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CRUISE REPORT No. 15

RRS *DISCOVERY* CRUISE 229
02 JUL - 31 JUL 1997

BENGAL
High resolution temporal and spatial study of the
BENthic biology and Geochemistry of a
north-eastern Atlantic abyssal Locality

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1998

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STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13201 # 6	28/ 7	48 56.01N 48 55.70N	16 12.60W 16 11.13W	CTD MS MSP	0-4838	1523-1834	Bottles at 50m(4), MSP OK	4848
13201 # 7	28/ 7	48 53.81N 48 52.90N	16 8.14W 16 5.11W	WASP	4848-4851	2047-2347	Good run Tow dist. 4.067 km.	4851

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #79	22/ 7 	48 51.70N 48 51.86N	16 32.88W 16 33.48W	WASP	4837-4841	0017-0201	Good film record, no altimeter Tow dist. 0.789 km.	4844
13200 #80	22/ 7	48 49.53N	16 28.66W	MLT.CORER	4844-4844	0547-	Pull out 6.48t, 12 good cores	4844
13200 #81	22/ 7	48 49.93N	16 29.34W	BOX CORER	4844-4844	0925-	Limiter, very good core, IOS protocol	4844
13200 #82	22/ 7	48 48.92N 48 48.92N	16 27.99W 16 27.91W	BWS	4844-4844	1515-1523	Rig stable, systems functioned	4844
13200 #83	22/ 7	48 50.11N 48 50.00N	16 29.97W 16 28.41W	CTD MS	0-4837	1800-2109	Bottles at 5mab(7) and 9mab(5)	4841
13200 #84	23/ 7	48 47.95N 48 47.97N	16 33.28W 16 40.18W	CP	4840-4843	0026-0327	Net torn, catch rather small, ca 3t mud Tow dist. 8.449 km.	4843
13200 #85	23/ 7	48 50.05N 48 50.00N	16 29.57W 16 29.56W	CTD MS	0- 3	0830-0847	Bottles at 3m for GIF	4846
13200 #86	23/ 7	48 50.00N 48 50.02N	16 29.76W 16 29.71W	CTD MS	0- 3	0922-0930	Bottles at 3m for GIF	4845
13200 #87	23/ 7	48 50.02N	16 29.84W	MLT.CORER	4844-4844	1156-	Pull out 4.23t, 12 good cores	4844
13200 #88	23/ 7 24/ 7	48 52.10N 48 48.52N	16 25.47W 16 36.01W	BN1.5/C	4845-4852	2106-0109	Bag of mud, small catch Tow dist. 14.502 km.	4852
13200 #89	24/ 7	48 50.05N	16 29.90W	MLT.CORER	4846-4846	1031-	Pull out 4.23t, 11 good cores	4846
13200 #90	24/ 7	48 50.01N 48 49.48N	16 29.92W 16 28.10W	CTD MS	0-4833	1233-1608	Bottles at 11mab(3),14mab(4),20mab(2)	4844
13200 #91	24/ 7 27/ 7	48 49.97N 48 50.49N	16 17.87W 16 18.35W	NIOZL	4847-4847	1934-1353	Successful deployment	4847

DOCUMENT DATA SHEET

AUTHOR	*PUBLICATION DATE*
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REFERENCE

Southampton Oceanography Centre Cruise Report, No. 15, 69pp.

ABSTRACT

RRS *Discovery* Cruise 229 was the fourth in a series of cruises within a 3-year contract (MAS3 CT950018), BENGAL, funded under the MAST III programme of the EU, running from February 1996 to January 1999. The overall objective of the contract is to monitor the influence of the seasonal sedimentation of phytodetritus on the benthic biology and chemistry of a study site on the Porcupine Abyssal Plain.

Cruise 229 was timed to follow the expected deposition of phytodetritus on the seafloor in May/June. Although little phytodetritus was apparent, the cruise recovered a very comprehensive set of water column and seafloor samples. Successful operations included: multiple corer, box corer and Kasten core seabed sampling; CTD, rosette multi-sampler, marine snow profiler, stand-alone-pumping system and bottom water sampler studies of the water column; WASP seabed photography; semi-balloon otter trawl, chalut á perche (beam trawl) and epibenthic sledge megabenthos sampling; recovery and redeployment of long-term sediment trap, Bathysnap and Module Autonome de Colonisation moorings; and short-term operations of other landers and moorings, NIOZ benthic lander, BIOFEED enrichment experiment rig, DEMAR benthic amphipod trap and a moored stand-alone-pumping system.

KEYWORDS

ATLNE; BENGAL; BENTHIC COMMUNITIES; BIOTURBATION; CORING; CRUISE 229 1997; CURRENT METERS; DETRITUS; *DISCOVERY*; LANDER; MICROBIOLOGY; NORTHEAST ATLANTIC; PHOTOGRAPHY; RESPIROMETRY; SEDIMENT CHEMISTRY; SEDIMENT TRAPS; TRAWLING; WATER SAMPLING

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STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #51	15/ 7	48 49.09N	16 30.36W	VEGEBOX	4844-4844	0726-	Limiter, good cores, SAMS protocol	4844
13200 #52	15/ 7	48 49.84N	16 29.84W	BOX CORER	4844-4844	1059-	Limiter, good cores, IOS protocol	4844
13200 #53	15/ 7	48 54.68N	16 35.56W	MLT.CORER	4847-4847	1541-	Lander site, 12 good cores	4847
13200 #54	15/ 7	48 55.46N 48 54.85N	16 36.12W 16 35.97W	CTD MS	0-1000	1807-1901	Bottles 43m(4) and 1000m(8), wire test	4845
13200 #55	16/ 7	48 49.02N 48 48.75N	16 21.59W 16 20.93W	DEMAR	4844-4844	0033-1234	12 hour drop, good large catch	4844
13200 #56	16/ 7	48 49.23N 48 48.59N	16 29.59W 16 28.52W	SAPS	4845-4865	0110-0310	Good samples at 80 and 100mab	4845
13200 #57	16/ 7	48 48.90N	16 28.55W	BOX CORER	4840-4840	0711-	Poor core sampled for microfauna only	4840
13200 #58	16/ 7	48 48.78N	16 29.65W	MLT.CORER	4842-4842	1723-	Pull out 4.47t, 12 good cores	4842
13200 #59	16/ 7 19/ 7	48 48.54N 48 48.53N	16 20.28W 16 20.01W	NIOZL	4846-4846	2150-1215	Functions running 2300/16 to 1100/19	4846
13200 #60	17/ 7	48 52.11N 48 48.34N	16 26.66W 16 42.01W	OTSB14	4843-4847	0253-0741	Good clean catch Tow dist. 20.042 km.	4847
13200 #61	17/ 7	48 43.18N	16 33.72W	MLT.CORER	4842-4842	1321-	Lander site, 11 good cores	4842
13200 #62	17/ 7	48 49.94N 48 48.71N	16 29.89W 16 28.86W	CTD MS	0-4794	1612-1921	Bottles at 50(5), 65(5), 100mab(2)	4844
13200 #63	17/ 7	48 49.91N 48 48.35N	16 29.75W 16 29.40W	CTD MS	0-4745	1951-2258	Bottles at 100(3), 250(5), 500mab(4)	4835
13200 #64	18/ 7	48 49.14N	16 28.74W	MLT.CORER	4844-4844	0113-	12 good cores for BIOFEED	4844

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13077 # 1	14/ 3 8/ 7	48 56.59N	16 30.87W	MAC	4843-4843	1340-0830	Delayed recovery	4843
13077 #62	22/ 3 21/ 7	49 0.42N	16 18.14W	SED TRAP	1000-4747	1905-0731	SOC rig, good samples from all 3 traps	4847
13078 #32	5/ 4 6/ 7	48 59.50N	16 31.46W	SED TRAP	4832-4832	0026-1017	NIOZ rig, good, 12 weekly samples	4832
13078 #47	8/ 4 9/ 7	48 54.68N	16 34.92W	BSNAP	4844-4844	0743-1645	Successful deployment	4844
13200 # 1	4/ 7	48 49.98N	16 30.30W	MLT.CORER	4843-4843	1758-	Pull out 4.40t, 12 good cores	4843
13200 # 2	4/ 7 5/ 7	48 50.04N 48 49.84N	16 30.02W 16 29.72W	CTD MS	0-4837	2049-0026	Bottles at 6mab	4843
13200 # 3	5/ 7 8/ 7	48 58.10N 48 56.97N	16 24.86W 16 25.42W	NIOZL	4845-4845	0317-0816	All systems functioned	4845
13200 # 4	5/ 7	48 48.68N	16 29.19W	BOX CORER	4844-4844	0454-	No limiter, sampled by GIF and AWI	4844
13200 # 5	5/ 7	48 55.04N	16 27.93W	MAC	4844-4844	0911-	For recovery on future cruise	4844
13200 # 6	5/ 7	48 49.95N	16 29.96W	MLT.CORER	4842-4842	1013-	Pull out 4.35t, 12 cores for BIOFEED	4842
13200 # 7	5/ 7 13/ 7	48 55.01N 48 53.19N	16 30.03W 16 30.89W	BIOFEED	4844-4844	1451-1520	Released in error, dhanbuoy imploded	4844
13200 # 8	5/ 7	48 48.80N	16 29.51W	BOX CORER	4844-4844	1532-	Limiter, IOS protocol on part core	4844
13200 # 9	6/ 7	48 51.96N 48 46.21N	16 24.61W 16 31.63W	OTSB14	4840-4844	0020-0254	Good catch, legs twisted on recovery Tow dist. 13.687 km.	4842

CONTENTS

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #24	9/ 7	48 49.79N	16 29.21W	MLT.CORER	4844-4844	0917-	Pull out 4.45t, 12 good cores	4844
13200 #25	9/ 7	48 49.50N	16 28.45W	BOX CORER	4844-4844	1320-	Limiter, excellent core, IOS protocol	4844
13200 #26	9/ 7 12/ 7	48 55.86N 48 54.95N	16 35.19W 16 34.49W	NIOZL	4844-4844	2020-1200	All systems functioned	4844
13200 #27	10/ 7	48 52.50N 48 42.44N	16 39.31W 16 41.00W	OTSB14	4839-4848	0030-0405	Good clean catch Tow dist. 18.764 km.	4848
13200 #28	10/ 7	48 49.09N	16 30.34W	MLT.CORER	4842-4842	1348-	Pull out 4.29t, 12 good cores	4842
13200 #29	10/ 7	48 49.80N 48 49.76N	16 29.07W 16 28.99W	BWS	4843-4843	1901-1909	All systems functioned, rig dragged	4843
13200 #30	10/ 7 11/ 7	48 49.91N 48 49.12N	16 29.93W 16 30.69W	CTD MS	0-4837	2205-0105	Bottles 5-100mab	4843
13200 #31	11/ 7	48 48.79N 48 48.75N	16 23.43W 16 19.88W	DEMAR	4842-4842	0515-1037	Nominal 6 hour drop, small catch	4842
13200 #32	11/ 7	48 49.77N	16 28.90W	MLT.CORER	4843-4843	0512-	Pull out 4.45t, 12 good cores	4843
13200 #33	11/ 7	48 48.70N	16 20.38W	MLT.CORER	4844-4844	0902-	Pull out 4.40t, 12 good cores	4844
13200 #34	11/ 7	48 49.97N 48 48.94N	16 30.03W 16 30.68W	CTD MS	0-4834	1356-1706	Bottles 40mab-1500m	4844
13200 #35	11/ 7 12/ 7	48 44.03N 48 55.85N	16 32.82W 16 40.22W	OTSB14	4842-4845	2300-0615	Good catch with 3t of mud Tow dist. 23.705 km.	4845
13200 #36	12/ 7	48 50.00N 48 50.02N	16 29.93W 16 29.93W	BWS	4844-4844	1830-1838	Samples OK, rig damaged at surface	4844

ITINERARY

Sail Vigo 1300B Wednesday 2 July 1997
Arrive work area 1620Z Friday 4 July 1997
Depart work area 0020Z Tuesday 29 July 1997
Arrive Vigo 0900B Thursday 31 July 1997

SCIENTIFIC PERSONNEL

BRIAN BETT (PSO)	Southampton Oceanography Centre (CDSP)
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DONAL EARDLY	University College Galway
DAVINA GAIR	University of Liverpool
JOELLE GALERON	IFREMER, Centre de Brest
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ROB WITBAARD	NIOZ, Texel

Location	Central site																Lander site					
																	C	D	B	A	E	A
Station	13200														13201		13200					
Series	#1	#6	#12	#18	#24	#28	#32	#46	#58	#64	#71	#80	#87	#89	#1	#5	#16	#33	#43	#53	#61	#67
GENT: Meiofauna	2	-	2	-	2	-	2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
GENT: Pigments	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
SOC: sliced to 15cm	1	-	-	1	-	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
SOC: sliced to 2cm	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
SOC: >200µm fraction	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
SOC: echiuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
UL: sliced	-	-	3	-	3	-	3	3	3	-	3	-	-	-	-	-	-	-	-	-	-	-
UL: frozen	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
UNIVAN	-	-	1	-	1	-	1	1	1	-	1	4	-	-	-	-	-	-	-	-	-	-
PATRAS	-	-	2	-	2	-	2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-
UCG: activity	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
UCG: DNA	-	-	-	2	-	2	-	1	2	-	-	-	-	1	1	-	-	-	-	-	-	-
QUB	1	-	-	1	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Gif: porewater + radionuclides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	2	2	1
Gif: porewater (Nitr.+Phos)	1	-	-	1	-	2	-	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-
Gif: radionuclides only	1	-	-	1	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Gif: surface layer (radionuclides)	-	-	-	-	-	1	-	-	-	-	-	-	2	4	-	8	-	-	3	-	2	2
IUEM:silica	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	1	-	4	-	-	-	1
GEOMAR: radionuclides	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
GEOMAR: biochemistry	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
BIOFEED		12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-
AWI	1	-	2	1	1	2	2	-	1	-	3	1	4	4	3	-	2	2	3	4	1	2
NIOZ: Oxygen	-	-	1	1	-	1	-	-	-	-	1	1	1	-	1	-	1	1	1	1	1	1
NIOZ: Pigments	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	3	3	3	3	3	3
NIOZ: Porosity / resistivity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Frozen	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	2	2	1	2	2	2
Sediment contact water	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-
TOTAL CORES USED	12	12	12	12	12	12	12	12	12	12	12	12	12	11	12	12	12	12	12	12	11	12

SHIP'S PERSONNEL

MIKE HARDING	Master
PETE NEWTON	Chief Officer
PHIL OLDFIELD	2nd Officer
SYD SYKES	2nd Officer
DAVE SUGDEN	Radio Officer
BERNIE MCDONALD	Chief Engineer
STEVE DEAN	2nd Engineer
STEVE BELL	3rd Engineer
GREG LEWIS	Bosun
PHIL ALLISON	Bosun's Mate
DAVE BUFFREY	Seaman
STEW COOK	Seaman
BOB DICKINSON	Seaman
TIMMY EDWARDS	Seaman
STEVE KESBY	Seaman
ALAN BRIDGE	Motorman
EDDIE STAITE	Senior Catering Manager
PETE LYNCH	Chef
ANDY DUNCAN	Messman / Steward
SHIELA CARTER	Steward
JEFF ORSBORN	Steward

INTRODUCTION

This was the forth in a series of cruises undertaken during the BENGAL project (1996-99) and was funded by the EU MAST III programme (contract MAS3 CT950018). BENGAL - high resolution temporal and spatial study of the BENthic biology and Geochemistry of a north-eastern Atlantic abyssal Locality - has the overall aim of improving the understanding of how the physics, chemistry and biology of the abyssal benthic boundary layer respond to and modify the incoming signal from the overlying surface waters and translate it into the palaeoceanographic record.

The Porcupine Abyssal Plain study site (centred 48° 50' N 16° 30' W) is thought to receive a regular annual deposition of phytodetritus in May / June. The BENGAL field programme is based around this seasonality, focusing concerted sampling effort on the 1997-98 annual cycle. This cruise was intended to provide an opportunity to sample the seafloor soon after the annual deposition of phytodetritus.

Phytodetritus

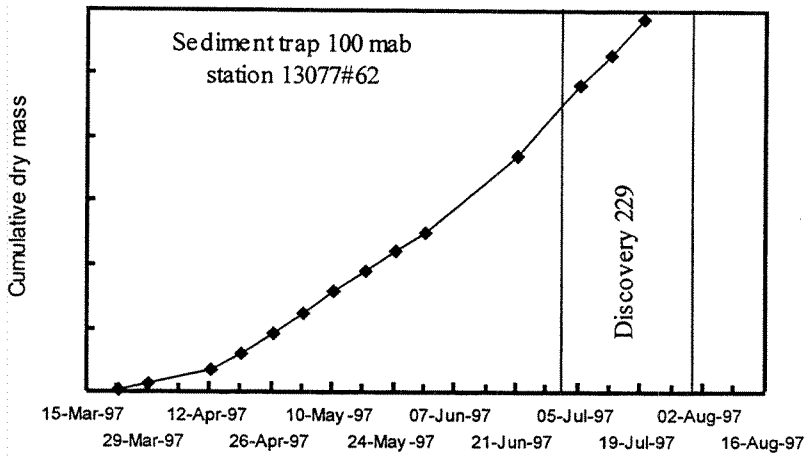
The presumed annual deposition of phytodetritus on the seafloor at the Porcupine Abyssal Plain study site is a major factor in the planning and science of the BENGAL programme. Observations made at this study site prior to the BENGAL programme suggest that phytodetritus typically arrives on the seafloor in late May to early June. Consequently, RRS *Discovery* cruise 229 was intended to sample the immediate post-deposition conditions at the site.

While operating at sea, the best indication of phytodetritus on the seafloor is given by its recovery on the tops of multiple corer samples. The cores obtained during this cruise indicated that very little phytodetritus was present on the seafloor. The follow table provides a comparison of multiple corer-based observations of phytodetritus available from the Porcupine Abyssal Plain:

Cruise	Month	Year	Phytodetritus
Discovery 185	Aug-Sep	1989	Present in variable quantities on the surface of most cores. A few devoid of phytodetritus but some with near complete layers several millimetres thick.
Challenger 79	May-Jun	1991	Present on several cores, absent from many. Some cores with thick layers of phytodetritus.
Challenger 111	Mar-Apr	1994	Phytodetritus not obviously present.
Discovery 222	Aug-Sep	1996	One or two lumps of phytodetritus present on the surface of about 20% of core, but never in any great quantity.
Discovery 226	Mar-Apr	1997	No trace of phytodetritus on any cores.
Discovery 229	July	1997	Phytodetritus very rare; single large lumps only 5 of well over 200 cores.
Challenger 135	October	1997	No phytodetrital aggregates

No significant phytodetritus was recorded in the cruises before (March/April 1997) or after (October 1997) the present cruise; however, previous cruises spanning the May to September period (*Discovery* 185, 222 and *Challenger* 79) have all recovered appreciable amounts of phytodetritus.

