14.6x10
				159-52-301	0	0.05	0.034	Hex/Zea	
				159-52-290	surf-tot	0.06			
				159-52-291	surf-<20	0.06			
				159-52-292	surf-<2	0.06			
8/6-Stn. 53	12.22-12.42 (12.24)	29 05.2 N	19 33.7 W	159-53-302	NT/Optics	0.06	0.027	Zea(Hex)	13.0
8/6	14.30	29 23.2 N	19 20.8 W	159-UW-303	NT	0.06			12.5
	16.27	29 43.6 N	19 04.9 W	159-UW-304	NT	0.07			12.7
	18.35	30 06.6 N	18 47.8 W	159-UW-305	NT	0.06			13.8
	20.34	30 27.9 N	18 31.9 W	159-UW-306	NT	0.05			13.1
	22.28	30 48.3 N	18 16.7 W	159-UW-307	NT	0.05			12.5
9/6	00.27	31 09.3 N	18 00.7 W	160-UW-308	NT	0.05			14.2
	02.27	31 29.5 N	17 45.5 W	160-UW-309	NT	0.05			13.4
	04.29	31 50.7 N	17 29.9 W	160-UW-310	NT	0.06			15.6
	06.22	32 10.7 N	17 13.9 W	160-UW-311	NT	0.06			15.8
9/6-Stn. 54	08.00-08.42	32 25.6 N	17 02.9 W	160-54-312	115	0.41	0.294	DVa(Hex/DVb)	
				160-54-313	100	0.43	0.310	DVa(Hex/DVb)	
				160-54-314	55	0.12	0.091	Zea/Hex	
				160-54-315	30	0.08	0.056	Zea/Hex	
				160-54-316	7	0.05	0.031	Zea/Hex	13.8
				160-54-317	0	0.05	0.032	Zea/Hex	
				160-54-318	0-tot	0.05			
				160-54-319	0-<20	0.05			
				160-54-320	0-<2	0.04			
9/6-Stn. 55	12.40-13.18	32 39.4 N	17 09.7 W	NIL	NIL	NIL	0.027	Zea(Hex)	NIL
9/6	14.21	32 46.0 N	17 22.2 W	160-UW-321	NT	0.06			15.8x10
	16.20	33 06.6 N	17 29.8 W	160-UW-322	NT	0.05			14.6
	18.54	33 38.1 N	17 30.0 W	160-UW-323	NT	0.07			14.7
	20.25	33 57.7 N	17 30.2 W	160-UW-324	NT	0.07			14.0
	22.37	34 25.4 N	17 30.1 W	160-UW-325	NT	0.07			13.8
10/6	00.36	34 50.4 N	17 29.9 W	161-UW-326	NT	0.07			13.6
	02.27	35 14.1 N	17 29.9 W	161-UW-327	NT	0.07			13.3
	04.30	35 40.9 N	17 30.3 W	161-UW-328	NT	0.07			14.8
	06.27	36 05.7 N	17 30.1 W	161-UW-329	NT	0.07			14.1
10/6-Stn. 56	09.00-10.35	36 36.8 N	17 30.2 W	161-56-330	140	0.13			
				161-56-331	100	0.48			
				161-56-332	84	0.62			

				161-56-333	70	0.27	
				161-56-334	55	0.13	
				161-56-335	35	0.09	
				161-56-336	20	0.09	
				161-56-337	7	0.09	16.5
				161-56-338	0	0.09	
				161-56-340	0-Tot	0.08	
				161-56-341	0-<20	0.08	
				161-56-342	0-<2	0.05	
10/6-Stn. 57	12.30-12.56 (12.40)	36 59.4 N	17 29.5 W	161-57-339	NT/Optics	0.15	13.7
10/6	14.45	37 22.3 N	17 29.6 W	161-UW-343	NT	0.08	13.8x10
	16.41	37 46.8 N	17 30.6 W	161-UW-344	NT	0.05	13.4
	19.05	38 17.4 N	17 29.8 W	161-UW-345	NT	0.18	15.0
	21.12	38 44.7 N	17 29.9 W	161-UW-346	NT	0.12	18.6
	23.10	39 03.8 N	17 30.1 W	161-UW-347	NT	0.10	17.5
11/6	01.08	39 27.9 N	17 30.2 W	162-UW-348	NT	0.09	17.5
	03.10	39 52.7 N	17 30.1 W	162-UW-349	NT	0.17	23.4
	05.21	40 20.8 N	17 30.1 W	162-UW-350	NT	0.20	22.3
	08.05	40 55.5 N	17 29.9 W	162-UW-351	NT	0.20	20.5
11/6-Stn. 58	09.01-10.11	41 04.7 N	17 29.9 W	162-58-355	120	0.03	
				162-58-356	80	0.14	
				162-58-357	55	0.59	
				162-58-358	45	1.50	
				162-58-359	36	0.29	
				162-58-360	24	0.19	
				162-58-361	13	0.20	
				162-58-362	7	0.19	21.5x10
				162-58-363	0	0.20	
				162-58-352	0-tot	0.17	
				162-58-353	0-<20	0.16	
				162-58-354	0-<2	0.11	
11/6-Stn. 59	11.46-12.12 (11.50)	41 19.0 N	17 12.2 W	162-59-364	NT/Optics	0.20	22.0x10
11/6	13.13	41 28.1 N	17 03.1 W	162-UW-365	NT	0.24	22.3x10
	15.31	41 49.9 N	16 43.0 W	162-UW-366	NT	0.21	21.6
	17.36	42 09.9 N	16 23.9 W	162-UW-367	NT	0.18	22.9
	19.48	42 30.9 N	16 03.9 W	162-UW-368	NT	0.21	26.6
	21.54	42 51.8 N	15 42.9 W	162-UW-369	NT	0.25	28.8
12/6	00.03	43 13.8 N	15 21.6 W	163-UW-370	NT	0.33	33.1
	02.00	43 34.9 N	15 06.9 W	163-UW-371	NT	0.38	34.3
	03.54	43 54.3 N	14 47.6 W	163-UW-372	NT	0.28	30.7
	05.57	44 16.3 N	14 26.3 W	163-UW-373	NT	0.41	35.5
	07.27	44 31.5 N	14 09.7 W	163-UW-374	NT	0.48	42.1
12/6-Stn. 60	08.28-09.50	44 40.8 N	14 00.6 W	163-60-376	100	0.06	
				163-60-377	50	0.26	
				163-60-378	40	1.18	
				163-60-379	35	1.37	
				163-60-380	20	0.46	
				163-60-381	7	0.43	
	09.20	44 40.7 N	14 00.6 W	163-60-375	NT	0.40	34.9x10
12/6	11.54	44 59.0 N	13 41.2 W	163-UW-382	NT	0.57	46.1x10
	13.51	45 18.7 N	13 19.2 W	163-UW-383	NT	0.60	47.3
12/6-Stn. 61	15.03-15.19 (15.05)	45 29.5 N	13 07.5 W	163-61-384	NT/Optics	0.86	71.4x10
	19.43	46 13.5 N	12 18.4 W	163-UW-385	NT	0.69	68.4x10
	(21.43?)	46 34.3 N	11 54.6 W	163-UW-386	NT	0.85	78.0
	23.36	46 52.2 N	11 33.6 W	163-UW-337	NT	0.37	78.3
13/6	01.33	47 12.0 N	11 10.9 W	164-UW-338	NT	0.82	24.9x3.16

