Cover Photo missing
(was pasted in original as a glossy print)

RRS Discovery Cruise 236
Lisbon to Southampton
24 August 1998 -22 September 1998

Principal Scientist
Imants G. Priede
University of Aberdeen
Department of Zoology, Tillydrone Avenue
Aberdeen. AB24 2TZ

United Kingdom

Cover Photograph

The *Royal Research Ship Discovery* lying at Santa Apolonia Quay, Lisbon at the start of Cruise 236.

Personnel (Left to Right)

Back Row: Volker Nuppenau, Jean-François Rolin, Michael Poser, Glyn Collard, Martin Collins.

Middle Row: Anders Tengberg, Henrik Stahl, Peter Mason, Felix Enders, Rhys Roberts, Jerome Blandin, Phil Bagley, Fotis Pantazoglou, Sibylle Grandel, Costas Christodoulou, Susannah Way, Phillipe Rodier, Jon Short, Emma Jones, Camila Henriques, Juan Zwolinski, Anthony Grehan, Andrey Vershinin.

Front Row: Alexis Khripounoff, Jean-Claude Caprais, Dominique Birot, Keith Avery (Captain), Monty Priede.

.

SCIENTIFIC PERSONNEL

PRIEDE , I. (Monty) G. (Principal Scientist)	U. Aberdeen UK
COLLINS, Martin A.	U. Aberdeen UK
BAGLEY, Phil M.	U. Aberdeen UK
JONES, Emma G.	U. Aberdeen UK
WAY, Susannah J.	U. Aberdeen UK
ENDERS, Felix T.	U. Aberdeen UK
HENRIQUES, Camila I.R.	U. Aberdeen UK
GREHAN, Anthony J.	U. Galway Ireland
KRIPOUNOFF, Alexis	IFREMER France
BIROT, Dominique	IFREMER France
BLANDIN, Jerome	IFREMER France
CAPRAIS, Jean-Claude	IFREMER France
RODIER, Phillipe	IFREMER France
ROLIN, Jean-François	IFREMER France
TENGBERG, J. Anders M.	U. Göteborg Sweden
STAHL Henrik J.	U. Göteborg Sweden
VERSHININ Andrey V.	Moscow Russia
NUPPENAU, Volker	GEOMAR Germany
POSER, Michael	GEOMAR Germany
GRANDEL, Sibylle	GEOMAR Germany
ZWOLINSKI, Juan P.	U. Lisbon Portugal
CHRISTODOULOU, Costas	IMBC Greece
PANTAZOGLOU, Fotis	IMBC Greece
MASON Peter J.	RVS Southampton UK
PHIPPS Richard A.	RVS Southampton UK
ROBERTS Rhys	RVS Southampton UK
TAYLOR Phil	RVS Southampton UK
SHORT Jon B.	RVS Southampton UK

SHIP'S PERSONNEL

AVERY, Keith O.	Master
GAULD, Philip D.	Chief Officer
HOLMES, John C.	2nd Officer
PARROTE (Pav) M.C.	3rd Officer
McGILL Ian G.	Chief Engineer
JETHWA (Jet) K.G.	2nd Engineer
COLLARD Glyn	3rd Engineer
PARKER Phil G.	3rd Engineer
SUGDEN Dave M.	Electrical Officer
HARRISON Martin A.	CPO (Deck)
THOMSON Ian N.	PO (Deck)
BUFFERY Dave G.	Seaman
COOPER Gerry	Seaman
EDWARDS Timmy R.	Seaman
PERKINS Joe R.	Seaman
DICK Dave T.	Motorman
PERRY Clive K.	SCM
CONNELLY Dave	Chef
MINGAY Graham M.	Mess Man
ORSBORN Jeff. A.	Steward
ROBINSON Peter W.	Steward

Participant Institute Addresses

University of Aberdeen
Department of Zoology
Tillydrone Avenue
Aberdeen
AB24 2TZ
Scotland

Institute of Marine Biology Crete
PO Box 2214
Heraklion 71003
Crete
Greece

GEOMAR FZ,
Wischhofstr. 1-3,
24148 Kiel,
Germany

Octopus GmbH
Kieler Str. 51,
24594 Hohenwestedt,
Germany

Martin Ryan Marine Research Institute
University College Galway
Galway
Ireland

IFREMER Centre de Brest
BP 70, 29280 Plouzané
France

Department of Analytical & Marine Chemistry
University Göteborg,
S-41296, Göteborg,
Sweden

P. P. Shirshov Institute of Oceanology,
23 Krasikova,
Moscow 117218,
Russia

RVS Southampton Oceanography Centre,
Empress Dock,
Southampton
SO14 3ZH UK

Address List

Name	Institute	Tel. / Fax.	e-mail	Private Address	
Alexis Khripounoff	IFREMER	+33-29822-4302	Akripoun@ifremer.fr	1 rue d'Ypres	29200 Brest
Anders Tengberg	Univ. Göteborg	++46-31-7722776 / +46-31-7722785	anders@amc.chalmers.se	Kenedyg.16B	41473 Göteborg
Andreij Vershinin	IORAN	+ 7-095-125-33-55 / + 7-095-124-59-83	Rozanov@coran.msk.ru	Ostrovitjanosk 16-4-87	117321 Moskov
Anthony Grehan	MRI NUI, Galway	+353-91-512004 / +353-91-525005	anthony.grehan@ucg.ie	115 Renmore Park	Galway, Ireland
Camila Henriques	Aberdeen University	01224-639965	u01cir@abdn.ac.uk	20 Castle Street	Aberdeen, AB11 5BQ
Dominique Birot	IFREMER	+33-29822-4100 / +33-29822-4135	dbirot@ifremer.fr	3 rue Turenne	29200 Brest
Emma Jones	Aberdeen University	01224-272-889	e.g.jones@abdn.ac.uk	339 Holburn St.	Aberdeen, AB 107FQ
Felix Enders	Aberdeen University, CAU Kiel	++ 49-4851-2920		Eichenweg 6	25709 Marne
Fotis Pantazoglou	IMBC	+3081346860,242022 / +3081-241882	fotis@imbc.gr	Komninon 84	71307 Heraclion-Crete
Henrik Stahl	Univ. Göteborg	++46-31-7722776 / +46-31-137384	henrik@amc.chalmers.se	Egnahemsv 18B	41321 Göteborg
Jean-Claude Caprais	IFREMER	+33-29822-4524 / +33-29822-4547	jcaprais@ifremer.fr	11allee pare on vilm	Plouzane
Jean-Francois Rolin	IFREMER	+33-29822-4108 / +33-29822-4135	jrolin@ifremer.fr	17 Rampe du Merle Blanc	29200 Brest
Jerome Blandin	IFREMER	+33-29822-4688 / +33-29822-4135	jblandin@ifremer.fr	1 rue Louis Bréhier	29200 Brest
Jon Short	RVS	+ 44-1703-596284 / + 44-1703-596383	jos@soc.soton.ac.uk	172 Rollestone Road Holbury	Southhampton, SO 45 2HA
Juan Zwolinski	Lisbon University	3511-468 2130 / 3511 4842602	Mop05046@mail.telepac.pt	Av. Saboia 828 1e	2765 Estoril, Portugal
Kostas Christodoulou	IMBC	++3081-346860,242022 / ++3081-241882	kchris@imbc.gr	Themistokleous 49	71307 Crete, Greece
Martin Collins	Aberdeen University	+ 1224-272889 / + 1224-272396	m.a.collins@aberdeen.ac.uk		
Mark Parrotte (Pav)	RVS Marine	0044 0151 7260876	pav.sts@sea.soton.ac.uk	No.5 Hesketh St., Aigburth	Liverpool, L 17 8KJ
Michael Poser	GEOMAR	++49-431-600-2682 / ++49-431-600-2680	mposer@geomar.de	Knooper Weg 96	24103 Kiel
Monty Priede	Aberdeen University	++44 1224 272873 / ++44 1224 272396	i.g.priede@aberdeen.ac.uk	Den O'Howie, Ellon.	Aberdeen, AB 41 8QT, UK
Phil Bagley	Aberdeen University	01224-272889	p.bagley@abdn.ac.uk	2. Westerton Cott, Pitcaple	Inverurie Aberdeen Shire
Phil Taylor	RVS	01703-596218	pgt@soc.soton.ac.uk	Hafod, Sigingstone Lane,	Llanmaes
Philippe Rodier	IFREMER	33-29822-4659	prodier@ifremer.fr		
Peter Mason	RVS	01703-596046 / 01703-596066	pjm@soc.soton.ac.uk	Ty Coch, Broad Lane, Swanmore	SO32 2 PD
Sibylle Grandel	GEOMAR	++49-431-600-2687	sgrandel@geomar.de	Boninstr. 47	24114 Kiel
Susannah Way	Aberdeen University	01358-789631	s.j.way@abdn.ac.uk	Bankhead House, Auchterless	Turriff, AB53 8BD
Volker Nuppenau	Octopus GmbH	0177-8929282	schierer@biolab.com	Gottorpstr. 67	22605 Hamburg

Figure 1. *RRS Discovery* 236 Cruise Track

ITINERARY

Depart: Santa Apolonia Quay, Lisbon	- 24 August 1998
Arrive: Southampton Oceanography Centre	- 22 September 1998

OBJECTIVES

This cruise was financed by the European Commission, Marine Science & Technology MAST-III Programme as part of Project Number CT 950010 Autonomous Lander Instrument Packages for Oceanographic Research. ALIPOR; It was the second of two cruises aboard the *RRS Discovery* aimed at operating a fleet of European Lander vehicles in the NE Atlantic. The general aims of ALIPOR are stated in the following preamble to the original project proposal:

"Autonomous landers that can conduct experiments and gather data on the sea floor have the potential to revolutionise oceanographic research. By using a number of landers, the spatial and temporal coverage of a single ship can be increased by orders of magnitude. Landers also enable small ships to carry out deep sea research without the need for wires extending to full ocean depth. Landers have been specified as a necessary component of all the major subsurface oceanographic research programmes, BENGAL,OMEX, JGOFS, HiBETS etc.

European laboratories have already developed a variety of landers. An essential next step is for these to work together in a co-ordinated fashion.

Landers from all the partners will be carried on a multi-lander cruise of the RRS Discovery in the North East Atlantic in 1996. This will comprise the largest fleet of landers ever assembled and will be the prototype for future deep-sea oceanographic expeditions in the next century. This expedition, will confront for the first time the problems of inter-compatibility of systems and management of such a complex exercise. A diversity of landers will be deployed including monitoring of water column above the floor, tracking of abyssal fishes, probing the sediment, in situ chemical analysis, biological and metabolic studies"

The initial *Discovery* Cruise 222A was completed in 27 July – 26 August 1996. Since that time major improvements and developments in equipment had been undertaken by the various partners in the ALIPOR project. The main objective of Cruise 236 was therefore to test this novel equipment under operational conditions in the NE Atlantic. This technical objective was however integrated within a general scientific aim to investigate physical, chemical and biological processes in the benthic boundary layer. The cruise was timed after seasonal deposition of phytodetritus from the surface layers should have settled out on the sea floor in the NE Atlantic.

Two main working areas were identified

Porcupine Seabight	45° N 13°W	2500m depth
Porcupine Abyssal Plain	48° 50'N 16°30'W	4800m depth

The latter station known as PAP is the main station in BENGAL and other European and national research programmes. Various locations in the Porcupine Seabight were to provide a contrast to this standard NE Atlantic abyssal locality.

The following free-fall landers were on board the ship at Lisbon:

1. **MAP II.** (Module Autonome Pluridisciplinaire). IFREMER. A new lander for long term monitoring of near bottom currents and physical parameters.

3. **IFREMER RAP2.** Benthic chambers, measurement of sediment community metabolism. Fitted with a new movable chamber "drawer" system and a prototype *in situ* chemical analyser

4. **Göteborg Lander.** Benthic chambers, measurement of sediment community metabolism and geochemical fluxes. This was a new lander equipped with the prototype "gel peeper" system for sediment profile chemistry.

5. **AUDOS II.** (Aberdeen University Deep Ocean System). Photography of demersal fishes attracted to baits and tracking using ingestible Code Activated Transponders. A new version of this lander system.

6. **ISIT Lander.** (University of Aberdeen) A new modular tripod lander fitted with a low light video camera for observing deep-sea bioluminescence.

7. **LAFF II.** (University of Aberdeen) Large Abyssal Food Fall experiment lander with an acoustically operated trap for studying scavengers feeding on a cetacean carcass.

8. **Fish Trap**. (University of Aberdeen) A simple 1m cube trap deployed on the sea floor with an acoustic release, designed to capture large fish in the main trap and small Crustacea in auxiliary traps.

9. **IMBC Lander**. A new compact lander with a single sediment interface chamber.

10. **ATTIS I**. (Aberdeen) Acoustic Transponder Tracking and Interrogation System. Tracking of Fish.

11. **ATTIS II**. (Aberdeen) Acoustic Transponder Tracking and Interrogation System. Tracking of Fish.

In addition to the free-fall lander equipment the following gears for use from conventional winch wires were loaded:

12. **SPI instrument** (Sediment Profile Imaging) from the University of Galway.

13. **Multi-corer**. (GEOMAR) for obtaining sediment samples for comparison with SPI images and samples obtained using the benthic chamber landers.

14. **CTD** (RVS) Conductivity Temperature & Depth. The Standard Instrument normally used on the ship to be used for obtaining samples of bottom water for priming the chamber landers and as a frame for attaching equipment for tests.

15. **Plankton net**. (Aberdeen) A small 1m diameter net for collecting surface samples for student projects.

It was also agreed to recover the following equipment deployed at the PAP station on previous cruises of the *FS Meteor* and *RRS Discovery.* Two GEOMAR landers were to be recovered and redeployed during *Discovery 236* whereas a BENGAL sediment trap mooring was being recovered at the end of a long term mission.:

16. **GEOMAR FFR** lander. Benthic chambers, measurement of Sediment community metabolism. Station Number M42/2 #437

17. **GEOMAR FFB** lander "Biological lander equipped with stereo cameras and other gear. Station Number M42/2 #399

18. **Sediment trap mooring**. A BENGAL station managed by Dr. R. Lampitt of the Southampton Oceanography Centre. Discovery Station Number 13368#55 deployed during Cruise D231.

CRUISE NARRATIVE

N.b. All times BST = Local summer time in Portugal GMT +1

Wednesday 19 August Lisbon

The *RRS Discovery* was lying at Santa Apolonia in the City of Lisbon after having departed from EXPO 98 where she had been open to visitors for 5 days and hosting receptions during the evenings. 10,764 visitors had been welcomed on board during 5 days.

The PSO and Camila Henriques who had helped with the EXPO, were the first members of the Cruise 236 scientific party on board for a farewell reception hosted by the captain. They were later joined by Emma Jones, a second student also from Aberdeen. All the EXPO exhibition material on board the ship had been cleared away. IMBC equipment had been delivered to the ship in Lisbon.

Thursday 20 August

0900h Commenced preparation of the ship for Cruise 236.
RVS personnel spent the morning moving the winches into their correct positions, bolting them down and connecting the hydraulics. The container of Aberdeen equipment was craned onto the after-deck ready for unloading.

1310h Martin Collins arrived from Aberdeen. During the afternoon the Aberdeen container of scientific gear was emptied.

Friday 21 August

During the morning, the IFREMER team arrived, and their equipment on a truck from Brittany was unloaded by noon. Anders Tengberg and Andrey Vershinin from Göteborg arrived together with their gear. The Göteborg lander was on the *FS Meteor* due to dock in Lisbon on Saturday. It had been planned to leave the Göteborg lander at the PAP station to be recovered early during D236 however the lander had been damaged during the Meteor cruise. A new module for the Göteborg lander was therefore loaded on the *RRS Discovery.*

The LAFF II frame was assembled on the after-deck. Work was restricted by the fact that the ship's cranes overheated in the high temperatures prevailing in Lisbon at this time.

1430h It was realised that the pure water "Milli Q system" was not on the *RRS Discovery,* having been removed in Southampton prior to sailing to the EXPO. This had not been anticipated in the cruise planning. Ways of borrowing a system locally or delivering the original from Southampton were discussed.

1940h Phil Bagley and Sue Way arrived in Lisbon, 7 hours late and without baggage containing crucial video equipment and electronic components.

Saturday 22 August

0900h The main task scheduled for the day was the transfer of gear from the *FS Meteor* arriving in Lisbon that morning, however rough weather off Lisbon had delayed her arrival

1030h *FS Meteor* was lying off Belem, Lisbon awaiting a Pilot.

Offers were received from the IPIMAR institute to provide "Milli Q" water to the *RRS Discovery* but following radio communications with the *FS Meteor* it was agreed to transfer the "Milli Q" system from the *Meteor* to *Discovery.*

1300h Göteborg personnel were at the *Meteor* helping to load equipment into containers for transfer to the *Discovery.* Accumulating delays meant that these would not arrive on the *Discovery* until 1600h at the earliest. Furthermore personnel from the *FS Meteor* were having to leave for flights home to Germany. The bosun was very short staffed by the end of the day.

1700h The first truck from the *FS Meteor* arrived with the Göteborg container and the Göteborg lander was loaded on the *Discovery*. The truck returned to the *Meteor* to collect the GEOMAR equipment. It was realised there may be a problem with the "Milli Q" system since the *Discovery* does not have a suitable water prefiltration system.

The baggage of Phil Bagley and Sue Way had still not arrived so they had to go shopping for clothes.

1800h The second truck load from the *Meteor* arrived and all the gear was loaded onto the *Discovery.* In the evening a meeting was held on the *FS Meteor* with PSO Olaf Pfannkuche to discuss possible future work and to review the aims of the current ALIPOR cruise.

Sunday 23 August

The scientific party had checked out of their respective hotels and reported to the ship. It was decided to delay sailing of the ship until such time that Phil Bagley and Sue Way's baggage had arrived.

Several last minute changes in personnel were then necessary:

Messman **Keith Bryson** had been advised by doctors, on Wednesday 19th August to be repatriated owing to a virus infection that was not responding to treatment. RVS were contacted and informed that the ship could not sail without a replacement from Southampton.

Arne Malzahn of GEOMAR was ill and was replaced by **Michael Poser**.
Ursula Witte of GEOMAR had hurt her ankle on the way to the airport to fly to Lisbon. The captain insisted this should be examined by a Doctor and it was found that there was a serious fracture and torn ligament and she was not fit to sail. Arrangements were made for her to move to a hotel and fly home.

Juan Zwolinski, a student from the University of Lisbon who had helped with the ship during EXPO was invited to come on the cruise.

The *RV Yokosuka* of GEMTEC in Japan was tied up astern of the *RRS Discovery.* Scientists from the two ships exchanged visits. The *RV Yosuka* had the *Shinkai 6500* three-man submersible on board and was a remarkably spacious and well appointed ship. She had just returned from a dive programme on the mid Atlantic ridge vent sites.

