CRUISE REPORT

RRS DISCOVERY CRUISE D251T

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UKORS EQUIPMENT TRIALS

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Southampton Oceanography Centre
UNIVERSITY OF SOUTHAMPTON AND NATURAL ENVIRONMENT RESEARCH COUNCIL

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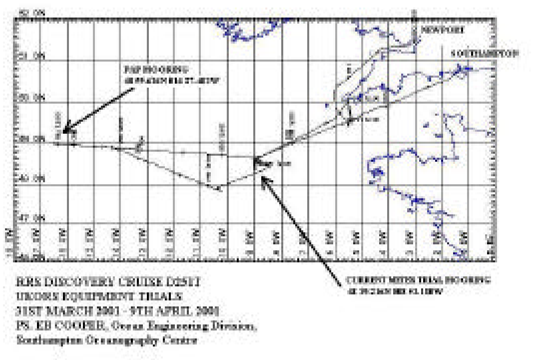
1.0 OVERVIEW

Following the refit of RRS Discovery, a trials exercise was programmed for the shakedown of ship-fitted instrumentation and systems post-refit, for the testing of instrumentation recently included within the National Marine Equipment Pool and the training of UKORS technicians. Two "science" activities were also included within the exercise, the utilisation of an Autonomous Nutrient Analyser and the deployment of a sediment trap mooring on the Porcupine Abyssal Plain, this activity had been held over from an earlier Discovery cruise.

As with all activities of this nature there needs to be a responsive scheduling depending on progress with experiments and equipment status through the period of time available. Two boat transfers were required off Penzance to exchange staff one of the transfers was planned within the cruise programme; the second was as a consequence of equipment issues, which needed specialist attention.

In spite of weather downtime and the need for a long transit to and from the PAP mooring site most activities were undertaken or attempted, to a useful point.

1.1 TRACK PLAN



2.0 SCIENTIFIC PARTICIPANTS

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3.0 **ACTIVITY REPORTS**

3.1 ANA Autonomous Nutrient Analysers

The ANA system, supplied on loan by WSOcean Systems Ltd. for testing, is designed to automatically carryout chemical analyses of the ocean surface waters. The analyser uses aqueous solutions of the reacting chemicals and is attached to the non-toxic sea water supply. The system also produces an RS232 output of processed data, which were logged by a PC and the data transmitted back to SOC via an Orbcomm Satellite Communicator.

The non-toxic supply was turned on and left to flush for 24 hours before the ANA system was connected, connection occurred on day 092 15:30 GMT and was run continuously until day 099 06:34 GMT. For calibrations purposes nutrient samples were taken approximately every 4 hours with salinity samples being taken twice daily.

The Orbcomm Satellite Communicator initially performed very well, but no messages were received between day 094 and 11:30 of day 095. As an attempt to cure the problem, the communicator was power cycled on day 095 at 11:15, which would have lost any buffered messages, but communications were re established.

TSG Salinity Samples D251T

Sample No.	Date	Time GMT
1	2/4/01	17:01
2	3/4/01	05:07
3	3/4/01	17:21
4	4/4/01	05:46
5	4/4/01	17:58
6	5/4/01	06:22
7	5/4/01	17:32
8	6/4/01	06:29
9	6/4/01	17:45
10	7/4/01	07:14
11	7/4/01	17:44
12	8/4/01	05:57
13	8/4/01	17:59
14	9/4/01	05:57
15	9/4/01	06:28

TSG Nutrient Samples D251T

Sample No.	Date	Time GMT
1	2/4/01	17:03
2	2/4/01	21:06
3	3/4/01	01:03
4	3/4/01	05:08
5	3/4/01	09:30
6	3/4/01	13:49
7	3/4/01	17:23
8	3/4/01	21:15
9	4/4/01	01:00

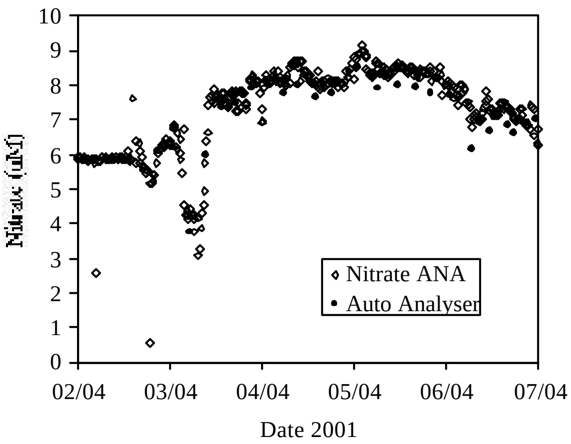
10	4/4/01	05:44
11	4/4/01	09:36
12	4/4/01	14:09
13	4/4/01	18:00
14	5/4/01	01:00
15	5/4/01	06:24
16	5/4/01	11:34
17	5/4/01	16:09
18	5/4/01	20:03
19	6/4/01	01:00
20	6/4/01	06:25

Sample No.	Date	Time GMT
21	6/4/01	11:33
22	6/4/01	16:00
23	6/4/01	17:48
24	6/4/01	23:13
25	7/4/01	07:12
26	7/4/01	12:14
27	7/4/01	17:46
28	7/4/01	23:46
29	8/4/01	05:59
30	8/4/01	10:55
31	8/4/01	14:18
32	8/4/01	18:03
33	9/4/01	05:55
34	9/4/01	06:27

The chemical side of the ANA system performed well until it ran out of one of the reagents about 0600h on the 7 April (day 97). Measurements of nitrate were made every 15 minutes. 850 measurements were made before the reagent ran out.

The instrument measures a known concentration standard every sixth sampling interval. The concentration of this standard was 10.0 micro Moles per litre potassium nitrate. This standard was determined 143 times. The mean absorbance of the standard 0.536 with a percent standard deviation of 3.0.

During the cruise 34 samples of seawater were collected from the ships non-toxic sea water supply (the same stream of water that the ANA system was sampling from). The samples were stored in a refrigerator. Concentrations of nitrate in these samples were determined using a standard Auto-Analyser in the laboratory in Southampton after the end of the cruise on the 11 April. The plot presented below shows that good agreement was achieved between the ANA and the Auto-Analyser results.



R. Pascal & D. Hydes

3.2 Testing of a Nanostructured Dissolved Oxygen Sensor for use with a CTD

A collaborative project between the Chemistry Dept. of Southampton University and SOC OED has resulted in a novel electrochemical dissolved oxygen sensor for use with a CTD. Unlike conventional membrane oxygen sensors, it has a fast response time, is less affected by bio fouling and doesn't suffer hysterise with high pressures.

After initial testing on the RRS James Clark Ross a number of problems were identified, namely the effect of ship motion on the flow passing the head and variations in the earth reference, producing large changes to the signal output. The sensor head and electronics have been re -designed to include a silver chloride electrode that provides a stable reference and a seabird pump system was added to provide a constant flow across the head.

The objective of this trial was to ascertain whether these modifications had been successful in producing a more stable and less noisy output and to integrate the sensor into the Seabird CTD system.
On deployment 2, he pressure switch for activating the pump was tested and was found to engage at approximately 15m. On the other casts various hose configurations were used and the effects on data quality were monitored. During deployment 4, both the pump and flow head was disconnected.