Post-cruise interpretations of phytodetritus are available from the sediment trap (13077#62) and Bathysnap (13078#47) moorings recovered during the present cruise. A plot of the cumulative dry mass flux recovered by the deepest trap (100 mab) in the string is shown below.



The data from this trap suggest a slight increase in the rate of dry mass flux at about the time phytodetritus deposition is expected to start (i.e. early June), though clearly there has been no major increase in flux prior to the cruise. Initial observation of the film from the Bathysnap time-lapse camera revealed that up to the time of recovery, 9 July 1997, there was no visual indication of the arrival of phytodetritus.

With no significant indication of phytodetritus on the seafloor during the present cruise and its apparent absence from the seafloor during the following cruise (RRS *Challenger* 135, October 1997), it is not yet clear whether the 1997 phytodetritus fall was a) very light, or b) rather late. Previous Bathysnap observations on the Porcupine Abyssal Plain suggest that phytodetritus is more-or-less undetectable on the seafloor by October.

The Bathysnap system (13200#95) and the sediment trap array (13200#96) deployed during the present cruise, for intended recovery during RRS *Discovery* cruise 231 (March 1998), will hopefully allow a more definitive assessment of the 1997 phytodetritus fall.

SPECIFIC OBJECTIVES

1. To recover moorings deployed on previous BENGAL cruises:
    a) SOC sediment trap array (13077#62)
    b) NIOZ sediment trap (13078#32)
    c) Bathysnap, time-lapse camera system (13078#47)
    d) MAC, Module Autonome de Colonisation (13077#1)
2. To operate short-term (intra-cruise) moorings:
    a) NIOZ lander, 5 deployments
    b) DEMAR amphipod trap, 4 deployments
    c) NIOZ sediment trap, 1 deployment
    d) BIOFEED enrichment experiment, 1 deployment
    e) Moored stand-alone pumping system, 1 deployment
3. To deploy long-term (inter-cruise) moorings:
    a) SOC sediment trap array
    b) NIOZ sediment trap
    c) Bathysnap
    d) MAC
    e) BIOFEED enrichment experiment
4. To operate a variety of water column samplers and instruments:
    a) CTD with rosette multi-samplers, numerous deployments
    b) Bottom water sampler, 4 deployments
    c) Stand-alone pumping system, 3 deployments
    d) Marine snow profiler, 2 deployments
5. To operate a variety of seabed samplers:
    a) Multiple corer, about 20 good deployments
    b) Plain box corer, about 10 good deployments
    c) Vegematic box corer, about 5 good deployments
    d) Kasten corer, 2 deployments
6. To operate a variety of bottom-towed gears:
    a) Semi-ballon otter trawl, 4 deployments
    b) Beam trawl (Chalut à perche), 4 deployments
    c) Wide-angle seabed photography system, 3 deployments
    d) Epibenthic sledge, 2 deployments

NARRATIVE (see figures 1 and 2)

Tuesday 1 July

The scientific party joined *Discovery* throughout the day, though some were without their luggage. Essentially all of the loading of cruise equipment had been completed by RVS personnel the previous day. A safety briefing and a vessel familiarisation for scientists were carried out.

Wednesday 2 July

Sailing was delayed from 0900B to allow some outstanding items to arrive and to permit two of the scientific party to go ashore for new clothing - their luggage was still missing in transit. Discovery sailed at 1300B. An emergency muster and boat drill was carried out on passage through Vigo Bay.

Thursday 3 July

From 0200B, clocks were retarded one hour to Alpha time. This was an auspicious day - the 35th anniversary of *Discovery*'s launch and, by exceptional coincidence, the birthday of our Captain, Mike Harding. Both conditions were duly celebrated later. A science meeting was held to establish the general gear deployment requirements of the various science groups.

Friday 4 July

From 0200A clocks were retarded one hour to Zulu time (unless otherwise stated all subsequent times are GMT / UTC). On passage to work site. The PES fish was deployed at 0900 for the run in to the site (ETA 1600). No paper could be found for the dynamometer chart recorder, but it was jury rigged with some paper from the old wave recorder. *Discovery* arrived at the work site at 1620 and began operations with a deployment of the multicorer **(13200#1)**. Winch problems were immediately experienced, the *elastic band* was waggling excessively (worn sheave bearing), this was quickly fixed and the deployment continued. The multicore produced 12/12 good cores - but showed no sign of significant phytodetritus. The CTD was then deployed **(13200#2)** with two releases and the otter trawl (OTSB14) acoustic monitor attached for wire tests. The deployment was intended to collect water near-bottom and at the chlorophyll maximum; however, numerous misfires occurred, so all bottles were fired at the bottom to avoid any potential confusion.

Saturday 5 July

On recovery of the CTD, all bottles were found to be closed and the rotor had returned to position one; i.e. all of the indicated misfires were genuine. *Discovery* repositioned to lander site B and the NIOZ lander was deployed **(13200#3)** in darkness without event. Returning to the central position, the box corer was deployed **(13200#4)** and a good sample obtained. Discovery moved off again and the MAC (Module Autonome de Colonisation) was successfully deployed **(13200#5)**. Back at the central station the multiple core was deployed

(13200#6), yielding 12/12 good cores (with just one piece of phytodetritus) all of which were destined for redescent on the following BIOFEED deployment. After 'feeding', the cores were attached to the BIOFEED rig (this mooring also carried a recording current meter) and the rig successfully deployed **(13200#7)**. The box corer was then deployed **(13200#8)** and yielded a fair core, marred by the footprint of the corer's frame on one corner of the core surface. The otter trawl was shot **(13200#9)** in the early evening, and employed the vessel overnight.

Sunday 6 July

Recovery of the trawl was somewhat problematic with the sweeps being twisted their full length from the main warp swivel to the doors. Surprisingly, the net was not twisted and contained a good clean catch. The NIOZ sediment trap deployed **(13078#32)** on the preceding BENGAL cruise (*Discovery* 226) was then successfully recovered. The next operation was the first deployment **(13200#10)** of the Bottom Water Sampler (BWS, aka *benthic cow*), this proved to be something of a learning experience. To keep the gear on the bottom for the many minutes required, needed near continuous payout of warp. On recovery one *udder* was missing, one water container leaking, and there were signs that the frame had gone over on its side on the bottom. A deep CTD cast followed **(13200#11)**, with all bottles firing correctly. The multiple corer was then deployed **(13200#12)**.

Monday 7 July

The multiple corer provided 12/12 good cores, but again little evidence of phytodetritus. The CTD was then deployed **(13200#13)**, successfully recovering water samples from throughout the water column. Two moorings were then deployed in quick succession: the NIOZ sediment trap **(13200#14)** and DEMAR, a seafloor amphipod trap, **(13200#15)**, both without event. The multiple corer was then back in action, this time at lander site C, for the next deployment **(13200#16)**, and again yielded 12/12 good cores. A box corer at the central position followed **(13200#17)** also producing a good sample. And at the same site, yet another multiple corer 12/12 good core success **(13200#18)**. The stand-alone pumping system (SAPS) was then deployed **(13200#19)** through the darkness hours.

Tuesday 8 July

The SAPS was recovered, having operated correctly. The following deployment of the box corer **(13200#20)** produced a good core that included a *gashed mound* - a biogenic structure probably produced by an echiuran worm. In the interests of efficient use of ship time a sequence of near-simultaneous mooring ascents and recoveries was planned - it didn't work out quite that way.

The NIOZ lander **(13200#3)** was successfully released. *Discovery* steamed to the position of a MAC deployed on an earlier cruise, acoustic communication could not (apparently) be established with that unit or another MAC in the near vicinity. Giving up on the MACs *Discovery* returned to, and successfully recovered the NIOZ lander. The DEMAR mooring

(13200#15) was then successfully released. The mooring surfaced as expected (all acoustic traces were normal all the way to the surface). However, on recovery a splice just above the first buoyancy package was found to have pulled out with consequent loss of the frame, trap, acoustic release, FSI current meter and the Billings G6600-3 buoyancy package. Subsequent acoustic monitoring and interrogation suggested that the remains of the rig were sinking slowly.

At this unhappy time it became apparent that release commands had been sent to both MAC units earlier in the day (rather than simple interrogations), consequently *Discovery* steamed back to the MAC position from a down drift direction. On the run in to that position, radio signals were detected from MAC **(13077#3)** and the rig sighted. The mooring's lines were badly twisted, complicating the recovery, but the unit appeared to have worked well. A further search was made for the second MAC **(13077#1)**, but there was no sight or (radio) sound of the rig. Still unable to make acoustic contact with the second MAC, its fate is unknown.

Following this excitement, the BWS was successfully deployed **(13200#21)** and a deep CTD cast initiated **(13200#22)** that also carried an acoustic release and FSI current meter for wire tests.

Wednesday 9 July

Following the recovery of the CTD, a box corer drop was started, but halted immediately on graunching sounds coming from overhead. The warp had jumped a sheave on the hanger top. There followed a short delay while the damaged section of wire was cropped and the warp re-terminated. The subsequent box corer deployment **(13200#23)** showed signs of a double contact with the bottom, having a box impression on the core surface. Reliable as ever, the next deployment, of the multiple corer **(13200#24)**, yielded 12/12 good cores. Not to be outdone, the following box corer deployment **(13200#25)** produced a good core. Next on the programme was the recovery of a Bathysnap deployed **(13078#47)** during RRS *Discovery* cruise 226. This was successfully completed, but not before considerable confusion over the acoustic signals. In short, a second pinger, thought to be a lost BIOFEED rig from a previous cruise, consistently confused the interpretation of acoustic traces, and the erroneous conclusion that it was a lost BIOFEED also subsequently resulted in the premature release of BIOFEED (**13200#7**, see below).

After that excitement the NIOZ lander was successfully deployed **(13200#26)** at lander site A. Subsequently, the otter trawl was shot **(13200#27)** to fish through the night.

Thursday 10 July

A straightforward recovery of the trawl yielded a good clean catch. *Discovery* returned to the central position and the multiple corer was deployed **(13200#28)**, providing yet another set of twelve good cores. The BWS was deployed next **(13200#29)** and proved to be rather problematic. On recovery the solid bridle on top of the frame had been bent, the swivel

presumably having lodged under one of its legs. A deep CTD cast **(13200#30)** took the programme through to Friday.

Friday 11 July

Following the successful recovery of the CTD, the DEMAR rig was deployed **(13200#31)**. Two successful multiple corer deployments followed, one **(13200#32)** at the central position, and one **(13200#33)** at lander site D, both of which yielded the traditional 12/12 good cores. The DEMAR rig **(13200#31)** was then successfully recovered. A deep CTD cast **(13200#34)** followed during which the scientific party engaged in an emergency muster and boat drill. The otter trawl was shot **(13200#35)** in the early evening and fished throughout the night.

Saturday 12 July

The otter trawl proved to be problematic and stayed on the bottom for seven hours! When finally recovered, it came up with the sweeps badly twisted again and the net contained a large quantity of mud. The programme then called for a Vegematic box corer deployment; however, over enthusiastic rigging of the corer, bent one of the spade retainers and the planned deployment was abandoned to enable the recovery of the NIOZ lander at an appropriate time. The lander **(13200#26)** surfaced on schedule. At about this point the crane on the starboard A-frame pedestal failed and could not be restarted. After some delay, the lander was eventually recovered over the stern using the port crane and the double-barrelled winch. Cranes continued to cause problems; in moving the BWS in to launch position, a hose on the hanger top crane burst. For this deployment the BWS was fitted with a new lifting eye, a safety strop from frame to eye, and a Bathysnap weight (40 kg) was bolted to each of the three feet. The deployment **(13200#36)** appeared to go well - clear water was collected and there was no indication of the gear falling over on the bottom. However, at recovery the swivel was again hung up under one of the solid lifting bridles. The bridle bent after clearing the water allowing the gear to drop a couple of feet, the resultant snatch loading caused damage to the CTD cable termination and smashed the perspex mount of one of the water containers. After a short delay to repair the CTD cable connector, a deep CTD cast followed **(13200#37)**.

Sunday 13 July

Following a successful recovery, the CTD was redeployed **(13200#38)** for another deep cast. A Vegematic box corer was deployed next; this being the first use of the coring warp, pay out was kept at a low rate initially. After bottoming, the corer was hauled to 50 metres above bottom and hung there for a short time to allow fine tuning of the coring warp scrolling gear. Staying with the coring warp, the Kasten corer was deployed **(13200#40)**. As expected, with only a 1 m core barrel available, the resultant core lacked the upper sediment layer, but was otherwise a good sample. The NIOZ lander **(13200#41)** and the DEMAR rig **(13200#42)** were then deployed, both without incident.

It was now planned to attempt to recover the BIOFEED rig thought to be that lost on a previous cruise and which had confused the recovery of the Bathysnap earlier in this cruise. The mooring was successfully released; however, it was immediately obvious that the mooring was rising only very slowly. During the long estimated ascent the multiple corer was deployed **(13200#43)** at lander site B, yielding 12/12 good cores.

There followed an epic night-time mooring recovery. The rig released, through my own mistake, proved to be the BIOFEED laid during the present cruise **(13200#7)**. Acoustic traces from the rig were difficult to pick up (the search was started from the position of the previous lost rig). *Discovery* was navigated on to the rig with pinger traces initially and finally began receiving reliable acoustic ranges at 1600 m. The initial approach made a beam pass at about 500 m. One turn to starboard continued the approach and the gear was sighted at an acoustic range of 230 m. Only the very top of the lazy float was visible at the surface. The rig was grappled with some difficulty - there being no rope at the surface. To enable the recovery, a strangling line was dropped down the grappling line and worked over the lazy float. The recovery then progressed normally and well. All of the glass buoyancy in the dan buoy was gone, with considerable implosion damage to the hard hat. Just when success seemed inevitable, a current meter appeared from the water, identifying the rig as that deployed during the present cruise (i.e. **13200#7**) and not the previously lost rig.

Nothing since the initial confusing acoustic signals during the recovery of the Bathysnap **(13078#47)** suggested a mistake was being made. Everything seemed to fit the theory that the old BIOFEED rig had fallen over on its side, hence the weak signals, inability to release from overhead, but ability to release from long range. It was also coincidental that BIOFEED **13200#7** was deployed exactly downwind of BIOFEED **13078#22**. This is a classic example of a propagating error, with the facts being fitted to a tempting but erroneous theory. Other than providing a useful lesson, the only good to come of this was the fortuitous recovery during calm seas - it seems likely that any swell would have kept the lazy float submerged.

Monday 14 July

After that high drama, a deployment of the SAPS **(13200#44)** was completed without incident. Success continued with a good drop of the Vegematic box corer **(13200#45)**. After a false start, when the warp jumped off a sheave on the hanger top, the following multiple corer deployment **(13200#46)** also produced good samples (12/12 as ever). Coring success continued with a good box corer sample from deployment **13200#47**. Two deep CTD casts followed **(13200#48 and 49)**.

Tuesday 15 July

After recovering the second of the CTDs, the Kasten corer was deployed **(13200#50)** and produced a sample identical to the last **(13200#40)**. Two box corer deployments followed, a Vegematic **(13200#51)** and a plain **(13200#52)**, both yielding good cores. After a brief delay

to allow a determined fishing vessel to closely pass our position, the multiple corer was deployed **(13200#53)** providing another 12/12 cores. A shallow CTD cast was made **(13200#54)** during which DEMAR **(13200# 42)** was released. DEMAR was successfully recovered and quickly redeployed as station **13200#55**. The SAPS was deployed **(13200#56)** overnight.

Wednesday 16 July

After successful recovery of the SAPS, the subsequent box corer deployment **(13200#57)** yielded only a poor sample. The NIOZ lander **(13200#41)** and the DEMAR rig **(13200#55)** were then recovered without incident. After carrying out yet another 12/12 good multiple corer deployment **(13200#58)** the NIOZ lander was redeployed as station **13200#59**. The otter trawl was then deployed **(13200#60)** to fish overnight.

Thursday 17 July

Again the trawl proved to be reluctant to leave the bottom, but on this occasion produced a good clean catch. Then shock, horror, the subsequent multiple corer deployment **(13200#61)** at lander site E produced only 11/12 good cores (in truth the corer produced 12/12, this was converted to 11/12 by a less reliable scientist). A pair of deep CTD casts followed **(13200#62 and 63)** before the multiple corer was back in action again **(13200#64)**.

Friday 18 July

The multiple corer produced 12/12 good cores which were all subject to redescent on the BIOFEED rig, deployment **13200#65**. The WASP camera system was then deployed **(13200#66)** for the first time on this cruise; it fished well, but electronic problems resulted in no altimeter data being printed on to the film. To finish the first half of the scientific programme, the multiple corer was deployed **(13200#67)** at lander site A and produced the traditional 12/12 good cores.

Admitting good progress with the programme, and to accommodate the inordinate number of birthdays that fall in July (and in the hope of not generating a hostage to fortune) the scientific party was stood down for the night. The evening also duly marked the retirement of Mike Thurston, and I would (and I am sure Mike would) like to thank all concerned. During the festivities *Discovery* was employed in a quick pass of the SOC sediment trap position to (successfully) confirm acoustic communications and then proceeded to carry out an echo sounding run through some of the rougher terrain that borders the study sight to the north.

Saturday 19 July

The scientific programme restarted with the successful recovery of the NIOZ lander **(13200#59)**, and continued with the deployment of the BWS **(13200#68)**. On recovery of the BWS the conducting swivel on the CTD cable was found to be leaking, the swivel was removed and the subsequent CTD deployment **(13200#69)** proceeded without it.

Sunday 20 July

After completing the CTD station, the beam trawl (IFREMER chalut à perche) was shot **(13200#70)** in the early hours of the morning. The beam trawl was fitted with the SOC OTSB acoustic monitor which worked well throughout the deployment. The trawl yielded a small but clean catch. On return to the central position the multiple corer was deployed **(13200#71)** and produced another 12/12 good cores. The DEMAR rig was then deployed **(13200#72)**, during which time the warp was switched from trawl to core, and a Vegematic box corer drop subsequently completed **(13200#73)**. The NIOZ lander was deployed **(13200#74)** at lander site E and the box corer, plain this time, deployed **(13200#75)** again.

Monday 21 July

A deep CTD cast was completed **(13200#76)** in the early hours of the morning after which *Discovery* set course for the SOC sediment trap position **(13077#62)**. The recovery progressed well, with only a few minor problems over tangled mooring lines. All three traps had worked well, although one of the current meters had flooded. A pair of box corer deployments were then undertaken, one plain **(13200#77)** and one Vegematic **(13200#78)** interspersed by the recovery of the DEMAR rig **(13200#72)**. The WASP system was then fished overnight **(13200#79)**.