Loading of material from the *Meteor* was completed during the day. In the evening the missing luggage of Sue Way and Phil Bagley arrived so the ship would be able to sail as soon as the new mess man arrived

Monday 24 August

0830h **Juan Zwolinski** arrived on board in time for the scheduled sailing time of 0900h

0930h The ship's agent informed us that the new mess man **Graham Mingay** would arrive at 1930h in the evening. The time of sailing was therefore set as 2030h with shore leave extended to 1900h. Work continued during the course of the day on preparation of gear for the cruise.

2000h Graham Mingay arrived. Preparations for sailing were initiated immediately.

2035h *RRS Discovery* commenced casting off with the pilot on board.

2154h Set course 270°T out of the Tagus.

Tuesday 25 August

0026h Altered course to 335°T directly for the Porcupine Abyssal Plain. *RRS Discovery* continued at a steady speed all day impeded by 25-35 knot winds, speed made good was as low as 6 knots. It was very uncomfortable for the scientific party not used to sea going.

0900h Meeting of the Scientific Party in the Lounge
0930h Conducted tour of all the landers and experiments.
1030h Scientific meeting in the Plot
1300h PSO addressed the ship's company in the plot to explain the cruise objectives.
1615h Muster and lifeboat stations drill.

Wednesday 26 August

RRS Discovery continued on a steady course with conditions improving.

1155h Hove to and deployed the Precision Echo Sounder transducer towed body (PES fish)

1310h **Test 236/98/01#1 CTD 5021m 43°35.8'N 13°03.6'W**
The opportunity was taken in this deep water of the Thetis gap to test the CTD together with acoustic releases for the LAFF II lander. This provided a first opportunity to evaluate the new ARCADE, Acoustic Release Command and Display Equipment.

1529h Ceased veering at 5224m of cable out and commenced testing the releases. Initial results with the ARCADE were disappointing owing to problems with the transducers. Both releases worked using the MORS deck unit and a dunking transducer. It appeared not possible to use the PES fish transducers. The CTD rosette also did not trigger.

1652h Commenced heaving.

1820h CTD inboard.

1935h **Test 236/98/01#2 CTD 5021m 43°35.8'N 13°03.6'W.**
A second test was attempted but aborted when wheels in the winch system jammed.

2025h *RRS Discovery* resumed her passage to PAP while RVS personnel examined the winch problems.

Thursday 27 August

0703h The weather had improved markedly, only 11 knots of wind and the winches had been repaired overnight by RVS personnel. It transpired that new bearings had been fitted by a contractor who had failed to grease them. Therefore a new set of bearings were totally ruined. Fortunately a spare set of bearings were kept on the ship and the repair was quite straight forward.

0938h **Test 236/98/02 CTD 4427m 45°54.8'N 14°29.4'W.**
The intended test from the previous evening was resumed with releases from the MAP II, IMBC and Göteborg landers. Anderaa housings from the IMBC and Göteborg landers were also tested.

1142h On the bottom. The ARCADE system proved very effective and executed all the commands.

1304h CTD frame in board

1344h **Test 236/98/03 ISIT 4385m 48°55'N 14°29'W.**
The ISIT lander frame was suspended from the CTD wire together with acoustic releases to be tested. It was lowered slowly to 100m.

1400h The programmed video sequence on the ISIT started and the lander was lowered to 4200m recording throughout most of the descent. A baleen whale swam very close to the ship at this time: within 50m probably a sei whale.

1601h Veering ceased and tests of releases commenced using the ARCADE system.
1614h Releases all tested and hauling commenced.

1740h ISIT inboard. All releases had fired. *RRS Discovery* continued on course to the PAP station.

Friday 28 August
0915h *RRS Discovery* arrived at the PAP station and hove to.

1010h **Test 236/98/04 LAFF II to 100m 48°49.95'N 16°29.60'W.**
The LAFF lander was shackled to the trawl warp and lowered through the "A" frame to 100m totally assembled for tests prior to deployment. The releases and trap were triggered to check mechanical function. The cameras were allowed to run for 2 exposures

1123h LAFF II test complete. *RRS Discovery* remained hove to on the central PAP position.

1147h **Station 236/98/01 CTD 4800m 48°49.05'N 16°29.25'W.**
CTD cast to obtain bottom water for priming the chamber landers and test the acoustic releases from the fish trap and the RAPII lander.

1320h Ceased veering and tested the releases using the ARCADE.
1342h Commenced hauling.
1524h CTD was back in board and all release testing was complete.

1720h **Station 236/98/02 LAFF II 4804m 48°55.02'N 16°14.96'W.**
LAFF II deployed with the carcass of an Atlantic white-sided dolphin; *Lagenorhynchus acutus*. Commenced deployment at 1710h, at 1718h the frame was released; a total 10 minutes elapsed from comencement to the mooring flag sinking.

1754h **Station 236/98/03 MAP II 4804m 48°55.02'N 16°15.98'W.**
MAP II, the new version of the IFREMER Module Autonome Pluridisciplinaire, was deployed using a crane over the star board side. The descent was observed on the ARCADE display.

2133h **Station 236/98/04 RAP II 4804m 48°56.95'N 16°36.99'W.**
The large IFREMER respirometer lander was deployed 1 nmile south of the GEOMAR FFR lander deployed by the *FS Meteor*. The RAP II was lifted over the starboard side using the main crane.

2212h **Station 236/98/05 IMBC 4803m 48°57.10'N 16°35.06'W.**
An innovative compact lander from the Greek Institute of Marine Biology, Crete. It was very simple to handle being so light-weight. The lander was craned over the starboard side.

RRS Discovery then moved back to the central PAP station for sediment profile imaging (SPI) work during the night.

2325h *RRS Discovery* hove to on station.

Saturday 29 August

0129h **Station 236/98/06 SPI 4800m 48°49.05'N 16°29.25'W.**
This new version of SPI was lowered on the CTD wire.

0318h SPI camera on the bottom.

0554h SPI was back in board. There was some difficulty in determining when the frame was on the sea floor. *RRS Discovery* moved to the GEOMAR FFR lander recovery station.

0715h *RRS Discovery* hove to over the GEOMAR FFR position. The release command was sent using the ARCADE and the lander began to ascend.
0840h GEOMAR FFR surfaced.
0905h GEOMAR FFR grappled.
0914h GEOMAR FFR in board. All systems had apparently worked well with a full set of cores taken in the chambers.

0958h *RRS Discovery* moved to the IMBC station 236/98/05 in order to check the acoustic release. It was dull day with low cloud heavy rain and increasing wind strength.

1032h IMBC lander release found to be OK with the lander on the sea floor in the anticipated position.

1158h **Station 236/98/07 ISIT 4807m 48°54.09'N 16°23.88'W.**
This new lander from Aberdeen University, equipped with an ISIT video camera owned by Dr Peter Herring of SOC, was deployed with floats trailed over the stern and an aft crane lowering it under the stern "A" frame. The whole procedure took 13 minutes from commencement to sinking of the dahn buoy.

Descent was apparently very slow, it seemed the ballast units were too light.

1319h **Station 236/98/08 Göteborg lander 4802m 48°57.24'N 16°35.15'W.**
The Göteborg lander equipped with a single chamber and a gel peeper profiler was deployed. This reduced equipment complement was necessitated by the loss of the central chassis on the previous *FS Meteor* cruise. Deployment was simple using the starboard large crane. The descent rate was slow possibly owing to reduced weight compared with the original design.

1433h Wind strength increasing to 30-40 knots. *RRS Discovery* moved to the ISIT station 236/98/07 position to check that the ISIT had landed.

1452h A radio signal was heard in the laboratory and it was suspected that the LAFF lander had surfaced. However it was found to be one of the GEOMAR radios active on board. Novatech have few frequencies for their radios and several landers shared the same frequency on this cruise.

The afternoon was spent checking all the landers acoustically. All were found on the sea floor in their correct positions. In the meantime work on deck became difficult in worsening weather. A fish trap mooring was being prepared.

1732h The position of the lost LAFF I lander from *RRS Discovery* Cruise 222 was interrogated by ARCADE and the pinger was found to be still active. This raised the prospect of dragging for it during this cruise.

1945h **Station 236/98/09 Fish Trap 4616m 48°57.24'N 16°33.00'W.**
A fish trap on loan to Aberdeen University from the FRS Marine Laboratory. Aberdeen was deployed baited with sperm whale meat. Fortuitously it landed on a small benthic hill recently charted by the *FS Meteor*. The trap was tracked to the sea floor using ARCADE.

2200h ca. Fish trap landed.

RRS Discovery hove to for the night there being no further work to do. SPI was not operational. The wind was moderating to below 20 knots but sea state was still quite high.

Sunday 30 August

0756h Station 236/98/07 ISIT lander Recovery
The lander was released using the ARCADE system. It was a grey dull overcast day with wind speed of 20 knots.

0950h ISIT surfaced
1012h ISIT Grappled
1027h All gear in board. *RRS Discovery* moved to the MAP station.

1144h Station 236/98/03 MAP II lander recovery
MAP II was released after a slight delay owing to poor visibility. Rain showers and fog reduced visibility to less than 100m. It was eventually decided to go ahead as the weather cleared slightly.

1346h MAP II surfaced

1523h Grappled. It took four attempts to grapple this lander. The weather had become very rough, rain was beating down hard and the lander pellet line was not floating, so the lander frame itself had to be grappled.

1533h Lander in board. Towed astern of the ship and lifted through the "A" frame using the double barrel winch. The lander was placed inside the hanger. However this operation was hampered by the limited height available beneath the travelling crane hook.

1732h **Station 236/98/10 AUDOS 4804m 48°49.1'N 16°23.90'W.**
The AUDOS was deployed with four CATs through the "A" frame using the crane. Weather conditions had improved by this time and it was sunny. Two CATs however were scraped off onto the deck during the deployment. The ballast clump had not been placed centrally on the deck.

RRS Discovery then moved to the central coring site for the GEOMAR multicorer.

1904h **Station 236/98/11 Multi-corer 4794m 48°51.41'N 16°29.85'W.**
2110h Corer on the bottom. This is the small GEOMAR corer with four tubes and a prototype sediment profiler designed for the GEOMAR lander which was being tested.
2247h Corer back in board with a good set of samples. The electrode profiler housing however had leaked.

Monday 31 August
0009h **Station 236/98/12 ISIT Lander 4806m 48°54.22'N 16°36.44'W.**
The second deployment of ISIT at PAP, this time with the camera and a black target facing upwards. It was a nice clear moonlit night.

RRS Discovery then hove to overnight until the recovery of RAP II which was to commence early in the morning at first light.

0518h Station 236/98/04 RAP II Recovery. Release triggered.
0753h RAP II surfaced with 25 knot winds and considerable swell. It was hauled through the "A" frame using the main trawl warp.
0820h Grappled
0832h All in board. RAP II was hauled through the "A" frame using the main trawl warp. The recovery was quite difficult.

RRS Discovery then proceeded to the AUDOS location

1024h Station 236/98/10 AUDOS recovery. Release triggered.
By this stage the ARCADE was used routinely for all recoveries.
1214h AUDOS surfaced.
1252h AUDOS grappled. As the AUDOS was moved aft relative to the ship the floats disappeared under the starboard side of the ship and obviously were hit by the rotating screw. Three syntactic buoyancy modules were cut from the upper float stack.
1318h AUDOS all in board. Slightly battered. The wind by this time was 30 knots.

Conditions were too bad to continue lander recovery work. After being hove to for a while it was decided to proceed with the relaunch of the MAP II lander.

1658h **Station 236/98/13 MAP II 4804m 48°54.93'N 16°15.98'W.**
The MAP II was simply craned over the side for this long term deployment until the end of the cruise. A sediment trap was added to the frame. The location was as close as possible to the original position on Station 03.

The weather was bright sunny and breezy. Gradually the wind turned from the North to the West and moderated. It was decided to recover the fish trap as it is a relatively robust piece of equipment. By this time, the day's working schedule was only half done.

1840h Station 236/98/09 Fish Trap, Recovery
2042h Fish Trap surfaced. The sun had just set and it was fortunate the lander was immediately visible since there was no strobe light.
2125h Fish Trap Grappled.
2134h Fish Trap inboard with 3 grenadier fish of the species *Coryphaenoides armatus* and amphipods.

RRS Discovery then moved to the central coring position for wire work.

2315h **Station 236/98/14 Multi-corer 4800m 48°51.58'N 16°30.11'W.**
Multicorer with further tests of the GEOMAR profiler drive mechanics.

Tuesday 1 September
0302h Multicorer in board . The pressure test on the profiler was apparently also successful.

0336h **Station 236/98/15 CTD 4800m 48°52.51'N 16°31.43'W**
CTD deployed with a test of a new configuration of strobe for the SPI vehicle. The Galway, RVS and IMBC personnel had spotted a leak in the SPI strobe system and spent the last few days designing and building a new module.
0601h CTD on the bottom.
0736h CTD back in board with the rosette having apparently worked properly but unfortunately there was still a small leak in the SPI strobe unit.

RRS Discovery then moved back to the area where most of the landers were located to retrieve the last two chamber landers missed on the previous day owing to bad weather.

0824h Station 236/98/08 Göteborg Lander recovery. Release triggered.
0922h Göteborg Lander surfaced in quite calm sunny conditions. A very fast ascent about twice as fast as all the other landers.
0949h Grappled. It was found that the pellet line was under the lander and it took a long time to untangle it.

1011h Göteborg lander on deck. It was lifted using the starboard crane above the winch control room. This lander had so much buoyancy that it ascended faster than the pellet line.

RRS Discovery then moved to the next lander recovery.

1019h Station 236/98/05 IMBC Lander recovery. Release triggered.
1207h IMBC Lander surfaced.
1230h IMBC Lander grappled
1233h IMBC Lander on board after a very simple lift using the starboard main crane. The pellet line was tied to the hook.

1306h Station 236/98/12 ISIT Lander Recovery . Release triggered.
1503h ISIT surfaced
1538h ISIT grappled
1554h ISIT all in board. This was a simple recovery in still conditions with extremely good underwater visibility. Clear blue water with 20m plus visibility.

RRS Discovery then moved north to investigate a Fish Trap mooring abandoned by Bernd Christiansen.

1700h 49°00'N 16°35.3'W Began interrogating the twin releases on this mooring
1720h Attempts abandoned after there was no response from either of the releases despite the excellent sea conditions. *RRS Discovery* returned to the PAP central coring site.

1847h **Station 236/98/16 Multicorer 4800m 48°51.48'N 16°29.92'W**
The multicorer was deployed together with the prototype strobe housing for the SPI camera system.

2221h Corer in board. Pressure test on the strobe assembly seemed OK.

RRS Discovery then returned north to the chamber lander area to deploy two landers that wished to remain at the PAP site while the ship departed for the Porcupine Seabight.

2327h **Station 236/98/17 GEOMAR I 4806m 48°56.50'N 16°36.47'W**
This lander was deployed over the side on a moonlit clear calm night with no difficulty. Care was needed however to avoid releasing ballast with the handling lines.

Wednesday 2 September

0010h **Station 236/98/18 Göteborg Lander 4805m 48°56.32'N 16°33.8'W**
This was a straight forward deployment but the descent rate of the lander was very slow (20 $m.min^{-1}$). This may have been because a larger pellet float had been attached to help ensure the floating recovery line ascended ahead of the lander.

RRS Discovery remained on station between these two landers to observe their descent.

0336h The Göteborg lander was at a depth of over 4000m continuing a slow descent. *RRS Discovery* then began steaming eastwards to the Porcupine SeaBight.

1359h **Station 236/98/19 Fish Trap 3989m 49°59.92'N 14°17.8'W**
The fish trap baited with sperm whale meat was deployed near the 4000m contour where Jones *et al.* 1998 had carried out previous studies on dolphin carcass consumption. *RRS Discovery* resumed the passage eastwards.

1934h **Station 236/98/20 AUDOS 2495m 49°51.9'N 13°00.08'W**
The AUDOS was deployed in an area where it was expected to track the morid *Antimora rostrata.* The syntactic buoyancy that had been lost on the previous recovery was replaced with two glass spheres, one in the dahn buoy and one in the mooring line above the main syntactic module.

RRS Discovery then commenced a 42 mile passage southwards to the OMEX II site to deploy the chamber landers, IMBC and RAPII which were being prepared inside the hanger.

Thursday 3 September

0006h **Station 236/98/21 IMBC Lander 1434m 49°09.9'N 12°47.9'W**
A very simple deployment in calm conditions on a moonlit night.

0022h **Station 236/98/22 RAP II 1463m 49°09'N 12°48.1'W**
The RAP II was programmed for five days to take a series of three measurements using the moveable chamber supported on the drawer lever arm.

0112h **Station 236/98/23 SPI 1450m 49°07.25'N 12°47.64'W**
The first SPI deployments with a new strobe system assembled using parts from a Novatech strobe.

0430h SPI inboard *RRS Discovery* steamed back northwards to the AUDOS location

0913h AUDOS recovery Station 236/98/20 release triggered.
1011h AUDOS surfaced.
1047h AUDOS grappled
1059h AUDOS all inboard. A relatively easy retrieval with calm seas.

At this time the winds speed began to increase to force 5 with stronger winds forecast.

1202h **Station 236/98/24 ISIT 2497m 49°51.96'N 13°00.00'W**
The ISIT was deployed with the camera looking upwards and target in place. This depth is close to the upper limit of distribution of *Coryphaenoides armatus,* the dominant abyssal fish.

1536h **Station 236/98/25 SPI 2500m 50°03.10'N 12°56.69'W**
The SPI had worked well with the new strobe system so work proceeded as fast as possible on grabbing images.
2004h SPI in board

2058h **Station 236/98/26 AUDOS 2525m 50°02.6'N 12°58.3'W**
The second deployment of AUDOS in the *Antimora rostrata* zone. The winds was at 30 knots gusting to 40 knots and the ship's screw had to be working to maintain station.

2300h **Station 236/98/27 CTD 2500m 49°55.4'N 12°59.83'W**

Friday 4 September
0040h CTD on the bottom
0140h CTD in board following tests of rosette function.

0231h **Station 236/98/28 SPI 2500m 49°53.10'N 12°53.67'W**
More SPI work as part of a transect across the Goban spur.

0550h SPI in board and *RRS Discovery* moved to the AUDOS position

0757h The wind was 20 to 30 knots and some time was taken debating whether it would be prudent to release AUDOS. The first release commands were sent using ARCADE and failed on both releases. Acoustically the releases responded and functioned well.

0806h Release attempts were made with the MORS deck unit.

0913h It was clear that AUDOS was stuck on the sea floor despite the use of two MORS releases.

1200h Strong winds continued and it was too rough to do any other work. *RRS Discovery* remained hove to over AUDOS checking every half-hour acoustically in case AUDOS released itself. The distance between the release and the sea floor was measured at approximately 5m indicating that the buoyancy was still intact.

1600h Wind steady at 30-40 knots it was too rough to work

2300h *RRS Discovery* was still hove to in Gale force winds.

Saturday 5th September
0600h *RRS Discovery* had remained hove to over the AUDOS station overnight and regular checks were made in case the lander surfaced. By the morning it was evident that AUDOS was stuck on the sea floor.