Cast	Depth	Sensor	Setup
1	101m	A25	Flow head attached, pump activated before cast
2	101m	A25	Flow head attached, pressure switch to activate pump
3	100m	A25	Flow head attached, pump activated before cast
4	100m	A25	Flow head removed, pump deactivated.
5	100m	A25	Flow head attached, pump activated before cast
6	150m	A25	Flow head attached, pump activated before cast, hoses point sideways
7	30m	A25	Flow head attached, pump activated before cast, short hoses pointing up
8	4750m	A25	Flow head attached, pump activated before cast, short hoses pointing up
9	4522m	A25	Flow head attached, pump activated before cast, short hoses pointing up

R. Pascal

3.3 Ocean Surveyor 75kHz ADCP

Introduction

The OS75 transducer was installed while the Discovery was dry -docked in refit, with the deck unit and P.C. fitted during the mobilisation period prior to D251. Connections to the ship's gyro and serial RS232 leads for communications and navigation were added at this time. The vessel's 150kHz NB-VM ADCP was also modified to accept a synchronisation signal from the OS75, allowing simultaneous transmission from both instruments.

It had been arranged for an RDI engineer, Mr L Michel, to commission the system alongside and test it at sea, and to also carry out some training of personnel. The dockside acceptance tests (see respective document) were performed and passed (see separate report from RDI to follow). Testing at sea while Mr Michel was on board would be restricted to shallow water only (<200m) as it had not been possible to procure his stay for the whole cruise. Limited sea acceptance testing (see respective document) was carried out and the data recorded on a CD-ROM. A full report from
Mr Michel is to follow in due course.

Interference Test

This was carried out in broad band mode in shallow water and was therefore not a true representation of the effects of interference on the instrument. However, the effect of, for example, the 10kHz echo sounder can be clearly seen in the echo intensity plot below (Fig 1).

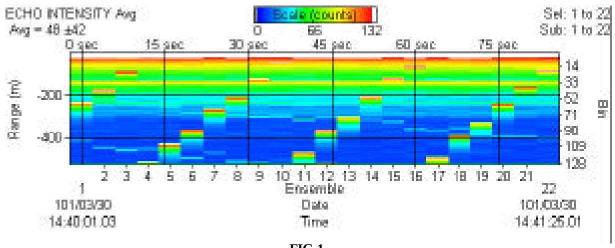


FIG 1

Compare this with the "all sonars off" plot (Fig 2).

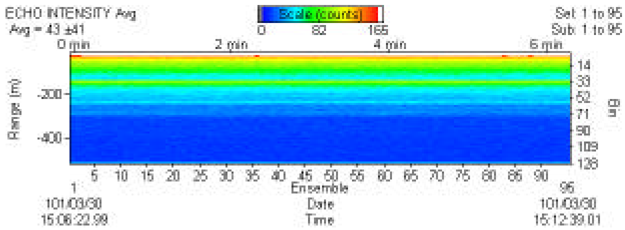


FIG 2

The worst case of interference however, was observed later on in the cruise during a CTD cast using a 10kHz beacon for depth verification in deep (>4500m) water. Figure 3 shows that as the CTD and pinger come within the range of the ADCP (approximately after the 150 min mark), range is severly curtailed and data quality degraded.

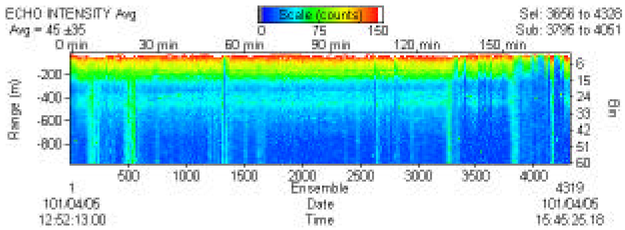


FIG 3

From this result it may be inferred that where ADCP data is important during station work an altimeter should be used instead of a pinger. No altimeter was available for this on D251T so this recommendation should be tested at a later date.

Alignment Error

A "figure 4" type of course was run at various speeds to attempt to ascertain the alignment error. Both the 150kHz NB ADCP and the OS75 were both installed at an angle of 45 degrees to the ship's centre line as recommended by RDI. Although Mr Michel carried out several different re-processing regimes on the data, the results were inconclusive. At this point it is believed that the 150kHz NB ADCP's alignment correction is true, but that of the OS75 requires further analysis. A final solution is expected in the RDI report from Mr Michel.

ADCP Synchronisation

The synchronisation modifications were tested thoroughly by Mr Michel and found to operate satisfactorily. The OS75 sends a trigger signal to the 150kHz NB ADCP and the two instruments transmit simultaneously to avoid one interfering with the other.

Range Tests

With the poor weather experienced at the PAP deep water site and pressure to fulfil the other commitments of the cruise, the range tests were not accomplished. However, the data recorded during a deep CTD cast did indicate that ranges in excess of 800m were attainable even in marginal conditions (see fig 4).

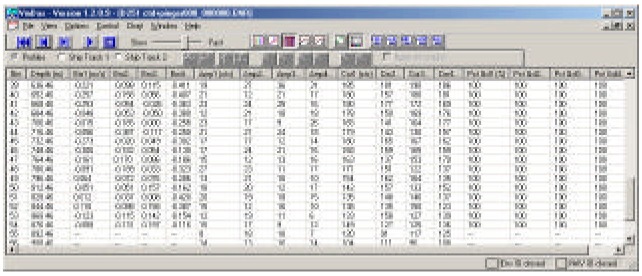


FIG 4

Conclusion

Despite the incomplete test results for the OS75, I believe it is clear that the system is operational. It promises to be a useful tool as part of the suite of scientific instrum entation aboard the RRS Discovery and eventually to replace the ageing NB ADCP. Further range and interference tests should be arranged at the earliest opportunity to confirm that the system is fully functional.

Future developments would involve incorporating Ashtech data for inclusion of pitch and roll information to ADCP data. Thought should also be given to networking the OS75 PC to allow the ADCP data to be available to any user.

J. Wynar

3.4 Engineering Trials and Objectives

3.4.1 Preamble

DY251T was a post refit trials cruise scheduled for the purposes of shaking down existing equipment, trialling new equipment, commissioning modified equipment and carrying out staff training. For Mechanical Engineering these requirements were relevant to a number of installations. These are listed below and more detailed treatment of each item forms the remainder of this report section.

- 3.4.2.1 10 Te main winch
- 3.4.2.2 20 Te main winch
- 3.4.2.3 Hydrogen gas generator
- 3.4.2.4 Nitrogen gas generator
- 3.4.2.5 Non toxic sea water system
- 3.4.2.6 Forward gantry
- 3.4.2.7 Seismic air compressor installation
- 3.4.2.8 -90ºC freezer
- 3.4.2.9 OED staff training
- 3.4.2.10 RSU staff training

3.4.2 Reports

3.4.2.1 10 Te Main Winch

This permanently installed equipment was trialled extensively during the cruise in conjunction with CTD deployments. No problems were experienced. It hasd been intended to install a modification into the 37kW hydraulic power unit in order to bring it to the same configuration as that for the 20 Te system. In the event however, staff and time constraints combined with other priorities meant this work could not be carried out. Although unfortunate, this is not considered to represent a problem at present and this view is supported by the satisfactory performance of the unmodified system during this cruise.