	03.31	47 32.7 N	10 47.5 W	164-UW-339	NT	1.08	40.0x3.16
	05.27	47 51.9 N	10 24.8 W	164-UW-340	NT	1.02	34.0x3.16
	06.55	48 05.1 N	10 09.6 W	164-UW-341	NT	1.57	49.8x3.16
	07.14	48 07.7 N	10 06.6 W	164-UW-342	NT	2.34	27.6x1
13/6-Stn. 62	09.50-10.28	48 27.0 N	09 41.8 W	164-62-346	80	0.18	
				164-62-347	60	0.53	
				164-62-348	50	1.31	
				164-62-349	30	3.00	
				164-62-350	20	3.02	
				164-62-351	13	2.94	
				164-62-352	7	2.94	20.1x1
				164-62-353	4	2.96	
				164-62-354	0	2.89	
				164-62-343	0-tot	2.86	
				164-62-344	0-<20	1.41	
				164-62-345	0-<2	1.04	
13/6	12.52	48 37.6 N	09 03.4 W	164-UW-355	NT	1.00	23.0x3.16
	14.10	48 42.5 N	08 41.1 W	164-UW-356	NT	2.14	22.4x1
13/6-Stn. 63	14.50	48 43.2 N	08 37.4 W	164-63a-357	NT/Optics	2.19	33.5x1
14.30-15.55	15.05	48 43.9 N	08 36.8 W	164-63b-358	NT/Optics	2.03	35.7x1
	15.55	48 44.6 N	08 34.8 W	164-63c-359	NT/Optics	2.00	34.4x1
13/6	16.30	48 45.0 N	08 26.6 W	164-UW-360	NT	2.49	35.9x1
13/6-Stn. 64	17.00-17.27 (17.18)	48 47.0 N	08 16.6 W	164-64-361	NT/Optics	1.81	33.7x1
13/6	18.52	48 52.7 N	07 49.0 W	164-UW-362	NT	2.14	33.5x1
	19.35	48 55.4 N	07 38.3 W	164-UW-363	NT	1.93	33.9
	20.25	48 57.8 N	07 25.6 W	164-UW-364	NT	2.20	34.4
	22.14	49 05.3 N	06 58.5 W	164-UW-365	NT	1.31	30.1
14/6	00.15	49 14.4 N	06 27.7 W	165-UW-366	NT	1.99	37.5
	02.15	49 22.7 N	05 56.6 W	165-UW-367	NT	1.94	36.2
	04.12	49 30.6 N	05 25.0 W	165-UW-368	NT	1.74	28.5
	06.02	49 39.0 N	04 53.0 W	165-UW-369	NT	0.83	26.9
14/6-Stn. 65	08.57-10.42	49 50.2 N	04 09.5 W	165-65-370	20	2.44	
				165-65-371	13	2.47	
				165-65-372	7	2.39	50.0x1
				165-65-373	1	2.34	
	10.14			165-65-374	NT/Optics	2.40	
14/6-Stn. 66	13.06-13.17 (13.09)	50 00.2 N	03 28.0 W	165-66-375	NT/Optics	1.47	32.4x1

Appendix A6-15 Oxygen, DIC and Respiration Samples Collected

CTD	Date	Lat	Long	Analyses
A6-01	15.5.98 JD 135	33 37.1 S	18 00.2 E	Profile oxygen and DIC
A6-02	16.5.98 JD 136	32 20.2 S	17 52.6 E	Profile oxygen and DIC Oxygen production and respiration @ 2m, 7m, 10m, 20m, 40m, 80m, 120m DIC production and respiration @ 2m, 7m, 20m, 40m ETS @ 2m, 7m, 20m, 40m, 80, 120m
A6-04	17.5.98 JD 137	29 31.2 S	16 27.2 E	Profile oxygen and DIC Oxygen production and respiration @ 3m, 5m, 7m, 20m, 25m, 40m, 130m DIC production and respiration @ 3m, 5m, 20m, 25m ETS @ 3m, 5m, 7m, 20m, 25m, 40m, 130m POC @ 3m, 5m, 7m, 20m, 25m, 40m, 130m
A6-07	18.5.98 JD 138	26 41.8 S	14 14.8 E	Profile oxygen and DIC Oxygen production and respiration @ 4m, 13m, 17m, 30m, 45m, 80m, 160m DIC production and respiration @ 4m, 30m, ETS @ 4m, 9m, 13m, 17m, 20m, 30m, 45m, 80m, 160m
A6-10	21.5.98 JD 141	28 55.8 S	16 11.3 E	Profile oxygen and DIC Oxygen production and respiration @ 3m, 7m, 11m, 25m, 35m, 60m, 110m DIC production and respiration @ 3m, 7m, 25m ETS @ 3m, 7m, 11m, 25m, 35m, 60m, 110m
A6-12	22.5.98 JD 142	24 45.0 S	14 19.5 E	Profile oxygen and DIC Oxygen production and respiration @ 3m, 7m, 23m, 35m, 45m, 58m, 100m DIC production and respiration @ 3m, 7m, 35m ETS @ 3m, 7m, 15m, 23m, 35m, 45m, 58m, 100m
A6-15	23.5.98 JD 143	21 39.3 S	12 24.4 E	Profile oxygen and DIC Oxygen respiration @ 3m, 7m, 20m, 35m, 40m, 60m, 100m, 200m DIC respiration @ 20m, 35m ETS @ 3m, 7m, 15m, 20m, 35m, 40m, 60m, 100m, 200m
A6-17	24.5.98 JD 144	18 59.8 S	12 00.0 E	Profile oxygen and DIC Oxygen respiration @ 80m, 100m, 180m DIC respiration @ 80m ETS @ 60m, 80m, 100m, 180m
A6-18	24.5.98 JD 144	18 59.8 S	12 00.0 E	Profile oxygen and DIC Oxygen production and respiration @ 7m, 11m, 30m, 45m, DIC production and respiration @ 11m, 45m Time series of O2 and DIC respiration @ 45m ETS @ 7m, 11m, 20m, 30m, 45m
A6-20	25.5.98 JD 145	17 40.0 S	11 20.1 E	Profile oxygen and DIC Oxygen production and respiration @ 1m, 30m DIC production and respiration @ 1m, 7m, 30m ETS @ 1m, 3m, 7m, 13m, 20m, 30m, 40m, 50m, 100m
A6-22	26.5.98 JD 146	14 44.6 S	07 51.6 E	Profile oxygen and DIC Oxygen production and respiration @ 1m, 12m, 35m, 50m, 62m, 80m, 140m, 200m