0700h The weather situation was reviewed. The wind had moderated to 20-25 knots so it was possible that some work might be done. However a very deep depression from a tropical storm was coming across the Atlantic Ocean very

rapidly and was forecast to be in our area by 1800h. It was decided to leave AUDOS, retrieve the ISIT lander and then proceed northwards to get out of the path of the storm, winds of force 9-11, up 60 knots were forecast.

0935h Approaching the ISIT station release pinger activated.

0940h Station 236/98/24 ISIT lander released.
1033h ISIT lander surfaced.
1115h ISIT grappled.
1128h ISIT on deck.

The ISIT was secured in the hanger and *RRS Discovery* immediately departed on a northerly course to avoid the incoming storm which was forecast to pass into the Bay of Biscay. The wind strength had already increased and had turned to the south.

A provisional waypoint at 52°09'N 12°45'W was targetted as a site where gas hydrates had recently been discovered at the North of the Porcupine Seabight. This would be an interesting area for SPI investigations; the Hovland mounds.

2200h *RRS Discovery* was almost over the Hovland mounds however the storm was approaching fast force 9-11 forecast winds for areas Sole and Shannon. It was decided to proceed further north over night.

Sunday 6th September

0845h The storm had slowed its eastward progression and remained on a more northerly track than previously expected. It was therefore decided to heave to and ride out the adverse conditions at 53°57'N 13°25'W 110 miles west of Achill Island. Wind was force 8-11 from the SE and barometer continuing to fall.

1300h Wind strength decreased to force 8 but sea state was somewhat worse. *RRS Discovery* was 300 miles from the Porcupine Seabight stations and 350 miles from PAP. Once the storm had passed it would take a day and a half to get back on station to resume work. All the scientific party were resigned to the situation. The *RV Pelagia* had run to the south and indicated that she would be later than the planned time of 9 September for the rendezvous at PAP.

1600h *RRS Discovery* commenced moving back southwards as fast as prevailing conditions allowed.

2000h Increased speed to 8 knots.

Figure 2. Weather Fax and Barograph records for 6th September 1998

Monday 7 September

0715h *RRS Discovery* was hove to over one of the suspected methane hydrate mounds at the north of the Porcupine Seabight. Wind was force 7 it was decided to attempt some opportunistic SPI work on this station.

0823h **Station 236/98/29 SPI 660m 52°18.7'N 12°58.8'W**

0912h SPI was taken inboard after just five images had been taken at the Magellan putative methane hydrate mounds. The weather was too rough for the ship to hold station.

0938h *RRS Discovery* continued on a "tacking" course towards the AUDOS station.

2100h Through a series of contacts with the *RV Pelagia* by FAX and by telephone it was agreed that the *RV Pelagia* should not come north towards the PAP site. The weather forecast indicated force 6-8 westerly winds throughout the Porcupine Seabight and PAP areas until at least 11 September.

RRS Discovery continued on a tacking course southwards now making to the IMBC lander position in the first instance.

Tuesday 8 September

0800h It was now 5 days since the last lander deployment and the scientific work of the cruise was continuing to be severely delayed by the bad weather. The weather conditions were still considered marginal for working and there was no forecast of good conditions for another 5 days.

1350h *RRS Discovery* approached the IMBC lander site, it was decided to attempt a recovery of this light-weight lander.

1416h Station 236/98/21 Recovery of gear. IMBC Lander released
1447h IMBC lander surfaced Wind 20-30 knots gusting to 23knots.
1508h IMBC lander grappled
1511h IMBC lander in board. It appeared to have worked well with all syringes activated.

The weather remained too rough to recover of the heavy IFREMER RAP II lander. In the mean time it was decided to attempt recovery of the AUDOS by dragging. *RRS Discovery* remained hove to while equipment for dragging of moorings was craned out of the container on the upper deck. An acoustic survey was done to determine the precise position of AUDOS.

Wednesday 9 September

0230h It had been planned to commence dragging for AUDOS but the weather was too rough. All other scientific work were suspended.

1400h The wind had moderated sufficiently to deploy a CTD.

1435h **Station 236/98/30 CTD/ *In situ* Analyser 2387m 50°05'N 12°54.12'W**
The IFREMER *in situ* analyser equipment for Nitrate, ammonia and pH was tested on the wire for comparison with water samples taken by the CTD rosette.
2043h CTD/analyser in board.

2130h *RRS Discovery* moved to the AUDOS Station 26 to activate the acoustic pinger and then hove to approximately 5 miles down wind of the station to prepare the grappling gear. A string of 4 grapple anchors was prepared for towing along the bottom behind a 1 tonne ballast clump attached to the end of the trawl warp.

2244h **Grappling for AUDOS Station 26.**
First grapple deployed.
2313h Second grapple deployed
2337h Third grapple deployed

Thursday 10 September
0014h Fourth grapple deployed
0032h There were some problems with the winch spooling and a crow bar had to be used was used to help the last few turns to come off the winch.
0106h Dragging line off the drum

0128h The main winch was started up.
0148h The ballast 1 tonne chain clump was in the water.
0200h A pinger attached to the coring wire 100m above the ballast.
0300h Gear on the bottom ready to tow.

The strategy adopted was to make an initial tow past the AUDOS site and then make a sharp turn to bring the grapple line across the AUDOS position.

Drag sweep 1.
0356h Nearest approach to AUDOS 0.17 NM
0448h *RRS Discovery* turned to port
0630h Sweep 1 completed; a failure

RRS Discovery moved to line up for a second sweep.

Drag sweep 2
1027h 1.9 NM off position making the second approach.
1214h 0.22 NM off AUDOS closest approach.
1303h 0.8 NM past AUDOS made a turn to port.
1351h Doubled back at a range of 1.1 NM other side of AUDOS
1442h Sweep 2 Completed: a failure.

Drag Sweep 3
1615h *RRS Discovery* lined up for the third approach
1817h Closest approach 0.35 NM.
1857h Start turn to starboard at 0.79 NM past the AUDOS position.
2035h Suspected AUDOS had been caught.

2150h Executed a very tight turn to the south, starboard and sweep past AUDOS again.
2344h Second close approach 0.23NM.

Friday 11 September
0200h Range 2.4NM, the third sweep had been a failure.
RRS Discovery hove to to recover the dragging gear.

0302h 1 tonne chain clump in board.
0336h Deck winch problem, work ceased.
0345h Recommenced recovery work.
0436h 1st grapple in board
0553h Last grapple in board.
0557h All gear secure, *RRS Discovery* set course for the IFREMER RAP II station.

1100h Hove to at the RAP II station.

1112h Station 236/98/22 RAP II released.
1155h RAPII surfaced.
1220h RAP II grappled
1230h RAPII on deck.
1338h RAP II was in the hanger.

RRS Discovery moved to a SPI station on the Goban Spur.

1630h **Station 236/98/31 SPI 1500m 49°30'N 12°52'W**
SPI outboard for a series of images at 1500m depth on the north side of the Goban Spur.
1900h The main traction winch broke down. It was also noticed that the sheave on the large block on the gantry was not turning.
2225h SPI inboard after considerable delays owing to the winch problem.
RRS Discovery steamed towards the AUDOS station 26.

Saturday 12 September
0215h *RRS Discovery* arrived at AUDOS station 236/98/26 and acoustic checks commenced.
0242h Following verification that AUDOS remained on the sea floor. *RRS Discovery* resumed passage to the fish trap station.

0840h Station 236/98/19 Fish Trap Released.
1023h Fish Trap surfaced.
1057h Fish Trap Grappled
1112h Fish Trap in board. Four *Coryphaenoides armatus* were captured but the soft parts had been almost entirely eaten by amphipods.
RRS Discovery now moved westwards to return to the PAP site.

2130h Arrived at PAP and spoke to the PSO on board the *RV Pelagia* Gerard Duineveld. The *Pelagia* had deployed their BOLAS Lander as agreed at 48°55.8'N 16°35.0'W near to the landers deployed by the *RRS Discovery.*

2150h **Station 236/98/32 ISIT 4800m 48°55.5'N 16°30.00'W**
ISIT deployed at PAP on a dark overcast rainy night with force 4 winds; very unpleasant conditions.
RRS Discovery continued to the main chamber lander area.

2333h **Station 236/98/33 RAP II 4808m 48°55.9'N 16°36.30'W**
A rather untidy deployment of RAP II over the starboard side. The wind was gusting to 35 knots and one of the handling lines was held for too long so that the lander started its descent one end first.

Sunday 13 September

0013h **Station 236/98/34 IMBC 4715m 48°56.84'N 16°33.17'W**
The IMBC lander was deployed with no problems showing the value of a light weight structure. It was inadvertently placed on the same benthic hill that the fish trap was on for its earlier deployment.

0113h **Station 236/98/35 Fish Trap 4715m 48°58.04'N 16°34.78'W**
The Fish trap was deployed baited with sperm whale. An uneventful deployment.

RRS Discovery moved slowly towards the IMBC lander station to monitor its descent to the sea floor.

0203h Monitoring having been completed, *RRS Discovery* moved to the GEOMAR lander position to be ready for recovery in the morning.

0539h Station 236/98/17 GEOMAR FFR released for recovery
0703h GEOMAR Lander on the surface. Visibility was poor, foggy with rain so the lander could not be seen.
0723h GEOMAR lander sighted
0746h GEOMAR lander grappled.
1758h GEOMAR lander in board.

RRS Discovery then moved to the second lander that had been deployed just prior to leaving PAP earlier in the cruise. There was a big swell and poor visibility with fog persisting.

0840h Station 236/98/18 Göteborg Lander released for recovery.
0930h Göteborg lander on the surface but not visible.
0935h Lander sighted.
1000h Lander grappled however there were problems with recovery because although the new float on the recovery line had ensured the system was not tangled, the rope was not long enough for the freeboard of the *RRS Discovery.* This caused a delay in moving the lander round to the stern and the two masts on the lander were smashed on the underside of the hull.
1025h Göteborg lander in board.

1204h Station 236/98/32 recovery ISIT lander released
1403h ISIT lander surfaced
1436h ISIT lander grappled
1452h ISIT all in board, a very straight forward recovery with all the floats "boss clipped" to the mooring line.

Problems had been experienced during coring and SPI work with the large block on the gantry, the sheave would not rotate. It was decided therefore to switch to a smaller spare sheave. This job was undertaken by the crew with some difficulty owing to the big swell and motion of the ship. The weather continued with drizzle and 20 knot winds. Once the block had been changed wire work at the PAP station could commence.

Work continued on board to prepare the GEOMAR FFR and Göteborg landers for redeployment.

1527h **Station 236/98/36 CTD 4828m wire 48°56.91'N 16°30.24'W**
A final CTD cast was carried out at the PAP station to provide reference bottom water for chemistry.
1732h Maximum wire out 4828m
1906 CTD in board.

2032h **Station 236/98/37 Multi-corer 4800m 48°56.92'N 16°37.04'W**
This multi-corer sample was taken for GEOMAR near the site of all the landers.
2215h The replacement block was overheating and smoking so the speed of the wire was slowed down.

Monday 14 September
0048h Multi-corer in board, with no successful cores.
No further work was possible during the night owing to failure of the gantry bock.*RRS Discovery* remained hove to.

0725h **Station 236/98/38 GEOMAR FFR 4800m 48°56.99'N 16°36.87'W**
The GEOMAR chamber lander was deployed with one chamber missing. Two normal chambers and the Gust microcosm were in use.

0810h *FS Meteor* Cruise M42/2 Station# 399 GEOMAR FFB1 Lander recovery
This lander equipped with stereo camera and ADCP was released.
0935h GEOMAR lander on the surface
1003h Lander grappled but the pellet line was wrapped under the lander. It proved impossible to free it to lift the lander out of the water. Eventually the lander was lifted by crane using the handling lines and snatch hooks attached to the lander lifting ring.

The GEOMAR FFR lander was followed acoustically to the sea floor.
At this time the *RV Pelagia* was working nearby recovering the BOLAS lander. Since no further wire work was possible on *RRS Discovery* it was

decided to recover a sediment trap mooring placed at PAP during a BENGAL cruise earlier in the year in March.

1130h *RRS Discovery* passed within hailing distance of *RV Pelagia* currently operating a CTD and mutual greetings were exchanged. This was *Pelagia's* last station before returning to her home port at Texel.

RVS personnel continued throughout the day dismantling and servicing the defective main gantry block.

1342h Sediment Trap Mooring Recovery on behalf of Dr Richard Lampitt SOC.
(Station 13368#55 on D231) Mooring released. 48°59.96'N 16°13.63'W
1406h Mooring surfaced in quite calm sunny conditions.
1408h Mooring grappled and hauling commenced. There were three sediment traps
and three Anderaa current meters on this 4000m mooring.
1741h Mooring recovery complete

RRS Discovery then returned to the main lander area of PAP.

2020h **Station 236/98/39 Göteborg Lander 4806m 48°55.04'N 16°34.60'W**
This lander was deployed near the chamber lander cluster with just the gel peeper module operational. The microprocessor system had been replaced with one supplied by the IMBC team.

2030h The gantry block had been reassembled. It had been discovered that the grease channels were blocked and the bearings had been running completely dry. The block was secured until it could be lifted into place during daylight.

Phil Bagley and the Aberdeen team had been working throughout the previous two days fitting an AUDOS style experiment to the ISIT lander. This was now ready for its first trial.

2122h **Station 236/98/40 ISIT 4806m 48°53.9'N 16°34.98'W**
ISIT deployed with legs extended and a hydrophone attached to each connected to an AUDOS data logger. 4 CATS and bait were suspended beneath the camera. An amphipod trap was also mounted on the frame.

In view of the fact that no other work was possible the *RRS Discovery* remained on station to monitor the arrival of the lander on the sea floor. She then remained hove to until morning when the crew could turn to, to fit the block to the gantry.

Tuesday 15 September
0900h Crew commenced work on the block
1030h Work on the block completed
During this time there were three killer whales near the ship.

1047h Station 236/98/40 ISIT lander recovery. Acoustic release triggered
1246h ISIT surfaced
1316h ISIT grappled

1327h ISIT all in board. All the baits and CATs had been removed.

1421h **Station 236/98/41 Multi-corer 4806m 48°57.11'N 16°37.21'W**
With the main gantry block operational, the system was tested by deploying the GEOMAR multi-corer near the landers.
1613h Commenced hauling
1805h All in board, no cores had been taken.

RRS Discovery set course to the PAP central coring station. The weather was bright, sunny and calm with a slight swell on the surface decreasing.

1915h **Station 236/98/42 SPI 4800m 48°51.5'N 16°30'W**
SPI was deployed at the PAP central coring station. This was the first deployment after repairs to the essential gantry block. It was a nice calm evening with a glorious sunset.

Wednesday 16 September
0005h Whilst SPI was drifting a plankton net was deployed over the stern starboard quarter and a quantity of small pelagic organisms including myctophid fishes were captured.
0055h Plankton net in board.
0130h SPI returned in board with a full set of 50+ images for this station.

0219h **Station 236/98/43 ISIT 4800m 48°54.07'N 16°30.29'W**
The ISIT was deployed for a second time with the fish tracking system on board together with baits and four CATS. It was a beautiful calm night and consequently it was an easy deployment.

RRS Discovery immediately moved to near the GEOMAR lander to take a multicore sample.

0312h **Station 236/98/44 Multi-corer 4800m 48°56.21'N 16°35.44'W**
0455h It was noticed that the multi-corer was drifting too close to the GEOMAR lander, therefore the ship slowly began to tow the gear away from this location.
0545h Veering recommenced
0605h Commenced hauling.

0722h IMBC Lander Station 236/98/34. To save time in a busy schedule the release was fired as 2000m of CTD cable remained to be hauled.

0806h Multicorer inboard after an extended deployment. No samples were obtained. It was quite a calm day, with slight drizzle.

0907h IMBC lander on the surface.
0935h IMBC lander grappled

0938h IMBC lander in board having apparently worked well. All the syringes were full of samples. This was a very straight forward recovery with the lander lifted in board over the side using the crane hook.

0940h Göteborg Lander Station 236/98/39 Recovery. The release was fired at 2.1 NM range again to save time in a full schedule.
1026h Göteborg Lander on the Surface
1055h Göteborg Lander grappled
1105h Göteborg Lander all in board. The recovery was somewhat difficult, the recovery line was caught around one of the flag poles which consequently was broken off. The lander was lifted out over the starboard side using the crane, but swung wildly across the deck before it was brought under control.

RRS Discovery then moved towards the MAP II and LAFF II sites 14NM to the east.

1200h MAP II Station 236/98/13 Recovery. The Acoustic release was triggered.

1308h To save time, the nearby LAFF II release was triggered. A significant delay was observed on the ARCADE before take off, presumably the delay before the trap closed triggered the dropping of weights and finally the vehicle accelerated upwards.

1400h MAP II surfaced in fog with just 100m visibility around the ship. It was tracked by radio direction finding and was eventually spotted at 1425h.

1451h MAP II grappled.
1459h MAP II all in board, a very safe recovery through the stern „A' frame.

RRS Discovery then moved to the LAFF II position where the vehicle was already ascending.

1551h LAFF II Station 236/98/02 surfaced.
1624h LAFF II grappled
1645h LAFF II all in board. There was a spectacular catch of 25 grenadiers *Coryphaenoides (Nematonurus) armatus* but the dolphin carcass had not been greatly consumed.

RRS Discovery set course back to the west to the ISIT position in the hopes of recovering the vehicle before darkness fell.

1810h ISIT Station 236/98/43. Released
2006h ISIT on the surface
2050h ISIT grappled just as it was getting dark
2105h ISIT on the deck, a straight forward recovery of this vehicle with glass float boss-clipped to the mooring line.

Having completed an extraordinary day with 1 lander deployment and 5 recoveries *RRS Discovery* then moved onto station in preparation for the SPI work through the night.

2143 h **Station 236/98/45 SPI 4800m 48°55.81'N 16°33.70'W**
The second SPI deployment following refurbishment of the instrument. The station was near the lander deployment area at PAP.

Thursday 17 September

0200h SPI series completed, commenced hauling.
0336h SPI in board.

0422h **Station 236/98/46 Multicorer 4800m 48°57.08'N 16°37.03'W**
A further attempt to get core samples in the GEOMAR lander area.
0625h Commenced hauling.
0803h Multi-corer in board having failed to sample any sediment.
At this time the weather was atrocious, with heavy torrential rain coming in through the bridge windows and lightning all around the ship. The release of the RAP II lander was delayed to consider the weather forecasts. The wind was 25 knots, ignoring human comfort on the deck, it was decided that the sea and the wind speed were not dangerous and release of the vehicle was authorised.

0830h RAP II lander Station 236/98/33 released.

0955h **Station 236/98/47 ISIT 4801m 48°54.60'N 16°35.54'W**
ISIT deployed while the RAPII was ascending. There was a delay because one of the double benthos float packs came off the mooring and fell into the water during deployment. A spare float pack was shackled on and the *RRS Discovery* went round and picked up the stray float by 1020h

A poor weather forecast with a deep depression was forecast for Friday 18 September so it was decided that all landers should be back on board by the end of the day.