3.4.2.2 20 Te Main Winch

There were two principle objectives to be achieved with respect to this equipment. The first was simply to establish confidence in the system function following refit. The second concerned a stub shaft on the trawl wire storage drum. The shaft which supports some 50% of the drum load of around 15 Te, failed catastrophically some 30 months ago during a wire winding exercise. A repair was carried out at that time but because of the known structural weaknesses inherent in the design and the difficulty in achieving a satisfactory weld in the somewhat exotic steels selected by the French designers, the repair and indeed, all the equivalent shafts within the system were placed under a regime of non destructive testing. During refit this testing revealed a seriuos crack some 120mm long through the welded connection. It was considered that a further attempt to repair by welding was certain to be futile. Accordingly, a design exercise was undertaken and a new, flanged stub shaft was made and fitted to the storage drum mechanically, using fitted bolts.

Given the need to verify the integrity of the repair, the trawling wire was selected for use in conducting the winch tests. Measurements at the stub shaft during rotation revealed a throw of some 1.8mm at the drum end of the stub shaft and a throw of 1.4mm at the inboard end, 180 degrees opposed to the former. This prompted the opening of the bearing assembly to determine whether any damage was occurring. None was seen and it was noted that the bearing appeared to be of a spherical design potentially offering the capability to accept the misalignment. The bearing identification marks were noted and the bearing design will be confirmed as soon as possible. SHE, the refit contractors. Will also be notified of these findings as a precaution against possible remedial work being required in the future.

Turning now to the test deployment itself. A weight 2 Te was attached to the trawl wire and deployed over the stern of the vessel down to 1500 metres without incident. However, when an attempt to begin recovery was made the winch system failed to respond to a haul command. This fault was traced to a PLC/system interface relay, R51 which commands hydraulic boost pump pressure into the 300kW hydraulic power unit. Although the relay was energising normally and indicating its state correctly, a signal was not in fact being sent to the solenoid valve controlling boost pressure due to failure of relay contacts. This resulted in insufficient system boost pressure and was the cause of the inability to haul. A replacement relay was fitted and the system returned to normal operation. The test deployment was then recovered without further difficulty.

It had been intended to conduct a second deployment using the same system but this was precluded initially by insufficient time and subsequently by unsuitable weather conditions. Although regrettable, this omission is not considered to be a matter for concern.

3.4.2.3 Hydrogen Gas Generator

This equipment was set to work for a period of six days after being set up on a bench within the hangar and a risk assessment produced. Hydrogen and oxygen vent pipes were run to the outside of the vessel. Some difficulty was experienced in achieving a stable running condition. This was found to be due to the requirement for a load into which to deliver the generated hydrogen gas. Such a load is required by the system to act as a metering device, without which the generator is easily set into a fault condition dur to the apparent free release of hydrogen. Constricting the hydrogen discharge pipe and reducing the delivery pressure to a minimal value overcame this difficulty. Following this the equipment operated with little intervention at about 40% of maximum output for the duration mentioned above.

3.4.2.4 Nitrogen Gas Generator

This equipment was set to work for a period of seven days after being set up on a bench within the hangar and a risk assessment produced. The generator performed faultlessly and without intervention for the entire period.

3.4.2.5 Non Toxic Sea Water System

This system has been run throughout the cruise in support of sampling instrumenation, itself on test. No fault with the system was identified. During refit a “Decon 90” injection system was installed to allow a recurrent problem of biological pollution of non-toxic seawater to be addressed. At the time of writing the injection of Decon 90 has not yet taken place due to the sampling programme mentioned above. This injection will take place before the end of the cruise. No difficulties are envisaged as the equipment concerned has already been subject to commissioning tests.

3.4.2.6 Forward Gantry

Work was carried out at refit to prepare the forward gantry for future use as an ultra clean sampling position on the vessel. The intention was that it be available for use with plastic coated or synthetic ropes in the shallow deployment of nets and similar sampling devices. These devices would potentially be deployable concurrently with say, a CTD and would be immune from cross contamination via system components also in use with grease coated wire ropes etc. The gantry was tested and operated prior to sailing with satisfactory results. A small deck winch was mounted for the cruise so that the efficacy of the arrangements could be confirmed. Seizure of a pump element within the forward hydraulic power unit prevented the deck winch from being operated. Although the seized pump was not required the design of the power units places all three of the pump elements present in tandem, thus the one failure rendered them all unavailable. Spares were available on board but required some machining work before they could be used. It was considered tjhat the equipment and time available to do this work was inadequate to ensure a satisfactory result and therefore the deployment test did not proceed. However, once the pump unit had been repaired the winch function can be demonstrated with the vessel alongside, following which the facility may be considered available for scientific use.

3.4.2.7 Seismic Air Compressor Installation

For several members of the Mechanical Engineering comple ment on board, work on this installation formed the major part of the cruise activities. It had been intended that the compressor systems would be fully commissioned prior to sailing, leaving the period of the cruise to achieve some extended running of the machinery. This would have built confidence in its reliability, something which has been in very short supply in the past.

In the event, various circumstances combined to turn the cruise into a commissioning exercise. Of particular relevance is Hamworthy ’s practice of using subcontractors for all their electrical and control system work. Subcontractor commitments meant that the necessary expertise was not available to progress the work at the crucial moment. This difficulty was compounded by the attendance of another subcontractor, unfamiliar with the system, on the day arranged for final commissioning. An eror in the relay logic of the new manual control system allowed star and delta contactors to close together. This occurred on two compressors before the error was recognised and resulted in irrepairable damage to the contactors concernec, thus terminating the commssioning.

As things turned out it may be considered that this was fortuitous. Hamworthy had already provided a service engineer, Mr Luke Scott, in support of the cruise. However, he had no control systems expertise and it was this expertise which was the primary requirement. Strong representations to Hamworthy on this issue had produced no change in their position until the incident mentioned above. They then undertook to send their subcontracted control engineer, Mr Alan Bull, to join the vessel by boat transfer in Penzance immediately upon his return to the UK. As Mr Bull was the designer of the new manual control system and had expertise in PLC programming for compressors, this was very welcolm news although it did cost some time in making a second call off Penzance to pick him up.

After leaving Penzance with both Mr Scott and Mr Bull on board we were in a strong position to make progress with the compressors and full advantage has been taken of this. Several days were spent identifiying and rectifying numerous faults in both the compressors themselves and in the hard wired relay logic control system. Single compressors were run up as required in order to verify machine and system performance. An unexpected problem was encountered in the failure of the four new cooling water admission valves to opern at the compressor first stage pressure of 3 bar. This was overcome temporarily by removal of the valve springs but in view of the known problems caused by internal condensation resulting from overcooling this issue will certainly have to be addressed as asoon as possible. In the meantime a strict discipline of manual valve closure is required.