Tuesday 22 July

Conditions were perfect for WASP, with the vehicle holding an altitude between 4 and 6 m throughout the deployment - though there having been no word from shore-side regarding the previous electronic problem, no altimeter data were recorded on the film. The programme then proceeded with yet another 12/12 good deployment of the multiple corer **(13200#80)** and a successful box corer deployment **(13200#81)**, which additionally yielded a very fine xenophyophore specimen. The BWS was then deployed **(13200#82)**; on this occasion *Discovery* was able to hold perfect position, allowing ideal operation of the gear. This success was partly marred by the discovery of a series of minor kinks at the end of the CTD cable on recovery. It would appear that the slack line paid out had dropped in perfect coils over the BWS frame, and on taking up the strain had all briefly snagged on one bolt head, producing a regular series of little kinks. A deep cast CTD followed **(13200#83)** without incident. The beam trawl was then deployed **(13200#84)** to fish overnight.

Wednesday 23 July

On recovery, the roof of the net was found to have a large tear and the cod end contained some two to three tons of mud. After extensive use of the fire hoses, this big bag of mud was reduced to a very small catch. There followed a pair of extremely shallow (5m !) CTD casts **(13200#85 and 86)** before the multiple corer produced another 12/12 good cores **(13200#87)**. The following intended launch of the epibenthic sledge was delayed when the flash gun failed to fire on deck. This problem was eventually traced to a bad connection in the harness which

was made good by Martin Lann (NIOZ). The sledge was then deployed **(13200#88)** and fished overnight.

Thursday 24 July

The sledge was recovered with a fair quantity of mud in the net, which yielded only a small catch. To add to the disappointment, the flash gun had flooded through its bulkhead connector, the flood having occurred during the descent, no seafloor photographs were obtained. The NIOZ lander was then successfully recovered **(13200#74)** and the multicorer produced the statutory 12/12 cores (one dropped on deck later) from station **13200#89**. The following deep CTD cast **(13200#90)** proved to be problematic with a seeming return to pressure related misfiring that had plagued the previous *Discovery* BENGAL cruise. A planned second deployment of the CTD was postponed to allow servicing, and the NIOZ lander successfully deployed **(13200#91)** in the meantime. The subsequent CTD deployment **(13200#92)** again proved to be problematic with no successful bottle fires below 2000 m.

Friday 25 July

With the weather deteriorating (force 7 winds and lumpy seas) the scientific programme was suspended to restart after breakfast with a deployment of the beam trawl **(13200#93)**. On recovery of the beam trawl, which yielded only a small catch, *Discovery* immediately set off up wind to position for another trawl. The beam trawl was re-launched **(13200#94)** and fished overnight.

Saturday 26 July

On recovery the trawl contained an amount of mud but also a good catch on this occasion. *Discovery* then steamed to the NE for an intensive bout of mooring work. Bathysnap **(13200#95)** and the SOC sediment trap rig **(13200#96)** were successfully deployed. Both moorings were watched (acoustically) to the bottom, with recovery intended by *Discovery* in March 1998. The NIOZ sediment trap was then successfully recovered **(13200#14)** and redeployed **(13200#97)**, with recovery intended by *l'Atalante* in October 1997 (Note, this mooring was recovered during RRS *Challenger* cruise 135). The mooring work completed, *Discovery* returned to the central position and carried out a full depth CTD cast with the marine snow profiling (MSP) camera system attached **(13200#98)**. The MSP appeared to have functioned correctly, though problems with bottle firing continued. The overnight slot was filled by the deployment of the epibenthic sledge **(13200#99)**.

Sunday 27 July

In a near identical result to its previous deployment, the sledge returned with a quantity of mud, little in the way of a catch, a flooded flash gun, and no seabed photographs. After a considerable steam back, the NIOZ lander was recovered **(13200#91)** for the last time during this cruise. The first deployment on the new station number was of the ever reliable multiple

corer **(13201#1)** producing the inevitable 12/12 good cores. A Vegematic box corer deployment **(13201#2)** followed, also producing a good core.

Monday 28 July

A SAPS on a mooring (DEMAR rig) was deployed **(13201#3)** in the very early hours and WASP fished **(13201#4)** before the SAPS was subsequently recovered without incident. The last multiple corer deployment **(13201#5)** of the cruise followed, not only producing the usual 12/12 good cores, but also the unexpected bonus of an echiuran worm apparently *in situ* in its burrow (vertical burrow with slit opening on sediment surface). *Discovery* now proceeded to the NE of the study area, *en route* passing over the positions of BIOFEED, Bathysnap and the SOC sediment trap rig, all of which responded to 'off' pings. The CTD with MSP attached was deployed **(13201#6)** in the vicinity of the SOC sediment trap rig. To round off the science programme, WASP was deployed **(13201#7)**, the camera run being completed just before midnight.

Tuesday 29 July

With WASP well clear of the bottom, the PES fish was brought inboard. On recovery of WASP, all gear was secured and *Discovery* set course for Vigo. At 0200 clocks were advanced one hour to Alpha time. At a respectable hour the scientific party began packing their gear. An end of cruise science meeting and the PSO's RPC rounded out the day.

Wednesday 30 July

At 0200A clocks advanced another hour to Bravo time. For the scientific party the day was spent in continued packing and report writing.

Thursday 31 July

Discovery tied up in Vigo at 0900B. The entire day was spent loading the five lorries required to remove all of the scientific gear from the ship. The scientific party dispersed.

GEAR AND TOPIC REPORTS

BIOFEED experiments (see figure 4)

The artificial enrichment experiments initiated on RRS *Discovery* cruises 222 and 226 were continued during this cruise. A short-term experiment was completed and a second long-term experiment deployed for recovery during the forthcoming l'Atalante cruise, Sept 1997 (note, this rig was recovered during RRS *Challenger* cruise 135).

The BIOFEED mooring is based on the original IOS DEMAR amphipod trap system, the trap being replaced by a core carrying unit. The core carrier and acoustic release (MORS OEM unit firing two pyroleases) are mounted on a small bottom landing frame with a recessed ballast weight. The mooring above the frame consists of a 50 m braid line to a Billings triple

pack float (G6600-3), a 10 m braid line to a Billings recovery float with xenon flasher fitted, and finally a 15 m length of polypropylene line with a single Billings float (G6600). The first of the two deployments made, 13200#7, also carried a recording current meter let in to the mooring just above the frame. Details of the BIOFEED deployments are summarised below:

Station	Gear	Details	Comment
13200#6	Multicorer	Cores on deck at 11:45, 5.VII.97	12 good cores
13200#7	BIOFEED	Deployed at 12:48 on 5.VII.97	
		Recovered at 23:54 on 13.VII.97	
13200#64	Multicorer	Cores on deck 02:42, 17.VII.97	12 good cores
13200#65	BIOFEED	Deployed 0409hr, 17.VII.97	
		Recovery intended l'Atalante, Sept 1997	

Similar procedures were followed for both experiments. All cores were of excellent quality with generally flat surfaces and clear overlying water. The only notable feature of the first BIOFEED set (13200#6) was a large lump of fresh phytodetritus on multicore 6 (BIOFEED control core 3) and a lump of gelatinous material on multicore 12 (BIOFEED enriched core D3); the second set (13200#64) was devoid of phytodetritus. Before the first deployment, numbers for the six enriched cores (2, 3, 5, 7, 10 and 12) and the six control cores (1, 4, 6, 8, 9 and 11) were chosen at random and used for both experiments. As on cruise 226, a preweighed amount (approximately 0.5 mg) of algal mixture (equal quantities of *Emiliani huxleyi, Dunaniella minuta* and *Haslea ostrearia*) was added to each of the enriched cores as detailed below:

Experiment 1				Experiment 2		
13200#6 Multicore position	13200#7 BIOFEED position	Inoculum (mg)	Samples	13200#64 Multicore position	13200#65 BIOFEED position	Inoculum (mg)
7	A1	0.5065	Bacteria-forams	7	A1	0.5159
5	A2	0.5159	Bacteria-nematodes	5	A2	0.5067
3	A3	0.5218	Bacteria-chemistry	3	A3	0.5087
10	D1	0.5042	Chemistry-nematodes	10	D1	0.5211
2	D2	0.5165	Chemistry-forams	2	D2	0.5139
12	D3	0.5100	Forams-nematodes	12	D3	0.5291
1	C1	Control	Bacteria-forams	1	C1	Control
4	C2	Control	Bacteria-nematodes	4	C2	Control
6	C3	Control	Bacteria-chemistry	6	C3	Control
8	B1	Control	Chemistry-nematodes	8	B1	Control
9	B2	Control	Chemistry-forams	9	B2	Control
11	B3	Control	Forams-nematodes	11	B3	Control

The first experiment ended prematurely after eight and a half days (see account in the cruise narrative). After some discussion it was decided to process the cores for bacteria, chemistry, metazoan meiofauna and foraminifera according to the prearranged protocol, with each core (enriched and control) being subsampled for two purposes (see table above). The second experiment was deployed for recovery during the l'Atalante cruse in September/October 1997.

Andy Gooday, Brian Bett, Donal Eaddly, Davina Gair,
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Bathysnap time-lapse camera system (see figure 4)

The cruise objectives called for the recovery of a Bathysnap deployed on RRS *Discovery* cruise 226 and its redeployment for recovery in March 1998 (RRS *Discovery* cruise 231). The previously deployed Bathysnap, 13078#47, was successfully recovered (after some confusion, see account in cruise narrative). Shipboard examination of the recovered camera indicated that an appropriate quantity of film had run through and that all systems had functioned well.

The Bathysnap deployed, 13200#95, consisted of the following: ballast tripod and weights, support frame with compass, flash gun, camera and acoustic release attached. (Release: MORS RT661 OEM s/n 322, two pyrolease unit; commands, ON A282, PINGER A294, PYRO A281+A291, REL1 A281+A224, OFF A223). The mooring continued: 1.5 m braid line, Aanderaa current meter, 50 m braid line, break-point, 1 m braid line, Billings triple float (G6600-3), 10 m braid line, chain dropper, Billings float (G6600) with dan mast carrying xenon flasher and flag, 15 m polypropylene line, ending with a Billings float (G6600).

Preliminary examination of the film recovered from 13078#47 on return to SOC suggests that no major fall of phytodetritus had occurred prior to, or during, RRS *Discovery* cruise 229.

Brian Bett

DEMAR benthic amphipod trap (see figure 4)

The free-fall amphipod trap (DEMAR) utilised the fish trap frame in order to incorporate a MORS mechanical release rather than a pyro-activated one. The frame measures 1.8 x 1.2 x 1.5 m and encloses the release, trap and balancing plate. The trap measures 500 x 500 x 200 mm and has solid top and bottom. Each of the four walls has a large rectangular window into which is fitted a 500 mm mesh funnel with a square aperture 40 mm on a side. A cylindrical bait container of 10 mm mesh is located centrally within the trap. The rig consists of the frame and attachments with a 170 kg ballast weight located within a recess on the underside, short bridles, a 50 m strop of 10 mm braidline, a Billings triple buoyancy pack, a 10 m strop, another Billings triple, another 10m strop, a Billings single dan buoy, a 15 m polypropylene

lazy line, and a Billings single to act as lazy line float. The rig is launched by hand, buoyancy first, with the frame hung over the stern on a crane and released with a slip-hook.

Bait consists of one or two mackerel. At the Porcupine Abyssal Plain work site a single unprotected mackerel in the trap is stripped to bare bones in 15-20 hours. Deployments scheduled for 12 hours or less were baited with one unprotected mackerel, whereas longer deployments, up to c. 50 hours, require two mackerel, one of which is wrapped in muslin.

As on RRS *Discovery* cruise 226, DEMAR was used as a vehicle for testing and trials of FSI current meter / CTDs. The instrument package was mounted between top and bottom bars of the frame. The mutual benefits of this arrangement were significant, with DEMAR providing a rapidly recycled testbed for the FSI instrument, and the current meter providing precise DEMAR touchdown times thus obviating the need for long periods of 'listening down', and also generating high quality water current data most particularly at those speeds below the stall speed of the conventional Aanderaa current meters.

DEMAR was deployed five times. The first deployment was a disaster. Everything went according to plan until the rig surfaced. At some point between surfacing and grappling a splice on the strop between the two Billings triple buoyancy packs pulled out. A single Billings triple was not sufficient to support the weight of frame, trap, release and FSI current meter, and the lower part of the rig was lost. Subsequent deployments were successful, and a series with bottom residence times approximating to 6, 12, 24 and 48 hours was obtained. The 6 hour deployment returned with a very small catch and the bait hardly touched, possibly a result of the very low current velocities experienced for most of the bottom residence time. Longer deployments took larger catches with correspondingly more of the bait consumed. The 48 hour deployment saw all of the unprotected and 90% of the wrapped mackerel consumed, suggesting that bottom times of >50 hours would be imprudent with this gear.

Some preliminary sorting was undertaken, suggesting that the composition of the fauna was similar to that found previously, with *Paralicella* spp. dominating numerically and *Eurythenes gryllus* most important in terms of biomass. There are indications that aff. *Paracallisoma* sp. nov., an entity not recorded from this site prior to the BENGAL cruises, continues to be present in significant numbers.

Mike Thurston

MAC - Module Autonome de Colonisation (see figure 4)

The fourth BENGAL MAC (Module Autonome de Colonisation) was deployed 5 July at 07:41, at 49° 55.02′ N 16° 27.93′ W. This MAC is intended to stay on the bottom for 3 months, for recovered on the l'Atalante cruise, Sept 1997 (This MAC, 13200#5 was recovered during RRS *Challenger* cruise 135).

One of the two MACs deployed during the Bengal cruise 2, RRS *Discovery* 226, was recovered 8 July after approximately four months on the bottom at 49° 56.6′ N 16° 30.9′ W. It seemed to have worked successfully. Samples from each tray were taken for bacterial density and activity and the remainder of the recovered material (sediment, glass beads and organisms) was preserved in buffered formalin. These samples were later sieved on a 250μm mesh and preserved in formalin. A number of large amphipods and polychaetes were easily recognised; amphipods were separated and supplied to Mike Thurston for identification.

No contact could be made with the second MAC deployed in March, further attempts will be made from l'Atalante in Sept 1997.

Joelle Galeron & Philippe Crassous

Moored Stand-Alone Pumping System (see figure 4)

In addition to the conventional deployments of the SAPS (see below) carried out on a vertical wire from Discovery's midships gantry, a single SAPS unit was also successfully deployed on a mooring. Use of the mooring enabled the SAPS to be located very close to the bottom (1 mab). The SAPS unit was fitted to a length of scaffold pole, and the pole slung within the DEMAR amphipod trap frame (trap removed), the DEMAR rig was deployed and recovered as normal.

Brian Bett

NIOZ benthic lander (see figure 4)

During the cruise, five successful lander deployments were made: two deployments of ~75 hours and 3 deployments of ~60 hours. A 6th deployment failed completely as a result of an electrical short-circuit in the Albex unit, which drained the power supply. During the other deployments only minor, non-fatal, problems were encountered.

As in previous Bengal cruises, the lander was equipped with a Technicap sediment trap which sampled at daily intervals, two Niskin bottles, one large incubation chamber and two smaller grabs. Oxygen consumption measurements were made from both the two small grabs and the large incubation chamber. As on the preceding Bengal cruise, small amphipod traps were attached both to the lander frame and the lazy line. During this cruise, for the first time the amphipod trap on the lazy line worked, and trapped about 35 adult *Eurythenes gryllus*. Sub samples of the specimens caught in these traps were frozen in liquid nitrogen and will be analysed for the RNA/DNA ratio as a measure of their condition. The remaining specimens were used by Katrin Iken for species determination and to establish a length-weight relationship for the more common species.

The material caught in the sediment trap will be analysed for pigment composition and material characterisation. Material caught in the last deployment was supplied to Robert Turnewitsch for the determination of ^{234}Th activity.

The sediment grab samples taken by the lander were sieved on 300 and 250 μm mesh screens. Samples from two of the lander deployments were taken by SAMS for sorting and comparison with their box core samples. Faunal biomass estimates will also be made.

Water samples taken by the lander were supplied to Christophe Rabouille and Olivier Ragueneau. These samples will be used in the calculation of nutrient fluxes across the sediment-water interface.

The oxygen consumption rates measured with the benthic chambers were in the same order of magnitude as those determined on previous Bengal cruises, i.e. 8-20 umol/m^2/hr. The explanation for the lack of any significant difference in consumption rates in comparison with the previous cruises is probably the low input of organic rich material. While the lander sediment trap caught considerable amounts of green *fluffy* material in September 1996, such material was absent from the trap samples collected during this year. The low fluxes of organic rich material towards the bottom is corroborated by the samples caught in a separate trap which sampled at weekly intervals between April 1997 and the start of RRS *Discovery* cruise 229.

From each of the lander stations, four multicore samples were collected for the determination of the downcore pigment distribution, sediment oxygen profiles and resistivity. None of the oxygen profiles showed marked differences from the profiles taken during earlier cruises. Had a massive deposition of phytodetritus taken place the maximum penetration depth would have been expected to change.

CTD water from both the deep-water chlorophyll maximum and near-bottom was filtered with the aim to determine the concentration of phytopigments. These will be used in combination with the sediment trap samples to assess the downcore distribution of pigments at the lander sites.

Measurements of oxygen concentration in water sampled from multicores, CTD, and lander Niskin bottles showed that the average concentration was 239.9 ± 2.6 μmol/l. This value is slightly higher than that measured during RRS *Discovery* cruise 226 (236.4 μmol/l).

Rob Witbaard

Sediment traps (see figure 4)

SOC Sediment traps

The SOC sediment trap string previously deployed on RRS *Discovery* cruise 226, as station 13077#62, was successfully recovered on 21 July, having been deployed for 120 days. All three traps appear to have worked well, although one of the current meters was found to be flooded.

The trap string was refurbished and redeployed on 26 July as station 13200#96, with recovery intended from RRS *Discovery* cruise 231 during March 1998. The deployed mooring is illustrated in figure 7. The acoustic release deployed is a MORS RT661B2S, serial number 321, with the following codes: ON C447, OFF C448, PINGER C470, REL C446 + C485.

Ian Waddington, Brian Bett

NIOZ sediment trap

A sediment trap, of the same type as used on the lander, was deployed at about 10 m above the seafloor during the previous cruise (5 April, RRS *Discovery* cruise 226). This trap was successfully recovered on 6 July. The samples obtained in this trap were fixed with 6% formalin. These will be used for qualitative description of the sedimented material. As far as possible quantitative analyses will also be undertaken.

This trap was subsequently redeployed and recovered during the cruise (7-26 July) with the sampling interval set to two days. The material recovered was not fixed and will be used for both quantitative and qualitative analyses. One of the samples was taken by Robert Turnewitsch and Barbara Springer for the measurement of Thorium activities to estimate sedimentation rate. In three of the cups, organisms were found, a polychaete in two cases and a holothurian in the third.

The trap was then redeployed (26 July) for recovery by l'Atalante in Sept 1997.