				ETS @ 1m, 7m, 12m, 25m, 35m, 50m, 62m, 80m, 140m, 200m
A6-23	27.5.98 JD 147	11 37.2 S	04 08.3 E	Profile oxygen and DIC Oxygen production and respiration @ 2m ETS @ 2m, 7m
A6-24	27.5.98 JD 147	11 37.2 S	04 08.3 E	Profile oxygen and DIC Oxygen production and respiration @ 20m, 52m, 75m, 85m, 100m, 140m ETS @ 20m, 32m, 52m, 75m, 85m, 100m, 140m, 200m
A6-25	28.5.98 JD 148	08 37.6 S	00 36.5 E	Profile oxygen and DIC Oxygen production and respiration @ 2m ETS @ 2m, 7m
A6-26	28.5.98 JD 148	08 37.6 S	00 36.5 E	Profile oxygen and DIC Oxygen production and respiration @ 16m, 47m, 65m, 80m, 200m ETS @ 16m, 28m, 47m, 65m, 80m, 130m, 200m
A6-27	29.5.98 JD 149	05 51.9 S	02 37.1 W	Profile oxygen and DIC Oxygen production and respiration @ 1m ETS @ 1m, 7m
A6-28	29.5.98 JD 149	05 51.9 S	02 37.1 W	Profile oxygen and DIC Oxygen production and respiration @ 50m, 58m, 120m, 200m ETS @ 12m, 22m, 33m, 50m, 47m, 58m, 120m, 200m
A6-29	30.5.98 JD 150	02 48.7 S	06 09.8 W	Profile oxygen and DIC ETS @ 1m, 7m
A6-30	30.5.98 JD 150	02 48.7 S	06 09.8 W	Profile oxygen and DIC Oxygen production and respiration @40m Respiration time series @ 40m ETS @ 13m, 24m, 40m, 55m, 65m, 120m, 200m
A6-31	31.5.98 JD 151	00 01.7 S	08 51.0 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 7m
A6-33	01.06.98 JD 152	03 04.3 N	12 46.2 W	Profile oxygen and DIC Oxygen production and respiration @ 1m ETS @ 1m, 7m
A6-34	01.06.98 JD 152	03 04.3 N	12 46.2 W	Profile oxygen and DIC Oxygen production and respiration @ 18m, 60m, 75m, 90m, 140m, 200m DIC production and respiration @ 60m ETS @ 18m, 60m, 75m, 90m, 140m, 200m
A6-35	02.06.98 JD 153	05 51.7 N	16 04.9 W	Profile oxygen and DIC Oxygen production and respiration @ 1m ETS @ 1m, 7m
A6-36	02.06.98 JD 153	05 51.7 N	16 04.9 W	Profile oxygen and DIC Oxygen production and respiration @ 50m, 60m ETS @ 14m, 40m, 50m, 60m, 80m, 120m, 200m
A6-37	03.06.98 JD 154	09 03.7 N	19 07.2 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 14m ETS @ 1m, 7m, 14m
A6-38	03.06.98 JD 154	09 03.7 N	19 07.2 W	Profile oxygen and DIC Oxygen production and respiration @ 40m, 50m, 60m, 80m, 120m ETS @ 22m, 33m, 40m, 50m, 60m, 80m, 120m, 200m
A6-39	04.06.98 JD 155	12 47.1 N	19 14.7 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 12m ETS @ 1m, 7m, 12m
A6-40	04.06.98 JD 155	12 47.1 N	19 14.7 W	Profile oxygen and DIC Oxygen production and respiration @ 30m, 40m, 50m, 60m, 100m, 200m

				DIC production and respiration @ 30m ETS @ 22m, 30m, 40m, 50m, 60m, 100m, 200m
A6-41	05.06.98 JD 156	16 22.5 N	20 00.0 W	Profile oxygen and DIC Oxygen production @ 1m, 13m ETS @ 1m, 7m, 13m
A6-42	05.06.98 JD 156	16 22.5 N	20 00.0 W	Profile oxygen and DIC Oxygen production and respiration @ 35m, 40m, 48m, 60m, 120m, 200m DIC production and respiration @ 35m Oxygen and DIC respiration time series @ 35m ETS @ 17m, 35m, 40m, 48m, 60m, 120m, 200m
A6-43	06.06.98 JD 157	20 24.3 N	20 00.1 W	Profile oxygen and DIC Oxygen production and respiration @ 1m (screened 200 um and unscreened) 7m, 30m, 80m, 200m DIC production and respiration @ 7m ETS @ 1m (screened & unscreened), 7m, 12m, 16m, 20m, 30m, 40m, 80m, 160m, 200m
A6-44	07.06.98 JD 158	24 30.3 N	20 00.0 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 20m, 80m, 90m, 120m, 200m ETS @ 1m, 20m, 34m, 53m, 80m, 90m, 120m, 200m
A6-45	08.06.98 JD 159	28 41.0 N	19 52.2 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 36m, 146m, 155m, 165m, 200m ETS @ 1m, 20m, 36m, 62m, 96m, 146m, 155m, 165m, 180m, 200m
A6-46	09.06.98 JD 160	32 25.6 N	17 02.9 W	Profile oxygen and DIC ETS @ 1m, 7m, 30m, 55m, 100m, 115m, 120m, 140m, 200m
A6-47	10.06.98	36 36.8 N	17 30.2 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 7m, 20m ETS @ 1m, 7m, 20m
A6-48	10.06.98 JD 161	36 36.8 N	17 30.2 W	Profile oxygen and DIC Oxygen production and respiration @ 55m, 89m, 100m, 140m, 200m DIC production and respiration @ 89m Time series respiration @ 89m ETS @ 1m, 7m, 20m, 35m, 55m, 89m, 100m, 140m, 200m
A6-49	11.06.98 JD 162	41 04.7 N	17 29.9 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 13m, 45m, 55m, 60m, 80m, 200m DIC production and respiration @ 45m ETS @ 1m, 7m, 13m, 24m, 36m, 45m, 55m, 60m, 80m, 120m, 200m
A6-50	12.06.98 JD 163	44 40.8 N	14 00.6 W	Profile oxygen and DIC ETS @ 7m, 20m, 35m, 40m, 50m, 100m, 250m
A6-51	13.06.98 JD 164	48 27.0 N	09 41.8 W	Profile oxygen and DIC Oxygen production and respiration @ 1m, 4m, 7m, 30m, 50m, 60m, 200m DIC production and respiration @ 1m, 7m ETS @ 1m, 4m, 7m, 13m, 20m, 30m, 50m, 60m, 80m, 100m, 200m

Appendix A6-16 Samples taken for New Production, and Dark Community Production

Date	Position	No. Depths	Depth Range (M)	Rate Variable
16/5	32°20S	6	0 – 20	^{15}N uptake – 24h
	17°52E	1	20	^{15}N-NH_4 – regeneration/oxidation
		1	7	^{15}N uptake – 4h
17/5	29°31S	6	0 – 20	^{15}N uptake – 24h
	16°27E	1	3	^{15}N uptake – 4h
18/5	26°42S	6	0 – 30	^{15}N uptake – 24h
	14°15E	1	30	^{15}N-NH_4 – regeneration/oxidation
		1	13	^{15}N uptake – 4h
		6	7 - 160	^{14}C - nitrification
21/5	28°56S	6	0 – 25	^{15}N uptake – 24h
	16°11E	1	25	^{15}N-NH_4 – regeneration/oxidation
		1	7	^{15}N uptake – 4h
		6	7 – 60	^{14}C – nitrification
		5	7 - 60	ΔDIN
22/5	24°45S	5	0 – 35	^{15}N uptake – 24h
	14°19E	1	35	^{15}N-NH_4 – regeneration/oxidation
		1	7	^{15}N uptake – 4h
		6	7 - 60	^{14}C - nitrification
23/5	21°29S	1	7	^{15}N uptake – 4h
	12°24E	1	35	^{14}C – nitrification, 24h time series
24/5	18°59S	6	0 – 45	^{15}N uptake – 24h
	11°59E	1	45	^{14}C – nitrification, 24h time series
		1	45	ΔDIN, 24h time series
25/5	17°39S	6	0 – 30	^{15}N uptake – 24h
	11°19E	1	30	^{15}N-NH_4 – regeneration/oxidation
		1	7	^{15}N uptake – 4h
		6	7 – 50	^{14}C – nitrification
		5	7 - 50	ΔDIN
26/5	14°44S	6	0 – 50	^{15}N uptake – 24h
	07°51E	1	50	^{15}N-NH_4 – regeneration/oxidation
		1	12	^{15}N uptake – 4h
		6	7 – 80	^{14}C – nitrification
		5	7 - 80	ΔDIN
27/5	11°37S	6	0 – 75	^{15}N uptake – 24h
	04°08E	1	75	^{15}N-NH_4 – regeneration/oxidation
		3	0 – 18	^{15}N uptake – 4h
		4	50 – 100	^{14}C – nitrification
		1	18	^{15}N-uptake kinetics. Low addition
28/5	08°37S	6	0 – 65	^{15}N uptake – 24h
	00°35E	1	65	^{15}N-NH_4 – regeneration/oxidation
		3	3 – 16	^{15}N uptake – 4h
		6	7 – 130	^{14}C – nitrification
		5	7 - 130	ΔDIN
29/5	05°52S	6	0 – 50	^{15}N uptake – 24h
	02°37W	1	50	^{15}N-NH_4 – regeneration/oxidation
		3	0 – 12	^{15}N uptake – 4h
		6	7 – 120	^{14}C – nitrification
		1	12	^{15}N-uptake kinetics. Low addition
30/5	02°49S	3	0 –13	^{15}N uptake – 4h
	06°10W	2	13 – 40	^{15}N-uptake kinetics. Low addition
		4	40 – 120	^{14}C – nitrification
		5	7 - 120	ΔDIN
Date	Position	No. Depths	Depth Range (M)	Rate Variable
01/06	03°04N	5	0 – 75	^{15}N uptake – 24h
	12°46W	1	75	^{15}N-NH_4 – regeneration/oxidation
		2	0 – 7	^{15}N uptake – 4h
		5	7 – 140	^{14}C – nitrification