An issue identified at an early stage was poor interfacing between the compressor control system and the ship's main power generation PMS (Power Management System, a PLC which controls the behaviour of the main generator sets.) because the compressors are large loads at 245kW each, signals are sent to the PMS requesting permission to start. No start may proceed until permission is received. Two particular problems have been identified. First, a request signals a requirement for headroom of 1700A. If a six cylinder genset (as opposed to a nine) is selected as next in sequence on the PMS inputs then, although the genset starts and is synchronised onto the bus, permission is not given as1700A headroom is not achieved. However, instead of calling for another genset the PMS assumes it has finsihed and does nothing further leaving the compressor start hung, waiting for permission which never comes. Second, if a start request is sent to the PMS when a genset is already within a shutdown cycle then instead of being stored and executed when the shutdown cycle completes it is lost and again, the compressor start is hung. Further, the Chief Engineer reports that the genset shutting down is also deselected from PMS control thus making it unavailable to the system until manually reset. Resolution of these PMS ussues must lie with the system designers, Hill Graham Controls, via RSU whose staff are aware if the problems encountered.

Working around the PMS interface problems all compressors were fully commissioned and the new manual control system was also commssioned with every control permutation possible being tested and signed off. On 07/04/2001 all four compressors were running together at full output under manual control with no problems apparent.

Attention has since been turned to compressor PLC programs, which are known to contain bugs. Work is continuing on this but at the time of writing it has been established that PLC manual will be a useful primary system once some software modifications to remove non failsafe options have been implemented. This is being done and will result in a new version of the program (RVS10). PLC automatic appears rather less useful. Final decisions remain to be taken but it appears that removal of this element of the programming may turn out to be advisable.

In conclusion it may be said that although the amount of running time was not as high as had been intended the approach adopted has been extremely productive. The presence on board of Mr Scott and Mr Bull has allowed the standard of installation to be advanced far beyond what would have been achieved with the vessel alongside.

3.4.2.8 -90ºC Freezer

A new sample storage freezer, capable of achieving temperatures down to -90ºC was placed on board during the post refit mobilisation. This has been fully secured in the after starboard section of the after hold during the cruise and subsequently set to work. A set point of -70ºC was input and the unit achieved this temperature within 4 hours. An installed chart recorder logging the temperature of the cabinet shows good, stable temperature control around the set point for commssioning to date.

3.4.2.9 OED Staff Training

For OED Mechanical Engineering staff, training has concentrated upon the seismic compressor installation in particular. Good progress has been made in developing knowledge and experience of both the existing and new compressor control systems and the compressors themselves.

Familiarisation of staff with the hydrogen and nitrogen gas generators has also been accomplished.

3.4.2.10 RSU Staff Training

Prior to DY251T, the possibility of carrying out training of RSU staff in theoretical and practical aspects of scientific deployments using the ship's winches had been discussed with RSU managers ashore. At that time a positive indication was given. However, shortly after commencement of the cruise a converstion with the Master revealed that he had no knowledge of this arrangement. Furthermore, the Master expressed the view that until a more structured approach to the issue of training crewmen was in place he saw little point in pursuing it. Therefore no training of this sort was undertaken.

G.M. Batten

3.5 CTD

A total of 9 CTD casts were undertaken for cruise 251T. The 24-way stainless steel frame was used for all the casts, with the following basic configuration:

Sea-Bird 9*plus* CTD system, s/n 09P-24680-0635
(includes Digiquartz temperature compensated pressure sensor, s/n 83007)
Sea-Bird 11*plus* CTD deck unit, s/n 11P-24680-0587
Sea-Bird 3P temperature sensor, s/n 03P-4103 (primary sensor)
Sea-Bird 4C conductivity sensor, s/n 04C-2570 (primary sensor)
Sea-Bird 5T submersible pump, s/n 5T-3086 (primary sensors pump)
Sea-Bird 3P temperature sensor, s/n 03P-4105 (secondary sensor)
Sea-Bird 4C conductivity sensor, s/n 04C-2570 (secondary sensor)
Sea-Bird 43B oxygen sensor, s/n 43B-0013 (connected through secondary sensors)
Sea-Bird 5T submersible pump, s/n 5T-3086 (secondary sensors pump)
Chelsea MKIII Aquatracka fluorometer, s/n 88/2360/108
SeaTech LSS, s/n 339 (low gain setting)
SeaTech transmissometer, 20cm path length, s/n T-1022D
Pascal Micro-electrode oxygen sensor, s/n 0001
Sea-Bird 32 Carousel water sampler, 24 position, s/n 32-24680-0344
10 kHz beacon, s/n B6
SBE Breakout Box, s/n BO19106

The auxiliary A/D channel configuration was as follows:

Aux 0=SBE 43B

Aux 3=Chelsea fluorometer
Aux 4=Pascal oxygen
Aux 6=SeaTech LSS
Aux 7=SeaTech transmissometer

The first 5 CTD casts were shallow profiles, none more than 150 metres in depth, and were used to investigate the overall performance of the sensors, particularly the newly JIF supplied SBE 9/11*plus* suite and the Pascal DO sensor. These casts were also used to experiment with different plumbing arrangements and to compare the two oxygen sensors, and to check on the integrity of the recently manufactured Breakout Box for the SBE system. On cast number five several water samples were taken through the Carousel, for salinity calibrations. Two acoustic releases were also attached to the frame for release mechanism checks on casts one and five. Cast number six was to 170 metres, and was used for more oxygen sensor performance analysis; cast number seven was to calibrate several TDR and was only to 30 metres. Casts number eight and nine were the deep casts, to 4800 metres and 4500 respectively, and numerous salinity water samples were taken from different bottles, with all bottles fired. On both casts a large amount of SBE modulo errors and their resulting "spikes" were observed, but post-processing and further analysis in consultation with Sea-Bird revealed the data errors to be not "real" in that they were the result of computer errors in the Windows operating system. Unfortunately on cast eight a large voltage shift and subsequent noise was noticed in the SeaTech LSS and transmissometer, and the cause was found to be salt water leaking into the Breakout Box. For cast nine, the BOB was replaced by the titanium version, s/n BO19107T. Later examination of the failed box revealed a loose bulkhead connector to be the culprit; the BOB was rinsed with fresh water, cleaned and allowed to dry, and has been successfully bench tested. No problems were observed during cast nine with the titanium BOB. The last plumbing configuration of the SBE 43 oxygen sensor produced the best data on both downcasts and up casts, and all the remaining SBE sensors performed faultlessly throughout the cruise. Finally, no problems were noted with any of the auxiliary sensors, other than previously stated.

J. Benson

3.6 Surface Sampling (Surfmet)

Prior to cruise DY251T all the relevant meteorological and surface sensors were either recalibrate or replaced with recently calibrated units.
The gimbal mountings for the PAR light sensors were dispensed with and the PAR sensors fitted to the gimbal mounts used for the TIR sensors. This was done because of the poor serviceability of both types of gimbals. The bearings for the TIR gimbals were up-graded to fully environmentally sealed units and the anti-vibration mountings were replaced with anti-vibration matting.
The *Surfmet* system was switched on before sailing and run for the entire cruise except for a short period, mid- cruise, when it was stopped so that new coefficients for the light sensors could be added. The non-toxic water was switched on 091/13:00 and run for the rest of the cruise. An average of three wet salinity samples were taken per day to test for salinity offset and drift. These will be processed back at SOC.
At the time of writing there have been no reported problems with the system.