Rob Witbaard

Box coring (see figure 3)

A modified USNEL-type box corer was used throughout the cruise with a fair success rate given the generally good weather conditions. Two rigging variations were adopted, a) either the plain box (i.e. the standard open core) or the *vegematic* box (i.e. an open core fitted with a removable array of 25 subcores), and b) with or without a penetration limiter (i.e. a stop on the corer's central column that prevents complete descent of the column through the frame's gimballed neck). Overall performance of the sampler and the sampling operations undertaken are summarised in the following table.

Station	Box type	Core quality	Depth limiter	Core length (cm)	Sampling protocol	Fate of samples	Remarks
13200#4	Plain	Good	-	46	CFR	CFR SOC AWI SAMS(sc)	Echinosigra (Billett); komoki (Gooday); sieved macrofauna (Iken); photographs
13200#8	Plain	Acceptable	fitted		IOS	IFREMER SAMS(sc)	Double contact, area sampled 500x355mm (=0.1775m2); Ophiocten (Galeron)
13200#17	Plain	Very good	fitted	36	IOS	IFREMER SAMS(sc) SOC	Ophiocten (Galeron); xenophyophore (Gooday)
13200#20	Plain	Very good	fitted	39	IOS	IFREMER SAMS(sc) SOC	Decayed gash mound; Ophiocten (Galeron); xenophyophore (Gooday)
13200#23	Plain	Moderate	fitted	38	IOS	IFREMER SAMS(sc)	Weak double contact
13200#25	Plain	Very good	fitted	38.5	IOS	IFREMER SAMS(sc)	Extensive undisturbed Rhizammina; cuspidariid bivalve in 1-3cm layer (Galeron); photographs
13200#39	Vege	Moderate	fitted		SAMS	SAMS	Probable weak double contact; core C4 subsampled
13200#45	Vege	Good	fitted		SAMS	SAMS	
13200#47	Plain	Good	fitted	38.5	IOS	IFREMER SAMS(sc) SOC	Xenophyophores including two large specimens (Gooday)
13200#51	Vege	Good	fitted		SAMS	SAMS	Subcore C2 sampled in detail
13200#52	Plain	Good	fitted	38	IOS	IFREMER SAMS(sc) SOC	Large Iosactis in funnel-pit, discoidal tunicates, etc (Galeron); xenophyophores (Gooday); photographs
13200#57	Plain	Unsuitable	fitted			SAMS (sc) AWI	Subsampled for macrofauna (Iken)
13200#73	Vege	Very good	fitted		SAMS	SAMS	Subcore C3 sampled in detail
13200#75	Plain	Good	-	46	CFR	CFR SAMS(sc) AWI	0-2cm sieved for macrofauna
13200#77	Plain	Very good	fitted	39	IOS	IFREMER SAMS(sc) SOC	Kolga and most picked specimens (Galeron); some pickings (Lamont); some xenophyophores (Gooday)
13200#78	Vege	Very good	fitted		SAMS	SAMS SOC	Small xenophyophores (Gooday); subcore B3 sampled in detail
13200#81	Plain	Very good	fitted	38	IOS	IFREMER SAMS(sc) SOC	6 Kolga (Galeron); Reticulammina (1 very large, 1 small), xenophyophores (Gooday); photographs
13201#2	Vege	Very good	fitted		SAMS	SAMS	Xenophyophores (Gooday); subcore C3 sampled in detail

Mike Thurston

Vegematic sampling

The vegematic box operated without problems. It was possible to withdraw the subcores without removing the grid after detaching the box door and subcore mounting rods. Split pins at the ends of the rods were omitted and are only required when transporting the vegematic box. The box has to be fitted abutting one side of the corer in order that the subcore mounting grid does not foul the linking arms of the box closure flaps. The set of subcores used varied in cross-sectional dimensions between 92 and 96 mm. Wave data from the Shipborne Wave Recorder Mk4 Version 1.6 was used to determine the final wire veer rate which was 22 m/min

for the first three deployments, 20 m/min for fourth and fifth deployments and 18 m/min for the last deployment.

Six vegematic boxcore samples were obtained. These were treated as in previous BENGAL cruises: one central subcore being horizontally sectioned (0-1, 1-2, 2-3, 3-5 and 5-10 cm) and the 0-10 cm section of sediment collected from the other 24 subcores. All samples were sieved on 300 and 250 μm mesh sieves.

The first three vegematics showed varying degrees of disturbance, indicating that some slight side slip of the box had occurred as the sediment was contacted, while the latter three were of much better quality with clean penetration. The following table provides details of each deployment.

Station	SAMS no.	Quality	Comment	Fate	Impact speed
13200#39	680	1	Some disturbance A1-A5, A2 large extra lump on top of surface, E4 echiuran 40x8 mm, A3 echinoid	SAMS 24 sc's x 10 cm, 1 sc. x 1,1,1,2,5 cm slices,	22 m/min
13200#45	681	3	Some slumping due to side slip @ impact otherwise good core, brittle star & several surface fauna in vials	SAMS 24 sc's x 10 cm, 1 sc. x 1,1,1,2,5 cm slices,	22 m/min
13200#51	683	3	Central cores slumping from side slip, xenos C1, A4, E3; C2 subsectioned but not well	SAMS 24 sc's x 10 cm, sc. C2 x 1,1,1,2,5 cm slices, xenos	22 m/min
13200#73	686	3	No disturbance, few surface features; A5 perforated tube,C4 juvenile holothurian	SAMS 24 sc's x 10 cm, sc. ?? x 1,1,1,2,5 cm slices, 1 xeno Gooday	20 m/min
13200#78	689	3	Good core, A1 rare foram, B2 tanaid (in vial), B2, C3, B5 xenos, slight disturbance B2, B3, cracks C4, C5	SAMS 24 sc's x 10 cm, 1 sc. x 1,1,1,2,5 cm slices, xenos Gooday	20 m/min
13201#2	691	3	D2 ophiuroid, B5 tunicate, B4 amphipod, A4, B2 xenos, slight cracks E3&4	SAMS 24 sc's x 10 cm, 1 sc. x 1,1,1,2,5 cm slices, xenos	18 m/min

Delicate fauna observed on the surfaces of the subcores were picked-off prior to preservation and sieving of the sediment. Few larger macrofaunal specimens were encountered; these consisted of a juvenile echinoid (*Portelesia* sp.) and an echiuran in 13200#39, one ophiuroid (*Ophiocten* sp.) in each of 13200#45 and 13201#2, one juvenile holothurian (?*Kolga* sp.) in 13200#73, one tanaid in 13200#78 and a benthic tunicate and amphipod in 13201#2. Xenophyophores were picked from the surfaces for Andy Gooday (see his account elsewhere in this report).

Peter Lamont

BWS - Bottom Water Sampler (see figure 3)

The Bottom Water Sampler is a device specifically designed to sample the near-bottom water layer, 0-1 m above bottom. It is lowered to the bottom on a conducting cable and stands there for about 20 minutes. It must remain stationary for 5-10 minutes in order to avoid any interference from resuspended sediments. Once the sediment has settled, pumping of near-bottom water is started and continues for 8 minutes. Operation of the BWS is monitored by means of a compass and turbidity probe; the resultant data are monitored in real-time.

Deployment 1 (13200#10). Sediment on both the tripod and the frame, and a bent lifting eye suggested that the device may have fallen over while on the bottom. Three of the four water bottles worked properly.

Deployment 2 (13200#21). Although the BWS may have fallen over again (mud on the frame), all of the water bottles worked properly.

Deployment 3 (13200#29). A stronger lifting eye was mounted (thanks to RVS technicians) prior to this deployment. To obtain more information on the behaviour of the BWS at the bottom, it was equipped with an acoustic current-meter / CTD / tilt sensor instrument (Falmouth Scientific 3D-ACM plus HA-CTD; Waddington, SOC) and the particle camera was used to monitor the seafloor below the rig. Unfortunately the acoustic current meter did not work during this deployment. Bent top bars indicated that the BWS may have been dragged along the bottom. This may have caused the long resuspension period observed. The video showed that the camera had not been directed towards the sea floor while the BWS was on the bottom - evidently the BWS had fallen over.

Deployment 4 (13200#36). For the fourth deployment the bars and legs of the frame were strengthened and weights (3 x 50 kg from the SOC Bathysnap) were mounted below the feet. All data (compass, tilt sensor, camera, OBS) indicated that the BWS had worked well. When heaving the device up to the surface the swivel got stuck in the frame.

Deployment 5 (13200#68). For the fifth deployment additional strengthening bars were welded to the frame.

Deployment 6 (13200#82). The sixth deployment worked well.

The water samples collected with the BWS will be used for the determination of total suspended matter, particulate organic carbon and nitrogen, particulate carbonate, chlorophyll equivalents, particulate and dissolved ^{234}Th, bacterial cell number and cell volume.

The same parameters will be determined from CTD rosette water samples collected at 5 and 10 m above bottom; each BWS deployment was followed by a CTD deployment. Four further CTD casts, collecting samples at 5, 10, 25, 50, 100, 500 and 1000 m above bottom were

carried out for analysis of ^{234}Th, seston, chlorophyll equivalents and bacterial cell number and volume. Thorium analyses were undertaken onboard ship.

Ten cores from the multicorer (five from station 13200#1 and five from 13201#1) were sectioned for subsequent analysis for phospholipids, carbohydrates, proteins and chlorophyll equivalents. A further five cores (3 x 13200#18) were retained for ^{210}Pb and (2 x 13201#5) ^{234}Th analysis.

Barbara Springer & Robert Turnewitsch

CTD+MS

The CTD and rosette multisampler were used on numerous occasions throughout the cruise to provide a variety of samples for many ultimate purposes. The CTD generally performed well throughout the cruise. Towards the end of the cruise the bottle firing mechanism became unreliable in deep-water, in a similar fashion to pressure related failures experienced on earlier BENGAL cruises on RRS *Discovery*. These failures late in the programme do not appeared to have caused and significant problems for the scientific party.

Brian Bett

Kasten core (see figure 3)

The Kasten core, fitted with a one metre barrel, was deployed two times during the cruise. On both occasions the corer was deployed with its 600 kg ballast load removed. Nevertheless, on both occasions the core over-penetrated, with sediment being forced up into the coring head. Both deployments produced useful samples of a good quality. No cracks or elongation were visible in the first core and stratigraphic features were perpendicular to the direction of penetration. The second core did have two cracks. The barrel mounting system (core head and core catcher) prevents sampling of the full barrel length, in total a 70 cm length of sediment was sampled.

In the soft fine-grained sediments of the Porcupine Abyssal Plain study site, it would be more appropriate to use a minimum barrel length of two meters in future cruises.

Samples were collected for sedimentology and planktonic Foraminifera for ^{18}O / core dating. Kasten cores were subcored with 7 cm square section core liners which were capped and stored at 4°C. Additional samples for subsequent analysis of paleomagnetism were collected in U-section conduit piping.

Station	Location	Subsamples	Core length (cm)
13200#40	Central Position	2	69
13200#50	Central Position	2	68

Christophe Rabouille

Multiple corer (see figures 3 and 4)

The multiple corer was deployed 22 times of which 16 deployments were at the central site and six were at the five lander sites (see table below). The gear performed as well as ever, returning a total of 262 cores out of a possible 264. Final lowering speed was either 12 or 15 m/min, depending on the swell state. Two cores were lost on deck, on deployments 13200#61 and 89, when the core catcher on core head position 7 failed to engage fully with the bottom of the tube because of a projecting hinge screw. The only other problems occurred on deployments 13200#53 (at lander site A) and 13200#89 (at the central site) in which several cores were slightly disturbed by a sideways pullout; however, even these cores were overlain by clear water. The excellent performance of the corer during this cruise may have been partly attributable to the new bungee loops which ensured a secure top seal and to the generally favourable weather conditions.

The cores resembled those obtained during March on RRS *Discovery* cruise 226. Several from each deployment contained large or small burrows, but worm casts were not observed. A few cores yielded large organisms, notably three xenophyophores (see below), an ophiuroid (Ophiocten gracilis) and an unlucky echiuran worm captured *in situ* in its burrow about 20 cm below the sediment surface. However, the most surprising feature of these samples was the rarity of substantial amounts of phytodetritus. Single large, greenish-brown lumps, a centimetre or more in size, lay on the surface of five cores, but otherwise phytodetritus occurred only as small fragments which were noticed during core processing. The large lumps were not integrated, to any noticeable extent, with the sediment and apparently had arrived on the seafloor fairly recently.

As is usual at the Porcupine Abyssal Plain site, the cores were consistently around 30-32 cm long. Core stratigraphy was similar to that observed on previous cruises. At the central site, there was a distinct discontinuity between dark brown sediment and an underlying lighter brown sediment at about 24 cm depth. At Lander site A, a similar discontinuity was present at the bottom of the cores, at about 28-30 cm depth. If this is the same feature, then it suggests that sedimentation rate at the Lander site is higher than that at the central site.

As on previous cruises, the cores were used for a wide variety of purposes (see table below and elsewhere in this report). At the central site these included metazoan and foraminiferal meiofaunal studies (Tasks 56-63), BIOFEED (Task 64), sediment organic chemistry (Tasks 50,51), silicate chemistry (Tasks 74, 76), radionuclides (Task 40), nitrate and phosphate chemistry (related to Task 40), enzyme analyses (related to Task 68), pigment analyses and porosity determinations (related to Task 43), bacterial activity and community structure (Tasks 52, 53), and isotope analyses of organisms to establish trophic relationships (Tasks 69, 71). Additional cores were used for oxygen profiles and frozen for chemical and biological purposes (including analysis for actinomycetes). The core containing the echiuran was sliced

into layers and the sediment close to the burrow subsampled separately from the remaining sediment. Cores from the Lander sites were used mainly for chemical (pigments and pore-waters) and radionuclide analyses. Sediment contact water for DNA studies was taken from two deployments (13200#71, 13201#5).

Station	Location	Useable	Length (cm)	Remarks
13200#1	Central	12	30-32.5	Undisturbed, a few small fluff lumps
13200#6	Central	12	30-33	Undisturbed, a few small fluff lumps; BIOFEED set
13200#12	Central	12	30.5-32	Undisturbed, large burrow, few small fluff lumps
13200#16	Lander C	12	29-33	Undisturbed, no obvious fluff, one big burrow
13200#18	Central	12	29.5-32	Undisturbed, large burrow; 2 large xenos on one core
13200#24	Central	12	30-31	Undisturbed, large burrow, few small fluff lumps
13200#28	Central	12	30-33	Undisturbed, most with flat surfaces; 1 ophiuroid
13200#32	Central	12	30-32	Undisturbed, most with flat surfaces
13200#33	Lander D	12	30-32	Undisturbed, 2 cores with large holes; 1 xeno
13200#43	Lander B	12	29-34	Undisturbed, no surface features; no colour discontinuity
13200#46	Central	12	29.5-34.5	Undisturbed, sloping surfaces, large burrow, 'black lump'
13200#53	Lander A	12	23.5-35	Clear water; side pull caused some disturbance; no colour discontinuity
13200#58	Central	12	30.5-32	Undisturbed, flat few features; perforated tube
13200#61	Lander E	11	28-30.5	Undisturbed, flat, 1 fairly large fluff lump; sharp discontinuity at 21cm
13200#64	Central	12	30.5-33	Undisturbed, fairly featureless; BIOFEED set
13200#67	Lander A	12	27-31.5	Undisturbed, fairly featureless; discontinuity at 28-30cm
13200#71	Central	12	30-32	Undisturbed, quite a lot of holes, otherwise featureless
13200#80	Central	12	29.5-31.5	Undisturbed, big fluff lumps of 3 cores
13200#87	Central	12	29-31.5	Undisturbed, several with big burrows
13200#89	Central	11	29.5-33	Clear water; side pull caused some disturbance; several large burrows
13201#1	Central	12	31-32.5	Undisturbed, 1 large fluff lump
13201#5	Central	12	29-31.5	Undisturbed; echiuran worm is situ

Location	Central site																Lander site					
																	C	D	B	A	E	A
Station	13200														13201		13200					
Series	#1	#6	#12	#18	#24	#28	#32	#46	#58	#64	#71	#80	#87	#89	#1	#5	#16	#33	#43	#53	#61	#67
GENT: Meiofauna	2	-	2	-	2	-	2	2	-	-	-	2	-	-	-	-	-	-	-	-	-	-
GENT: Pigments	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
SOC: sliced to 15cm	1	-	-	1	-	1	1	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-
SOC: sliced to 2cm	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-
SOC: >200µm fraction	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
SOC: echiuran	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
UL: sliced	-	-	3	-	3	-	3	3	3	-	3	-	-	-	-	-	-	-	-	-	-	-
UL: frozen	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-
UNIVAN	-	-	1	-	1	-	1	1	1	-	1	4	-	-	-	-	-	-	-	-	-	-
PATRAS	-	-	2	-	2	-	2	2	2	-	2	-	-	-	-	-	-	-	-	-	-	-
UCG: activity	-	-	-	1	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
UCG: DNA	-	-	-	2	-	2	-	1	2	-	-	-	-	1	1	-	-	-	-	-	-	-
QUB	1	-	-	1	1	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-
Gif: porewater + radionuclides	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	1	2	2	1
Gif: porewater (Nitr.+Phos)	1	-	-	1	-	2	-	1	-	-	1	-	2	-	-	-	-	-	-	-	-	-
Gif: radionuclides only	1	-	-	1	-	1	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Gif: surface layer (radionuclides)	-	-	-	-	-	1	-	-	-	-	-	-	2	4	-	8	-	-	3	-	2	2
IUEM:silica	-	-	1	-	1	-	1	-	-	-	-	-	-	-	-	1	-	4	-	-	-	1
GEOMAR: radionuclides	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
GEOMAR: biochemistry	5	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
BIOFEED		12	-	-	-	-	-	-	-	12	-	-	-	-	-	-	-	-	-	-	-	-
AWI	1	-	2	1	1	2	2	-	1	-	3	1	4	4	3	-	2	2	3	4	1	2
NIOZ: Oxygen	-	-	1	1	-	1	-	-	-	-	1	1	1	-	1	-	1	1	1	1	1	1
NIOZ: Pigments	-	-	-	-	-	1	-	-	-	-	-	2	-	-	-	-	3	3	3	3	3	3
NIOZ: Porosity / resistivity	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Frozen	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	2	2	1	2	2	2
Sediment contact water	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	-	-
TOTAL CORES USED	12	12	12	12	12	12	12	12	12	12	12	12	12	11	12	12	12	12	12	12	11	12

Table of megabenthos data from otter trawl hauls (see preceding text for details)