		5	7 - 140	ΔDIN
02/06	05°52N 16°05W	6 1 3 4 1	0 – 60 60 0 – 14 40 – 120 14	^{15}N uptake – 24h ^{15}N-NH_4 – regeneration/oxidation ^{15}N uptake – 4h ^{14}C – nitrification ^{15}N-uptake kinetics. Low addition
03/06	09°04N 19°07W	6 3 1 5 5	0 – 50 0 – 14 40 40 – 80 40 - 80	^{15}N uptake – 24h ^{15}N-NH_4 – regeneration/oxidation ^{15}N uptake – 24h ^{14}C – nitrification ΔDIN
04/06	12°48N 19°15W	6 1 3 1 5	0 – 50 50 0 – 14 28 – 100 14	^{15}N uptake – 24h ^{15}N-NH_4 – regeneration/oxidation ^{15}N uptake – 4h ^{14}C – nitrification ^{15}N-uptake kinetics. Low addition
05/06	16°23N 20°00W	6 3 1 1	0 – 40 0 – 14 35 35	^{15}N uptake – 24h ^{15}N uptake – 4h ^{14}C – nitrification, 24h time series ΔDIN, 24h time series
06/06	20°24N 20°00W	6 1	0 – 20 1	^{15}N uptake – 24h ^{15}N & ^{14}C, tracer addition test
07/06	24°30N 20°00W	6 1 5	0 – 80 19 65 – 120	^{15}N uptake – 24h ^{15}N uptake – 24h ^{14}C – nitrification
08/06	28°41N 19°52W	6 3 1 5	0 – 145 0 – 35 35 96 - 200	^{15}N uptake – 24h ^{15}N uptake – 24h ^{14}C – nitrification ΔDIN
09/06	32°26N 17°30W	1 1	30 30	^{15}N uptake – 4h ^{15}N-uptake kinetics. Low addition
10/06	36°37N 17°30W	6 1 3 1 1	0 – 89 89 0 – 20 89 89	^{15}N uptake – 24h ^{15}N-NH_4 – regeneration/oxidation ^{15}N uptake – 4h ^{14}C – nitrification, 24h time series ΔDIN, 24h time series
11/06	41°04N 17°26W	6 1 3 5 2	0 – 55 55 0 – 13 45 – 120 55, 60	^{15}N uptake – 24h ^{15}N-NH_4 – regeneration/oxidation ^{15}N uptake – 4h ^{14}C – nitrification ΔDIN
12/06	44°41N 14°01W	1	7	^{15}N & ^{14}C, tracer addition test
13/06	48°27N 09°42W	6 4 1	0 – 30 20 – 60 7	^{15}N uptake – 24h ^{14}C – nitrification ^{15}N-uptake kinetics. Low addition
14/06	49°50N 04°10W	1	7	^{15}N-uptake kinetics. Low addition

Appendix A6-17 Discrete CTD nutrient samples

CTD	Date	Depths
CTD 01	15/5/98	10, 20, 30, 40, 60, 80, 100, 120
CTD 02	16/5/98	2, 4, 7, 10, 15, 20, 40, 80, 120
CTD 03	16/5/98	2, 7, 10, 15, 40
CTD 04	17/5/98	3, 7, 13, 20, 25, 40, 80, 130
CTD 05	17/5/98	3, 7, 15
CTD 06	18/5/98	2
CTD 07	18/5/98	4, 7, 13, 17, 20, 30, 45, 80, 160, 250
CTD 10	21/5/98	3, 7, 11, 17, 25, 35, 60, 110
CTD 12	22/5/98	3, 7, 15, 23, 35, 45, 58, 80, 100
CTD 17	24/5/98	60, 80, 100, 140, 180
CTD 18	24/5/98	7, 11, 15, 20, 30, 45, 55
CTD 19	25/5/98	3, 7, 13, 20, 30, 40, 50, 100, 200
CTD 20	26/5/98	2
CTD 22	26/5/98	7, 12, 25, 35, 50,. 62, 80, 140, 200
CTD 23	27/5/98	2, 7
CTD 24	27/5/98	20, 32, 52, 65, 75, 85, 100, 140, 200
CTD 25	28.5.98	1, 7
CTD 26	28/5/98	16, 28, 35, 43, 47, 65, 80, 130, 200
CTD 27	29/5/98	1, 7
CTD 28	29/5/98	12, 22, 33, 40, 47, 50, 58, 120, 200
CTD 29	30/5/98	1, 7
CTD 30	30/5/98	13, 20, 24, 30, 40, 55, 65, 120, 200
CTD 31	31/5/98	1, 7
CTD 32	31/5/98	Aborted, termination u/s
CTD 33	1/6/98	1, 7
CTD 34	1/6/98	18, 32, 50, 55, 60, 75, 90, 140, 200
CTD 35	2/6/98	1,7
CTD 36	2/6/98	14, 26, 34, 40, 51, 60, 80, 120, 200
CTD 37	3/6/98	1, 7, 14
CTD 38	3/6/98	22, 33, 40, 44, 50, 60, 80, 120, 200
CTD 39	4/6/98	1, 7, 14
CTD 40	4/6/98	22, 26, 28, 35, 40, 50, 60, 100, 200
CTD 41	5/6/98	1, 7, 13
CTD 42	5/6/98	17, 26, 30, 35, 40, 48, 60, 120, 200
CTD 43	6/6/98	7, 12, 16, 20, 30, 40, 50, 80, 160, 200
CTD 44	7/6/98	7, 20, 34, 53, 65, 75, 80, 90, 120, 200
CTD 45	8/6/98	7, 20, 36, 62, 96, 146, 155, 165, 180, 200
CTD 46	9/6/98	7, 30, 45, 55, 80, 100, 110, 120, 140, 200
CTD 47	10/6/98	1,7,20
CTD 48	10/6/98	35, 45, 55, 70, 89, 90, 100, 140, 200
CTD 49	11/6/98	7, 13, 24, 36, 45, 55, 60, 80, 120, 200
CTD 50	12/6/98	7, 20, 35, 40, 50, 100, 250, 500, 750, 1000, 1250, 1500
CTD 51	13/6/98	4, 7, 13, 20, 30, 50, 60, 80, 100, 200
CTD 52	14/6/98	3, 7, 13, 20, 30, 40, 60

Appendix A6-18. Underway Nutrient Analysis.

Underway Start	Underway End
15/5/98: 1742	16/5/98: 0600
16/5/98: 1202	17/5/98: 0630
17/5/98: 2032	18/5/98: 0200
18/5/98: 1216	18/5/98: 1455
20/5/98: 1515	21/5/98: 0630
21/5/98: 1134	22/5/98: 0624
23/5/98: 1721	24/5/98: 0630
24/5/98: 1450	25/5/98: 0600
25/5/98: 1209	26/5/98: 0600
29/5/98: 0234	29/5/98: 0825
30/5/98: 2032	31/5/98: 0809
3/6/98: 1345	4/6/98: 0700
4/6/98: 1427	4/6/98: 1846
5/6/98: 0725	5/6/98: 0856
5/6/98: 1340	6/6/98: 0850
10/6/98: 1725	11/6/98: 0700
12/6/98: 1718	13/6/98: 0936
13/6/98: 1314	14/6/98: 0851
14/6/98: 1109	14/6/98: 1501

Appendix A6-19. TD-Fe and SPM, CTD Sampling log.