1111h RAP II Station 236/98/33 surfaced.
1130h The weather had completely changed, it was bright and sunny and dolphins were playing round the bows of the ship as RAP II was approached.
1148h RAP II grappled
1200h RAP II all in board, recovered through the A frame, very well controlled with a lot of handling lines.

1210h GEOMAR Station 236/98/38 Lander released
1325h GEOMAR lander surfaced. There was a delay before the lander could be picked up because the RAPII lander was still being moved into the hanger.
1405h GEOMAR lander grappled
1411h GEOMAR lander in board, recovered over the starboard side using the crane in quite calm conditions there was no serious problem.

1438h Fish Trap Station 236/98/35 released.
1640h Fish Trap on the surface
1708h Fish Trap grappled.

1725h Fish Trap all in board. Numerous amphipods and a very good specimen of *Spectrunculus grandis* were captured.

The final lander work of the day was again to retrieve the ISIT lander just before dusk in anticipation of poor weather the next day.

1810h ISIT Station 236/98/47 released, just after 6 hours had elapsed on the sea floor.
2006 ISIT on the surface
2038 ISIT Grappled
2050h ISIT on deck with all CATs and bait having been consumed.

It was just getting dark and *RRS Discovery* having recovered all the landers from the PAP area proceeded to the central core area to do a final multicore station. The weather forecast had changed much for the better with the expected depression having moved off to the north. A calm night was in prospect with good conditions for core and SPI work.

2155h **Station 236/98/48 Multicorer 4804m 48°50.96'N 16°29.31'W**
The corer was deployed with only two tubes in the hope of getting good penetration with the weights available.

2347h Commenced hauling

Friday 18 September
0136h Multicorer in board with no success. *RRS Discovery* then proceeded to the SPI station in the North of the PAP area.

0247h **Station 236/98/49 SPI 4800m 48°58.62'N 16°24.96'W**
SPI outboard for the first of two SPI stations proposed for PAP to conclude the studies there.
0917h SPI in board. *RRS Discovery* proceeded to the next station.

1027h *RRS Discovery* hove to at the proposed final SPI station. In the meantime it was agreed that the IFREMER team could test their autoanalyser on the CTD wire (4h) after the SPI cast was complete.

1250h The SPI camera battery had failed to take a charge. It was therefore necessary to fully discharge it before attempting a recharge. It was decided in view of the delay to abandon the final SPI station at PAP and move east towards the Porcupine Seabight and the AUDOS station.

In the mean time the IFREMER team were preparing their test on the CTD, the position of which was not critical. The aim was to arrive at the AUDOS station on the morning of Saturday 18th to allow 24h of dragging work.

1729h **Station 236/98/50 CTD/*In Situ* Analyser to 3000m 49°14.66'N 15°18.58'W**
RRS Discovery hove to and the IFREMER auto-analyser was lowered on the CTD frame to test at high pressure and low temperature. The programme was allowed to run for two hours.
2032h Tests completed hauling began.
2117h CTD equipment in board.

RRS Discovery resumed passage to the Porcupine Seabight.

Saturday 19 September

0711h **Station 236/98/51 ISIT 2529m 49°56.13'N 12°57.91'W**
The ISIT was deployed with 6 CATs and the tracking equipment in the Porcupine Seabight at the *Antimora rostrata* depth.

RRS Discovery then moved to prepare for dragging for AUDOS.

0815h The AUDOS position was checked acoustically and the lander was clearly still in the position that it had had been left previously.

0921h *RRS Discovery* hove to 3.6 miles from the AUDOS position and deployment of dragging gear commenced. A 150 kg clump of chain was attached to the end of the drag line and the first drag hook was set just in front of it.

0952h The second drag anchor was deployed
1020h A pair of drag anchors was attached at the half way point of the drag line.
1103h A pair of drag anchors was attached shackled "in line" behind the final length of wire.
1208h 1.5 tonne of ballast was deployed.
1215h A MORS transponder was attached 300m up the coring wire.
1228h At 2.5 miles from the AUDOS location *RRS Discovery* started steaming forwards at 2 knots while wire was being paid out.
1314h With 2750m of wire out the chain clump was on the bottom.

1404h Closest approach to AUDOS 0.24 nautical miles on the GPS, 2553m slant range on acoustics.
1430h At 1.0 NM past the AUDOS position *RRS Discovery* turned hard to port and then traced a circle round the AUDOS GPS position of 1-1.2 NM radius thus keeping the clump rotating around the mooring. The position of AUDOS was continually checked on the ARCADE and MORS deck units.

1811h The dragging circle was almost complete and AUDOS appeared on the acoustics to move away from the ship faster that indicated by GPS. Hauling of the wire therefore commenced with *RRS Discovery* steering 140°T out of the circle.

1841h Range of AUDOS exceeded the length of wire out. It seemed the drag had been a failure. *RRS Discovery* started lining up for a second drag pass of the day.

1917h The AUDOS radio was heard on the surface. *RRS Discovery* moved slowly towards the AUDOS position while the main warp was hauled to recover the dragging gear. Visual contact was maintained with the AUDOS. Recovery of the dragging gear was complicated since the first set of drag anchors had hooked the blue tail section of the bottom line forming a noose. It was all wound onto the winch as a tangle. The AUDOS ballast and strop were retrieved intact caught in a loop of the orange wire.

2203h All the dragging gear was in board. *RRS Discovery* proceeded to pick up AUDOS in the dark. A strobe light on dahn buoy aided location.

2328h AUDOS grappled
2340h AUDOS in board with very little sign of any damage.

Sunday 20 September

RRS Discovery remained hove to on the ISIT position whilst celebrations went on into the night.

0740h Recovery of ISIT Station 236/98/51. Released
0840h ISIT surfaced
0851h ISIT grappled
0910h ISIT on deck.

0912h The PES Transducer fish was retrieved in board.
END OF SCIENCE *RRS Discovery* set course 093°T for Southampton.

1030h A Post Cruise Meeting was held in the Library with the Captain, First Officer, PSO and RVS chief technician. The cruise was overall judged to have achieved 60 % of the objectives with time lost mostly owing to weather

2000h PSO's RPC in the bar continued to 2300h

Monday 21 September

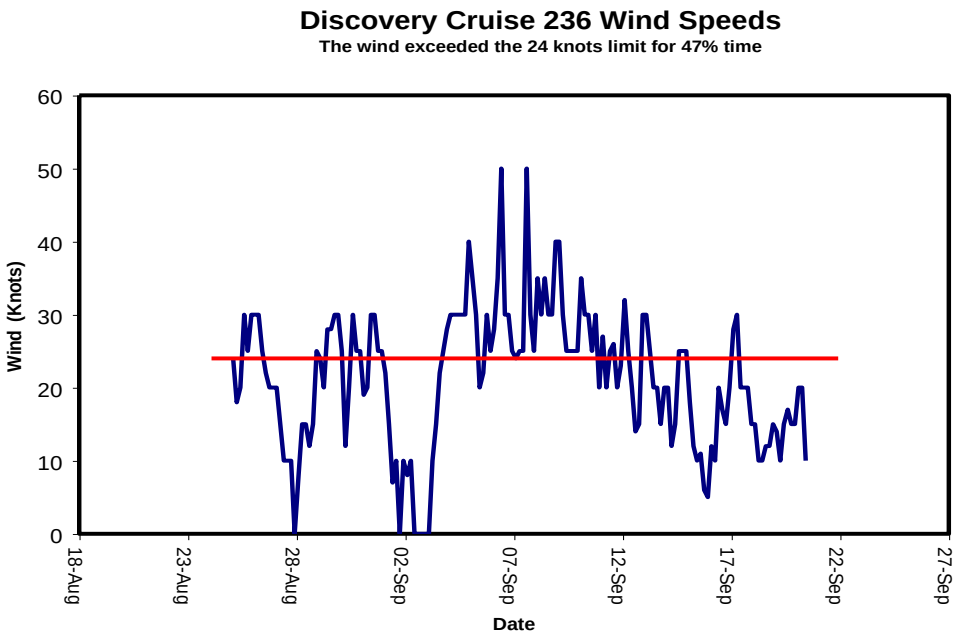
The weather was calm as the *RRS Discovery* entered the English Channel, early morning fog cleared to give sunshine by mid morning.

The day was spent packing of equipment for off-loading in Southampton.

Tuesday 22 September

0900h *RRS Discovery* alongside at the Southampton Oceanography Centre.
Unloading commenced immediately.

Figure 3. Wind speeds from the bridge log of *RRS Discovery.*The horizontal bar indicates 24 knots (average Force 6) considered to be the upper safe limit for lander operations.



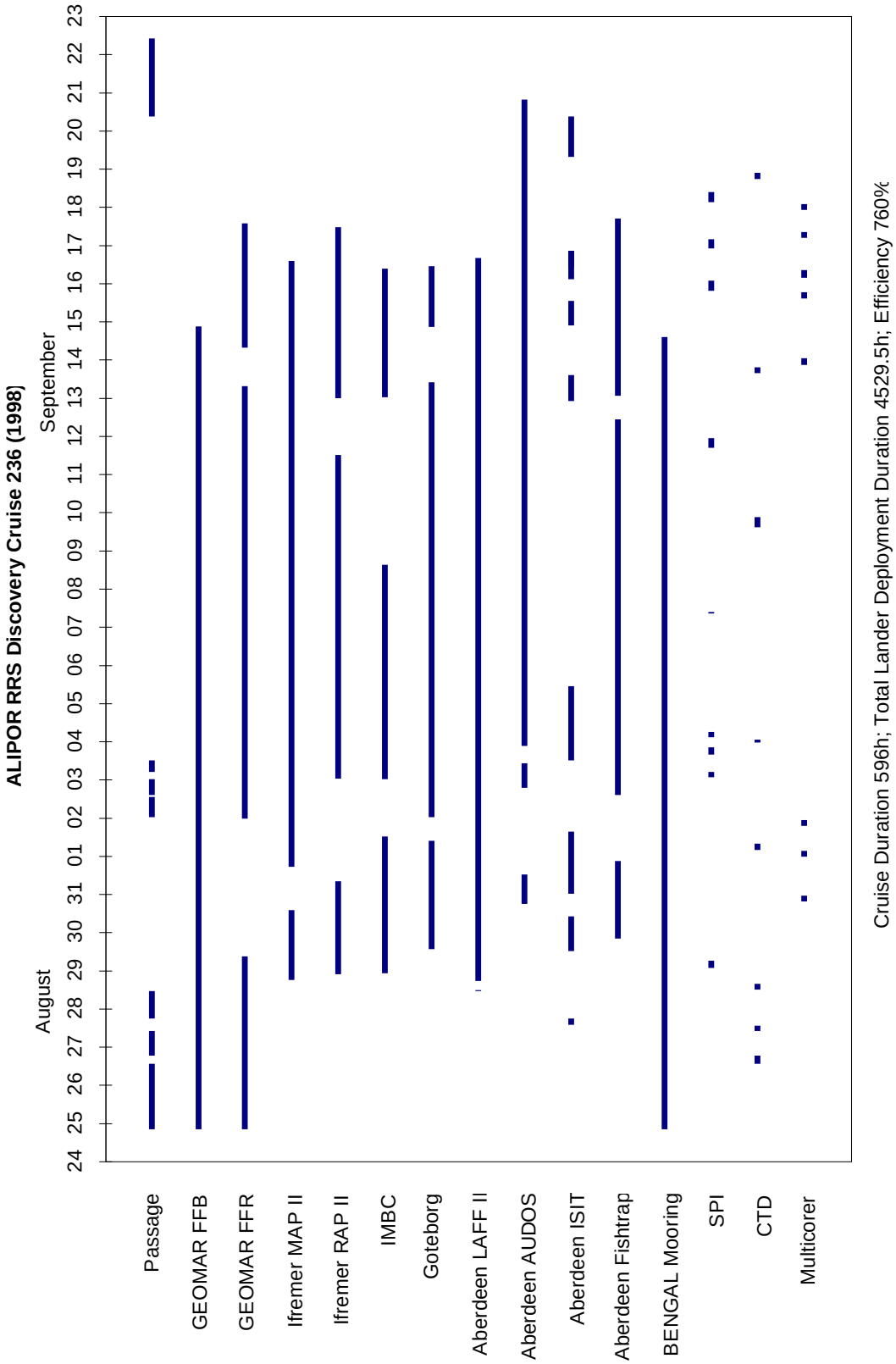


Figure 4: Time bar chart for the ALIPOR research cruise 236 (1998). Bar lines represent lander and wire gear deployment duration's over the course of the cruise. Wire gears were SPI, CTD, and Multicorer, all other gears were landers.

Figure 5. Location of Lander Stations at PAP.

Figure 6. Location of Chamber Landers at PAP

Figure 7 Location of Landers at the Porcupine Seabight

Figure 8. Track of the first attempt to drag for AUDOS. A single turn to port was executed.

Figure 9. Track of the second attempt to drag for AUDOS, featuring a U-turn around AUDOS.

Figure 10 The third attempt to recover AUDOS. This featured an attempted circle around the vehicle in rough weather.

Figure 11. The final successful track for recovery of AUDOS by dragging. A simple circle was steered around the vehicle totally entangling the mooring.

Analysis of Lander Recovery Times.

One of the major constraints on lander operations is the time required to find a lander after it has surfaced and then the time necessary to manouver the ship alongside, grapple the mooring and get the lander inboard. Landers can be divied into two kinds. Those with floatation attached to the body of the lander and those with a buoyancy string like a mooring line. The latter type requires the floats to be removed as the lander is recovered.

The table opposite indicates the results achieved during Discovery cruise 236. Times are given in minutes from when the lander first surfaced (determined by the time of reception of the first VHF radio signal) until the first grapple line is secured on the lander. This therefore includes any search time and ship's manouvering time. The time from grappling to inboard reflects the handling time for the lander.

Recoveries on this cruise were slower than on the previous ALIPOR cruise *Discvoery 222*. Average of 50 minutes compared with 36 minutes achived previously. This probably reflects the poor weather experienced during this cruise. Notable is the extremely rapid handling of the IMBC compact lander (3 minutes from grappled to inboard.). As on the previous cruise the surpirsing result is that overall recovery times for the two kinds of buoyancy distribution are not significantly different.

Phil Bagley & Monty Priede

Analysis of Lander Recovery Times

Vehicle	Sta. no.	Recovery times (Minutes) Grapple	In board	Total	
GEOMAR FFR5	M42/2#437	25	9	34	
GEOMAR FFR5	17	43	12	55	
GEOMAR FFR5	38	40	6	46	
MAP II	3	97	10	107	
MAP II	13	51	68	119	
RAP II	4	27	12	39	
RAP II	22	25	10	35	
RAP II	33	37	12	49	
Goteborg	8	27	22	49	
Goteborg	18	30	25	55	
Goteborg	39	29	10	39	
IMBC	5	23	3	26	
IMBC	21	21	3	24	
IMBC	34	28	3	31	
LAFF II	2	33	21	54	
ISIT	7	22	15	37	
ISIT	12	35	16	51	
ISIT	24	42	13	55	
ISIT	32	33	16	49	
ISIT	40	30	11	41	
ISIT	43	44	15	59	
ISIT	47	32	12	44	
ISIT	51	11	21	32	
AUDOS	10	38	26	64	
AUDOS	20	36	12	48	
AUDOS	26	*251*	12	*263*	*Note 1*
Sediment trap		2	*216*	*218*	*Note 2*
Average time		**34.36**	**15.32**	**49.68**	
Minimum time		11	3	24	**ALL LANDERS**
Maximum time		97	68	119	
Average time		**35.93**	**14.64**	**50.57**	
Minimum time		21	3	24	**FLOATS ON BODY**
Maximum time		97	68	119	
Average time		**32.36**	**16.18**	**48.55**	
Minimum time		11	11	32	**FLOATS ON STRING**
Maximum time		44	26	64	

Note 1

Audos recovered by dragging, Drag cable had to be recovered prior to grappling.(not used for mean/min/max calculation)

Note 2

Sediment trap mooring 4000m long (not used for mean/min/max calculation)

Scientific Reports

I.M.B.C. Compact Lander

LANDER DESCRIPTION:

The I.M.B.C. compact lander is a small autonomous vehicle which is used for benthic marine biology and chemistry studies. Emphasis has been on making a compact lander that is easy to handle, of low cost and possible to operate off small ships (less than 10 m length). Although compact, the lander is able to operate down to full ocean depth (6000 m).

After landing a benthic chamber moves down and encloses of a piece of the sediment together with the overlying water. A stirrer is started, to avoid the creation of stagnant water in the chamber, and an incubation is started. By sampling the overlying water, at preprogrammed time intervals, and later on analyzing it sediment fluxes of various chemical compounds can be measured. The main parameter studied has so far been the oxygen consumption of the sediment, known to be mainly to be caused by biological activity. During this cruise both alkalinity and total carbonate were also analyzed on the water samples.

The main technical characteristics of the lander are:

- **Dimensions and weight**: 120*130*95 cm, 200 kg (in air with ballast), 25 kg (in water with ballast, at the surface). Ballast weight in air 60 kg (2*30 kg pieces of scrap iron).
- **Floatation**: four „Benthos' (USA) 17' glass spheres (25 kg positive buoyancy each). Giving the lander a positive buoyancy of 30 kg after weight release. A „Mors' (F) acoustic release is used to drop the weights.
- **Electronics:** All movements (of the chamber, the lid valve and the stirrer) as well as the triggering of the water sampling syringes are done by electric DC-motors housed in light weight delrin containers. Compensation against pressure and protection against incoming sea-water is done by filling the houses and the connecting cables (tubes) with Fluorinert FC77 electronic liquid. All actions are pre-programmed before launching and controlled by a „Tattletale' model 5F controller (from ONSET, USA) connected to an interface board. This microprocessor and the required energy 3 battery packs (two 9,6 volts 5 Ah,one 4.8 volts 4 Ah) are housed in a standard current meter pressure case (from Aanderaa, N).
- **Incubations and water sampling**: A 25 cm long benthic cylindrical Plexiglas chamber of 19 cm inner diameter (surface 284 cm^2) is gently inserted into the sediment after landing. The normal penetration depth is supposed to be 10 cm, leaving an overlying water column height of 15 cm. When penetration is completed a motor activated valve on the top of the lid closes off the system and the incubation starts. During the incubation five syringes of 50 ml are used to draw water at pre-programmed times from the chamber into 20 ml glass containers. The withdrawn volume is compensated for by incoming water (of known concentration) through a long thin tube (i.e. diffusion barrier).

- The normal sequence used during this cruise was: two samples before the incubation started, one in the middle of the incubation and two at the end. Before and during the whole incubation a stirrer is used to mix the chamber water.
- **Surface spotting**: by a flag, a flash and a VHF beacon (from Novatech, Canada).