Station	13200#9		13200#27		13200#35		13200#60	
	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)
Taxon								
Porifera	17	1.42	9	0.55		0.00	28	1.57
Umbellula	275	22.99	8	0.49	9	0.42	22	1.23
Pennatulacea	1	0.08		0.00		0.00		0.00
Actinauge	163	13.63	232	14.27	596	27.81	655	36.73
Amphianthus	79	6.61	74	4.55	84	3.92	132	7.40
Daontesia	23	1.92	13	0.80	46	2.15	110	6.17
Iosactis	7	0.59	9	0.55	12	0.56	57	3.20
Kadosactis	5	0.42	46	2.83	73	3.41	54	3.03
Segonzactis	12	1.00	12	0.74	14	0.65	32	1.79
Sicyonis	555	46.41		0.00		0.00	379	21.25
Actiniaria indet		0.00	1	0.06	9	0.42	1	0.06
Madreporaria	14	1.17	26	1.60	30	1.40	31	1.74
Zoanthidea	32	2.68	9	0.55	43	2.01	57	3.20
Echiura	109	9.11	65	4.00	206	9.61	512	28.71
Sipuncula	3	0.25	22	1.35	7	0.33	11	0.62
Turbellaria		0.00		0.00		0.00	+	
Vermes		0.00		0.00	1	0.05		0.00
Annelida	112	9.37	83	5.11	59	2.75	138	7.74
Worm tubes	++		++		++		++	
Cirripedia	6	0.50	8	0.49	23	1.07	10	0.56
Mysidacea	1	0.08	5	0.31	1	0.05	5	0.28
Isopoda		0.00		0.00	1	0.05	+	
Amphipoda		0.00		0.00		0.00	+	
Benthesicymus		0.00	158	9.72	10	0.47	86	4.82
Plesiopenaeus	78	6.52	198	12.18	61	2.85		0.00
Natantia (contaminants)	++		++		++		++	
Stereomastis	25	2.09	27	1.66	40	1.87	77	4.32
Munidopsis	14	1.17	71	4.37	219	10.22	134	7.51
Parapagurus/Epizoanthus		0.00		0.00		0.00	8	0.45
Colossendeis	2	0.17	7	0.43	5	0.23	18	1.01
Gastropoda	6	0.50	1	0.06	21	0.98	6	0.34
Bivalvia	7	0.59	9	0.55	5	0.23	8	0.45
Cephalopoda	69	5.77	3700	227.60		0.00		0.00
Dytaster	123	10.28	201	12.36	213	9.94	495	27.76
Freyella	8	0.67	15	0.92	26	1.21	27	1.51
Hyphalaster	59	4.93	54	3.32	327	15.26	913	51.19
Styracaster	36	3.01	45	2.77	152	7.09	450	25.23
Asteroidea indet		0.00	21	1.29	29	1.35		0.00
Ophiuroidea	21	1.76	32	1.97	29	1.35	100	5.61
Echinoidea		0.00		0.00		0.00	1	0.06
Amperima	9200	769.28	3706	227.97	23450	1094.15	14550	815.87
Benthodytes	4200	351.19	2000	123.03	2323	108.39		0.00
Deima	324	27.09	402	24.73	1014	47.31	788	44.19
Kolga+Ellipinion	827	69.15	228	14.03	1820	84.92	1745	97.85
Mesothuria	599	50.09	463	28.48	1251	58.37	572	32.07
Molpadia	37	3.09	147	9.04	279	13.02	728	40.82
Oneirophanta	16265	1360.04	22718	1397.46	31805	1483.99	19170	1074.93
Paroriza	2400	200.68	3793	233.32	11100	517.91	6410	359.43
Peniagone	99	8.28	70	4.31	50	2.33	45	2.52
Pseudostichopus villosus	8111	678.22	16807	1033.86	25128	1172.45	16920	948.76
Pseudostichopus sp	1314	109.87	1250	76.89	2238	104.42	3132	175.62
Pseudostichopus indet	181	15.13	186	11.44		0.00		0.00
Psychropotes longicauda	24216	2024.88	9474	582.78	22550	1052.16	27500	1542.02
Psychropotes semperiana	321	26.84		0.00	125	5.83	170	9.53
Holothurioidea misc	20	1.67	17	1.05	25	1.17	44	2.47
Crinoidea	1	0.08	1	0.06	1	0.05	2	0.11
Culeolus	69	5.77	29	1.78	32	1.49	69	3.87
Enigmatic	11	0.92	5	0.31	2	0.09		
Total invertebrates	70057	5858.00	66457	4088.00	125544	5857.76	96402	5405.58
Total holothurians	68114	5695.53	61261	3768.38	123158	5746.43	91774	5146.07
Total non-Holothurioidea	1943	162.47	5196	319.62	2386	111.33	4628	259.51
Fish	19261	1610.56	23805	1464.33	307	14.32	801	44.91

Table of megabenthos data from chalut à perche hauls (see preceding text for details)

		13200#70		13200#84		13200#93		13200#94	
Taxon	**Genus species**	**no.**	**Wt. (g)**	**no.**	**Wt. (g)**	**no.**	**Wt. (g)**	**no.**	**Wt. (g)**
Pennatulacea	Umbellula sp.	1	1					10	97
	Gen.sp.	2	1			3	1	6	2
Actiniaria	Actinauge abyssorum	9	66	11	68	15	82	58	347
	Amphiantus bathybium	10	19	7	18	32	57	60	138
	Sicyonis biotrans	1	190			3	307	1	136
	Kadosactis sp.	13	20	6	6			25	39
	Segonzactis platypus	2	3	6	5	2	1	7	10
	Daontesia sp.	7	24	5	15	3	6	19	55
	Iosactis sp.	7	7	6	4	8	6	15	7
	Gen.sp.							1	9
Zoantharia	Epizoanthus sp.	31	7	10	2	42	9	155	30
Scleractinia	Fungiacyathus sp.	6	13	3	4	1	2	14	24
Polychaeta	Polynoidae gen.sp.	38	41	25	26	41	37	117	126
Echiura		4	19	5	31	1	1	19	105
Sipunculida		1	1	4	4			4	2
Bivalvia		1	5	1	2			10	29
Gastropoda	gen.sp.	2	5	4	4			4	17
	parasitic / Oneirophanta							23	6
Scaphopoda				3	1				
Cephalopoda				1	13	1	25	1	90
Pycnogonida		3	6			4	8	2	5
Cirripedia	Scalpellum sp.	2	5			3	15	3	5
Amphipoda	Eurythenes gryllus					1	1		
Decapoda natantia	Benthesicymus sp.	6	89			7	90	4	49
	Gnathophausia sp.	1	6	2	15				
Decapoda reptantia	Stereomastis sp.			1	17	2	21	6	89
	Munidopsis parfaiti	2	80	2	31	1	13	3	35
	Glyphocrangon sp.	1	12						
Holothuroidea	Oneirophanta mutabilis	114	6975	58	4470	95	2850	325	15550
	Pseudostichopus villosus	56	7150	28	5300	29	2245	117	9750
	Pseudostichopus sp.	31	675	10	184	27	270	113	2800
	Psychropotes longicauda	77	11250	44	7925	85	2483	327	30910
	Psychropotes semperiana							2	61
	Paroriza prouhoi	3	968	1	605	3	351	14	5300
	Mesothuria sp.	3	50	1	68	4	156	9	602
	Peniagone sp.	3	27			2	12	2	15
	Deima sp.	6	738	3	670			3	305
	Benthodytes sp.					2	950	2	2037
	Amperima rosea	600	2690		3850	1080	3650	4700	24850
	Kolga sp. & Ellipinion sp.	230	620	62	183	172	253	520	1410
	Protencyra			1	1			3	5
	Gen.sp.	2	2					6	18
Asteroidea	Hyphalaster sp.	16	143	11	95	16	80	58	555
	Styracaster sp.	7	43	2	7	2	10	35	232
	Dytaster sp.					1	93	3	196
	Freyella sp.	3	3	3	6	1	2	7	7
	Gen. sp.								
Ophiuroidea		9	12	6	3	5	4	9	16
Echinoidea	Pourtalesia sp.			5	1				
Crinoidea				1					
Tunicata	Culeolus sp.	11	9	9	4	3	3	35	27
	Hexacrobilidae			24	8			7	5
Pisces	Synaphobranchus bathybius	3	763			2	638	1	297
	Chalinura leptolepis	3	135					1	129
	Chalinura profundicola	1	10					2	159
	Coryphaenoides sp.			1	2049				
	Conocara salmonea					1	803		
	Bathypterois longipes							1	12
	Xenodermichthys copei							2	30
	Macrouridae	1	4			4	85	7	40
	Aphyonidae							1	2
TOTAL		1329	32887	372	25695	1704	15620	6879	96772

Holothurian studies, Queens University Belfast

Samples of the guts of three holothurian species, *Psychropotes longicauda, Pseudostichopus villosus* and *Oneirophanta mutabilis*, were sampled for both enzymes and for foraminiferans. These holothurians were selected not only because of their abundance, but also because they have contrasting tentacle (?feeding) structures and lifestyles.

For enzyme analysis, the gut contents from four regions of the gut (oesophagus, anterior intestine, posterior intestine and rectum-cloaca) were pooled from five or more specimens taken from the same trawl. From the pooled samples, five replicate samples, of about 1 ml each, were taken from each of the gut sections. The samples were stored at -50°C. These samples will be used to investigate enzymatic activity in each section of the holothurian gut for each species and to test for intra-specific differences. For comparison, five replicate samples were taken of the top 5 mm of the sediment from five separate multiple corer samples from the Central Station. These samples were also stored at -50°C.

The oesophageal and rectal (cloacal) contents of five to six separate specimens of each of the species (*Psychropotes longicauda, Pseudostichopus villosus* and *Oneirophanta mutabilis*) were taken to investigate whether foraminiferans add significantly to the diet of holothurians. Foraminiferans are an important component of the meiofaunal community, particularly in the deep sea, but little is known of their trophic interactions. By comparing the contents of the anterior- and posterior-most sections of the gut it is hoped that the importance of foraminiferans in holothurian nutrition can be gauged.

Dave Billett

Microbiology, University College Galway

The main objectives of the microbiological studies were a continuation of the data series associated with the BENGAL project. The relevant BENGAL objectives are:

1) To collect sediment, water column and sediment contact water (SCW) samples (Task 52)
2) To carry out microbial activity determinations on samples and to preserve material for determinations of bacterial abundance and community structure. (Task 53)
3) To obtain gut content samples from holothurians (Samples to be treated as per objective 2: Task 68a)
4) To participate in the BIOFEED experiment (Tasks 64,65)

Sediment samples were collected with the multiple corer and sectioned at 1 cm intervals down to 5 cm depth. Subsamples of 1ml were taken for the determination of bacterial numbers by epifluorescence microscopy. Samples taken for bacterial community structure analysis, via nucleic acid based techniques, were immediately frozen. The table below lists all of the

Xenophyophores

As on previous cruises, all multiple core and box core surfaces were more-or-less thoroughly examined for epifaunal xenophyophores. This cruise yielded a particularly rich haul; a total of 38 specimens, 3 from two multiple core samples, 11 from vegematic box cores and 24 from plain box cores. This is more than three times as many as were collected on RRS *Discovery* cruise 226 in March 1997. The distribution of xenophyophores appeared to be patchy, the numbers present on individual, carefully examined box cores being as follows:

Specimens per box core	0	1	2	3	4	5	6	7
Frequency	5	2	3	2	1	2	0	1

Two of the three specimens recovered by the multicorer were side by side on a single core. What is even more remarkable is that they belonged to different species (see below).

The material was fairly diverse. As usual, *Galatheammina erecta* (15 specimens) and *Reticulammina labyrinthica* (11) were most common. The other species provisionally recognised were a flat *Galatheammina* (4 specimens), ?*Homogammina* sp. (3), *Galatheammina lamina* (2), a triangular *Galatheammina* sp. (1), *Reticulammina* sp. (1) and *Aschemonella ramuliformis* (1). Several specimens were particularly interesting. Box core 13200#81 yielded the largest example of *Reticulammina labyrinthica* recovered from the study site, an almost perfectly circular individual, 3 cm in diameter, with an ischnomesid isopod nestling within its reticulated structure. The *Reticulammina* sp. (which occurred side-by-side in the same multicore with a specimen of *R. labyrinthica*), has a lamellate morphology and is only the second specimen of this morphotype known from the Atlantic (the first was a new species found on the Cape Verde Abyssal Plain during RRS *Discovery* cruise 194). It certainly represents a new species. The *Aschemonella ramuliformis* joins a specimen recovered during RRS *Discovery* cruise 185 as only the second known complete example of this species.

Most of the material was preserved in formalin for taxonomic study, but three specimens were placed in 95% ethanol for molecular studies in collaboration with Dr Olga Kamenskaya (Moscow State University)

Andy Gooday

Gif sur Yvette Group

Multicore

Sampling was carried out for porewaters (slicing and centrifuging) and solid phase (radionuclides) material. At the central station, two separate cores were collected for each task, at the lander position only one core was collected for both tasks. At some stations,

additional cores were sampled for the interface using a pipette (radionuclides and organic carbon content). Porewaters were recovered after centrifuging at 3600 rpm, filtered to 0.2 µm and acidified with HCl. Solids for general use were frozen. Solids for radionuclides were kept at room temperature.

Station	Location	Porewater	Radionuclides	Interface
13200#1	Central Position	1	1	-
13200#16	Lander Site C	2	-	-
13200#18	Central Position	1	1	-
13200#28	Central Position	2	1	1
13200#33	Lander Site D	1	-	-
13200#43	Lander Site B	1	-	-
13200#46	Central Position	1	1	1
13200#53	Lander Site A	1	-	-
13200#61	Lander Site E	1	-	1
13200#67	Lander Site A	1	-	2
13200#71	Central Position	1	1	-
13200#87	Central Position	1	1	2
13200#89	Central Position	-	-	4
13201#5	Central Position	-	-	6

Box core

Samples were collected for sedimentology and planktonic Foraminifera for ^{18}O / core dating. The box cores were sampled with core liners which were then capped and stored at 4°C.

Station	Location	Samples	Core length (cm)
13200#4	Central Position	2	45
13200#75	Central Position	2	49

(see also the account of Kasten core operations elsewhere in this report).

NIOZ Lander

Samples were collected for Ca, NO_3 and PO_4 analysis from the tube linking the glass vials used for oxygen determination to the syringe on the BOLAS chamber. The mean sample volume recovered was 5 ml. The samples were filtered to 0.2 µm and kept in tightly closed containers at 4°C. Samples were also collected from the grab and the Niskin bottle for additional start and end values.

Station	Location
13200#3	Lander site B
13200#26	Lander site A
13200#59	Lander site D
13200#74	Lander site E
13200#91	Lander site C

Christophe Rabouille

University Liverpool Group

BENGAL Tasks 50/51

Sediment and pore water samples from 6 multiple corer deployments (2 or 3 cores per deployment, see table below) were collected. The cores used for sediment sampling were sectioned as follows: 0-5, 5-10, 10-20, 20-30, 30-40, 40-50, 50-60, 60-100, 100-150 and 150-200 mm. The sections taken for pore water sampling were 0-10, 10-20, 20-30, 30-40, 40-50 and 50-60 mm. The sediment samples were stored in solvent rinsed, foil wrapped petri dishes. Sections taken for pore water analyses were centrifuged in prewashed (Decon, MQ) 50 ml glass centrifuge tubes (15 minutes; 2500 rpm; 10°C). The supernatant pore waters were then transferred, using a glass pipette (solvent extracted) into prewashed (Decon, MQ, solvent extracted) glass vials. Whenever possible (see table below), back up sediment cores were taken, these were extruded whole while still frozen, and wrapped in solvent wiped foil. Ashed water filters from three SAPS deployments were taken from three depths (1000 m, 3000 m and 100 m above sea floor) by UCG for the Liverpool group. All samples were frozen to -50°C initially, and then stored in the freezer at -20°C for the rest of the cruise.

Station	Location	Core	Use
13200#12	Central	4	sediment chemistry
13200#12	Central	11	porewater chemistry
13200#12	Central	12	whole
13200#24	Central	11	sediment chemistry
13200#24	Central	8	porewater chemistry
13200#24	Central	5	whole
13200#32	Central	3	sediment chemistry
13200#32	Central	5	porewater chemistry
13200#32	Central	6	whole
13200#46	Central	3	sediment chemistry
13200#46	Central	4	porewater chemistry
13200#46	Central	9	whole
13200#58	Central		sediment chemistry
13200#58	Central		porewater chemistry
13200#58	Central		whole
13200#71	Central	9	sediment chemistry
13200#71	Central	11	porewater chemistry
13200#71	Central	12	whole
13200#87	Central	3	whole
13200#87	Central	4	whole

BENGAL Tasks 64/65

Our group also participated in the BIOFEED experiment. Known amounts (~0.5 mg) of the algal mixture (*Emilana huxlei : Dunaniella minuta : Haslea ostrearia* = 1:1:1) were provided by Liverpool, for the enrichment of the cores. The amount of algal material necessary to enrich the cores, while preventing anoxia, had been calculated based on oxygen consumption rates given by Rob Witbaard (NIOZ). For more details about the BIOFEED experiment refer to the account elsewhere in this report.

BENGAL Tasks 50/51 (University of Ancona)

Six replicate cores were collected from separate multiple corer deployments, (see table below) and sectioned as described above. Four replicate cores were taken from a separate deployment and 1 cm^3 subsamples of sediment from each section were collected, and placed in sterile plastic test tubes. Approximately 3 ml of 2% formalin were added to each sample (1 ml pipettman pipette, autoclaved tips) the mixture was homogenised by shaking. Samples were stored as before.

Station	Location	Core	Use
13200#12	Central	5	slicing
13200#24	Central	4	slicing
13200#32	Central	4	slicing
13200#46	Central	12	slicing
13200#58	Central		slicing
13200#71	Central	10	slicing
13200#80	Central	3	DNA
13200#80	Central	4	DNA
13200#80	Central	8	DNA
13200#80	Central	9	DNA

BENGAL Tasks 50/51 (University of Patras)

Two cores from 6 multiple corer deployments were sectioned for the University of Patras (see table below). Cores were sectioned and stored as described above.

Station	Location	Core	Use
13200#12	Central	1	sliced sediment
13200#12	Central	2	sliced sediment
13200#24	Central	10	sliced sediment
13200#24	Central	12	sliced sediment
13200#32	Central	1	sliced sediment
13200#32	Central	2	sliced sediment

13200#46	Central	1	sliced sediment
13200#46	Central	10	sliced sediment
13200#58	Central	1	sliced sediment
13200#58	Central	2	sliced sediment
13200#71	Central	7	sliced sediment
13200#71	Central	8	sliced sediment

BENGAL Task 20 (University of Patras)

Although not in the initial aims of this Bengal cruise, 10 CTD water samples from various depths were collected at the request of Professor Varnavas. The aim was to filter 30 litres from each depth, however, on occasion, the volume of water filtered was less as a result of clogging of the membrane filter (45 mm diameter; 0.45 μm pore size). These samples were collected and filtered by Jacob van der Weele (NIOZ).