CTD Station	Date	SDY	Latitude	Longitude	Depth	SPM
A6-01	15-May	135	33o37.1'S	18o00.2'E	-10	
					-20	
					-30	
					-40	
					-100	
					-120	
A6-02	16-May	136	32o20.2'S	17o52.6'E	-4	
					-10	
					-20	
					-40	
					-80	
					-120	
A6-04	17-May	137	29o31.2'S	16o27.2'E	-7	
					-13	
					-25	
					-40	
					-80	
					-130	
A6-06	18-May	138	26o42.6'S	14o47.9'E	-4	
					-40	
					-80	
					-160	
A6-07	18-May	138	26o41.8'S	14o14.8'E	-9	X
					-20	X
					-30	X
					-80	X
					-160	X
					-250	X
A6-09	18-May	138	26o41.8'S	13o30.1'E	-7	
A6-10	21-May	141	28o55.9'S	16o11.3'E	-3	X
					-7	
					-25	
					-35	
					-60	
					-110	
A6-12	22-May	142	24o45.0'S	14o19.5'E	-3	
					-7	
					-15	
					-35	
					-45	
					-58	
					-80	
					-100	
A6-15	23-May	143	21o39.3'S	12o24.4'E	-7	
					-20	
					-35	
					-60	
					-100	
					-200	
A6-16	24-May	143	21o23.9'S	12o06.1'E	-7	
A6-17 / A6-18	24-May	143	18o59.8'S	12o00.0'E	-7	X
					-30	X
					-60	X
					-100	X
					-140	X
					-180	X
A6-19	24-May	144	18o54.6'S	12o09.3'E	-7	
A6-20	25-May	145	17o40.0'S	11o20.1'E	-7	

					-20	
					-30	
					-50	
					-100	
					-200	
A6-21	25-May	145	17o26.5'S	11o04.5'E	-7	X
A6-22	26-May	146	14o44.6'S	07o51.6'E	-7	X
					-12	
					-25	
					-35	
					-50	
					-62	
					-80	
					-140	
					-200	
A6-23 / A6-24	27-May	147	11o37.2'S	04o08.3'E	0	
					-7	X
					-20	
					-32	
					-52	
					-65	
					-75	
					-85	
					-100	
					-140	
					-200	X
A6-25 / A6-26	28-May	148	08o37.6'S	00o36.5'E	-2	
					-7	X
					-28	
					-47	
					-65	
					-80	
					-130	
					-200	X
A6-27 / A6-28	29-May	149	05o51.9'S	02o37.1'W	0	
					-7	X
					-12	
					-22	
					-33	
					-47	X
					-50	
					-58	
					-120	
					-200	X
A6-29 / A6-30	30-May	150	02o48.7'S	06o09.8'W	0	
					-7	X
					-13	
					-20	
					-24	
					-30	
					-40	X
					-55	
					-65	
					-120	
					-200	X
A6-31 / A6-32	31-May	151	00o01.7'S	08o51.0'W	0	
					-7	X
A6-33 / A6-34	01-Jun	152	03o04.3'N	12o46.2'W	0	
					-7	X
					-18	

					-50	
					-55	
					-60	X
					-90	
					-140	
					-200	X
A6-35 / A6-36	02-Jun	153	05o51.7'N	16o04.9'W	0	
					-7	X
					-14	
					-34	
					-40	
					-51	X
					-60	
					-80	
					-120	
					-200	
A6-37 / A6-38	03-Jun	154	09o03.7'N	19o07.2'W	0	
					-7	X
					-14	
					-22	
					-33	
					-40	X
					-44	
					-50	
					-60	
					-80	
					-120	
					-200	X
A6-39 / A6-40	04-Jun	155	12o47.1'N	19o14.7'W	0	
					-7	X
					-14	
					-22	
					-26	
					-28	X
					-35	
					-40	
					-50	
					-60	
					-100	
					-200	
A6-41 / A6-42	05-Jun	156	16o22.5'N	20o00.0'W	0	
					-7	X
					-13	
					-26	
					-30	
					-35	X
					-40	
					-65	
					-120	
					-200	
A6-43	06-Jun	157	20o24.3'N	20o00.1'W	-7	X
					-12	X
					-16	X
					-20	X
					-30	X
					-40	X
					-50	X
					-80	X
					-160	X
					-200	X

A6-44	07-Jun	158	24o30.3'N	20o00.0'W	-7	X
					-20	
					-34	
					-53	
					-65	
					-75	
					-80	X
					-90	
					-120	
					-200	
A6-45	08-Jun	159	28o41.0'N	19o52.2'W	-7	X
					-20	
					-36	
					-62	
					-96	
					-146	X
					-155	
					-165	
					-180	
					-200	
A6-46	09-Jun	160	32o25.6'N	17o02.9'W	-7	X
					-30	
					-55	
					-115	X
					-140	
					-200	
A6-47 / A6-48	10-Jun	161	36o36.8'N	17o30.2'W	0	
					-7	X
					-20	
					-45	
					-89	X
					-200	
A6-49	11-Jun	162	41o04.7'N	17o29.9'W	-7	X
					-24	
					-45	X
					-60	
					-120	
					-200	
A6-50	12-Jun	163	44o40.8'N	14o00.6'W	-7	X
					-20	
					-35	
					-40	
					-50	
					-100	
					-250	
					-500	
					-750	
					-1000	
					-1250	
					-1500	X
A6-51	13-Jun	164	48o27.0'N	09o41.8'W	-7	X
					-13	X
					-20	X
					-30	X
					-50	X
					-60	X
					-80	X
					-100	X
					-200	X
A6-52	14-Jun	165	49o50.2'W	04o09.5'W	-7	X

Appendix A6-20. TD-Fe and SPM Underway Sampling log.

Date	SDY	Time	Latitude	Longitude	TD-Fe	SPM
15-May	135	2120	32o50.77'S	16o59.92'E	UW1	X
15-May	135	2302	32o36'S	16o45'E	UW2	
16-May	136	0307	32o20.18'S	16o47.65'E	UW3	
16-May	136	0708	32o20.36'S	17o41.90'E	UW4	
16-May	136	1102	32o03.37'E	17o51.94'E	UW5	X
16-May	136	1500	31o46.51'S	17o23.91'E	UW6	X
16-May	136	1902	31o22.85'S	16o32.41'E	UW7	X
16-May	136	2305	30o50.92'S	16o29.25'E	UW8	X
17-May	137	0303	30o11.96'S	16o53.08'E	UW9	X
17-May	137	0708	29o35.88'S	16o32.52'E	UW10	X
17-May	137	0845	29o31.23'S	16o27.21'E	UW11	
17-May	137	1101	29o21.51'S	16o14.98'E	UW12	X
17-May	137	1506	28o55.64'S	15o57.30'E	UW13	X
17-May	137	1906	28o21.68'S	15o31.43'E	UW14	X
17-May	137	2300	27o37.16'S	15o05.20'E	UW15	X
18-May	138	0325	26o49.66'S	14o48.61'E	UW16	X
18-May	138	0550	26o42.22'S	14o45.21'E	UW17	X
18-May	138	0702	26o41.73'S	14o26.61'E	UW18	X
18-May	138	0814	26o41.82'S	14o16.09'E	UW19	X
18-May	138	1015	26o42.25'S	14o07.30'E	UW20	X
18-May	138	1314	26o42.61'S	13o48.16'E	UW21	X
18-May	138	1408	26o42.27'S	13o38.06'E	UW22	X
18-May	138	1455	26o41.82'S	13o30.09'E	UW23	X
20-May	140	1522	32o35.36'S	17o27.09'E	UW24	X
20-May	140	1924	31o40.26'S	17o06.09'E	UW25	X
20-May	140	2306	30o50.7'S	16o47.7'E	UW27	X
21-May	141	0307	29o58.88'S	16o27.31'E	UW26	X
21-May	141	0706	29o06.11'S	16o12.86'E	UW28	X
21-May	141	0840	28o55.73'S	16o11.22'E	UW29	X
21-May	141	1105	28o37.56'S	15o53.30'E	UW30	X
21-May	141	1512	28o09.61'S	15o27.81'E	UW31	X
21-May	141	1906	27o30.0'S	15o04.7'E	UW32	X
21-May	141	2309	26o35.12'S	14o40.08'E	UW33	X
22-May	142	0305	25o45.94'S	14o27.12'E	UW34	X
22-May	142	0722	24o52.24'S	14o19.86'E	UW35	X
22-May	142	1145	24o18.80'S	14o07.60'E	UW36	X
22-May	142	1525	23o56.92'S	13o56.40'E	UW37	
22-May	142	1910	23o25.69'S	13o25.57'E	UW38	X
22-May	142	2300	22o49.40'S	12o49.00'E	UW39	
23-May	143	0258	22o12.8'S	12o28.0'E	UW40	X
23-May	143	0826	21o39.32'S	12o24.37'E	UW41	
23-May	143	1159	21o33.22'S	12o15.44'E	UW42	X
23-May	143	1525	21o20.98'S	12o04.7'E	UW43	
23-May	143	1904	20o49.74'S	11o40.16'E	UW44	
23-May	143	2330	20o14.36'S	12o01.09'E	UW45	X
24-May	144	0305	19o42.60'S	12o13.85'E	UW46	
24-May	144	0732	18o59.79'S	11o59.99'E	UW47	
24-May	144	1530	18o47.52'S	11o46.16'E	UW48	X
24-May	144	1911	18o35.99'S	11o14.25'E	UW49	
24-May	144	2300	18o24.99'S	10o42.63'E	UW50	
25-May	145	0305	17o59.12'S	11o03.09'E	UW51	X