D. Teare

3.7 D251 PES Trials

Two Precision Echo Sounder (PES) fish were mounted aboard RRS Discovery for the trials cruise. The forward of the two, PES1 was used with its existing cable IOS faired type. The second PES fish, PES2 was mounted 6 metres behind the first, slightly higher on a container bed.

PES 1 was fitted with a bracket mounted on the main fish casting just behind the towing strut. It was designed to hold 2 VEMCO miniloggers; these are self-contained units that are capable of logging temperature and pressure at a rate of up to 1Hz. At this interval the memory of the logger becomes full after 2.3 hours. At a sampling interval of 1 hour the deployment duration increases to 338 days 16 hours. For the initial deployment VEMCO 9048 was set to a sampling interval of 90 seconds to give over 8 days of recording. Transducer problems however prompted the recovery of the fish on day 093 1500 GMT, 3rd April 2001. The subsequent redeployment took place after mounting the 6 miniloggers onto the CTD frame for calibration and remained deployed for the duration of the trials.

PES 2 was used as a platform to monitor the towing performance of 4 cables manufactured by Cortland Cables and supplied by Scorpion Oceanics Limited in an attempt to compare and quantify their towed behaviour with that of the existing cable / fairing arrangement. The following cable types were all based on the same Kevlar strain member jacketed to 19 mm and were all cut to the same length of 30 metres for the trials. The basic cable type was fitted with the existing IOS Fairing. Two hairy fairings were available in single row and double row versions. The fourth resembled the basic cable but was formed with spiral effect longitudinal ridges. The last minute arrival of the cables with no a priori knowledge of their construction meant that a snap decision on terminating the cables had to be made. Linear Composite terminations were used and just before the trials cruise a 2-metre test piece of cable was tested to destruction in order to gauge its safe working load. The test piece snapped at a little less than 4 tonnes and was given a SWL of 750 kg.

The instrumental schematic shown over gives an overview of how the following measurements were made during the tow trials. As well as the temperature and pressure miniloggers that were also mounted on PES 1, these consisted of the in line cable tension as monitored by a 6 tonne Strainstall strain gauge and ambient noise measurements available through a single element 10 kHz transducer and an hydrophone.

The basic cylindrical cable was fitted with IOS fairing and towed at the following speeds through the water: 2, 4, 6, 8, 10, 11.5 knots as measured with the ship's EM log. At each speed minimum, maximum and average cable inclinations to the vertical were m ade, where possible by taking digital photographs of the cable against the horizon. When this was not possible marks were made on the guardrail corresponding to the position of the tow cable when viewed from the top of the aft winch drum cheek. In order to mark the vertical position of the cable a line was suspended from the gantry arm in line with the rotational axis of the sheaf, where this line touched the guardrail was taken as a datum.

The cable was exchanged for the single hair fairing type and tow speeds of between 2 and 4 knots were obtained, the cable strummed significantly at 4 knots whereupon some video was taken of the cable motion. Unfortunately the weather had deteriorated substantially by this time. The cable tension remained reasonably low when the ship had to be turned to run in front of the swell but the fish towed well under the ship and so the trial was terminated.

The third spirally sheathed cable to be tested was wound onto the winch in readiness for abatement in the Sea State. This occurred on the morning of Sunday 8th April 2001, directly after the mooring recovery. Keen to be off the ship accelerated to 11 knots and so no measurements were possible through the speed range. Qualitative observations however were that the cable strum med significantly from speeds of about 3-4 knots upwards, the vibrations being produced changing through several modes that were readily transmitted through the container bed on which the winch was mounted. This cable also had a tendency; though not as se vere to tow underneath the hull.

Several modifications to the towing assembly had to be made prior to any measurements being made: So that the inline towing tension could be monitored a stainless steel towing bracket was bolted through the regular cable m ounting holes on the winch drum, a 4½ SWL bow shackle connected this into the

Strainstall strain gauge. The outboard end of this strain gauge shackle was then connected via an oval link into the cable termination. At the other end of the cable a new pivot adapter had been fabricated prior to the cruise to allow the fish to be connected onto the cable termination. A new pivot bush had to be fabricated aboard as the original had substantial play possibly allowing it to vibrate during towing. The pivot retaining nuts had to be drilled and pinned, as the supplied tab washers did not adequately cage the nuts. The fibreglass body of the fish then had to be cut away near its pivot point to allow unobstructed movement of the cable termination.

The following VEMCO miniloggers were available for the trials cruise. Loggers 9048 and 9049 were used in PES 1, 9046 and 9047 were used in PES 2.

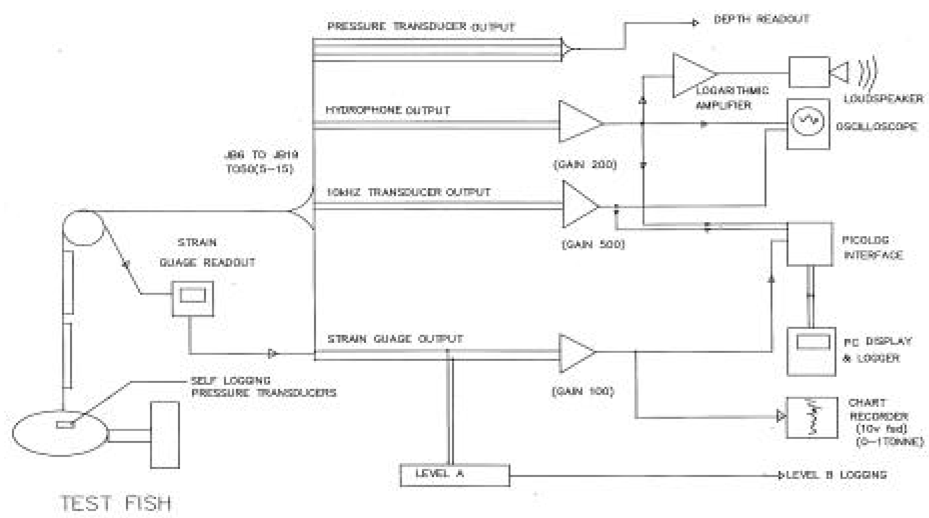
Serial Number	Temperature range	Pressure range
8544	-4.1 to 20.6 °c	0 to 895 m
8545	-4.1 to 20.6 °c	0 to 895 m
9046	-4.1 to 20.6 °c	0 to 153.7 m
9047	-4.1 to 20.6 °c	0 to 150.3 m
9048	-4.1 to 20.6 °c	0 to 253.9 m
9049	-4.1 to 20.6 °c	0 to 253.9 m

CTD calibration

On Wednesday 4 April 2001 jday 094 all 6 miniloggers were set to a delayed start of 121500. A short CTD cast of 30 metres was commenced by taking the CTD to 10 metres then to the surface; it was then taken to a depth of 30 metres and returned to the surface.