RESULTS

First deployment (Sta. 236/98/05)

The first deployment was made at the PAP site (water depth 4800 m) close to the other chamber landers participating in the cruise (Geomar ,Ifremer, Gothenburg). The chamber was programmed to incubate for 56 hours. The sinking speed was measured to 35 meters/min. The lander was recovered 3,5 days later (one day later than the initial plan ,due to bad weather). The ascending speed was 50 m/min, and the recovery was done using the starboard crane without difficulties.

The mechanics and electronics seemed to have worked without problems but analysis of the water samples (oxygen made by IFREMER, alkalinity and total carbonate by Gothenburg University and nutrients by Sibylle Grandel from GEOMAR) revealed no concentration changes in the overlying water with time. The most probable explanation is that the chamber had not penetrated the sediment.

Second deployment (Sta. 236/98/21)

This deployment was made at a shallower station (water depth 1434 m) in the OMEX area. The chamber was programmed to go deeper into the sediment. The incubation time was set to 48 hours.
Due to bad weather (wind speeds from 7-8 Beaufort) the lander was recovered three days later. Again the starboard side crane was used and recovery was made without problems in spite of strong wind and an important swell.
The mechanics and electronics had worked fine indicating an overlying water column height of 23.5 cm. Once again, the analyzing of oxygen samples did not reveal any significant concentration changes with time. On the other hand both alkalinity and total carbonate showed a significant increase giving rice to outgoing fluxes of 1.49 and 0.75 $mmol*m^2*day^{-1}$ respectively (see Fig. 1 for the alkalinity flux). Both the alkalinity (precision of 0.1 % Relative Standard Deviation) and total carbonate (0.2 % RSD) fluxes indicate that the chamber had penetrated the sediment, the valve closed the stirrer worked and that the sampling systems were operating satisfactory. The reason for not being able to measure any oxygen flux is, probably, that the precision of the method (1 % RSD) was lower or similar to the oxygen concentration change with time in the chamber. To be able to reach a detectable concentration change with time, in areas with low benthic activity, the overlying water column have to be lower, the precision of the analytical method better or the incubation time longer.

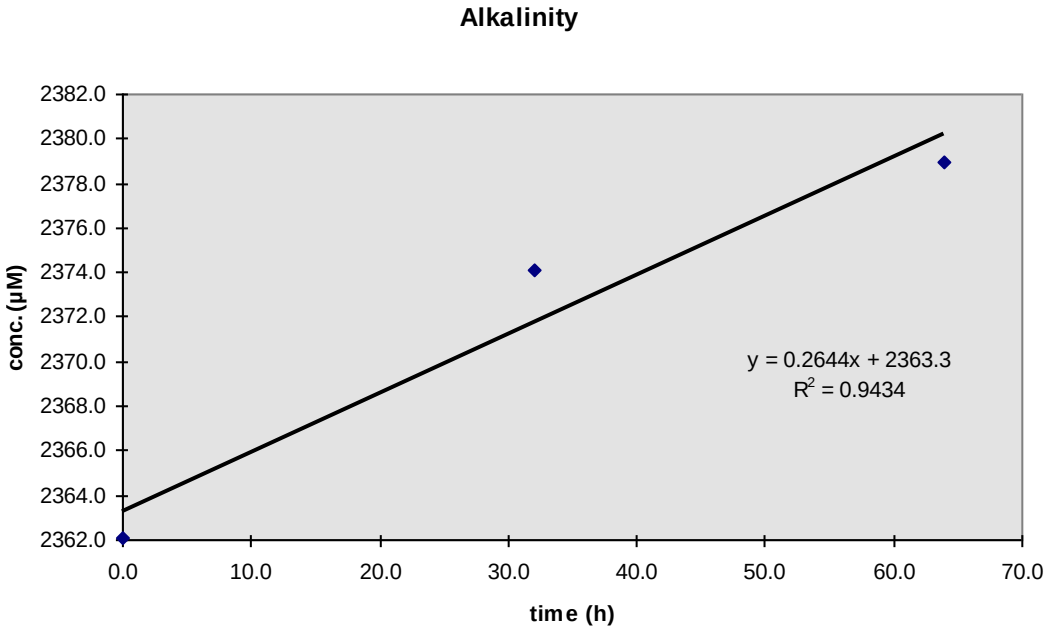


Fig.1: Alkalinity change with time in the overlying water at a water depth of 1434 m (the OMEX area).

Third deployment (Sta.. 236/98/34)

At the PAP site (water depth 4710 m). The chamber was set to go as deep as possible into the sediment, and the system was programmed for a 64 hours incubation. Launching and recovery was done, in wind forces of around Beaufort 6, without complications. The overlying water column height was at this occasion estimated to 21 cm. Although somewhat lower, this water column height was again not low enough to detect any concentration change of oxygen with time. Both outgoing fluxes of alkalinity and total carbonate was measured to 0.80 and 2.17 mmol*m^2*day^{-1} respectively (see Fig. 2 for the total carbonate flux) again indicating the good functioning of the system. These fluxes are in the same range as fluxes measured at the PAP site with the Gothenburg lander at several previous occasions.

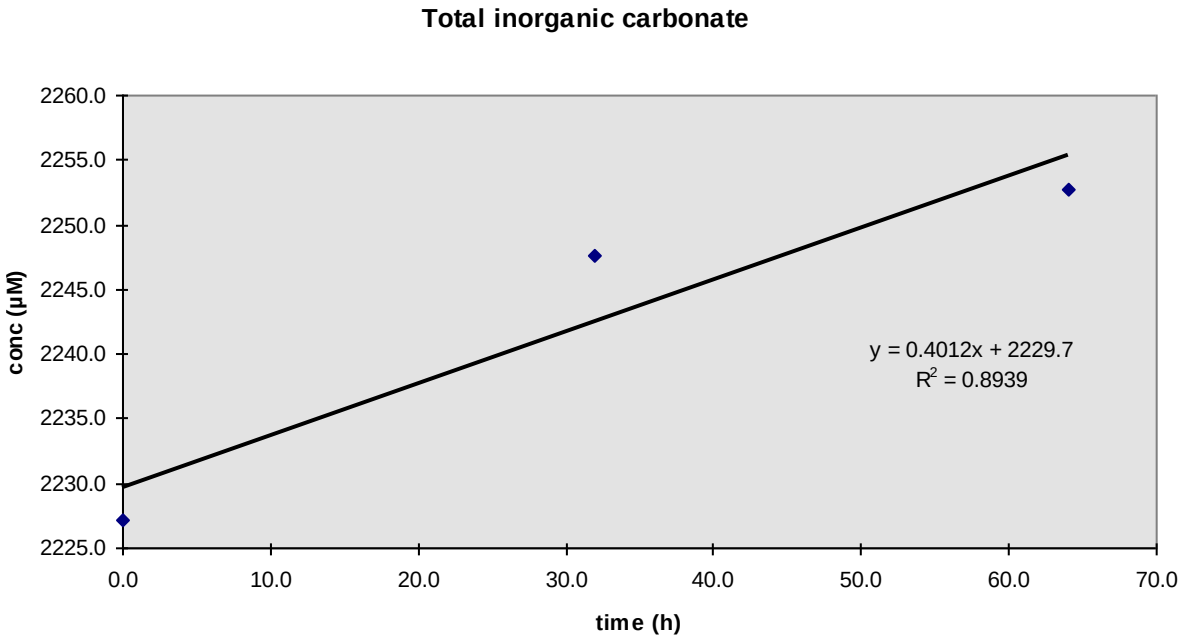


Fig.2: Total carbonate change with time in the overlying water at a water depth of 4710 m (the PAP area).

CONCLUDING REMARKS

This cruise was a good opportunity for testing the Compact Lander and compare the results with the other benthic chamber landers.

All electronic systems worked according to plan resulting in measured alkalinity and total carbonate fluxes at two stations. As for all other groups on this cruise our work was considerably reduced by bad weather. However, in difficult weather conditions a small lander is easier to handle with less risk for both material and crew making it operational beyond workable conditions for other bigger landers.

The collaboration with the other teams especially the IFREMER and Gothenburg teams gave us ideas for improving our lander as well as how to develop reliable systems for chemical analysis of the water samples (e.g. oxygen and alkalinity).

Once back in Crete emphasis will be put into increase the chamber penetration depth and thus reducing the height of the overlying water column which will lead to an easier detection of concentration changes in the overlying water. This is especially important working in areas with low benthic activity (e.g. the deep Atlantic and deep Mediterranean seas).

Kostas Christodoulou, Fotis Pantazoglou
Institute of Marine Biology of Crete
Heraklion Crete Greece

The Geomar Landers

Free-Fall Respirometer

Sta. M42/2 #437

The Geomar Free-Fall Respirometer had been deployed on 18th August 1998 during the Meteor Cruise M42/2, station # 437. On Discovery 236 the lander was recovered after 11 days of bottom time on 29 August 1998. The FFR contained 4 sediment chambers, three ordinary and one "Gust chamber" with eight 50ml syringes each.

All chambers worked well. The penetration depth was 15cm with overlaying water of 15 cm.

The lander was then deployed twice from the *RRS Discovery.*

Sta. D236/98/17

During this first deployment the lander was programmed to work for 6 days. However owing to bad weather the recovery was delayed until 13 days had elapsed. On recovery, chamber one and two were without sediment. Chamber three and the "Gust chamber" were filled with 15 and 13cm of sediment. All chambers closed correctly and all syringes were filled with 8samples.

We lost the flashlight and the radio beacon as we picked up the lander, because a rope turned around the holding clamp.

Sta. D236/98/38.

For this three day deployment the FFR carried only three chambers. One of the electronic pressure housings of the chamber two was loose and some drops of water had damaged the processor board.

The rotation speed of the "Gust chamber" was set to a higher speed of 38rpm.

This last deployment was successful too, but there was a little bit of water in two of pressure housings but these did not affect the functioning of the systems.

Geomar Free-Fall Observation-System (FFB)

Sta. M42/2 #399

We recovered the FFB on 14 September 39 days after it had been deployed by the *FS Meteor*. The FFB carried a stereo camera system and an ADCP. The cameras took 750 pictures each - one picture per hour. The system observed the sediment relief. After this cruise the pictures will be analysed by a 3D-Computer system.

Volker Nuppenau, Michael Poser, Juan Zwolinski*

GEOMAR, Kiel, Germany *University of Lisbon, Portugal.

Sediment Profile Imagery (SPI)

Equipment

Sediment profile imagery is a wire deployed optical coring device which allows rapid and virtually undisturbed imaging of the sediment-water interface. The use of digital camera technology facilitates immediate data retrieval following deployment . The technique is a useful adjunct to lander studies as it can be used for site reconnaissance. When used to provide information about small scale variability of the sediment/water interface it can add a degree of objectivity when scaling up point data of the type routinely taken by landers.

Principal objectives:

i) Carry out 10 deployments of the SPI to demonstrate successful customisation of the equipment for use in the deep-sea in line with ALIPOR deliverables.

ii) From the total allocated, carry out 5 successful deployments at PAP to satisfy twin programme BENGAL scientific deliverables, i.e. provide 200 images of the sediment/water interface at PAP to facilitate description of intersite variability.

Results

A total of nine deployments of SPI were achieved during the cruise including four at PAP and 4 in the Porcupine Seabight. A major technical problem which occurred on the first deployment at PAP was successfully overcome. The machine then operated at full capacity and reliability until the end of the cruise. In total, 303 images were taken at 6 sites ranging in depth from 660m and 4800m.

Table. 1 Location of SPI stations with number of images obtained at each

236 /98 St. No.	Site No.	Date Julian	Wire Time BST	Latitude Longitude	Depth	Bottom Time	No. of Images
06	PAP 1	29/08/98 237	0129 0554	45 49.05' 16 29.25'	4800	0340 0412	None
23	SB 1	03/09/98 242	0112 0430	49 07.25' 12 47.64'	1450	0052 0232	50
25	SB 2		1536 2004	50 03.1' 12 56.7'	2500	1534 1812	51
28*	SB 3	04/09/98 243	0231 0550	49.53.10' 12 53.67'	2500	0231 0500	37
29**	MM	07/09/98 246	0823 0912	52 18.7' 12 58.8'	660	0742 0753	5
31	SB 4	11/09/98 251	1630 2225	49 30' 12 52'	1500	1645 1929	52
42	PAP 2	15/09/98 258	1915 0130	48 51.5' 16 30'	4800	2010 2257	48
45	PAP 3	16/09/98 259	2143 0336	48 55.89 16 33.7	4800	2230 0104	53
49***	PAP 4	18/09/98 261	0247 0917	48 58.62 16 24.96	4800	0330 0638	7

28* Insufficient time allocation; 37 attempted. , 29** Opportunistic deployment at Magellan mound; 5 attempted. 49*** Camera battery failure.

These showed considerable variability in surface and sub-surface sedimentary features. All images were downloaded to computer and archived on 100 MB Zip disks with backups to a 2 GB Jaz drive. A number of Photoshop automated routines were developed during the cruise to handle image importation from compressed Kodak files and to carry out basic image enhancement.

Technical Problems:

Flash Assembly

The first deployment resulted in failure. Subsequent investigation with the help of Peter Mason (RVS) pinpointed damage on the flash board which was replaced. With working electronics the flash strobe still failed to fire. The SPI was dismantled and examination of the flash assembly showed that it had taken water. A new flash assembly was built through the combined efforts of several colleagues, Phil Bagley (Aberdeen) supplied a Novatech strobe plexiglass dome, Costas Christodoulou (IMBC) designed a high pressure adaptor and Ritchie Phipps (RVS) machine the appropriate fittings and blanks (for pressure testing). The new assembly was attached to one of the existing SPI flash arms.

Pressure testing of the new assembly again showed a small amount of leakage. A second pressure test with both arms, revealed that only one arm leaked. This suggested that one of the stainless steel welded joints was porous and a microscopic hole allowed water ingress under extreme pressure - x-ray examination is required to confirm this. The flash unit used in all remaining deployments was assembled using the non-leaking arm and performed admirably throughout the rest of the trip.

Bottom Detection

Additionally, the first deployment revealed that bottom positioning by monitoring the tensionmeter was difficult due to the noise generated by the weight of 19mm wire deployed. Phil Taylor (RVS) and Ritchie Phipps (RVS) provided a solution. Ritchie Phipps produced an exact copy of the trigger mechanism from spares and fitted it to the opposite side of the machine with the help of Rhys Roberts (RVS). This provided a bottom contact trigger for an attached acoustic pinger. On the bottom, the triggered pinger responded with a double rate ping which was visible on the echosounder display as a second trace and as a change in frequency using the audible unit. This worked very well.

Camera Battery Idiosyncrasies

Following these repairs the equipment worked at full capacity with 100 % success on each deployment. The only exception being the last PAP deployment which failed approximately 30 minutes after the start of sediment imaging due to a discharged camera battery. The reason for this is not altogether clear but may be due to a memory effect which inhibits a full charge cycle. A similar phenomenon occurred at the beginning of the cruise and appeared to be cured by ensuring discharge by remotely triggering the camera 2-300 times prior to charging,

Other technical/operational problems
A number of other minor problems occurred and were sorted out during operation:

i) smearing on the face plate - the wiper blade was replaced;
ii) pre-triggering during the descent to the bottom - the hydraulic piston valve was stopped down .

Summary

The cruise was very successful technically and sorted out the remaining technical problems surrounding deployment of SPI in the deep-sea. The science programme was quite successful, although lost ship-time for wire work due to bad weather, the loss of the AUDOS and subsequent days devoted to dragging for it and failure of the mid-ships winch resulted in curtailment of the initial cruise objectives.

Acknowledgements

I would like to thank Captain Keith Avery, and the officers and crew of Discovery for maintaining such an efficient and friendly atmosphere aboard. Special thanks to all the NERC Research Vessel Services technicians who gave freely of their expertise and without whom this study would not have been completed successfully.

Anthony J. Grehan
MRI, NUI, Galway, Ireland

Report on the IFREMER Experiments

The aims of this cruise for the IFREMER participants were :

1. -to deploy the new "Module Autonome Pluridisciplinaire" on the PAP station (4800m depth). This vehicle (MAP 2) is a deep sea bottom lander basically equipped with a currentmeter, a nephelometer, a camera-flash system and sediment trap.

2. -to test two new equipments (drawer and auto-analyser) of the IFREMER respirometer (RAP2) and to compare results obtained by this lander with three other equivalent instruments from GEOMAR (Germany), University of Goteborg (Sweden) and Greece (IMBC).

Results

1- The MAP 2 operations

Task 11.3 Data logging standard

Aims

The main aim for MAP2 lander (see description below) was to be operated in real conditions, in order to get the necessary feedback for modifications or validation of the improvements implemented within the ALIPOR framework (Task 11.3 Data logging standard).

In other respects, MAP2 could provide current data likely to interest the LAFF experiment, which was deployed simultaneously in the same area.

MAP2 description

MAP2 (Module Autonome Pluridisciplinaire II) is a multipurpose long term measurement platform intended to gather various physical parameters at the vicinity of the water-sediment boundary, in order to understand their interactions. It is composed of a tripod glass reinforced epoxy structure supporting a set of syntactic foam cylinders on its top, and three (one per leg) releasable lead ballasts. The release system is triggered by one of two MORS acoustic releases (RT661 bis and AR661 bis). For this cruise, the installed instruments set comprised:

OCEAN INSTRUMENTATION camera + 2 flash lights
MORS rotor currentmeter
SENSORTEC UCM-60 acoustic currentmeter (for evaluation purpose)
SONTEK Argonaut acoustic Doppler currentmeter (for evaluation purpose)
TECHNICAP sediment trap (2nd deployment only)
IFREMER designed nephelometer
SEA-TECH transmissiometer

The last two instruments were linked together and to a passive data logger through a CAN based communication network (Controller Area Network), allowing triplication of the collected data into three independent units. Furthermore, the passive data logger was fitted with a removable memory card (PCMCIA type) providing a handy way of retrieving all data directly on a laptop computer.

Deployments report

First deployment (Sta. 236/98/03)
(48°55'01.26N, 016°15'58.34W) 4800m.
deployed 28/08/1998 at 16:54 GMT
recovered 30/08/1998 at 14:30 GMT

The grappling operation was made difficult due to a non floating line between MAP2 and the first floating ball. The camera container hit the hull during recovery but no damage was ususstained. The transmissiometer and nephelometer data were extracted and showed that the data logging system had worked correctly. One of the nine sliding pads was damaged when crossing the threshold between the aft deck and the hangar. No influence on further operations.

Second deployment Sta. 236/98/13)
(48°54'56.81N, 016°15'59.42W) 4800m.
Sediment trap + floating line and ball added.
deployed 31/08/1998 at 15:57 GMT
recovered 16/09/1998 at 13:58 GMT

The data logging system worked correctly. The Sea-Tech transmissiometer was flooded due either to a crack in the viewport or to a broken Sea-Con connector. The currentmeter data will be extracted ashore.

2- The RAP 2 experiments

Task 3: Multi-lander cruise: Three successful deployments of the RAP 2 respirometer were achieved and no major problem was observed on this lander during the cruise.