25-May	145	1005	17o35.93'S	11o15.76'E	UW52	
25-May	145	1510	17o05.15'S	10o40.47'E	UW53	X
25-May	145	1928	16o32.95'S	10o01.76'E	UW54	
25-May	145	2301	16o03.37'S	09o25.78'E	UW55	
26-May	146	0314	15o28.57'S	08o43.96'E	UW56	X
26-May	146	0945	14o43.82'S	07o50.90'E	UW57	
26-May	146	1506	14o01.40'S	07o01.06'E	UW58	X
26-May	146	2028	13o16.77'S	06o06.53'E	UW59	
29-May	149	0920	05o51.79'S	02o37.66'W	UW60	
29-May	149	2312	04o06.78'S	04o38.29'W	UW61	
30-May	150	0836	02o48.70'S	06o09.91'W	UW62	
04-Jun	155	1010	12o47.52'N	19o14.67'W	UW63	
07-Jun	158	0930	24o30.35'N	20o00.02'W	UW64	
08-Jun	159	0448	27o56.49'N	19o59.88'W	UW65	X
08-Jun	159	0948	28o41.07'N	19o52.24'W	UW66	X
08-Jun	159	1500	29o29.36'N	19o16.05'W	UW67	
09-Jun	160	0825	32o25.69'N	17o02.92'W	UW68	X
09-Jun	160	1046	32o38.27'N	16o53.76'W	UW69	X
09-Jun	160	1545	33o00.40'N	17o30.09'W	UW70	
09-Jun	160	2309	34o31.80'N	17o29.90'W	UW71	
10-Jun	161	0405	35o35.50'N	17o30.20'W	UW72	
10-Jun	161	0831	36o32.26'N	17o30.28'W	UW73	
10-Jun	161	0920	36o36.85'N	17o30.30'W	UW74	X
10-Jun	161	1506	37o27.30'N	17o29.75'W	UW75	
10-Jun	161	2156	38o52.86'N	17o29.98'W	UW76	
11-Jun	162	0336	39o58.36'N	17o29.68'W	UW77	
11-Jun	162	0940	41o04.80'N	17o25.91'W	UW78	X

Appendix A6-21 High Volume Aerosol Sampling Log

Date	SDY	Filter	Plates	Time START	Time FINISH	Latitude	Longitude
SAMPLE FILTERS							
16-May	136	1	1	1556		31o40.47'S	17o10.82'E
20-May	140	1	1		1405	32o31.85'S	17o28.73'E
20-May	140	2	2	1410		32o31.85'S	17o28.73'E
21-May	141	2	2		0710	28o55'S	16o11'E
21-May	141	3	3	1345		28o24.72'S	15o40.24'E
23-May	143	3	3		1531	21o18'S	12o02'E
23-May	143	4	4	1537		21o18.75'S	12o02.51'E
25-May	145	4	4		1135	17o26.43'S	11o04.40'E
25-May	145	5	1	1247		17o24.29'S	11o01.47'E
27-May	147	5	1		0823	11o37.26'S	04o08.35'E
27-May	147	6	2	1026		11o33.49'S	04o04.04'E
28-May	148	6	2		0828	08o37.36'S	00o35.92'E
28-May	148	7	3	1525		08o07.86'S	00o05.82'W
28-May	148	7	3		1715	07o48'S	00o23'W
30-May	150	8	4	1320		02o31.42'S	06o29.44'W
31-May	151	8	4		1403	00o39'N	09o45'W
31-May	151	9	1	1544		00o39.91'N	09o45.26'W
02-Jun	153	9	1		0132	04o53.81'N	15o03.37'W
02-Jun	153	10	2	1100		05o57.12'N	16o09.95'W
04-Jun	155	10	2		0823	12o42.65'N	19o15.55'W
04-Jun	155	11	3	1112		12o52.52'N	19o13.77'W
06-Jun	157	11	3		0845	20o24.37'N	20o00.15'W
06-Jun	157	12	4	1354		21o15.33'N	20o00.56'W
08-Jun	159	12	4		0417	27o51.81'N	19o59.94'W
08-Jun	159	13	1	1657		29o49.13'N	19o00.74'W
09-Jun	160	13	1		1422	32o46.26'N	17o22.76'W
10-Jun	161	14	2	1120		36o46.04'N	17o30.17'W
12-Jun	163	14	2		0800	44o40.65'N	14o00.65'W
13-Jun	164	15	3	1122		48o30.97'W	09o27.13'W
14-Jun	165	15	3		2030	52o08.76'N	01o51.43'E
BLANK FILTERS							
09-Jun	160	B1	2	1718		33o18.63'N	17o29.84'W
10-Jun	161	B2	3	1118		36o46.00'N	17o30.17'W
13-Jun	164	B3	4	1120		48o30.97'N	09o27.13'W
13-Jun	164	B4	1	1120		48o30.97'N	09o27.13'W

Appendix A6-22 Mesozooplankton log.