Serial Number	Samples	Filename	Download time
8544	2630	BIN8544.001	125850
8545	2630	BIN8545.000	130352
9046	3290	BIN9046.000	130950
9047		BIN9047.000	131450
9048	3930	BIN9048.001	132030
9049	4370	BIN9049.000	132750

M. Hartman & C. Paulson



FAIRING TESTS -INSTRUMENTAL SCHEMATIC

3.8 D251 Trials Mooring

Mooring Date; Tuesday, 03 April 2001 day 093
Water Depth; 170 metres uncorrected
Start to deploy; 0547 GMT
Anchor away; 0600 GMT
Position; 48°39'12.8" N 08°53'10.1" W
Operation; Deployment
Personnel; A. Jones, J. Wynar, M. Hartman, Boatswain + ships crew, R. McLachlan (winch)

Description

The mooring is primarily comprised of Buoyancy, mooring line, instruments, acoustic release and anchor weight. The purpose of the exercise was to provide an assessment of the comparative data from the current meters, some new, some old and with differing measuring techniques especially at lower current speeds.

Relocation

In order to relocate the mooring once it has been released from its anchor there are several systems mounted onto the buoyancy package. One 10" diameter Seimac satellite relocation beacon ARGOS PTT 10116. A combined Novatech one second repeating strobe and VHF transmitter. One of the 17" glass buoyancy spheres is an instrument housing that has an ARGOS satellite transmitter PTT 10018 and flashing light contained within, two lead outs connect it to a 10 kHz pinger, all these are operated via a prototype pressure switch which is mounted onto the glass housing. Installed aboard the ship are receivers that can provide the bearing of these transmitters relative to the ship's heading. Prior to deployment the three systems were activated whilst the package was on the poop deck. Both flashing lights operated, the 10kHz acoustic beacon pinged and the ARGOS PTT 10018 was registered on the GONIO deck unit mounted on the bridge. No signal was detected from the other ARGOS transmitter. The signal from the VHF transmitter was not tested.

Buoyancy

The buoyancy package is made up from a Glass reinforced plastic framework joined with stainless steel fittings. Onto this frame are bolted 7 x 17" diameter glass spheres contained in yellow hard hats. The frame is bolted to 3/8" chain that runs through its centre section and extends to 2 metres below the frame. Another 17" sphere is bolted onto this chain. At the top of the frame there is a large link and 10-metre recovery line ending in a 10" glass buoyancy with orange hardhat.

Instruments

Suspended 10 metres beneath the buoyancy package are 4 currents meters, an FSI 3D-ACM, 2 Aanderaa RCM's (7 and an 11) and an Interocean S4. These were connected together with 0.75 metre lengths of galvanised wire rope with a clear jacket swaged with copper fittings.

Release Mechanism

In order to recover the mooring it is necessary to detach it from the anchor weight to this end a MORS RT661 B2S acoustic release was fitted into the mooring line. Prior to deployment 2 releases serial numbers 230 and 234 were secured to the CTD frame and lowered to depth. A MORS TT300 deck unit was patched through the PES fish providing successful wire tests on both units. Serial number 230 was chosen, as its responses to commands were deemed slightly more reliable.

Anchor

The anchor used was a 250-kg railway wheel. This was secured near the stern on the port side with a 2-metre length of chain that was linked into the acoustic release.

Mooring method

Buoy first. The mooring recovery line was thrown over the stern. The buoyancy was then lifted with the port crane into the water with a release hook linked into an 8-metre cable that was flaked out onto the deck and the other end was secured into a deck eye. Whilst the buoyancy was being towed astern a portion of the recovery line became wrapped around it. The four current meters and acoustic release were connected to this first length of line and laid in a line from this point to just in front of the double barrel winch system. A tail from the storage drum was taken around the winch through a block and attached to the end of the current meter string. Once the buoyancy had been released the crane picked up the block. Using the combination of crane jib and winch the instruments were raised and lowered over the stern after removing the stern deck stop. All of the instruments were outboard and were stopped off at the release link, where upon the anchor chain was attached. The crane then lifted the anchor outboard where it was cut away. Conditions for the deployment were good with little swell and wind.

A waterfall display was used to display the signal generated by the 10 kHz pinger as the mooring descended this duly ceased, presumably as the pressure switch deactivated, the time and hence depth of occurrence unfortunately was not noted.

Ranging

Using the TT300 deck unit patched through the PES fish, ranges to the acoustic release were obtained while the ship was hove to, at the mooring site, in transit and at the subsequent CTD position approximately ¼ mile from the site. The following times, ranges and positions were noted.

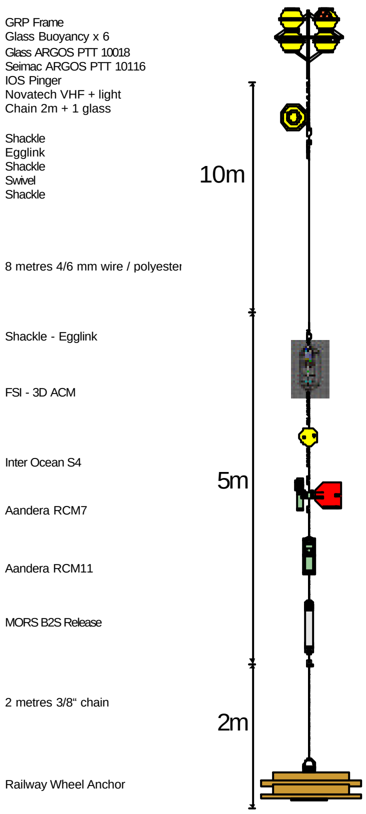
Range/ m	Latitude	Longitude	Time/ GMT
227,224,221,220	48 39 15.00 N	08 53 17.07 W	
218	48 39 15.87 N	08 53 16.00 W	
	48 39 16.16 N	08 53 15.55 W	
238			061530
263	48 39 19.89 N	08 53 13.30 W	
295	48 39 20.60 N	08 53 15.40 W	
329	48 39 21.10 N	08 53 17.70 W	
355	48 39 21.46 N	08 53 19.50 W	
382	48 39 21.34 N	08 53 21.56 W	
386	48 39 17.21 N	08 53 ??.22 W	062315
401	48 39 21 N	08 53 24.09 W	
437	48 39 20.64 N	08 53 26.68	

Recovery

The mooring recovery took place without incident at first light on Sunday 8th April 01, day 098. The acoustic release was interrogated at 0544 GMT whilst the ship was ½ a mile from the deployment position. A range of 854 metres was returned. Release commands were sent at 060100, shortly afterwards the pinger was turned on and the rise of the package could be seen on the waterfall display from the signals returned from the release and from the pressure-activated pingers. The mooring was seen on the surface at 060450 and the release was turned off at 060540. Both the test ARGOS beacon and light were activated as was the light of the Novatech transmitter although this could have been mounted higher on the frame than it was for improved visibility, the ARGOS beacon signal strength was at ¾ full power whilst it was off the starboard quarter. By 0632 the mooring was all inboard.

Both Aanderaa current meters provided engineering data and the S4 produced what seemed to be realistic data but the FSI seemed to start recording well whilst in the lab, recorded for an hour or two but then started to generate meaningless data which caused the reading software to time out. All the data were written to files for later processing.