Positions of each RAP 2 deployment

Stations	Position
PAP1-98 *(236/98/04)*	48°56'59N 16°36'59 W
OMEX-2-98 *(236/98/22)*	49°09'35 N 12°48'09 W
PAP2-98 *(236/98/33)*	48°56'.95 N 16°36'.99 W

Though the weather was often rough during the cruise and the weight of the RAP 2 is high (2.2 tons), the deployments and the recoveries were fortunately made without damage for the lander. The Argos beacon was used to determine the position of the respirometer by satellite observation. The Argos company gave us a position by fax about each hour when the lander was at the sea surface.

The RAP2 respirometer has two different incubation programmes

-The regular programme (used during the first deployment):
Implantation of the 3 chambers in the sediment (t0) → 3 water samplings at 3 different times (t1, t2, t3) → Pulling chambers off the sediment.

The multi-incubation programme:

Implantation of the 3 chambers in the sediment (t0) → first water samplings at a known time (t1) → Pulling chambers off the sediment. → Stabilization (3 hours) → Implantation at the same place of the 3 chambers in the sediment (t0) → second water samplings at a known time (t1) → Pulling chambers off the sediment→ Stabilization (3 hours) → Implantation at the same place of the 3 chambers in the sediment (t0) → third water samplings at a known time (t1) → Pulling chambers off the sediment.

This new programme of incubation permits observation of the animal respiration at different times during the same deployment, and was used successfully on the OMEX 2 and PAP2 stations.

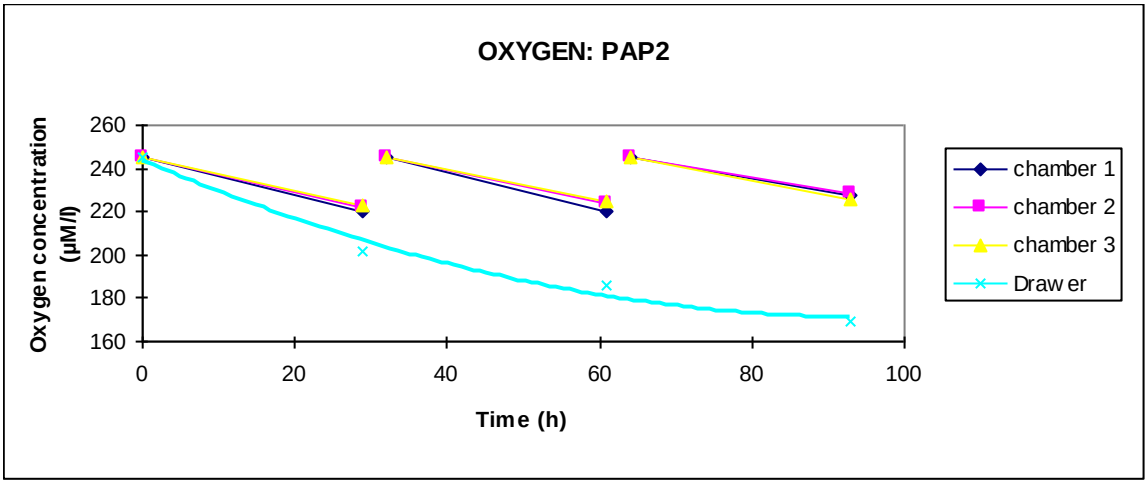


Figure 1. Example of results obtained by the multi-incubation programme (chambers) and the regular programme (drawer).

Chemical analysis :

The RAP II measures the chemical exchanges between the sediment and the water. 16 water samples were obtained after each deployment : 4 from the surrounding water (t=0), nine from three chambers and 3 from the drawer. The chemical analysis of sampled waters were made on board just after the lander recovery.

-Oxygen was measured by a Winkler method associated with potential redox probe.
-Alkalinity and ∑CO2 were determinated with potentiometric titration and calculated using the Gran function. ∑CO2 also was analysed by a colorimetric method.
-pH was measured by pH meter with a glass probe Orion with an accuracy of 0.004 pH unity and by colorimetric method.
-The Fluoride analysis was made by a specific probe.
-Ammoniac was determinated by a fluorimetric method
-We thank S. Grandel who analysed nutrients (Nitrate, Nitrite, ammonium and silicate) on board.

Preliminary scientific results :

At all 3 stations, we observe a decrease of the oxygen concentration under the RAP II chambers. The oxygen consumption by the biological metabolism is maximum at the shallow station OMEX 2, (1400m depth). The consequence of this O2 consumption is a production of CO2 which increases in all our experiments. The second observation is the increase of the alkalinity. This increase can be explained only by a regular dissolution of CaCO3. The new multi-incubation programme also permits to observe that the oxygen consumption decreases regularly with time.

DRAWER EXPERIMENT

Task 11.2 Lever Arm for Benthic Chamber.

Deliverable 11.2.4. Sea Deployment. Second Alipor cruise:RRS Discovery 236.
During the design phase, a drawer solution appeared to be more suited for a modular system than a lever arm. It was decided in agreement with all partners in January 1998 to use the RAP 2 lander (Respirometre Autonome Profond of Alexis Khripounoff from Ifremer) and this drawer during ALIPOR cruise.

Description of the device

When a lander hits more or less rapidly the sea floor, it produces a large cloud of sediment and disturbs the surrounding benthic life. The drawer is designed to lift and move the respiration chamber to an undisturbed area of sediment. The chamber on the drawer is the same as the three chambers used in the RAP 2.
The drawer brings the chamber away from the lander structure in X direction before that a vertical (Z) motion pushes it into the sediment. The Z motion includes: first a penetration phase and a few minutes after the closing of the lid of the chamber. The three sub-sampling bottles (cells) are actuated thanks to a sliding cable device moved by a rotating shaft. The stirring is similar to the one used in the three other chambers.
The safety of the system has been a priority in the design:
- the X direction drawer motor acts on a non-reversible gear box and the drawer is stopped from the surface down to 1050 m by an hydrostatic release finger,
- in case of bad tilting angle of the RAP 2, the drawer stops in X direction if it collides the soil thanks to a torque limitor,
- in case of hard sediment, the penetration stops and a premature closing of the cover is done (value set to 25 daN resistance for this cruise), should the penetration resistance increase a torque limitor avoids further Z motion that could induce an anchoring effect,
- there is no torque limitor action when the chamber is extracted and the drawer bring back.

Deployments

The drawer device was been deployed three times at sea on the RAP2 during this cruise.

First deployment Sta.236/98/04

Porcupine Abyssal Plain - 48°56.95'N - 16°36.99'W - 4804m - 28 to 31 August 98.
The drawer chamber is scheduled to act within a few minutes in accordance with the three chambers of the respirometer. The motion of the drawer is followed by the video camera situated on the RAP2 frame.
All sequences are performing well. A proof of the complete drawer motion (800mm) is brought by the film, tightness is ascertained by the chemical analysis. The torque limiter has been acted in penetration.

Second deployment:Sta. 236/98/22

Omex 2 site - 49°09'N - 12°48.1'W - 1463m - 3 to 11 September 98.
The drawer chamber is scheduled for a long term incubation while the three RAP2 chambers are performing three incubations. The landing, the motion of the drawer and the penetration phases are followed by the video camera.
All sequences are performing well. The motion of the drawer and the penetration are filmed. The area is not flat and the chamber penetrates in a slight hole. The chamber reaches the 25 daN limit and stops at the design depth of 90 mm.

Third deployment: Sta. 236/98/33

Porcupine Abyssal Plain - 48°55.9'N - 16°36.3'W - 4808m - 12 to 17 September 98.
Again, the drawer chamber is scheduled for a long term incubation while the three RAP2 chambers are performing three incubations; no camera installed.
All sequences are performing well. Evidence of sediment under the water sampling cells tends to prove a penetration of more than 90mm.

Tests on deck.

Several tests on deck has been performed in order to check other features of the system among them:
- Three incubation programme. One penetration is performed without drawer motion. A second one is done at half the drawer range. Then, the drawer comes back inside the lander frame. A third penetration is performed at the full drawer range.
This test is satisfactory. It nevertheless shows an energy consumption which could reach the limit of the battery packs at low temperature. In order to avoid a lack of energy inducing the risk of a drawer in an unsafe position for the lander recovery, this mode has not been used during a deployment.
- Maximum range. The drawer has been tested for a range of 1250mm, it provides a distance of 1000mm between the frame and the centre of the chamber.

CHEMICAL ANALYSER EXPERIMENTS

Task 10 Chemical analyser.

Aims

In the framework of the ALIPOR program, the module 10 aimed on the development of a chemical analyser which could carry out *in situ* pH and nitrate measurements in benthic chambers during their deployment at great depth.

This chemical analyser has been designed and built during the two first years of the project and the Discovery cruise n°236 gave the first opportunity to test the association of this device with the RAP2 lander of IFREMER in operational conditions.

Principle and description of the analyser

The analyser consists mainly in a 8 channels peristaltic pump, two 6 positions selection valves, two 2 positions injection valves and a colorimetric detection module with two independent flow cells. Each flow cell possess its own white source and two photodiodes with optical filter as detectors. Nitrate and pH are measured according Flow Injection (F.I.) methods.

The analyser has to work in autonomous mode with the RAP2 respirometer. At fixed time, it runs pre-programmed sequences. Two different types of sequence are used. The first one is « standardisation sequence » where the analyser carries out measurements over the environmental sea water and three different on board standards; the second one is ordinary sequence where the analyser performs measurements over two different benthic chambers and one standard. The selection of the origin of the sample i.e. environmental sea water or chamber sea water or standard is done by the use of the selection valve.

Methods and results

The colorimetric detection module failed during the first trials performed on board the Discovery at the beginning of the cruise. The analyser so could not be used for the two first deployments of the RAP2. After repairing the detection system, the *in situ* analyser was mounted on the CTD frame for a test and comparison with rosette water sample. The analyser was deployed on the 9 September between 14H35 and 20H43. It was immersed down to 2387 meter depth (50°05'N - 12°54'W). Very satisfying absorbance peaks were obtained for pH measurements but nitrate determinations failed due to leakage of the nitrate carrier tube.

The analyser was mounted on the RAP2 for the last deployment at the PAP station (48°55.9'N - 16°30.0W) at 4808 meters depth. From the 12 September at 23H33 until the 17 September at 11H11, the *in situ* analyser performed 3 standardisation cycles and 9 ordinary cycles which represent 78 measurements (39 for pH and 39 for nitrate). The data show an unusual delay of about 25 seconds in the time of appearance of the absorbance peaks which prevented the acquisition of the whole of the peak. The high pressure and the low temperature could be the causes of this delay.

On the 18 September the *in situ* analyser was again mounted on the CTD frame and deployed to 2150 meters down at a 3° temperature between 17H29 and 21H17 for a comprehensive test. Again a delay appeared but much smaller than previously. The increase of the acquisition period could provide an easy and effective solution to this problem.

MAIN CONCLUSIONS

The cruise 236 on the RRS Discovery was an excellent opportunity to demonstrate the reliability of the new MAP lander and the new equipment of the RAP 2:

-Except the transmissiometer, the MAP 2 equipments with the new data logging system worked correctly during the two deployments.

-The incubation results obtained by the RAP 2 show temporal variations of the sediment respiration. The integration of the drawer and the chemical auto-analyser into the RAP 2 is a success. The drawer system is a new device, It allows to operate 1 m outside a lander. With the RAP 2, it provides an additional feature to this lander as shown during the 3 deployments of this cruise.

D. Birot, J. Blandin, J.C. Caprais, A. Khripounoff, P. Rodier, J.F. Rolin

IFREMER, France

CRUISE REPORT FOR THE GÖTEBORG GROUP

Introduction

By using an autonomous benthic lander at three different stations on the Porcupine Abyssal Plain (water depth around 4800 m) we were able to, at the same site, sample both sediment (4 cores) and obtain sediment pore-water profiles (18 profiles) with a further development of the gel peeper technique. As a first step the gel profiles will be analyzed and compared, with the profiles obtained from the cores, for total carbonate (C_T or ΣCO_2), alkalinity (A_T) and calcium.
In addition, by collecting sediment with a multiple corer, pore water distributions were determined for total carbonate, alkalinity, calcium, Σnitrate, nitrite, ammonium, silicate and dissolved organic carbon (DOC) and sub-samples were taken for later analysis of grain size, organic C and N in the solid phase of the sediment (see Table 1: collected samples and other scientific groups which we collected/analyzed samples for). Furthermore various (nutrients, alkalinity and C_T) samples were analyzed from the chambers of the IMBC, IFREMER and GEOMAR landers (see Table 1) and bottom water was collected with Rossette bottles (mounted on a CTD) at regular intervals throughout the cruise and analyzed for oxygen, alkalinity and total carbonate.

Materials and methods

The lander (Virus III)

This lander was developed as a replacement of the Göteborg lander (Virus I which was lost during Bengal 226 in April 1997). The Virus III was previously used to obtain 20 successful chamber incubations during the Bengal 231 cruise in February-March 1998 and a cruise on-board RV Meteor (cruise 42/2) in July-August (1998). The inner frame of the lander was lost during the Meteor cruise and a provisory replacement tray controlled by old spare electronics was constructed in four days. This provisory inner frame is equipped with only two modules and has limited capacity, in both sampling and measuring, compared to the original version which had four modules (chambers, microelectrode profiler or gelpeepers) and was capable to perform up to 90 different preprogrammed mechanical actions (e.g. activating different sampling devices with stepper or DC motors or with burn-wires) as well as register signals from up to thirty-two different sensors (e.g. oxygen sensors, temperature, conductivity, revolution counters for stirring motors, re-suspension etc.) and controlling a video camera.
In spite of the loss our goal was to make 5 deployments, combining either the gelpeepers with oxygen and pH microelectrode measurements or with chamber incubations. Due to poor meteorological conditions we only managed to deploy three times (all at PAP, water depth around 4800 m). Unfortunately the poor functioning of our electronics omitted the possibility to obtain any chamber incubations.
Although we made several efforts to reconstruct, the autonomous microelectrode module (oxygen profiler built by SEABED BV, Nl) kept on leaking in water and/or had malfunctioning electronics. In fact this module, although very expensive, has never worked satisfactory in the deep-sea.
Mechanically the gelpeeper modules over all worked according to plans at all three stations including (after landing in chronological order): removal of a protective rubber membrane, penetration into the sediment, equilibration for at least 24 h,

retrieval of the gelpeepers at the same time as a stocking (which protects the gel from sediment particles) is removed and the rubber membrane closes of the peeper again (to prevent the gel from back-equilibration during recovery). All actions are triggered by burn-wire at preprogrammed time intervals. Over all 18 high resolution (4 mm) gel-profiles and four sediment samples from inside the gel tubes were obtained. The analyzes of the 600 gel samples can only be done after the cruise since precise weighing of the gel is required to obtain accurate results.
The average lander descent and ascent speeds were 30 m/min and 102 m/min, respectively. Throughout the cruise all surface spotting systems worked without any difficulties. The VHF-radio gave the exact moment of surfacing and a possibility to do short range spotting whereas the ARGOS positioning system gave longer range spotting with about 1 hour time intervals. Both acoustic releases worked without problems. During recovery some damages to the frame and antennas were done, but this could be repaired on-board.

Sediment sampling and pore water extraction

Sediment for pore water and solid phase studies was collected using a multiple corer according to the sampling schedule given in Table 1. The aim was to collect sediment at the same site as the lander was deployed, and at some additional sites of the central coring position (see Table 1 for information on sample treatment, number of cores, slicing intervals etc.).

Chemical analyses

Concentrations of alkalinity and total carbonate were determined on-board the ship using systems that were developed in Göteborg. The precision of the alkalinity titration was better than 0.25 % RSD (n=10) using a sample volume of 1 ml, and the precision of the newly developed IR-based system for determination of total carbonate was 0.20 % RSD (n=10), using a sample loop of 4 ml.

Σnitrate, nitrite, ammonium and silicate were also analyzed on-board with a precision around 2 % RSD using a volume of 5 ml altogether. The remaining samples will be analyzed in various labs with various methods (see Table 1). Another goal was to measure DOC on-board by high temperature catalytic oxidation (HTCO) using a SHIMADZU TOC-5000 total C analyzer, after acid treatment to remove dissolved inorganic carbon. Since the baseline of the instrument was not stable enough due to the movement of the ship we decided to freeze the samples (in acid washed vials) and to do the analyzing in Göteborg.

Preliminary results

Mechanically the gel peeper modules worked according to plans. If future analysis shows coherent chemical data of good quality it will give, to our knowledge, the first possibility ever to compare "classical" sediment profiles with this new open and non-intrusive way to obtain distributions of solutes in the sediment pore-water for the deep sea. In addition, the advantage of this technique is not being sensitive to pressure and temperature changes. The round shape of the gelpeepers also enables to get two dimensional pore water distributions of various solutes.

Sediment profiles of nutrients, alkalinity and C_t that were analyzed on-board generally seemed to be of good quality and looked similar, for each of the solutes (see Fig 1 for a typical silicate profile).