			>2000			1000-2000			500-1000			200-500			total		
Date	Time	Depth	reps	total	Subs	reps	total	Subs	reps	total	Subs	rep	total		reps	total	Subs
15/05/98	11:15	100m				3	500	50	3	1000	50	3	1000	50			
15/05/98	20:00	200m													3	1000	50
16/05/98		NT													3	500	50
16/05/98	08:00	100m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
16/05/98	20:00	200m													3	1000	50
17/05/98	08:00	100m	3	500	50	3	500	50	3	1000	50	3	1000	50			
18/05/98	04:00	100m													3	1000	50
18/05/98	08:30	200m				3	500	50	3	500	50	3	1000	50			
18/05/98	11:30														3	1000	50
18/05/98	15:00														3	1000	50
19/05/98		NT													2	1000	100
21/05/98	08:00	100m				3	500	50	3	1000	50	3	1000	50			
22/05/98	05:35	NT													3	500	50
22/05/98	08:00	100m	3	500	50	3	1000	50	3	1000	50	3	4700	50			
23/05/98	04:00	200m													3	1000	50
23/05/98	08:00	200m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
24/05/98	08:00	200m	3	500	50	3	1000	50	3	1000	50	3	5000	50			
24/05/98	13:55	NT													3	500	50
25/05/98			3	500	50	3	500	50	3	1000	50	3	4000	50			
25/05/98	11:30	200m													3	2000	50
25/05/98	18:54	NT													3	1000	50
26/05/98	08:30	200m	3	1000	50	3	1000	50	3	1000	50	3	1000	50			
27/05/98		200m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
27/05/98	14:13	NT													3	1000	100
28/05/98		200m	3	500	50	3	500	50	3	1000	50	3	1000	50			
29/05/98	08:30	200m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
29/05/98	13:30	NT													3	1000	50
29/05/98	21:00	200m													3	1000	50
30/05/98	08:30	200m	3	1000	50	3	1000	50	3	1000	50	3	1000	50			
31/05/98	08:30	200m	3	500	50	3	500	50	3	1000	50	3	1000	50			
01/06/98	09:00	200m	3	500	50	3	500	50	3	1000	50	3	1000	50			
02/06/98	09:00	200m	3	500	50	3	500	50	3	500	50	3	500	50			
03/06/98	03:15														3	1000	50
03/06/98	09:00	200m	3	1000	50	3	1000	50	3	1000	50	3	1000	50			
04/06/98	09:00	200m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
05/06/98	09:00	200m	3	2000	50	3	1000	50	3	1000	50	3	1000	50			
05/06/98		NT													3	1000	50
06/06/98	06:45	NT													3	1000	50
06/06/98	09:00	200m	3	1000	50	3	1000	50	3	1000	50	3	1000	50			
07/06/98	09:00	200m	3	500	50	3	500	50	3	500	50	3	1000	50			
08/06/98	09:00	200m				3	500	50	3	500	50	3	500	50			
09/06/98	08:00	200m	3	500	50	3	500	50	3	500	50	3	500	50			
10/06/98	09:00	200m	3	500	50	3	500	50	3	500	50	3	500	50			
10/06/98	13:50	NT													3	500	50
10/06/98	22:00	200m													3	1000	50
11/06/98	09:00	200m				3	500	50	3	500	50	3	1000	50			
11/06/98	23:00	NT													3	500	50
12/06/98	08:30	200m	3	500	50	3	500	50	3	500	50	3	500	50			
13/06/87	09:45	200m	3	500	50	3	1000	50	3	1000	50	3	1000	50			
14/06/87	09:00	20m				3	500	50	3	1000	50	3	1000	50			

Appendix A6-23. Particulates CHN analyses log.

Particulates log

			Surface <200						Surface<5							Chl Max <200						Chl Max <5				
Date	Time	Depth	Reps	Vol	No.				Reps	Vol	No				Depth	Reps	Vol	No				Reps	Vol	No.			
15/05/98	11:15	10	3	250	24	1b2	1c2	1d2	3	250	25	1e2	1f2	1g2												
16/05/98	08:00	7	3	250	28	1b5	1c5	1d5	3	250	29	1e5	1f5	1g5												
17/05/98	08:00	7	3	250	35	1h5	1a6	1b6	3	250	36															
17/05/98	11:00	7	3	250	38				3	250	39															
18/05/98	04:00	4	3	250	41				3	250	42															
18/05/98	08:30	4	3	250	47				3	250	48				7	3	250	49				3	250	50			
18/05/98	11:30	4	3	250	54				3	250	55															
18/05/98	15:00	4	3	250	56				3	250	57				10	3	250	58				3	250	59			
21/05/98	08:00	7	3	250	60				3	250	61															
21/05/98	11:00	7	3	250	67				3	250	68															
22/05/98	08:00	7	3	250	69				3	250	70															
22/05/98	12:00	7	3	250	79				3	250	80															
23/05/98	04:00	7	3	250	81				3	250	82															
23/05/98	08:00	NT(7	3	250	84				3	250	85															
23/05/98		7	3	250	92				3	250	93															
23/05/98		7	3	250	94				3	250	95															
24/05/98	08:00	7	3	250	103				3	250	104															
24/05/98		7	3	250	105				3	250	106															
25/05/98		7	3	250	113				3	250	114															
25/05/98	11:30	7	3	250	115				3	250	116															
26/05/98	08:30	7	3	250	123				3	250	124															
27/05/98	08:30	7	3	500	125				3	500	126				52	3	500	127				3	500	128			
28/05/98	08:30	7	3	500	146				3	500	147				47	3	500	148				3	500	149			
29/05/98	08:30	7	3	500	159	6a1	6b1	6c1	3	500	160	6a2	6b2	6c2	47	3	500	161	6a3	6b3	6c3	3	500	162	6a4	6b4	6c4
30/05/98	08:30	7	3	500	172	6a12	6b12	6c12	3	500	173	6d1	6e1	6f1	40	3	500	174	6d2	6e3	6f3	3	500	175	6d4	6e4	6f4
31/05/98	08:30	7	3	500	176	6d8	6e8	6f8	3	500	177	6d9	6e9	6f9												
01/06/98	09:00	7	3	500	187	7a5	7b5	7c5	3	500	188	7a6	7b6	7c6	60	3	500	189	7a7	7b7	7c7	3	500	190	7a8	7b8	7c8
02/06/98	09:00	7	3	500	200	7d1	7e1	7f1	3	500	201	7d2	7e2	7f2	51	3	500	202	7d3	7e3	7f3	3	500	203	7d4	7e4	7f4
03/06/98	09:00	7	3	500		7d11	7e11	7f11	3	500		7d12	7e12	7f12	40	3	500		8a1	8b1	8c1	3	500		8a2	8b2	8c2
04/06/98	09:00	7	3	500		8a7	8b7	8c7	3	500		8a8	8b8	8c8	30	3	250		8a9	8b9	8c9	3	250		8a10	8b10	8c10
05/06/98	09:00	7	3	500		8d3	8e3	8f3	3	500		8d4	8e4	8f4	35	3	250		8d5	8e5	8f5	3	250		8d6	8e6	8f6
06/06/98	09:00	7	3	250		8g1	8g3	8g5	3	250		8g2	8g4	8g6												
07/06/98	09:00	7	3	500		9a6	9b6	9c6	2	500		9a7	9b7		80	3	500		9a8	9b8	9c8	3	500		9a9	9b9	9c9
08/06/98	09:00	7	3	1000		9d4	9e4	9f4							146	3	1000		9d5	9e5	9f5						
09/06/98	08:00	7	3	1000		9d9	9e9	9f9							115	3	1000		9d10	9e10	9f10						
10/06/98	09.00	7	3	1000		10a5	10b5	10c5	3	1000		10a6	10b6	10c6	89	3	1000		10a7	10b7	10c7	3	1000		10a8	10b8	10c8
11/06/98	09:00	7	3	500		10d3	10e3	10f3	3	500		10d4	10e4	10f4	45	3	500		10d5	10e5	10f5	3	500		10d6	10e6	10f6
12/06/98	08:30	7	3	500		10d12	10g1	10g6	3	500		10e12	10g2	10g7	35	3	500		10f12	10g3	10g8	3	500		10g4	10g9	10g11
13/06/98	09:45	7	3	200		11a5	11b5	11c5	3	200		11a6	11b6	11c6	20	3	200		11a7	11b6	11c7	3	200				
14/06/98	09:00	7	3	250		11d1	11e1	11f1	3	250		11d2	11e2	11f2												

Appendix A6-24 AMT-6 Cape Town to Grimsby, Data Matrix.

Appendix A6-24 a. AMT-6 Cape Town to Grimsby, Data Matrix.