Minimum Gut Residence Time Protocol

The fluorimeter was calibrated in the range of 0.03 - 16 mM for AMC and MUF, the linear range for each substrate is from 0.03-4 mM. Both substrates were dissolved in 1-2 ml methoxyethanol before being made up to volume with MQ water. The total gut content of each animal was removed, its volume noted, and the gut sediment diluted 1+1 with artificial seawater (35 g NaCl/ l) to make it easier to work with. One ml aliquots of the gut sediment were pipetted (eppindorf, 1000 ml) into sterile plastic bags (5 ml, from UCG.), and 0.8 ml of substrate (L-AMC, or B-G-MUF, 0.1-16 mM, 6-7 ml methoxyethanol) was added (100 ml eppindorf pipette). For each experiment, eight concentrations were used, 0.12, 0.25, 0.5, 1, 2, 4, 8, and 16 mM, and for each concentration, two replicates and two blanks (gut contents for blanks were placed directly into 1.7 ml eppindorf vials and heated to 150°C prior to the addition of substrate) were also set up. The bags were then heat sealed and incubated at *in situ* conditions (480 bar, 4°C) for approximately one hour. After incubation, the gut-substrate mixture was transferred into 1.7 ml eppindorf vials, and the reaction quenched by placing the vials on a hotplate at 150°C for about 20 minutes. The vials were then cooled in a beaker of cold water and then centrifuged (2500rpm. 20°C, 20 minutes). The supernatant was then diluted by one hundred, and it's fluorescence measured (L-AMC 10 ml in 2 ml borate, 1M, pH 10, B-MUF, 10 ml in 3 ml borate, pH 10.)

Station	Gear	Species	Vmax
13200#9	OTSB	*Pseudostichopus spp.*	not determined
13200#27	OTSB	*Psychropotes longicauda*	not determined
13200#88	Benthic sledge	*Oneirophanta mutabilis*	not determined

For *Oneirophanta mutabilis*, the samples were incubated for 26 hours, in order to determine whether the previous incubation period had been insufficient to detect any activity. The results

obtained from this experiment have yet to be assessed. The problems encountered may have resulted from the elevated temperature of the animals when they reach the surface. The internal body temperatures of *Psychropotes longicauda* from the otter trawl and *Oneirophanta mutabilis* from the epibenthic sledge were found to be 13 and 10°C respectively.

Holothurian specimens were also collected for lipid and total hydrolysable amino acid analysis which will be carried out in Liverpool. Two sets of dissections were performed: (1) oesophagus, anterior, posterior, and rectum, and (2) foregut (first 1/2 of anterior), midgut (last part of anterior + mid section of posterior), and hindgut (last part of posterior + rectum). The results from these samples will be used to calculate feeding rates for each species studied, as detailed in the RRS *Discovery* cruise 222 report. The remains of the dissected specimens were retained for biochemical studies. Whole animals, six of each of the three dominant species, were also retained for biochemical analysis. A listing of the specimens retained is given in the account of Micheal Carton elsewhere in this report.

Davina Gair & Karen Mackenzie

Institut Universitaire European de la Mer Group

Multicore

Samples were collected for analyses of silicic acid and aluminium in porewaters, biogenic silica stocks, solubility and reactivity from ten multicores at the Central Position and Lander Sites. After sectioning and centrifugation, porewater samples were stored cool in teflon vials. Sediment was stored frozen for subsequent freeze-drying

Station	Location
13200#12	Central position
13200#24	Central position
13200#32	Central position
13200#33	Lander site D
13200#53	Lander site A
13200#61	Lander site E
13200#67	Lander site A
13200#71	Central position
13200#91	Lander site C
13201#05	Central position

NIOZ Lander

Samples were collected for silicic acid analysis from the NIOZ lander at four sites. They were sampled from the tube linking the glass vials used for oxygen determination to the syringe on

the BOLAS chamber. The mean sample volume recovered was 5 ml, with 1 ml used for the silicic acid sample. The samples were filtered to 0.2 µm and kept in tightly closed containers at 4°C. Samples were also taken from the grab and the Niskin bottle for additional start and end values.

Station	Location
13200#26	Lander site A
13200#59	Lander site D
13200#74	Lander site E
13200#91	Lander site C

CTD

Samples were collected from three CTD deployments for the determination of physical (temperature, salinity), chemical (oxygen, silicic acid, nitrate) and biological (POC/PON, chlorophyll, biogenic silica) parameters. Samples were also taken for ^{14}C and ^{32}Si production experiments. Samples for nutrients were stored at 4°C. After filtration on Nuclepore 0.6 µm filters, samples for biomass were either dried at 60°C (biogenic silica) or stored frozen (POC/PON, Chl-a). *In situ* simulated incubations were carried out through 24 hour periods for the determination of C and Si production. After filtration, samples were stored in scintillation vials at room temperature.

In addition to the three casts detailed above, 150 litres of surface water were filtered on 0.6 µm Nuclepore filters, for use in an intercalibration of the measurement of biogenic silica in suspended matter. A kinetic experiment was also carried out (^{32}Si) to determine the parameters of Si uptake rate by diatoms (6 hour incubation).

Station	Sample depths
13200#13	100 mab, 3000, 1000, 500, 300, 200, 100, 50, 34, 17, 10 and 3m
13200#38	100 mab, 3000, 1000, 500, 300, 200, 100, 50, 30, 15, 9 and 3m
13200#76	100 mab, 3000, 1000, 500, 300, 200, 100, 53, 35, 18, 11 and 3m
13200#85	3 m
13200#86	3 m

The depths in the euphotic layer were chosen according to a Secchi disk measurement performed the day before the experiment, to determine the vertical profile of light penetration. The shallower 5 depths thus corresponded to approximately 100, 25, 10, 1 and 0.1% of incident light.

Olivier Ragueneau

Meiobenthos Studies, University Gent

Two cores of 25.5 cm^2 from each of 6 multiple corer deployments were collected. Each core was sectioned into slices of 5 mm for the first centimetre, then 1 cm slices down to 5 cm and finally one slice of 5 cm down to 10 cm. Sectioning took place in the constant temperature laboratory at *in situ* temperature (3-4°C). From the first core of each deployment, one subsample of 1 ml was taken to study the distribution (patchiness) of the nematodes. From the second core from each deployment, two subsamples of 1 ml were taken respectively for estimating bacterial densities and for the analysis of the organic carbon. The remaining sediment from both cores was fixed to a final concentration of 4% formaldehyde. Meiofaunal composition, standing stock and the size spectra of the nematodes will be estimated from these cores. Two additional cores were collected and sectioned as described above. Each slice was stored in a Petri dish and frozen for later analysis of pigment and nutrient concentrations.

Maaike Steyaert

Trophic studies, Alfred Wegener Institute

The determination of trophic pathways is critical in understanding the structure, interactions and energy transfer in marine ecosystems. Such studies are normally based on stomach content analyses, but resolution of both temporal and spatial patterns is low. Naturally occurring stable isotopes of carbon ($^{12}C/^{13}C$) and nitrogen ($^{14}N/^{15}N$) can provide useful information about trophic pathways. These isotopes undergo a stepwise enrichment in the body-tissues of species of subsequent trophic levels. Isotope analyses is based on the actually assimilated material and allows the evaluation of long-term trophic relationships.

During the cruise, samples for stable isotope analysis were taken from multicore, box core, otter trawl, chalut à perche, SAPS, and amphipod traps (deployed on the NIOZ lander at 1 and 30 metres above bottom, both with protected bait). Meio-, macro-, and mega-benthos were sampled repeatedly (see lists below). Samples of smaller organisms were pooled into higher taxonomic levels in order to achieve sufficient mass for isotope analysis. All samples were freeze dried for isotope analyses at AWI. Stomach content analyses will be carried out on formalin preserved material from the otter trawl and epibenthic sledge.

sediment samples taken for community structure analysis. Sediment-contact-water (SCW) was collected from the water overlying the cores using a siphon.

Station	No. of cores for DNA analysis
13200#18	2
13200#28	1
13200#46	1
13200#58	1
13201#1	1

Water column samples were collected from the CTD rosette and filtered at 4°C using a Sterivex 0.2 μm filter. The filter was then preserved in 1.8 ml lysis buffer (EDTA, NaCl, Sucrose). The depths sampled in this way were: 50 m (25 l filtered), 100 m (25 l), 1000 m (24 l), 3000 m (20 l), 100 mab (20 l) and 6 mab (10 l and 15 l in two experiments). 5.5 Litres of water were also filtered from the overlying water from multicore deployment 13201#5. In each case, the samples were stored at -20°C.

SAPS (Stand-Alone Pumping System) is an *in situ* water filtration device, three of which were used during the course of this cruise. Two types of filter were used: 0.2 μm cellulose Nitrate filters were used to filter the bacterial fraction of the water column (UCG). These were preserved in glycerol and frozen for community structure analyses. GFD glass microfibre filters were used to filter particulate matter for both University of Liverpool and AWI. The filters for AWI were freeze dried for stable isotope examination, the University of Liverpool filters were frozen for analysis of organic carbon content.

Samples of gut contents were taken from four regions of the gut for each of three species of holothurian studied during the course of this cruise. Sections of gut wall and bacterial count samples were also retained. In all cases, the samples were preserved in glycerol and frozen for laboratory analyses of bacterial community structure. The three species studied were *Oneirophanta mutabilis*, *Psychropotes longicauda* and *Pseudostichopus* sp.. The gut was divided into four sections: the oesophagus, anterior intestine, posterior intestine and the rectum.

Gut content samples for bacterial counts, DNA and tissue samples were sourced as follows:

OTSB 13200#9 (*Oneirophanta mutabilis* and *Psychropotes longicauda*)
OTSB 13200#35 (*Oneirophanta mutabilis*)
Chalut a perche 13200#84 (all 3 species)
Chalut a perche 13200#93 (*Pseudostichopus* sp.)
Chalut a Perche 13200#94 (*Psychropotes longicauda*)
Epibenthic sledge 13200#99 (*Oneirophanta mutabilis*).

A series of pooled experiments were also carried out with University Liverpool and Queens University Belfast from the following sources:

Pseudostichopus sp. from OTSB 13200#60

Oneirophanta mutabilis from Chalut a perche 13200#70

Psychropotes longicauda from OTSB 13200#27.

Bacterial activity

Bacterial activity was investigated by observing the incorporation of radiolabelled compounds in samples incubated at both surface (1 bar) and seabed (480 bar) pressures. All incubations were carried out at the near-bottom temperature of 3°C and were for intervals of up to 18 hours. Bacterial DNA production was followed by the incorporation of [methyl-^{3}H] thymidine and protein production by the incorporation of L-[4,5-^{3}H] leucine. Activity experiments were performed on sediment, SCW and holothurian gut material. The three species of holothurian examined were *Oneirophanta mutabilis, Psychropotes longicauda* and *Pseudostichopus* sp.. Gut contents were divided into four sections: the oesophagus, anterior intestine (foregut), posterior intestine (midgut) and the rectum (hindgut). There was not always enough material in the oesophagus to carry out an activity experiment.

Thymidine incorporation was also performed on 6 cores from the BIOFEED experiment. Two cores were sliced and shared with a member from each group involved in the BIOFEED experiment (see account of Gooday elsewhere in this report). These were:

bacteria/nematodes cores A2 and C2

bacteria/chemistry cores A3 and C3

bacteria/foraminiferans cores A1 and C1

The cores were warm (15°C) on recovery which may have damaged the temperature- sensitive barophilic bacteria. The following table lists all of the activity experiments.

Station	Gear	Sample	Tracer
13200#18	Multicore	1 sediment core	Thymidine and Leucine
13200#24	Multicore	SCW	Thymidine
13200#27	OTSB	*Psychropotes* guts	Thymidine
13200#28	Multicore	1 sediment core	Thymidine and Leucine
13200#7	BIOFEED	6 sediment core	Thymidine
13200#58	Multicore	2 sediment core	Thymidine and Leucine
13200#60	OTSB	*Pseudostichopus* guts	Thymidine and Leucine
13200#70	Chalut	*Oneirophanta* guts	Thymidine
13200#71	Multicore	SCW	Thymidine
13200#93	Chalut	*Pseudostichopus* guts	Thymidine
13200#94	Chalut	*Psychropotes* guts	Thymidine
13201#1	Multicore	1 sediment core	Thymidine and Leucine
13201#1	Multicore	SCW	Thymidine

Michael Carton & Donal Eardly

Sample taxon / type	Number of species samples collected	Pooled sample collected
Foraminifera	1	✓
Porifera	1	
Cnidaria	12	
Sipuncula	1	✓
Platyhelminthes	1	
Nematoda	1	✓
Mollusca	7	
Scaphodoa		✓
Polychaeta	4	✓
Echiura	3	
Arthropoda	17	
Ostracoda		✓
Harpacticoidea		✓
Cumacea		✓
Isopoda		✓
Tanadacea		✓
Echinodermata	22	
Tunicata	2	
Pisces	7	
POM (surface layer)		✓
POM (80mab)		✓

Katrin Iken

Ornithology

Standard ten-minute observations were made from the bridge throughout the cruise as and when other duties allowed, and casual sightings were noted. In all, 174 standard observations were made over a period of 28 days (3-30 July), an average of 6.2/day, somewhat less than the target of 9/day, and 23 casual sightings were recorded. Weather during the cruise was fine for the most part. Winds were light to moderate throughout the period, with gale-force winds (≥34 knots = 17.5 m/s) recorded rarely and only during the hours of darkness. Wind direction was variable during the earlier part of the cruise while the influence of the Azores High Pressure System was strong but later the southwesterly quadrant came to dominate. Visibility was mainly good, deteriorating only rarely, usually during the occasional rain showers. The cruise falls into three parts; passage to the work site, occupation of that area, and the return to Vigo. Passage legs were short, about two days each, and can be considered together.

Passage to and from the work site (2-4 July, 29-30 July; 13+13 observations).

Birds were sparse with Cory's shearwater (*Calonectris diomedea*) the only species recorded outwardbound, and that species and the greater shearwater (*Puffinus gravis*) recorded on the return passage.

Work site, 48°50'N 16°30'W (4-28 July, 148 observations).

Nine species of seabird were recorded. However, numbers were low and birds were seen at only 48 observations (33%). Fulmars (*Fulmarus glacialis*) occurred most frequently (24 observations, 16%), followed by lesser black-backed gull (*Larus fuscus graellsii* - 15 observations, 10.1%), Cory's shearwater (12 observations, 8.1%) and British storm petrel (*Hydrobates pelagicus* - 9 observations, 6.1%). Apart from a flock of c. 150 Cory's shearwater and occasional flocks of Fulmars (maximum 37 individuals), bird numbers were very low. Even these small aggregations appeared to be artificial in that the flock of Cory's shearwater assembled during recovery of the OTSB and all of the larger flocks of Fulmars were associated with gash slicks, usually on evenings with light winds. Most sightings of British storm petrels were also associated with gash slicks. Cory's shearwaters were seen only up to 15 July suggesting that the cruise covered the end of high summer but preceded the onset of late summer and early autumn. The latter period is characterised by large numbers of greater shearwaters, but only a single individual of this species was recorded, on 24 July.

A combination of season and prevailing wind direction accounted for the near absence of land birds - 1 swallow (*Hirundo rustica*) and 2 house martins (*Delichon urbica*) formed the sum total of non-seabirds recorded.

MIKE THURSTON

ACKNOWLEDGEMENTS

RRS *Discovery* cruise 229 was an undoubted success, with the scientific programme fully completed to all intents and purposes, and certainly achieved more than I had realistically hoped to. For myself, and on behalf of all of the scientific party, I would like to thank Captain Mike Harding, all of his crew and all of the RVS support team for making it both possible and a pleasant experience.

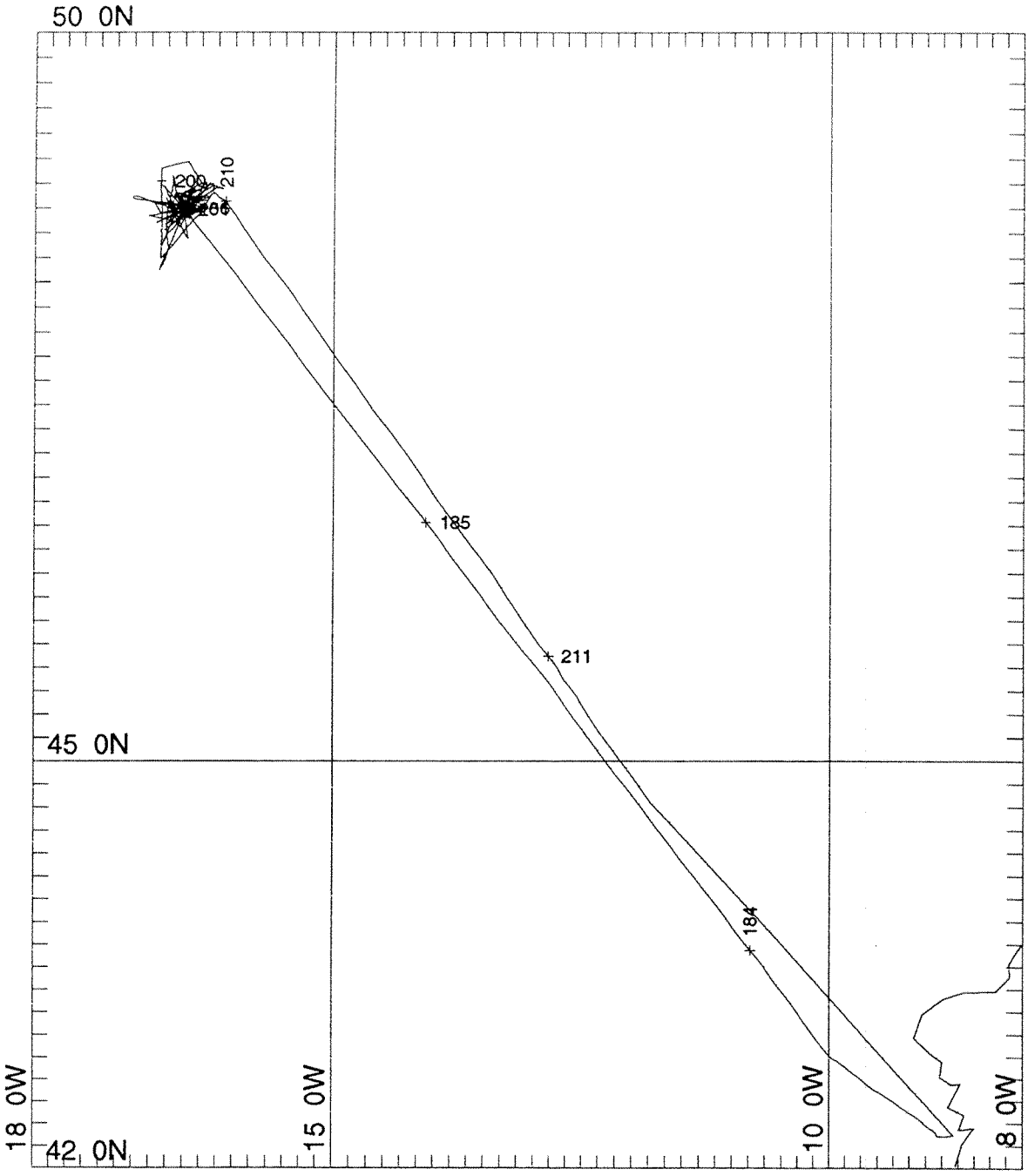

Figure. 1 Track chart showing *Discovery*'s passages to and from the Porcupine Abyssal Plain work site (annotations are Julian day numbers).