M. Hartman


GRP Frame
Glass Buoyancy x 6
Glass ARGOS PTT 10018
Seimac ARGOS PTT 10116
IOS Pinger
Novatech VHF + light
Chain 2m + 1 glass
Shackle
Egglink
Shackle
Swivel
Shackle
8 metres 4/6 mm wire / polyester
Shackle - Egglink
FSI - 3D ACM
Inter Ocean S4
Aandera RCM7
Aandera RCM11
MORS B2S Release
2 metres 3/8" chain
Railway Wheel Anchor
10m
5m
2m

3.9 Health and Safety Observation Report

Introduction

The cruise started sailing from Newport on am Saturday 31st March 2001 to undertake a series of equipment trials and re-deployment of a Sediment Trap mooring at Porcupine Aby ssal Plain.

Before joining the vessel all personnel were required to have:

- a valid passport;
- a valid ENG1 with original certificate;
- a valid dental certificate;
- protective and safety clothing, which included safety shoes and hard hats.

Scientists who are in charge of equipment or processes were required to have written risk assessments for the conduct of the operation.

Mobilisation

All personnel were required to sign on the crew agreement on joining the vessel and hand over the certificates mentioned above to satisfy the Master in terms of health, safety and competency. This was followed by a safety briefing given by the ship's staff relating to the safety requirements involved in sailing on the vessel.

Demobilisation

Demobilisation will commence on arrival in Southampton on Monday 9th April 2001 and all personnel will have to sign off the Ship's Articles.

Observation

As a new member of the Ocean Engineering Division, with health and safety responsibility, I was invited by the Principal Scientist to come aboard as an observer to get a better understanding of how the scientific activities are being carried out.

In the past people have explained to me what CTD, Sediment Trap mooring and current meter mooring are about but that didn't mean much to me, until I saw them close by and in operation. This report is not intended as an audit or an inspection but to explain what I have learnt on this trip and how I can use this experience to implement health and safety document ashore.

The ship has a very detailed health and safety management system certified to ISO 90002 and ISM Code. I have spent a lot of time studying these manuals to get a better understanding of how the health and safety is set up on ships. The crew is very committed in health and safety, spearheaded by their Captain. However, an incident did happen as we were leaving the dry dock at Newport, suggesting that, doesn't matter how well your safety structure is, there will always be incidents that you will not be prepared for.

The root cause of the problem was that alignments check for the bow thrust unit once powered up was not included in the Chief Officer's checklist. To ensure a similar incident is not repeated in the future management has amended the documented system to give clear pre sailing/arrival checks.

The lesson I have learnt from this is that there will always be problems but the most important factor is how effectively you tackle the situations and what system you put in to prevent a reoccurrence.

I was very pleased to see the swift and prompt action of the crew to rectify the situation, inform management ashore to change the documented system. Reference can be made to Near Miss report No: 006 available from the Captain.

Second day of the cruise everyone participated in a fire drill, to practice emergency procedures, which was conducted and performed efficiently.

I was also invited to attend a Safety Committee Meeting that was held between the Master, Principal Scientist and the technical staff. Anyone who had an item relating to health and safety on board was able to include this in the committee agenda via their appointed safety representative. The Safety Committee Minutes is posted on notice boards and raised issues would either be dealt by the committee or forwarded on to shore management for appropriate actions.

I found that the scientists are working to the health and safety guidelines but there are some areas where further improvements can be made. These includes:

a. Risk Assessments

Although, there are written risk assessments completed for all type of activities but most of them are out of date e.g. the risk assessment for “deployment and recovery of scientific moorings including sediment trap” was last reviewed on 18/09/98. Maybe there are no additional hazards but this need to be shown on the assessment form.

We must ensure that these assessments are reviewed prior to the task and people (not just the assessor but all persons affected by the task) are aware and understand their purposes. Risk assessments will also be more effective and easy to follow if they are conducted on one standard form.

b. Personal Protective Equipment (PPE)

I have seen several occasions when people are not storing their PPE correctly. I remember seeing a hard hat being left outside in the rain and safety harnesses not put away in their proper location. I have also been informed that during the refit work at Newport, OED staff had to be reminded to wear the correct PPE.

I am sure employees have received training and information on the use, maintenance and purpose of the equipment.

Summary

Seeing the type of work, the working conditions that the scientists work in and using the experience of this trip I feel a lot more confident in writing policies and procedures to eradicate these bad practices mentioned above. I have added a section (3.327 SEA GOING OPERATION) in our OED health and safety manual based on the experience of this trip.

The most important lesson I have learnt from this trip is that you need to be mentally very strong, be able to switch off, and adapt to a working environment so different from ashore and away from your family.

S. Khan

3.10 Mechanical Equipment

3.10.1 20 Te & 10 Te Winch Traction Systems including 300 kW Power Pack

The 10 Te system was used for 9 drops to 4800m. The cable was re-terminated and a load test of 2 tonnes for 5 minutes was applied.

The 20Te system would not haul with 1500m of wire out. The problem was traced to a loss of boost pressure on the 300kW power pack caused by a faulty boost pressure relay in the main power pack.

3.10.2 20 Te Storage System, including 37kW Power pack and 20 Te Inboard Compensator

Before the system was used a new 40W Power Supply Unit was fitted to the trawl warp scrolling counter. The trawl warp was used to a depth of 1500m with a 2 Te anchor clump.

3.10.2 10 Te Storage System, including 37kW power Pack and 10 Te Inboard Compensator

The 10 Te system was used for nine CTD deployments during the cruise with no problems.

3.10.3 10 Te & 20 Te Kley France Cable Haulers, including Power Pack

The 10 Te cable haulers were used for the CTD deployment with no problems. The 20 Te system was used for the deployment of the 2 tonne anchor clump with no problem.

3.10.4 PES Winch and Davit Assembly

This was used during the cruise, it was hard piped from the power pack next to the Caley haulers power pack. The system has four quarter turn valves fitted to it so that two PES davits can be run from the same power pack.

3.10.5 30T Cranes, Aft Port and Starboard

The aft port crane was used for the deployment and recovery of the mooring with no problems. The starboard crane was experiencing difficulties with the main ram prior to the cruise and required more work to be completed in port.

R. McLachlan

3.11 Computing Activities

Introduction

The purpose of this cruise was to test out the equipment and prove the functionality of the systems prior to scientific cruises later in the year with some areas of training.

Data Logging

Data was logged using the ISG ABC System. The Level A system collects data from individual pieces of scientific equipment. The Level B collects each of the Level A SMP messages and writes them to a disk, monitoring the frequency of the messages and warns the operator when messages fail to appear. The Level C system takes these messages and parses them into data streams.

The following list shows the data collected on D251T

Chernikeeff Log	LOG_CHF	MkII Level A
Ships Gyro	GYRONMEA	MkII Level A
Trimble GPS	GPS_4000	MkII Level A
Ashtech ADU	GPS_ASH	MkII Level A
Ashtech Glonass GPS	GPS_GLOS	MkII Level A
Echo-Sounder	EA500D1	MkII Level A
	EA500D2	MkII Level A
CTD Neil-Brown	CTD	MkII Level A
Winch	WINCH	SEG PC
ADCP	Level C direct log	ADCP PC
Surface Logger	SURFMET	SIG PC

Problems during the cruise

There was a problem with the modifications to the Ashtech GPS system, which required recalibrating. This took 5 days to sort out.