AREA	LAT RANGE	DAYS SDY	STAS	MLD (m)	SST (C)	CHL Z,Ch	Phyto	HPLC	K490	Sea CHL	R555 %	PAR 1%
S. BEN UP	-34 S - -27.5 S	135 - 137 139 - 141	601 - 605 610 - 612	8,20,30 27	15.5,16	0, 5.5	Mixed Ceratium	Per Hex Fuco	.17,.34 .10,.32		.19,.31 .18,.27	10,19 12,28
N. BEN UP	-28 S - -17.5 S	138 142 - 145	606 - 609 613 - 623	28,44			Diatoms + Cosco		.15 .08,.20		.18 .15,.27	14,34
GOG, EQ. UP	-17.5 S 7.5 N	146 - 153	624 - 638	24,49					.029, .072		.130, .214	34, 63
N. EQ S of UP	8 N - 16.5 N	154 - 156	639 - 643	21,46					.036, .085		.149, .200	31, 40
N.W. AFRICA UP	17 N - 21.5 N	156 - 157	644 - 648	25,45			Synecho +Cocco?		.093, .246		.151, .642	13, 28.5
CANIGO	(20 N) - 42.5 N	157 - 162	649 - 659						.025, .048		.130, .223	48, 123
S.W. APP,	47 N - 50 N	163 - 165	660 - 666	32,42			Phaeo Cocco		.081, .214		.170, 1.24	17, 32

Appendix A6-24b. AMT-6 Cape Town to Grimsby, Data Matrix.

AREA LAT RANGE	DAYS SDY	STA	MLD (m)	SST (C)	CHL Z,Ch	Phyto	HPLC Fuc Per Hex Ze Dv	K490 M-1	R555 %	Ret Chl	a488	c488	a555	c555
S. BEN UP	135	601	8	15.5	00, 5.48	Mixed	**0.9**, .25, **1.2**, .14, 0	.263	.247					
-34 S -	136	602	20	16	, 2.68	Ceratium	**0.4**, 0.3, **0.6**, 0 , 0	.185	.190					
-27.5 S	136	603	30		,5.03		**0.5**, **1.8**, 0.4, 0 , 0	.340	.240					
	137	604			,4.34		**1.3**, .15, **0.6**, 0.1, 0	.275	.307					
	137	605			,2.83		**0.8**, 0.1, ? , 0.1, 0	.173	.306					
	139	610			,1.04		.13, .07, **0.7**, 0, 0	.103	.178					
	141	611			,8.30		**1.7**, ? , **1.8**, .14, 0	-	-		0.344	1.434	0.261	1.316
	141	612			,6.00		**1.9**, 0.4, 1.0, 0.2, 0	.321	.272		0.388	1.744	0.283	1.635
N. BEN UP -	138	606			,3.49	Diatoms	**0.9**, 0.0, **0.9**, 0.0, 0	-	-					
28 S -	138	607			,2.23		**.35**, 0.14, 1.0,0.1, 0	.148	.262					
-17.5 S	138	608			,1.11		.12, 0.18, **.24**, .14,0	-	-					
	138	609			,1.60		**.25**, 0.1, **0.45**, 0.0,0	-	-					
	142	613			,2.44	+ Cosco	**1.4**, 0.0, 0.0, 0.0, 0	.130	.186		0.025	0.451	-.012	0.395
	142	614			,1.85		**1.2**, 0.0, 0.0, 0.0, 0	.145	.164		0.042	0.471	-.004	0.423
	143	615			,1.73		**.55**, 0.1, **0.6**, .13, 0	-	.-		0.075	0.706	0.026	0.635
	143	616			,1.66		**.55**, 0.0, 0.3, .15, 0	.204	.179		0.076	0.697	0.029	0.626
	143	617			,			-	-		0.103	0.838	0.037	0.773
	143	618			,1.79		.33, 0.16, **0.9**, 0.1,0	.197	.272		0.102	0.929	0.038	0.861
	144	619			,1.86		**0.9**, 0.0, 0.1, 0.0, 0	.080	.146		-.003	0.330	-.032	0.290
	144	620			,1.62		**0.9**, 0.0, 0.15, 0.0,0	-	-		0.093	0.380	-.028	0.336
	144	621			,3.97		**1.9**, 0.0, 0.14, 0.0,0	.107	.175		0.088	0.367	-.055	0.326
	145	622			,2.43		**1.1**, 0.0, 0.2, 0.0, 0	.165	.145		0.077	0.623	0.007	0.560
	145	623			,0.82		**0.3**, 0.0, 0.2, 0.0, 0	.083	.153		0.012	0.498	-.029	0.440

GOG,	146	624			,0.36			.072	.182		-.013	0.399	-.039	0.347
EQ. UP	146	625			,0.37			.062	.172		-.008	0.409	-.034	0.359
-17.5 S	147	626			,0.12			-	.-		-.065	0.167	-.065	0.152
7.5 N	147	627			,0.08			.031	.145		-.070	0.159	-.070	0.145
	148	628			,0.22			.056	.141		-.052	0.191	-.060	0.165
	148	629			,0.15			.041	.153		-.069	0.169	-.068	0.151
	149	630			,0.24			.056	.155		-.056	0.204	-.070	0.170
	150	631			,0.17			.039	.209		-.085	0.205	-.084	0.181
	150	632			,0.16			.030	.214		-.080	0.189	-.080	0.166
	151	633			,0.33			.064	.141		0.047	0.282	0.026	0.243
	151	634			,0.27			.064	..214		0.023	0.281	0.004	0.244
	152	635			,0.16			.029	.141		-.072	0.152	-.068	0.139
	152	636			,			-	-		-.074	0.157	-.073	0.144
	153	637			,0.24			-	-		-.065	0.163	-.071	0.147
	153	638			,0.20			.038	.179		-.075	0.175	-.075	0.161
N. EQ	154	639			,0.23			.045	.154		-.057	0.207	-.072	0.179
S of UP	154	640			,0.18			.036	.151		-.059	0.208	-.073	0.181
8 N -	155	641			,0.27			.059	.186		-.032	0.255	-.058	0.222
16.5 N	155	642			,0.18			.039	.149		-.046	0.209	-.069	0.182
	156	643			,0.47			.085	.200		0.006	0.376	-.028	0.326
N.W.	156	644			,0.75	Synecho		.093	.202		0.003	0.432	-.036	0.388
AFRICA UP	156	645			,2.40	+Cocco?		.142	.151		0.044	0.532	-.018	0.500
17 N -	157	646			,1.86			.231	.267		0.213	1.091	0.111	0.975
21.5 N	157	647			,1.60			.246	.344		0.230	1.239	0.134	1.107
	157	648			,1.14			.238	.642		0.295	1.553	0.171	1.277
CANIGO	158	649			,0.19			.040	.139		-.059	0.195	-.073	0.171
(20 N) -	158	650			,0.086			.013	.137		-.069	0.187	-.073	0.168
42.5 N	158	651			,0.095			.008	.136		-.071	0.175	-.074	0.159

	159	652			,0.034			.023	.130		-.060	0.152	-.069	0.141
	159	653			,0.027			.015	.136		-.072	0.140	-.075	0.130
	160	654			,0.032			.024	.134		-.074	0.150	-.086	0.139
	160	655			,0.027			.025	.152		-.067	0.210	-.078	0.193
	161	656						.030	.148		-.063	0.175	-.078	0.160
	161	657						.017	.149		-.067	0.175	-.077	0.163
	162	658						.048	.203		-.044	0.306	-.065	0.269
	162	659						.041	.223		-.041	0.313	-.061	0.279
S.W. APP,	163	660						.081	.170		-.001	0.406	-.035	0.373
USHANT	163	661						.102	.214		0.021	0.472	-.022	0.436
47 N -	164	662						.179	.179		0.099	0.817	0.005	0.826
50 N	164	663						.170	.695		0.132	1.066	0.063	0.975
	164	664						.214	1.245		0.206	1.384	0.126	1.263
	165	665						.168	.250		0.096	0.876	0.013	0.818
	165	666						.128	.353					