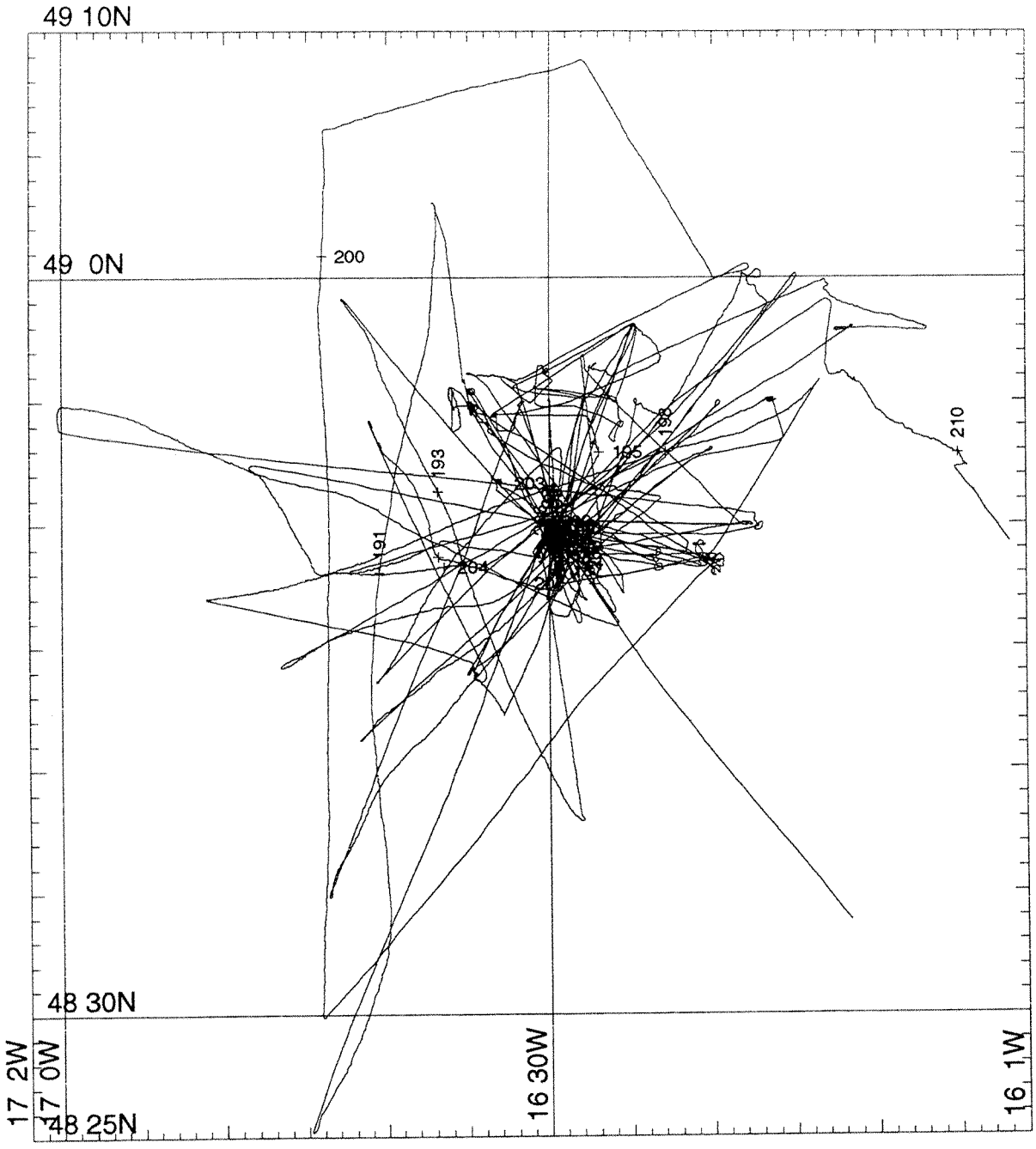

Figure. 2 Track chart showing *Discovery*'s operations in the area of the work site.

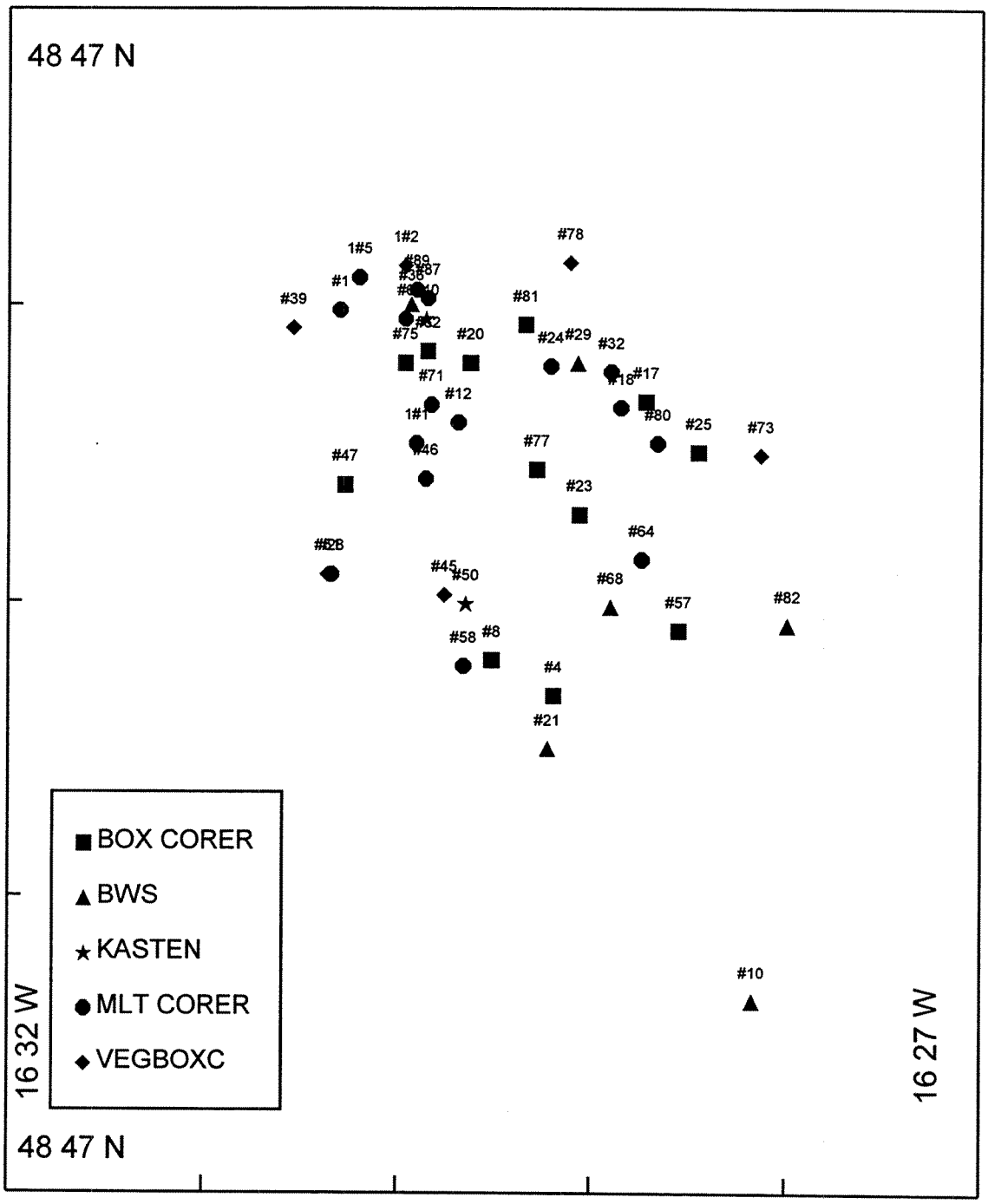

Figure. 3 Chart showing deployment positions around the central site. (Note that CTD and SAPS deployments are not shown).

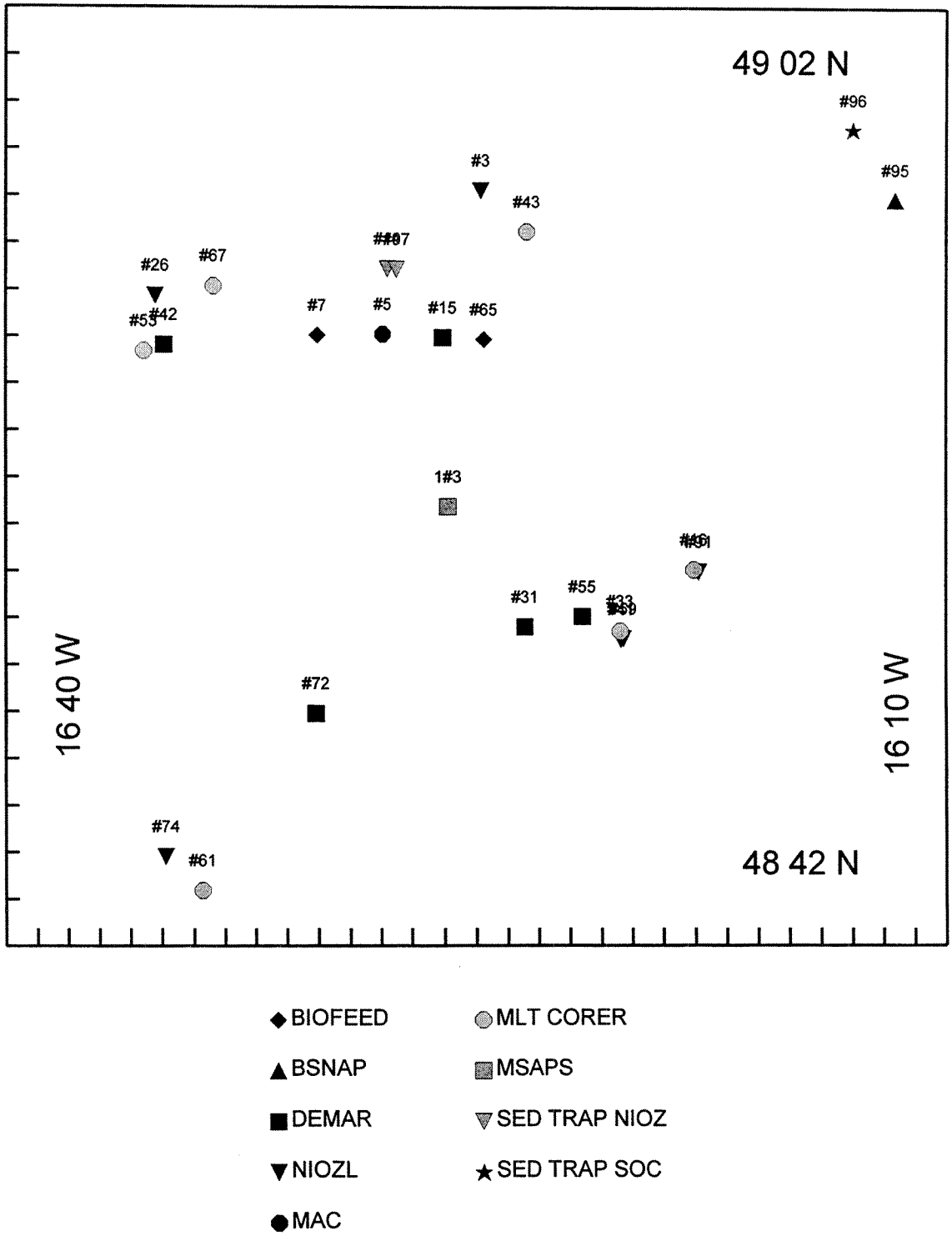

Figure. 4 Chart showing deployment positions in the wider study area. (Note that CTD, SAPS and those deployments shown on figure 3 are not shown here).

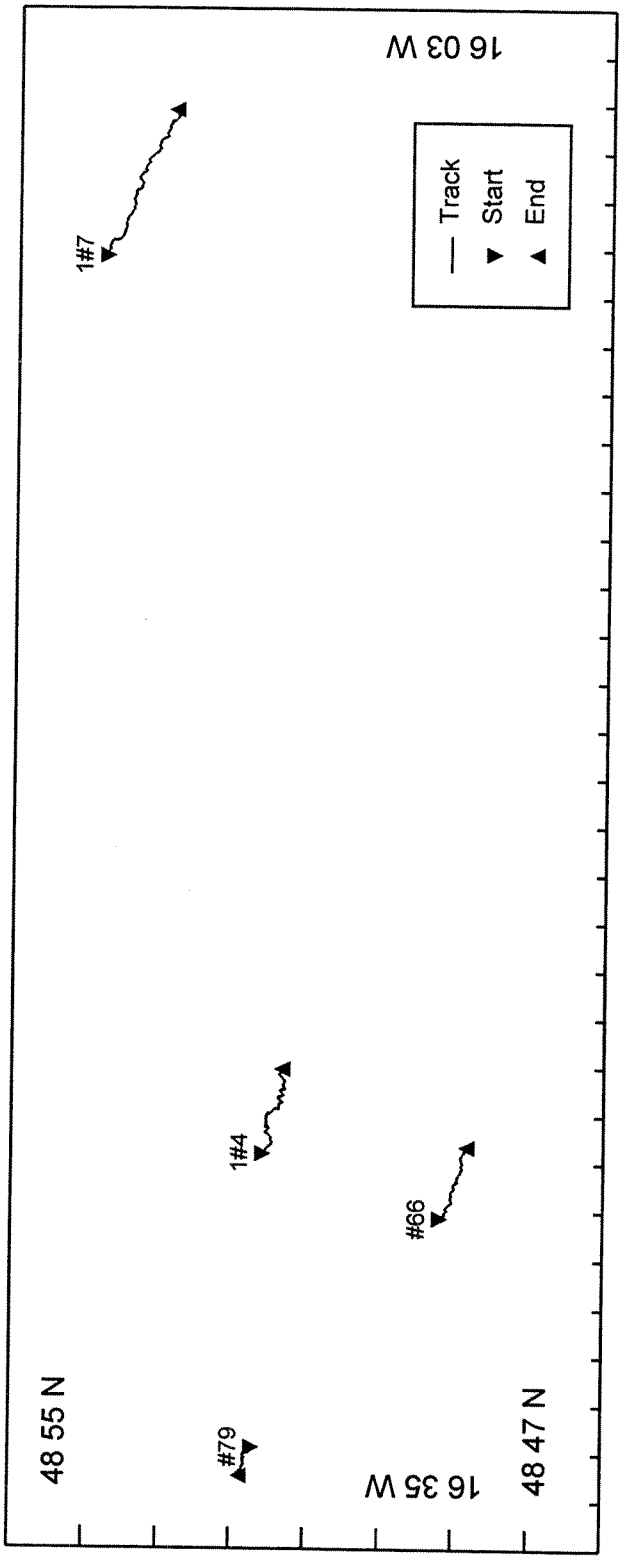

Figure. 5 Chart showing the tracks of WASP vehicle deployments.

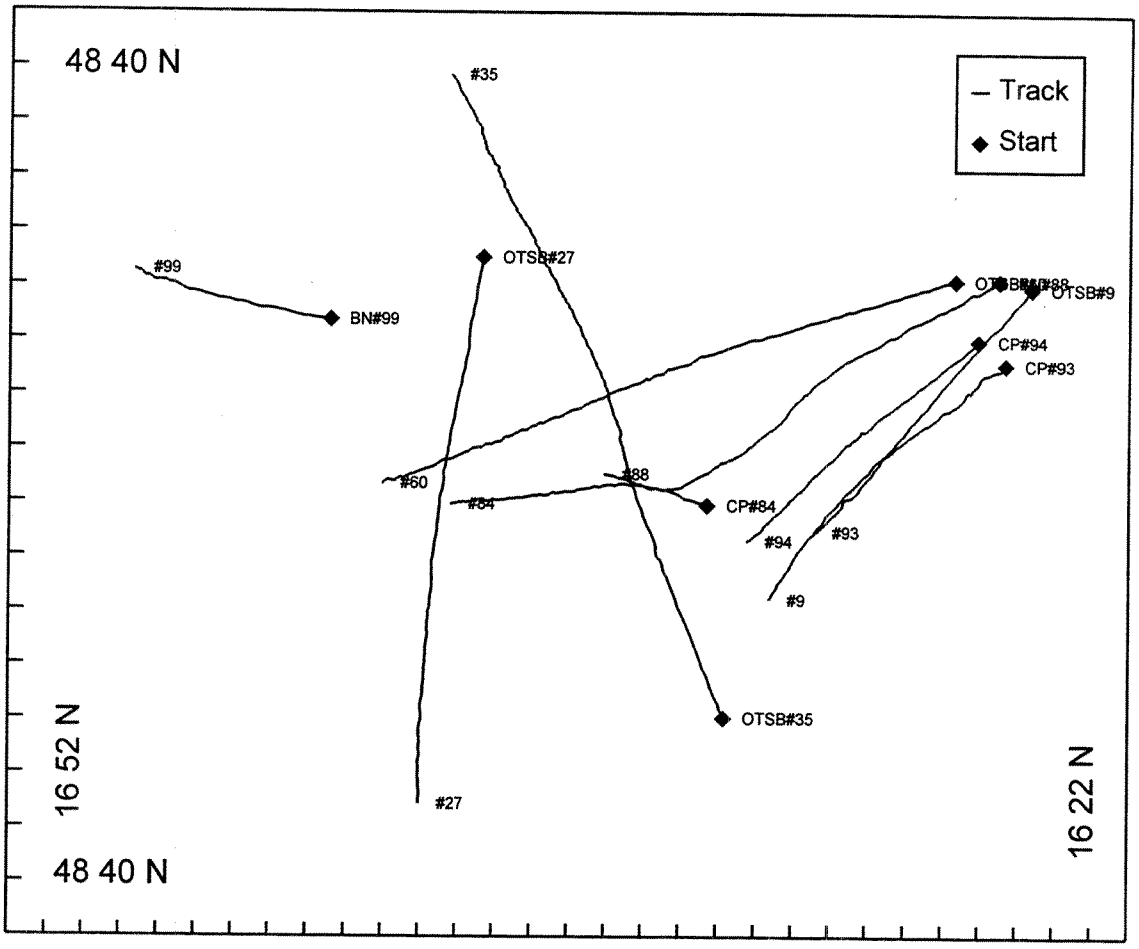

Figure. 6 Chart showing the tracks of epibenthic sledge (BN1.5/C), otter trawl (OTSB14) and Chalut à perche (CP) deployments.