Email System:

The E-mail system was transferred from a SPARC 1 to a SPARC 20 Workstation. This has increased the speed of operation thus reducing the overall cost.

GroupWise and Arcserve:

The Novell system was rebooted once during the trip, after a period of very slow response.

Data Processing

The main data processing for this cruise was the positional plots and familiarisation with other ISG programs.

Data Problems

On six or seven occasions the Ashtech Attitude sensing system needed resetting to force the resumption of logging.

DartCom Satellite System

This was a new system being utilised for the first time having been installed during refit. The system functioned well providing a good opportunity for training and configuration documentation writing.

Training

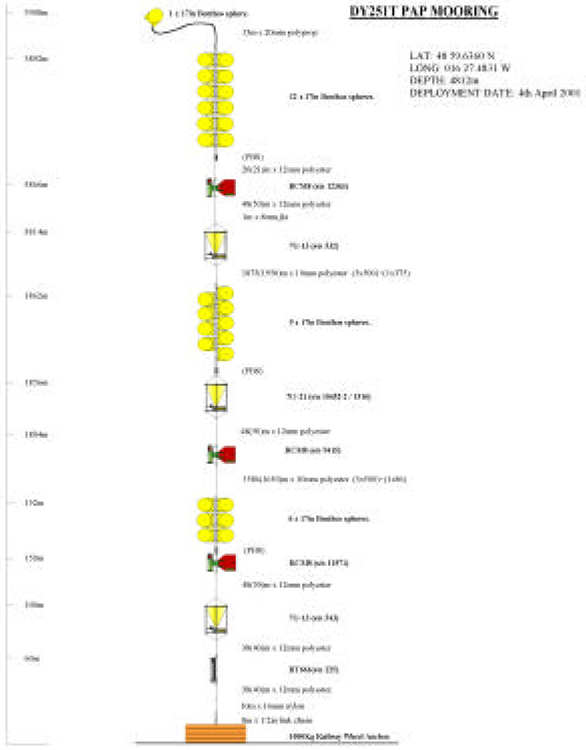
This leg provided the opportunity for Jeff Bicknell and Liz Rourke to increase their knowledge and familiarity with the shipborne computing systems.

J. Bicknell

3.12 PAP Mooring

A mooring consisting of RCM 8 current meters (3 off) and McLane sediment traps (3 off) was deployed at 48º 59.6360´ N, 016º 27.4831´ W in a water depth of 4812m as part of a long term monitoring programme overseen by Dr Richard Lampitt, Southampton Oceanography Centre.

E.B. Cooper


DY251T PAP MOORING
LAT: 48 59.6360 N
LONG: 016 27.4831 W
DEPTH: 4812m
DEPLOYMENT DATE: 4th April 2001

3.0 **DIARY OF EVENTS**

Date	JDay	Time (LT)	Event
25/03/01	084	0936-1045	V/l moved out of Newport dry dock to North Quay, North Dock.
26/03/01	085		Commenced mobilisation D251T.
			OED/UKORS technical party working at vessel. Continue mobilisation. Continue working on GMDSS station.
27/03/01	086		Continue mobilisation. Continue working on GMDSS station.
28/03/01	087		Continue mobilisation. Continue working on GMDSS station.
29/03/01	088		Continue mobilisation. Continue working on GMDSS station.
30/03/01	089		Continue mobilisation. Continue working on GMDSS station.
		1500	Scientific party join vessel and sign on Crew Agreement
		1530	Basic Safety Familiarisation briefing completed for non-RSU personnel joining in Newport.
31/03/01	090	0855	Pilot and Compass Adjuster on board
		0900	Commence singling up
		0913	Clear of berth
		1017	Back alongside checking bow thruster
		1120	Clear of berth.
		1129	Vessel through cut to South Dock.
		1155-1223	Vessel in sea lock.
		1341-1400	Compass swung off Barry Roads.
		1415	Pilot and Compass Adjuster away
		1424	Clear of pilotage area.
		1615-1645	Emergency Drill and Boat Muster.
01/04/01	091	0424-0551	Transit Land's End TSS
		0900-1500	Conducting ADCP survey in vicinity of 49º 30'N 5º 30'W
		1500-1830	Proceed towards Penzance.
		1830	Waiting off Penzance.
		1900	Disembark one scientist to boat off Penzance.
		1912	Reposition in vicinity 49º 30'N 5º 25'W
		2245-	
02/04/01	092	0206	CTD's in vicinity of 49º 33'N 5º 25'W
		0216-0248	Reposition to vicinity of 49º 35'N 5º 24'W
		0248-0751	ADCP / PES trials in vicinity of 49º 40'N 5º 23'W
		0751	Proceed towards Penzance.
		1130	Waiting off Penzance.
		1400	Embark one Hamworthy Engineer.
		1430	All documentation completed, proceed towards mooring site.
03/04/01	093	0535	Vessel hove to in vicinity 48º 39'N 8º 50'W
		0701	Deploy Current meter Mooring at 48º 39.2'N 8º 53'W in 172m.
		0730-0750	CTD at 48º 39.3'N 8º53.5'W
		0800	Resume passage towards Porcupine Abyssal Plain (PAP).
04/04/01	094	1359-1710	CTD at 49º 00'N 16º28'W.
		1806-2110	Deploy PAP mooring at 48º 59.64'N 16º 27.48'W.
		2225	Reposition to 48º 53'N 14ºW
05/04/01	095	0900	Hove to at 48º 53'N 13º 59'W
		1330-1644	CTD at 48º 53'N 14º 01'W
		1735-2012	Test main trawl winch.
		2056	Reposition to 47º 50'N 10º 15'W.
06/04/01	096	1000	Hove to at 48º 02'N 11º 01'W
		1015	Activities suspended due to adverse conditions. W'ly. F8/9 Various tests of PES completed while hove-to.
07/04/01	097		Hove-to throughout in vicinity of mooring 48º 39.2'N 8º 53.18'W.
08/04/01	098	0625	Conditions moderate enough to resume activities. Reposition to mooring.
		0654-0735	Recover mooring at 48º 39.2'N 8º53.2'W
		0755	PES x 2 deployed.
		0800	Proceed towards Southampton.
09/04/01	099	0810-0821	PES Recovery.
		0959	Entering Needles Channel.

1124 Pilot on board, East Lepe buoy.
1252 All secure starboard side to No. 27 Berth, Empress Dock, Southampton.

4.0 **ACKNOWLEGEMENTS AND CLOSING**

Acknowledgement is made here of all the participants in the exercise and also the support staff located at Southampton Oceanography Centre within the Research Ship Unit and Ocean Engineering Division.

Acknowlegement is made of commercial suppliers who made equipment available for some of the experiments and to the University of East Anglia for specific items added to the National Marine Equipment Pool through the Joint Infrastructure Fund Initiative under the award “Sampling Equipment for the UK Marine Physics and Chemistry Community”.

Trials cruises particularly post refit have proved to be valuable exercises in preparation of equipment and the commissioning of new systems for subsequent use under scientific programmes. The opportunity for training and exchange of ideas within support groups should not be undervalued.