Sibylle Grandel*, Henrik Ståhl**, Anders Tengberg** and Andrey Vershinin***

* GEOMAR, Kiel, Germany

** Department of Analytical and Marine Chemistry,

Göteborg University, Sweden

*** P. P. Shirshov Institute of Oceanology, 23 Krasikova, Moscow 117218, Russia

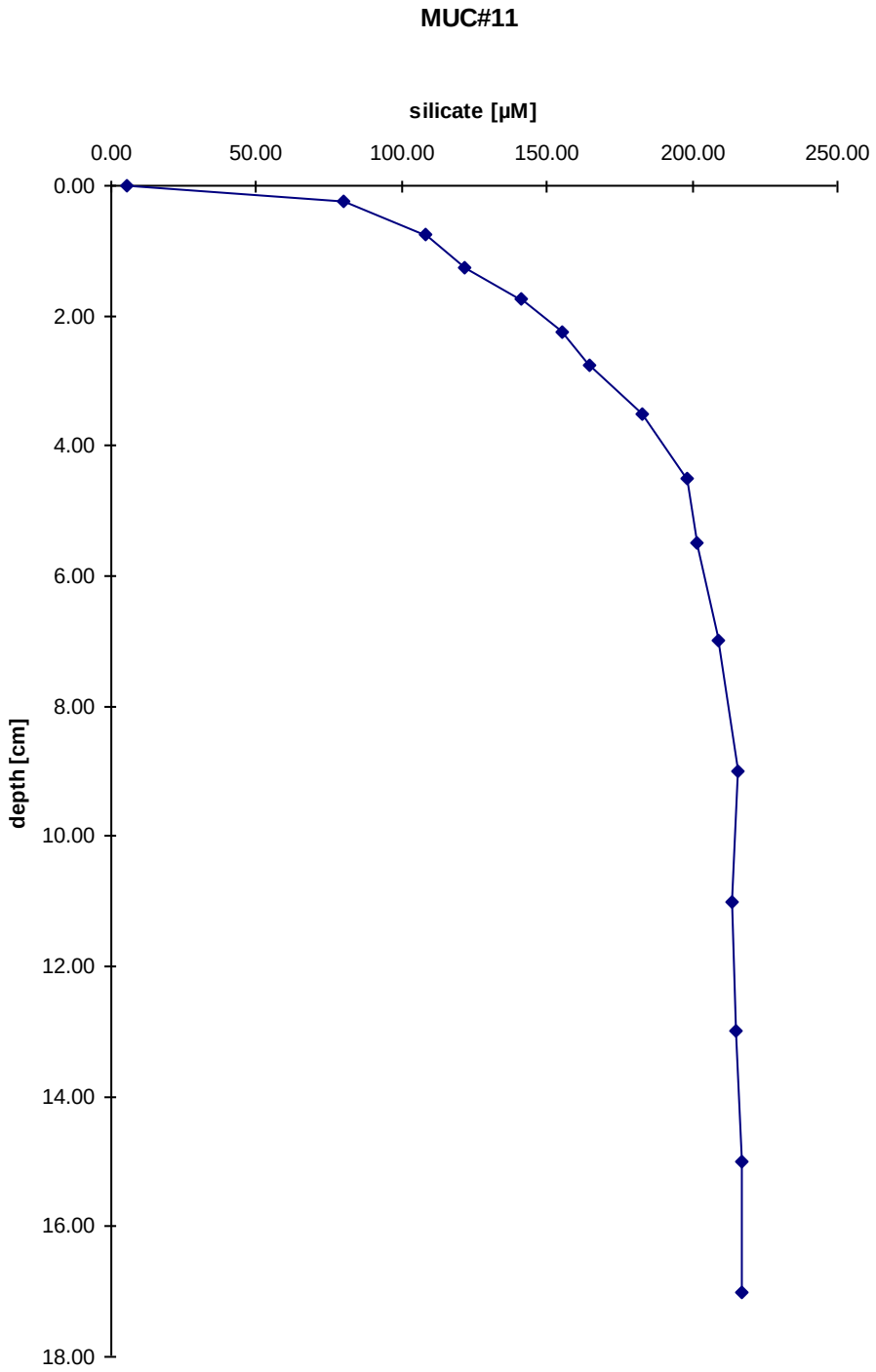


Fig. 1: Silicate concentration with depth in the sediment for cruise station 11.

Sample For	*Type of sample*	Specifications	Sample treatment	Sample storage	Station # (no. replicates)	Collection device	Remarks
Dr. O. Ragenau Univ. of Brest	Porewater samples for analysis of Si	From MUC 3 ml for each sample	Filtered with (0.45µ) cellulose acetate filter	Samples stored cold in supplied vials	#16	MUC	
Dr. Per Hall	Sediment for analysis of	0-3cm (5mm); 3-6 (10mm)	5ml of centrifuged sediment	Samples stroed frozen	#11	MUC	To be analysed
Univ. of Göteborg	grain size	6-20 (20mm)	from each level	in vials supplied by	#16	MUC	by Dr. A. Grehan
				Dr A. Grehan	#18	lander	
Dr. Per Hall	Pore water for analysis of	0-3cm (5 mm); 3-6 (10 mm)	Centrifuge at 4 deg ; 2400 RPM	DON/DOC frozen	#8	lander	only Ca
Univ. of Göteborg	Ca/DON/DOC	6-20 (20 mm)	for 30 min, filtered with (0.45µ)	Ca stored in coldroom	#16	MUC	only DOC/DON
			celluslose acetate filter		#18	lander	only CA
Dr. Per Hall	Pore water for analysis of	0-3cm (5 mm); 3-6 (10 mm)	Centrifuge at 4 deg ; 2400 RPM	Analysed onboard	#11	MUC	
Univ. of Göteborg	alkalinity & total	6-20 (20 mm)	for 30 min, filtered with (0.45µ)		#8	lander	only Alk and Ct
Sibylle Grandel GEOMAR	inorganic carbon (Ct) Nu		celluslose acetate filter		#16(x2) #18	MUC lander	only Alk and Ct
Dr. Per Hall	Gelpeepersample for	0-5cm (4mm); 5-10 (8mm)	Small gelpieces put in pre-	Samples stored cold	#8(x2)	lander	
Univ. of Göteborg	analysis of alkalinity, Ca and one other substance	10-20 (16mm)	weighed microcentrifugetubes		#18(x2)	lander	
					#39(x2)	lander	
Dr. Per Hall	Sediment samples for	0-3cm (5 mm); 3-6 (10 mm)	5ml of centrifuged sediment	Samples stored frozen	#11	MUC	chamber 3
Univ. of Göteborg	C/N analysis	6-20 (20 mm)	from each level		#16	MUC	chamber 2
					#18	lander	
C.	Flux samples for Alk	Alk and Ct measured	Alk, Ct & Nu	Analysed onboard	#5	lander	

Christodoulo F. Pantazoglou **IMBC**	Ct and Nu	by Goteborg group and Nu by S. Grandel	filtered with (0.45µ) cellulose acetate filter		#21 #34	lander lander	only Alk and Ct only Alk and Ct
Dr. A.Khripounoff IFREMER	Flux samples for Nu	Analysed by S. Grandel	Filtered with (0.45µ) cellulose acetate filter	Analysed onboard	#4 #22 #33	lander lander lander	
Dr. Ursula Witte GEOMAR	Flux samples for Nu	Analysed by S. Grandel	Filtered with (0.45µ) cellulose acetate filter	Analysed onboard	#437 #17 #38	lander lander lander	FFR5, M42/2
S. Grandel **GEOMAR**	O2-profile in core from MUC	Done by S. Grandel	Measured with O2- microelectrode in coldroom	Measured onboard	#11	MUC	
S. Grandel **GEOMAR**	Incubation experiment for Nu with core from MUC	Done by S. Grandel	Incubated in coldroom for 16 days. Sampling every 3:d day	Samples stored frozen	#14	MUC	

AUDOS Deployments

The Aberdeen University Deep Ocean Submersible (AUDOS) was deployed on three occasions during Discovery 236. The AUDOS is designed to photograph and track scavenging deep-sea fishes. During cruise 236 the aims were to track the grenadier, *Coryphaenoides (Nematonurus) armatus* at the PAP site and do some tracking of *Antimora rostrata* at 2500 m in the Porcupine Seabight. The AUDOS would be deployed with the latest update of the code-activated transponder (CAT), which includes a time delay in the response allowing fish to be located within 30 m, which was not possible with the previous version of the CAT.

Sta. 236/98/10

The first deployment was at PAP, but three of the four CATs were lost during deployment, but the fourth CAT was taken (presumably by a grenadier) and was tracked. The camera had also jammed during the deployment, but took about 300 frames. During recovery the AUDOS came under the starboard quarter and the syntactic foam was shattered by the propeller, fortunately the mooring line was not parted and the vehicle was brought safely on board.

Sta.236/98/20

The second deployment was at 2500 m in the Porcupine Seabight.and three fish were tracked. A section of film developed on board revealed the presence of a large spider crab and *A. rostrata* early in the deployment. The only problem with this deployment was that the current meter batteries expired. This was a consequence of the way the meter was set up to log. No current data was obtained.

Sta.236/98/26

The third deployment was also in the Porcupine Seabight. The AUDOS failed to release on the morning of 4/9/98. Both releases appeared to have fired. An initial attempt to grapple the AUDOS failed, but a second attempt on 19/9/98 succeeded and the AUDOS was recovered. It appeared that the release bar had become tangled on the battery holder, preventing the ballast from falling. Unfortunately the camera had again jammed and the fish tracking had only logged 4 of the expected 28 data files.

Fish tracking was fitted to the ISIT lander for four deployments (3 at PAP; 1 at PSB) and functioned successfully.

Martin Collins, Phil Bagley, Monty Priede, Sue Way & Felix Enders
University of Aberdeen, Scotland

ISIT Lander – Bioluminescence

Aims: The ISIT lander is newly designed and built to determine the extent, if any, of bioluminescence at depth in the ocean.

Lander: The ISIT lander consists of a tubular aluminium tripod frame with extendable legs, onto which is mounted an underwater ISIT (Intensified Silicon-Intensifier Target Tube) monochrome television camera, video recorder housing, deep sea light and twin Mors releases. Buoyancy for the vehicle is provided by 2 double Billings racks and 2 double Benthos racks attached to the mooring line (80m total length) by boss clips. A 20m floating rope is attached to the dhan buoy with flag, strobe (Novatech), VHF radio (Novatech) and single Benthos float. The ballast clump (100 – 140 kg) is held beneath the releases within an aluminium drum.

Results

During Discovery cruise 236, the ISIT lander was deployed 8 times.

Station 236/98/7

– PAP, camera looking down. Recording began during descent and at least 50 bioluminescent flashes were seen (between 2500 – 4000m). Only two other flashes seen 4 and 9 hours after touchdown.

Station 236/98/12

– PAP, camera looking up. Bioluminescent flashes (9) seen 10 – 15 mins after touchdown. Two other flashes 6 and 16 hours after touchdown.

Station 236/98/24

– PSB, camera looking up. Most bioluminescent flashes (25) seen 10 – 15 mins after touchdown. This station saw the highest number of bioluminescent flashes of all deployments. 3 other flashes, 6, 11 and 16 hours after touchdown.

Station 236/98/32

– PAP, camera looking down, baited with mackerel. Recording began during descent, 6 flashes seen (between 4300 – 4550m). The second recording period occurred 150 mins after touchdown by which time all the bait had been consumed, but only two bioluminescent flashes seen. 2 *Coryphaenoides armatus* observed. One further bioluminescent flash 6 ½ hours later.

Station 236/98/40

– PAP, camera looking down, baited with mackerel. With the temporary loss of the AUDOS (see AUDOS report) the ISIT lander was modified to carry three hydrophones, a deep sea battery (Deepsea Power and Light) and an AUDOS acoustic housing (Aberdeen University). 4 code activated transponders (CATS) were put into

bait (mackerel) sacks and attached to the vehicle within view of the camera. Very little bioluminescence – 2 flashes 35 – 40 mins after touchdown and 4 flashes after 4 hours. At least 3 *C. armatus* observed scavenging round the area, but all the bait had been consumed 45 mins after touchdown.

Station 236/98/43

PAP, camera looking down, baited and 4 CATS. Bioluminescence seen during descent (4700 – 4800m), then only 4 flashes between 30 - 60 mins after touchdown. *C. armatus, Spectrunculus grandis and Pleisiopenaeus armatus* observed. All the bait had gone 2 hours after touchdown.

Station 236/98/47

– PAP, camera down, baited and 4 CATS. Bioluminescence seen during descent only. One hour after touchdown *C. armatus* observed taking a CAT and *Histiobranchus bathybius* seen.

Station 236/98/51

– PSB, camera looking down, baited and 6 CATS. 3 bioluminescent flashes 30 – 60 mins after touchdown, and further flashes seen 1 ½ -2 ½ hours later. Lots of fish activity – small *C. armatus*, *H. bathybius*, *Antimora rostrata* and one large spider crab (10 – 15 cm carapace).

General comments:

The ISIT lander proved very successful and preliminary results show good video footage of both bioluminescence and fish behaviour. The video recorder, camera and light systems worked well, without any problems. Minor adjustments were made to the rotation of the camera to increase the view of the baited line, and the light was repositioned to better illuminate the field of view.

In deploying the lander only one incident occurred when a Benthos float rack came off the mooring line when a boss clip came undone. The floats were quickly recovered. Recovery of the lander was improved by the addition of three grappling handles, one on each side.

In terms of bioluminescence it appears that although it does occur at such depths it is very irregular and infrequent, and it is not possible at this stage to determine what is causing it. The higher incidence of bioluminescence during descent and within the first 10 – 15 minutes after touchdown is probably due to artificial disturbance of organisms by the lander itself and the fall-out of material from the mooring line above. It seems that scavenging fish do not bioluminesce and their presence does not stimulate other organisms to do so. The presence or absence of bait does not seem to have any appreciable effect on the degree of bioluminescence either. However, in respect of the original aim, it has been shown that bioluminescent organisms are living at depths of 4800m and below.

Susannah Way, Martin Collins, Phil Bagley, Felix Enders & Monty Priede
University of Aberdeen, Scotland

Fish Trap Deployments.

Evidence from the long-term baited camera studies (LAFF), has suggested a succession of amphipod species over time arriving at a food-fall. This succession may reflect the varying degrees of adaptation to necrophagous scavenging of different species guilds. Since the LAFF lander results are not strictly comparable to those of the standard 12-24h fish trap deployments of previous cruises, it was decided to carry out a series of fish trap deployments of varying duration in order to test this theory.

Methods

The trap, belonging to the SOAFD Marine Lab in Aberdeen, was based on the design of the previous University-owned trap used on the Alipor Discovery cruise 222, but with a few modifications. It consisted of a $1m^3$ cage, with 12mm mesh covering and 2 funnel entrances 140mm in diameter. The cage was suspended beneath a mooring line with 9 Benthos floats. These were individually boss-clipped onto 0 rings at intervals along the line. A dhan buoy with a mast, flag and radio beacon aided recovery. A Mors RT Release was attached to a frame on top of the cage. A ballast clump of 120 kg chain hung beneath the cage by a stainless steel wire strop which ran through a central funnel to the release. For each deployment, 4 smaller funnel traps (75mm diameter, with 20mm entrances at each end.) were also attached to the outside of the cage, both at the bottom and on top, to catch amphipods. In order to be more comparable to LAFF results, sperm whale muscle tissue was used as bait instead of the normal mackerel. The muscle tissue had been collected from a beached whale found on Crudden Bay, Scotland. Chunks of between 7-12 kg were used. Most of this was wired around the central funnel and was unprotected. Small pieces were cut off for the smaller amphipod traps. On return of the trap, any fish caught were processed. Length, sex and maturity measurements were taken. Brain, olfactory and muscle tissue samples were also collected. Any parasites found on the gills or internally were preserved in 5% formalin. Amphipods collected from the traps were counted and identified as far as possible before being preserved in 5% formalin also. In order to gain data from shorter length deployments, an identical funnel trap was attached to the ISIT lander on a number of deployments. Sperm whale meat was used on one deployment and mackerel on another 3.

Results

During the cruise 3 deployments were successfully completed; two at 4800m on the Porcupine Abyssal Plain and one at 4000m at the foot of the Porcupine Seabight. This latter position was the site of previous LAFF deployments. The duration of this experiment had been intended to be 120h (5 days), but bad weather conditions delayed recovery. For details, see table 1. Three fish, all *Coryphaenoides (Nematonurus) armatus,* were caught on the first deployment. Unfortunately the fish attracted to the trap during the second deployment appeared to have been unable to escape and had been attacked and eaten by amphipods. All had been reduced to skin, bone and some remaining muscle tissue. In the third deployment a single *Spectrunculus grandis* was caught and this was preserved whole.

St. no.	Date deployed Position	Time (h)	Depth (m)	Bait (kg)	No. of fish	Fish species	No. of amphipods
9	29/08/98 48° 57.2 N 16° 33.01 W	48	4700	12	3	*C.(N) armatus*	194
19	02/09/98 49° 59.2 N 14° 17.8 W	235	3989	7	4	*C.(N) armatus*	290
35	12/09/98 48° 58.04 N 16° 34.78 W	109	4800	11	1	*S. grandis*	591

Table 1. Deployment details for the fish trap experiments

Including those caught in the ISIT funnel trap deployments, over 1000 amphipods were collected in total. A change in the percentage composition of the main species-guilds was apparent in the results. *Paralicella* sp. and *Eurythenes gryllus* were the dominant species in the 48h deployment and also in all the shorter ISIT deployments (lasting 9-12h). In the longest fish trap deployment however, these two species constituted 23% of the total, whilst species of the *Orchomene* complex made up 77% of the catch. Full identification and confirmation of these results has yet to be made, but they do appear to conform to the theory suggested, that differing degrees of adaptation to scavenging results in a succession of different amphipod species arriving at food-falls over time.

Emma Jones and Camila Henriques

University of Aberdeen, Scotland.

The Large Abyssal Food-fall Experiment (L.A.F.F. 2)

The fate of cetacean carcasses in the deep-sea has been investigated using the L.A.F.F. autonomous lander vehicles 1 and 2 on a number of cruises in the last 3 years. This experiment was the 4th of its kind and, with a duration of 19 days, was longer than any previous deployment.

A stainless steel frame supported 2 Umel cameras with strobe flashes, ATTIS acoustic fish tracking electronics and hydrophone, a closing fish trap, and dual Mors acoustic releases. A dolphin carcass (112kg) was wired to a rigid stainless steel mesh underneath the instrument frame. One camera viewed the carcass from a vertical position, 2m above, whilst the second camera was positioned horizontally, 1 m away. A compass, reference scale, current ribbons and 6 acoustic fish tags containing the new design code activated transponders were attached in view of the cameras. The trap, which was suspended above and to the side of the carcass so as not to obscure the camera view, was activated at the end of the experiment by the ballast release system just prior to the lander leaving the sea floor. Amphipod traps were attached to the frame; two at the base and two at 2.5m above the bottom. These were baited with dolphin tissue. A mooring line with 16 Billings float packs provided positive buoyancy and a dhan buoy with flag, radio and Argos beacon aided surface recovery.

Sta.236/98/02

The LAFF 2 was deployed at PAP at 48° 55.05 N, 16° 14.98 W at 4800m depth. During the 19 days on the sea floor, the cameras took photos simultaneously at 30 minute intervals and the acoustic fish tags were interrogated every 9 minutes for the first 3 days, every 40 minutes for the next 7 and every hour for the remaining 9 days. Weather conditions for both deployment and recovery were good and there were no problems.

Both cameras have taken full rolls of film (800 frames in each), and tracking data was downloaded from the ATTIS system. Contrary to what had been predicted, much of the carcass remained uneaten although there was clearly high scavenger activity surrounding the food-fall, as 25 *Coryphaenoides (Nematonurus) armatus* were caught in the closing trap. All fish were immature females (stage 2-3) with a mean head length of 125mm (s.e. 1.7). Stomach contents were obtained from 3 specimens and were frozen for later analysis. Muscle, brain and olfactory tissue samples were taken from each and any visible gill and internal parasites were preserved. The carcass itself was frozen for later analysis. It was clear that amphipods had entered through various openings such as the eye sockets and mouth and were eating the soft tissue from the inside. The skin and blubber layer remained largely intact. The apparent inedibility of this layer to both fish and amphipods is believed to be the main cause of the slow consumption rate. Amphipods collected from the trap were identified as *Eurythenes gryllus* (60%), *Orchomene* sp. (35%) and *Paralicella tenuipes* and *P. caparesca* (5%). A full analysis of species present will be completed once amphipods from the main carcass have been collected and identified.

This 4th deployment of the LAFF vehicle seems to have been a success and has provided an interesting, if unexpected result. The analysis will hopefully provide further insights into the processes by which such large food-falls are consumed and dispersed and the time-scale over which this occurs.

Emma Jones
University of Aberdeen, Scotland

Performance of Aberdeen based Engineering systems

ARCADE

The Acoustic Release Command And Display Equipment was installed in the main lab and connected to the single element ship-bourne transducer. Three such transducers exist, 2 in the ship's hull (port and starboard) and one in the Precision Echo Sounder (PES) fish. Although, these transducers were documented as being identical, differing performances were observed. The port hull transducer and fish transducer produced the best results. This variation in performance was possibly caused by an impedance mismatch between the ARCADE and the transducers. Despite the matching difficulties, the ARCADE performed successfully during the cruise enabling detection and operation of MORS acoustic releases at all deployment sites (maximum depth 4807).

From extensive use on this cruise it was apparent that the ARCADE would benefit from a number of enhancements:

- To display a digital range measurement and signal received and executed window.
- Automatic lander accent/ decent time calculation option to give the user a clear and accurate method of estimating bottom landing time and surface time.
- Currently the ARCADE may have to many options available to the user. A system suitable for scientific use may benefit from a system with a subset of the currently available features.

Fish Tracking

AUDOS version 2B housed a new version of the Aberdeen fish tracking software. The system worked successfully for the first 2 deployments. The enhancements to the fish tracking system incorporated into the AUDOS 2B proved successful, reducing data offload time from 8h to 10minutes. During deployment 3 the ballast failed to release and AUDOS 2B remained on the sea floor until the last working day of the cruise. To enable fish tracking studies to continue an ATTIS unit was converted to a 3 channel AUDOS tracking system and deployed on the ISIT vehicle. Four such deployments were completed with fish being tracked on each deployment. The ATTIS to AUDOS conversion did not compromise the quality on fish tracking data, and each ISIT fish tracking deployment incorporated the new delayed Code Activated Transponder algorithm.

ATTIS

Two ATTIS landers were originally intended for use in conjunction with either the LAFF or AUDOS experiments to increase the tracking range of the fish studies. However, due to the AUDOS release failure an ATTIS electronics was sacrificed to

enable the upgrade to a full AUDOS fish tracking unit. The remaining ATTIS was not deployed as there was minimal scientific advantage in deploying only 1 ATTIS.

Concluding remark

The Aberdeen team operated 4 different landers (plus 2 ATTIS landers not deployed) on the cruise with technical support from only 1 engineer. Without considerable support from members of the Aberdeen team working out of speciality, this would have been an impossible task. I thank everyone concerned for their help.

Phil Bagley
University of Aberdeen, Scotland

Scientific Engineering Group
Research Vessel Services

Introduction

This report addresses the equipment used onboard that belongs to RVS's Scientific Engineering Group (SEG). The main responsibility for this equipment was the handling of the landers during deployment and recoveries and for the winch operations using the multi-corer, SPI and CTD.

There was a sediment trap mooring recovery and dragging for the lost lander that used other equipment belonging to the SEG.

20 tonne winch system
This was used primarily with vertical wire work for multi coring and SPI-ing The system operated successfully with control being switched to the main lab for SPI operations whilst it was on or near the sea floor.

This system was used to recover the large IFREMER lander via the aft gantry. A point to bear in mind for future operations where landers are recovered over the aft gantry using the main winch, is that the lander's pennant line must not be too long or else the shackles etc. will jam in the sheaves on the hangar top. In this case the pennant length was about as long as it could safely be used. Particular care should be taken with this feature for the occasions when the lander is deployed from one ship and recovered from another.

This winch system was also used to drag the "dragging" pennant and grapnels when searching for the lost lander.

The winch operated well for the duration of the cruise with the exception of one occasion when the band around the "cobra" traction part of the winch failed and it had to be removed.

10 tonne winch system
This was used in conjunction with the CTD package. It was used for some CTD profiles and water casts, pressure testing of the releases being used by the landers and for experimental testing of IFREMER's *insitu* auto analyser.

Other than a bearing that had to be changed on one of the sheaves early on in the cruise; the contractors failed to pack it with grease when they recently changed it, the system operated successfully for the duration of the cruise.

Gantries

These were used successfully during the cruise and the starboard one proved to be a stable area and method for deployment and recovery of equipment even in rough weather.

The starboard gantry has the potential to be a good tool for the recovery of landers, especially when the weather becomes rough. This is an area that we will be examining in the near future in light of the problems associated with aft recoveries, i.e. landers going under the stern, dangers associated with the ship's prop and the large snatch loads seen by the pennant recovery line.

The main block on the auxiliary gantry seized and had to be repaired. The failure was probably due to the grease-way being blocked and the grease not reaching the bearing surfaces. This unfortunately resulted in two nights of intended wire work being cancelled whilst it was being repaired.

Auxiliary hydraulic power packs
These hydraulic power packs were used to power the 3 tonne auxiliary winch and the aft starboard beam for the deployment of the small fishing net.

3 tonne auxiliary winch
This although very slow it was used successfully during dragging exercises to hold the 2 km of bottom drag wire.

Double barrel winch
This was used successfully for the recovery of most landers and the sediment trap.

Non-toxic sea water system
This was running for the duration of the cruise.

Workshop facility
The workshop facility was used throughout the cruise to repair and modify various pieces of equipment.

The SEG staff manufactured and modified many items to ensure that faulty scientific equipment would be made operable and capable of gathering data. The most important task was to fabricate a new flash light housing for the SPI. This was successfully manufactured and tested prior to installing it. Various blanks and covers were made to test the failed parts, proving that the most likely cause of the failure was due to a minute leakage, possibly in the welding of one of the old flash lamp support arms.

P.Mason R.Phipps and R. Roberts
RVS, Southampton, England.

Student Reports.

Two Portuguese undergraduate students from Lisbon joined the ship for this cruise. Camila Henriques who is studying at the University of Aberdeen, and Juan Zwolinski of the University of Lisbon. They wrote the following comments on their first experience of work at sea:

As a biology student, I can say that making part of this cruise was a fulfilling experience. During the time I spent in this ship, I learned numerous things in the fields of biology and engineering. This knowledge, otherwise only available to me trough books and publications, is by far much more stimulating and interesting. Of course this doesn't make me an expert, but now I am more updated of what's happening in these fields of research all over Europe. I am more curious now, and looking forward to see what is going to happen in Deep Sea research in the following years.

It has been a pleasure working with Michael and Volker from Geomar. They really make me feel all of the time that I was one of the team. During work either with chemical analysis or with the preparation of the lander itself, my questions were always answered and my help was never denied for lack of knowledge. As I'm sure that this has been a very good experience for me, I am also sure and glad that I had in fact contributed positively to the work held by the Geomar on this cruise.

Juan Pablo Zwolinski

Being a 4th year marine biology student I felt extremely privileged to be given the chance to take part in this cruise. It gave me the possibility to see, learn about and take part in a scientific research project having first hand access to work and information which had previously only been available to me through literature.

I was mainly involved with the Fish Trap deployments and the sorting of the biological data obtained from these samples, being able to put in practice some of the skills learnt at university. It was also extremely interesting to learn about the other projects that were all new to me.

I would like to thank Monty and all the Aberdeen team the chance to work with them and all the members of the scientific party for patiently teaching me new skills and answering all my questions. I could not forget to thank all the members of the crew in particular the ones helping me and Emma with our "Girlie Lander"! The ship's engineers, the leckie and Graham could not go unmentioned as they were the life and soul of the Discovery's parties and also did a good job at making me laugh!
Overall the cruise was a very rewarding experience both personally and scientifically.

Camila I. R. Henriques

Station List - *RRS Discovery* Cruise No . 236 ALIPOR

Station No.	Date	Time (BST)	Latitude	Longitude	Gear	Depth (m)	Remarks
TEST 236/98/01 #1	26 Aug	1310 1820	43°35.8'N	13°03.6'W	CTD	5021	Deep water test of the CTD in the Thetis Gap together with the acoustic releases for the LAFF II lander. The new ARCADE was used for the first time.
TEST 236/98/01 #2	26 Aug	1935	43°35.8'N	13°03.6'W	CTD	5021	A second test was attempted but failed owing to jamming of wheels in the main winch.
TEST 236/98/02	27 Aug	0938 1304	45°54.8'N	14°29.4'W	CTD	4427	Test 01#2 resumed with releases from the MAP II, IMBC and Göteborg landers. Anderaa housings from the IMBC and Göteborg landers were also tested.
TEST 236/98/03	27 Aug	1344 1740	43°55'N	14°29'W	ISIT (On wire)	4385	The ISIT lander frame was suspended from the CTD cable together with two acoustic releases to be tested. The video recorder was activated.
TEST 236/98/04	28 Aug	1010 1123	48°49.95'N	16°29.60'W	LAFF II (On wire)	to 100	The LAFF II Lander fully assembled was lowered to 100m for test of the trap and camera mechanisms.
236/98/01	28 Aug	1147 1524	48°49.05'N	16°29.25'W	CTD	4800	First Station of the Cruise at PAP a CTD to obtain bottom water and to test releases from the RAPII and Fish Trap.
236/98/02	28 Aug 16 Sep	1720 1551	48°55.02'N	16°14.96'W	LAFF II	4804	Large Abyssal Food Fall Experiment deployed at the PAP site. Little of the carcass was consumed but 25 fish were caught.

236/98/03	28 Aug 30 Aug	1754 1346	48°55.02'N	16°15.98'W	MAP II	4804	The new MAPII platform deployed near the LAFF experiment for a preliminary test over 2 days.
236/98/04	28 Aug 31 Aug	2133 0753	48°56.95'N	16°36.99'W	RAP II	4804	The first of the chamber landers deployed on this cruise at PAP. Recovered in quite rough conditions 25 knots wind,
236/98/05	28 Aug 1 Sep	2212 1207	48°57.10'N	16°35.06'W	IMBC	4803	The new IMBC compact lander deployed near the RAP II.
236/98/06	29 Aug	0129 0554	48°49.05'N	16°29.25'W	SPI	4800	The sediment Profile Imagery system was lowered on the Trawl wire for a series of images at the PAP central coring station.
FS Meteor M42/2 #437	29 Aug	0840	48°56.99'N	16°37.99'W	GEOMAR FFR	4804	GEOMAR Lander from the previous *FS Meteor* Cruise recovered
236/98/07	29Aug 30 Aug	1158 0950	48°54.09'N	16°23.88'W	ISIT	4807	First trial of the new ISIT video lander. The camera was set looking downwards.
236/98/08	29 Aug 1 Sep	1319 0922	48°57.24'N	16°35.15'W	Göteborg	4802	The Göteborg lander deployed with a single chamber and a gel peeper module. A difficult recovery owing to tangling of the recovery line
236/98/09	29 Aug 31 Aug	1945 2042	48°57.24'N	16°33.00'W	Fish Trap	4616	The Aberdeen University fish trap baited with sperm whale meat. It fortuitously landed an a small sea mount summit.
236/98/10	30 Aug 31 Aug	1732 1214	48°49.1'N	16°23.90'W	AUDOS	4804	AUDOS deployed with 4 CATs. During recovery the buoyancy hit the ship's screw and 3 syntactic modules were lost.

236/98/11	30 Aug	1904 2247	48°51.41'N	16°29.85'W	Multicorer	4800	First deployment of the GEOMAR small multicorer with 4 tubes.
236/98/12	31 Aug 1 Sep	0009 1503	48°54.22'N	16°36.44'W	ISIT	4806	Second deployment, this time with the camera facing upwards.
236/98/13	31 Aug 16 Sep	1658 1400	48°54.93'N	16°35.98'W	MAP II	4804	MAP II following an initial successful; test was deployed for the duration of the cruise. Had to be located by radio DF in the fog on recovery.
236/98/14	31 Aug 1 Sep	2315 0302	48°51.58'N	16°30.11'W	Multicorer	4800	Multicorer with a test of the GEOMAR profiler mechanism.
236/98/15	1 Sep	0336 0736	48°52.51'N	16°31.43'W	CTD	4800	CTD with a pressure test of a SPI strobe light.
236/98/16	1 Sep	1847 2221	48°51.48'N	16°29.92'W	Multicorer	4800	Multicorer with a second pressure test of the SPI strobe light.
236/98/17	1 Sep 13 Sep	2327 0703	48°56.50'N	16°36.47'W	GEOMAR FFR	4806	The GEOMAR chamber lander deployed at PAP prior to the ship leaving for the Seabight.
236/98/18	2 Sep 13 Sep	0010 0930	48°56.32'N	16°33.8'W	Göteborg	4805	The Göteborg lander also deployed to be left at PAP prior to the ship leaving for the Porcupine Seabight. Very slow descent.
236/98/19	2 Sep 12 Sep	1359 1023	49°59.92'N	14°17.8'W	Fish Trap	3989	Fish Trap deployed at the mouth of the Seabight at the foot of the rise.

236/98/20	2 Sep 3 Sep	1934 1011	49°51.9'N	13°00.08'W	AUDOS	2495	AUDOS in the Porcupine Sea Bight, expected to attract *Antimora rostrata.*
236/98/21	3 Sep 8 Sep	0006 1447	49°09.9'N	12°47.9'W	IMBC	1434	The first of two chamber landers deployed at the relatively productive OMEX II station.
236/98/22	3 Sep 11 Sep	0022 1156	49°09'N	12°48.1'W	RAP II	1463	Deployed very near the IMBC lander and programmed with the new moveable chamber operative. .
236/98/23	3 Sep	0112 0430	49°07.25'N	12°47.64'W	SPI	1450	The first test of SPI with a new strobe assembly, Very successful apparently.
236/98/24	3 Sep 5 Sep	1202 1033	49°51.96'N	13°00.00'W	ISIT	2497	ISIT deployed in the Porcupine Seabight with the camera looking upwards. Recovered just before tropical storm Danielle arrived.
236/98/25	3 Sep	1536 2004	50°03.1'N	12°56.7'W	SPI	2500	SPI operational in the Porcupine Seabight.
236/98/26	3 Sep 19 Sep	2058 1917	50°02.6'N	12°58.3'W	AUDOS	2525	A second AUDOS in the Seabight. Failed to release. Recovered by dragging. Both MORS releases had worked but the ballast strop had jammed..
236/98/27	3 Sep 4 Sep	2300 0104	49°55.4'N	12°59.83'W	CTD	2500	Further tests of the rosette
236/98/28	4 Sep	0231 0550	49°53.10'N	12°53.67'W	SPI	2500	Further SPI work in the Porcupine Seabight.

236/98/29	7 Sep	0823 0912	52°18.7'N	12°58.8'W	SPI	660	5 opportunistic SPI images at the Magellan hydrate mounds at the North of the Porcupine Seabight, curtailed by poor weather conditions.
236/98/30	9 Sep	1435 2043	50°05'N	12°54'W	CTD autoanalyser	2387	The IFREMER *in situ* analyser was mounted on the CTD frame for a comprehensive test and comparison rosette water samples
236/98/31	11 Sep	1630 2225	49°30'N	12°52'W	SPI	1500	A series of SPI images on the Goban Spur. Delayed by problems with the winch.
236/98/32	12 Sep 13 Sep	2150 1403	48°55.5'N	16°30.0'W	ISIT	4800	ISIT redeployed at the PAP station with a downward looking camera and bait.
236/98/33	12 Sep 17 Sep	2333 1111	48°55.9'N	16°36.3'W	RAP II	4808	RAP II deployed with a full complement of new equipment; the "drawer" and the *in situ* analyser.
236/98/34	13 Sep 16 Sep	0013 0907	48°56.84'N	16°33.17'W	IMBC	4715	The IMBC Lander final deployment at PAP, unfortunately landed on a slight benthic hill.
236/98/35	13 Sep 17 Sep	0113 1640	48°58.04'N	16°34.78'W	Fish Trap	4803	Fish Trap deployed at PAP baited with sperm whale. A very nice specimen of *Spectrunculus grandis* was caught.
236/98/36	13 Sep	1527 1906	48°56.91'N	16°30.24'W	CTD	4828 wire	A simple CTD at the PAP station.
236/98/37	13 Sep 14 Sep	2032 0048	48°56.92'N	16°37.04'W	Multicorer	4800	A reference multicore near the GEOMAR lander and sediment trap stations. Unsuccessful
236/98/38	14 Sep 17 Sep	0725 1325	48°56.99'N	16°36.87'W	GEOMAR FFR	4800	GEOMAR chamber lander redeployed at PAP with three modules; one Gust chamber and two ordinary chambers

FS Meteor M42/2 #399	14 Sep	0943	48°59.98'N	16°36.93'W	GEOMAR FFB	2387	Recovery of a biological lander with stereo camera and ADCP that had been deployed by the *FS Meteor*.
Discovery D231 13368#55	14 Sep	1406	49°00'N	16°14.5'W	BENGAL mooring	-	Sediment trap and current meter mooring 4000m long recovered on behalf of R. Lampitt SOC
236/98/39	14 Sep 16 Sep	2020 1026	48°55.04'N	16°34.60'W	Göteborg Lander	4806	Göteborg lander redeployed at PAP for a short mission with gel peepers only.
236/98/40	14 Sep 15 Sep	2122 1246	48°53.91'N	16°34.98'W	ISIT	4806	ISIT with legs extended, and a hydrophone on each to allow fish tracking. Downward looking camera with CATs and baits.
236/98/41	15 Sep	1421 1805	48°57.11'N	16°37.21'W	Multicorer	4806	A second attempt at multicoring near the lander sites. Failed to get any samples
236/98/42	15 Sep 16 Sep	1915 0130	48°51.5'N	16°30'W	SPI	4800	SPI work resumed after repairs to the ship' gantry block. A full set of 50 + images were obtained
236/98/43	16 Sep	0219 2006	48°54.07'N	16°30.29'W	ISIT	4800	A second ISIT equipped with a set of hydrophones to track fish. Very good video sequences were obtained.
236/98/44	16 Sep	0312 0806	48°56.21'N	16°35.44'W	Multicorer	4800	A much extended multicore cast owing to having to move the ship half way through deployment. Corer failed
236/98/45	16 Sep 17 Sep	2143 0336	48°55.81'N	16°33.70'W	SPI	4800	SPI near the lander sites at PAP

236/98/46	17 Sep	0422 0803	48°57.08'N	16°37.03'W	Multicorer	4800	A further failed attempt at obtaining samples with the problematic equipment.
236/98/47	16 Sep	0955 2006	48°54.6'N	16°35.54'W	ISIT	4801	A final short deploymemt of the ISIT lander with tracking equipment at the PAP station.
236/98/48	17 Sep 18 Sep	2155 0136	48°50.96'N	16°29.31'W	Multicorer	4804	A last effort at multicoring at the PAP central location. ended in failure.
236/98/49	18 Sep	0247 0917	48°58.62'N	16°24.96'W	SPI	4800	Sediment imagery in the northern part of the PAP station area.
236/98/50	18 Sep	1729 2117	49°14.66'N	15°18.58'W	CTD/ analyser	to 3000	A final test of the IFREMER *in situ* analyser on the CTD frame. 2 hour programme at depth.
236/98/51	19 Sep 20 Sep	0711 0840	49°56.13'N	12°57.91'W	ISIT	2529	ISIT with a fsh tracking system deployed at the Porcupine Seabight with 6 CATs