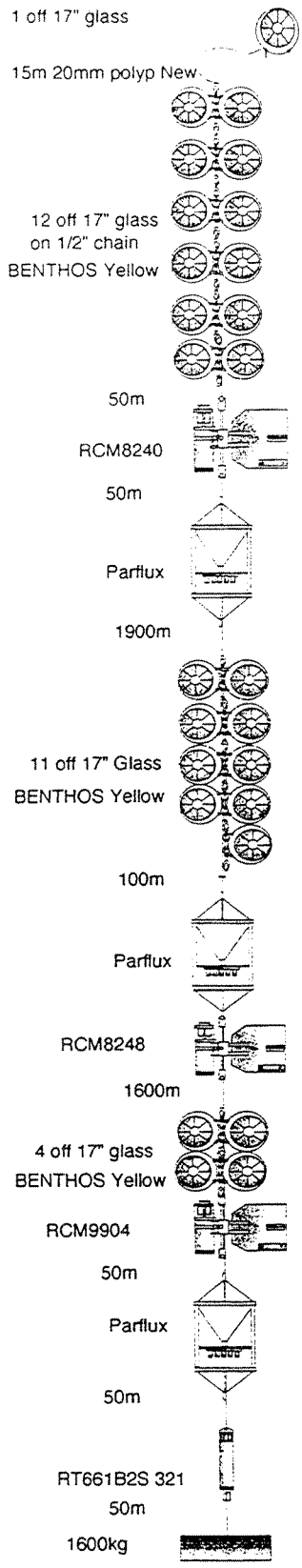

Figure. 7 Representation of the SOC sediment trap array deployed as station 13200#96 for intended recovery in March 1998 from RRS *Discovery* 231.

GEAR USED ON RRS *DISCOVERY* CRUISE 229

BIOFEED	Short-term *in situ* organic enrichment experiment based on recompressed multiple corer samples
BN1.5/C	Epibenthic sledge, single 4 mm mesh net
BOX CORER	Spade box corer (0.25 m^2), modified USNEL type, fitted with plain box
BSNAP	BATHYSNAP, free-fall time-lapse camera system
BWS	GEOMAR bottom water sampler
CP	Chalut à perche, 6 m beam trawl
CTD	Conductivity-temperature depth probe
DEMAR	Baited free-fall benthic amphipod trap
KASTEN	Kasten corer, 1 m, square section (15 cm), core barrel
MAC	Module Autonome de Colonisation, long-term enrichment and recolonisation experiment
MLT.CORER	Multiple corer, Barnett pattern, carrying 12 x 57 mm id core tubes
MS	Multi-sampler, water bottle rosette mounted on CTD frame
MSAPS	Stand-alone pump system mounted on free-fall rig
MSP	Marine snow profiler, particle camera mounted on CTD frame
NIOZL	NIOZ multifunction benthic lander system
OTSB14	Semi-balloon otter trawl with 14 m headline (effective fishing width 8.6 m)
SAPS	Stand-alone pump system
SED TRAP	Sediment trap array: SOC version with three carousel traps at 1000 m, 3000 m and 100 mab, NIOZ version with one carousel trap 11 mab
VEGEBOX	Spade box corer (0.25 m^2), modified USNEL type, fitted with 25 vegematic subcores (10 x 10 cm)
WASP	Wide Angle Seabed Photography vehicle

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #92	24/ 7 25/ 7	48 49.82N 48 48.64N	16 29.80W 16 30.80W	CTD MS	0-4834	2112-0118	No water, all bottles failed	4844
13200 #93	25/ 7	48 50.55N 48 47.46N	16 25.30W 16 30.42W	CP	4844-4849	1147-1404	Fished for 126min, good clean catch Tow dist. 8.488 km.	4849
13200 #94	25/ 7 26/ 7	48 50.99N 48 47.29N	16 26.03W 16 32.23W	CP	4847-4851	2309-0200	Fished for 171min, huge cleanish catch Tow dist. 10.227 km.	4851
13200 #95	26/ 7	48 57.92N	16 11.62W	BSNAP	4842-4842	1059-	For recovery in March 1998	4842
13200 #96	26/ 7	48 59.41N	16 12.97W	SED TRAP	4842-4842	1528-	SOC rig, for recovery in March 1998	4842
13200 #97	26/ 7	48 56.42N	16 27.48W	SED TRAP	4851-4851	1927-	NIOZ rig, for recovery in September	4851
13200 #98	26/ 7	48 49.93N 48 49.95N	16 29.61W 16 29.08W	CTD MS MSP	0-4838	1951-2315	Bottles at 100mab(3), 830mab(1), MSP OK	4848
13200 #99	27/ 7	48 51.36N 48 52.27N	16 43.42W 16 48.67W	BN1.5/C	4847-4850	0550-0740	Mud, small catch, flash flooded Tow dist. 6.639 km.	4850
13201 # 1	27/ 7	48 49.53N	16 29.90W	MLT.CORER	4848-4848	1841-	12 good cores, fluff on one	4848
13201 # 2	27/ 7	48 50.13N	16 29.96W	VEGEBOX	4848-4848	2228-	Limiter, good cores, SAMS protocol	4848
13201 # 3	28/ 7	48 51.36N 48 51.13N	16 25.88W 16 23.50W	MSAPS	4845-4845	0446-0646	Good bottom sample	4845
13201 # 4	28/ 7	48 51.59N 48 51.33N	16 26.79W 16 25.04W	WASP	4848-4848	0330-0530	Good run Tow dist. 2.196 km.	4848
13201 # 5	28/ 7	48 50.09N	16 30.20W	MLT.CORER	4848-4848	1136-	Pull out 4.41t, 12 good cores	4848

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #65	18/ 7	48 54.93N	16 24.75W	BIOFEED	4849-4849	0605-	Intended recovery Sep/Oct 1997	4849
13200 #66	18/ 7	48 49.28N 48 48.96N	16 28.77W 16 27.29W	WASP	4835-4841	0850-1020	Photographs but no altimeter reading Tow dist. 1.908 km.	4844
13200 #67	18/ 7	48 56.06N	16 33.37W	MLT.CORER	4845-4845	1500-	Lander site	4845
13200 #68	19/ 7	48 48.98N 48 48.75N	16 28.90W 16 28.86W	BWS	4845-4845	1800-1825	Water samples good, camera failed	4845
13200 #69	19/ 7 20/ 7	48 50.00N 48 48.93N	16 29.69W 16 29.90W	CTD MS	3844-4837	2146-0101	Bottles at 7mab(3) and 1000mab(5)	4845
13200 #70	20/ 7	48 51.62N 48 50.09N	16 31.80W 16 33.98W	CP	4845-4848	0412-0550	Good clean catch Tow dist. 3.891 km.	4848
13200 #71	20/ 7	48 49.66N	16 29.82W	MLT.CORER	4844-4844	1150-	Pull out 4.18t, 12 good cores	4844
13200 #72	20/ 7 21/ 7	48 46.95N 48 48.54N	16 30.07W 16 27.61W	DEMAR	4845-4845	1600-1622	24h deployment, good large catch	4845
13200 #73	20/ 7	48 49.49N	16 28.13W	VEGEBOX	4843-4843	1706-	Limiter, very good cores, SAMS protocol	4843
13200 #74	20/ 7 24/ 7	48 43.90N 48 43.65N	16 34.88W 16 34.54W	NIOZL	4845-4845	2106-0600	Successful deployment	4845
13200 #75	20/ 7	48 49.80N	16 29.96W	BOX CORER	4843-4843	2212-	No limiter, good core, sampled by GIF	4843
13200 #76	21/ 7	48 49.90N 48 49.45N	16 29.88W 16 28.30W	CTD MS	0-4833	0035-0336	Bottles at 100mab, 3000-3m for IVEM	4843
13200 #77	21/ 7	48 49.44N	16 29.28W	BOX CORER	4844-4844	1341-	Limiter, excellent core, IOS protocol	4844
13200 #78	21/ 7	48 50.14N	16 29.11W	VEGEBOX	4844-4844	2021-	Limiter, good cores, SAMS protocol	4844

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #10	6/ 7	48 47.65N 48 47.56N	16 28.17W 16 28.21W	BWS	4840-4840	1600-1608	3/4 water samples, ? rig tilted	4840
13200 #11	6/ 7	48 49.92N 48 50.14N	16 30.04W 16 29.70W	CTD MS	0-4837	1905-2230	Bottles 6-10mab, 48m, wire tests	4843
13200 #12	7/ 7	48 49.60N	16 29.68W	MLT.CORER	4842-4842	0054-	Pull out 4.35t, 12 good cores	4842
13200 #13	7/ 7	48 49.88N 48 49.05N	16 29.89W 16 26.97W	CTD MS	0-4834	0301-0625	12 bottles 100mab, 3000-4m	4844
13200 #14	7/ 7 26/ 7	48 56.43N 48 56.97N	16 27.79W 16 23.12W	SED TRAP	4833-4833	0837-1632	NIOZ rig, trap 11mab	4844
13200 #15	7/ 7 8/ 7	48 54.97N 48 55.19N	16 26.04W 16 25.81W	DEMAR	4844-4844	1056-1045	Strop splice failed at surface rig lost	4844
13200 #16	7/ 7	48 50.01N	16 18.03W	MLT.CORER	4843-4843	1148-	Lander site 1, 12 good cores	4843
13200 #17	7/ 7	48 49.67N	16 28.72W	BOX CORER	4843-4843	1601-	Limiter, excellent core, IOS protocol	4843
13200 #18	7/ 7	48 49.65N	16 28.85W	MLT.CORER	4843-4843	1933-	Pull out 4.31t, 12 good cores	4843
13200 #19	7/ 7 8/ 7	48 48.72N 48 47.43N	16 29.46W 16 28.66W	SAPS	100-3000	2345-0145	Pumps at 100, 1000, 3000m	
13200 #20	8/ 7	48 49.80N	16 29.62W	BOX CORER	4844-4844	0538-	Limiter, excellent cores IOS protocol	4844
13200 #21	8/ 7	48 48.50N 48 48.40N	16 29.22W 16 29.27W	BWS	4844-4844	2002-2010	All systems functional, ? rig tipped	4844
13200 #22	8/ 7 9/ 7	48 50.02N 48 48.75N	16 29.73W 16 28.49W	CTD MS	0-4837	2301-0214	Bottles 6-20mab, wire test	4843
13200 #23	9/ 7	48 49.29N	16 29.06W	BOX CORER	4844-4844	0535-	Limiter, good core, IOS protocol	4844

STN.	DATE 1997	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
13200 #37	12/ 7 13/ 7	48 49.83N 48 49.49N	16 29.91W 16 30.13W	CTD MS	0-4839	2149-0053	Bottles 5-130mab, wire test	4844
13200 #38	13/ 7	48 49.89N 48 48.75N	16 29.99W 16 30.90W	CTD MS	0-4840	0126-0432	Bottles 100mab, 3000-3m for IVEM	4843
13200 #39	13/ 7	48 49.92N	16 30.54W	VEGEBOX	4844-4844	0747-	Limiter, adequate cores, SAMS protocol	4844
13200 #40	13/ 7	48 49.95N	16 29.85W	KASTEN	4844-4844	1131-	Top 15cm of core lost, rest good	4844
13200 #41	13/ 7 16/ 7	48 48.52N 48 48.44N	16 20.36W 16 21.37W	NIOZL	4844-4844	1556-0915	Battery failure, no activities completed	4844
13200 #42	15/ 7	48 54.81N 48 55.03N	16 34.93W 16 36.08W	DEMAR	4844-4844	1833-1845	ETA bottom, 48 hour drop, big catch	4844
13200 #43	13/ 7	48 57.22N	16 23.38W	MLT.CORER	4849-4849	1920-	Lander site	4849
13200 #44	14/ 7	48 48.82N 48 47.52N	16 27.71W 16 26.82W	SAPS	40-3000	0310-0510	Excellent samples	4843
13200 #45	14/ 7	48 49.02N	16 29.75W	VEGEBOX	4844-4844	0846-	Limiter, good cores, SAMS protocol	4844
13200 #46	14/ 7	48 49.41N	16 29.85W	MLT.CORER	4844-4844	1239-	Pull out 6.55t, 12 good cores	4844
13200 #47	14/ 7	48 49.39N	16 30.27W	BOX CORER	4844-4844	1605-	Limiter, good core, IOS protocol	4844
13200 #48	14/ 7	48 49.91N 48 49.44N	16 29.95W 16 28.95W	CTD MS	0-4839	1810-2118	Bottles 4-13mab	4843
13200 #49	14/ 7 15/ 7	48 49.92N 48 48.93N	16 29.75W 16 30.07W	CTD MS	0-4831	2208-0112	Bottles 15-40mab	4846
13200 #50	15/ 7	48 48.99N	16 29.64W	KASTEN	4844-4844	0331-	Core cracked, missing top 15cm	4844

Epibenthic sledge (see figure 6)

The epibenthic sledge was deployed twice during the cruise. On both occasions it produced a large bag of mud with a varied, if small, catch. The catches were similar to those of the otter trawl hauls; dominated by the holothurians, but with most faunal groups represented.

The first net bottomed with a scope of 2.15, and fished well initially. Later, large regular changes in tension over a period of 2 minutes indicated that the cutting bar had cut deep into the sediment in a series of bites before freeing itself. The cutting bar had been set at its highest position, anticipating that the sledge would dig into the soupy sediment. On hauling the net stayed obstinately on the seabed for a further 3 hours, finally lifting off the seabed with a scope of just 1.32, following another series of large regular changes in tension. The ship's heading changed dramatically during the haul to follow the wind which veered from south west to north; this may have contributed to a less than successful haul.

The acoustic telemetry worked moderately well, giving a good indication of depth and the various tilt switches in the system. The variable tilt trace was very erratic and could not be seen for long periods. There was no evidence of the odometer or the flash working. On retrieval it was found that both had flooded. No seabed photographs were taken.

The second net was to be fished with a scope of no more than 1.8. The depth trace from the acoustic monitor became erratic and no clear indication of the depth of the net could be obtained, so the wire was paid out to 8700 m to give a scope of 1.8 and the ship's speed reduced to 1.5 knots to take the net onto the bottom. Fortunately in the calm conditions a bottom echo could be seen and by paying out of an extra 200 m the sledge was successfully landed on the seabed. The sledge performed well until halfway through the haul when there were again the regular, large changes in tension suggesting that the cutting bar was digging into the sediment. On recovery the flash was found to be flooded again and no photographs were taken.

Dave Billett

Trawling and megabenthos (see figure 6)

During this cruise megafauna was sampled with the SOC otter trawl (OTSB14) and the IFREMER beam trawl (the chalut à perche).

Otter trawl

The otter trawl is the same gear as was used on RRS *Discovery* cruises 222 leg 2 and 226. Briefly, it is a commercial shrimp trawl fished with 1.0 x 1.5 m dihedral otter boards and a 25 cm glass deep-sea float on the headline. The effective width of the net when fishing is 8.6 m. The body of the net is 41 and 37 mm stretch mesh netting, and the codend has a 6 mm mesh

liner. The trawl is fished on a single warp, but in order to deploy the otter boards and to gain full benefit from them, the boards are launched on 50 m bridles run off deck winches. These bridles are singled up onto a swivel attached to the main warp termination prior to paying out to operating depth. Recovery reverses this process.

The otter trawl was fished 4 times during the cruise (13200#9, #27, #35, and #60). For the first haul wire was paid out at 50-60 m/min reducing to 30-40 m/min with the ship making 3-4 knots reducing to 1.5-2.5 knots. At 12000 mwo, paying out was stopped and ship speed reduced to 1.5 knots resulting in bottom contact. Slow hauling commenced after 25 minutes. Tension was high but acceptable, and rate of haul was increased slowly to 20-25 m/min as tension allowed. The net came off the bottom with 9700 mwo after fishing for 2 hours and 24 minutes. At recovery, the legs were found to be twisted together immediately outboard of the main swivel, probably as a result of the omission of swivels at the inboard end of the legs. The haul produced a good clean catch of c. 70 kg of invertebrates and over 19 kg of fish. The second haul was fished in the same way except that ship speed was maintained at c. 2 knots after paying out was stopped at 12000 mwo and reduced to 1.5 knots only when slow hauling commenced 114 minutes after first bottom contact, when tension rose from 5.9-6.4 tonnes to unacceptable levels. The catch was clean, and contained c. 66.5 kg of invertebrates and nearly 24 kg of fish.

The pattern of the third and fourth hauls was initially the same, but after bottom contact, the speed of the net over the ground was allowed to drop too low following worries over tension readings. The boards collapsed and it is probable that subsequent high tension readings resulted directly from this. Misorientation of the boards is likely to increase the chances of a muddy catch, contribute to the difficulty of getting the net off the bottom, and explain the near-absence of fish in these two catches. The third haul was on the bottom for 7 hours and 15 minutes, came clear with barely 6000 mwo, and contained 3 tonnes of mud, c. 125.5 kg of invertebrates but only one small fish. The fourth haul was on the bottom for 4 hours 48 minutes, came off with 7600 mwo, and contained a clean catch of c. 96.5 kg of invertebrates but less than 1 kg of fish.

It is clear, as was evident from the OTSB deployments on RRS *Discovery* cruise 226, that the balancing of ship speed and winch speed is critical, and that the speed of the net over the bottom must not drop below the minimum design speed of the otter boards.

Holothurians dominated the catches, representing 92.2-98.1% of the invertebrate biomass. The four most abundant holothurian species, *Oneirophanta mutabilis*, *Psychropotes longicauda*, *Pseudostichopus villosus* and *Amperima rosea*, together accounted for 79.2-82.5% of invertebrate biomass. The rank order of these species differed among the four trawls, but the overall mean biomass (g/ha) fell within a factor of 2. This pattern conformed to that established on the two previous BENGAL cruises (RRS *Discovery* 222 leg 2 and 226)

rather than that found up to and including 1994, which was characterised by *O. mutabilis* equalling or outweighing all other holothurian species combined, and accounting for nearly half of the total invertebrate biomass. The table below shows clearly the overwhelming dominance of holothurians, with only actiniarians, cephalopods and asteroids contributing as much as 1% of invertebrate biomass in some hauls.

Mike Thurston

Chalut à perche

Megafauna were also sampled with the IFREMER beam trawl (chalut à perche). The design of the chalut and its operation were as described in RRS *Discovery* cruise 226 report. The chalut à perche was fished four times during the current cruise:

Station	Tow speed (knots)	Duration (hh:mm)
13200#70	1.5	1:40
13200#84	2-2.5	3:00
13200#93	2-2.5	2:10
13200#94	2-2.5	2:50

The first catch was good and clean, with about 33 kg of specimens in good condition. The second haul was not good, the upper part of the net was torn for about 2.5 m just behind the beam. The net was probably damaged at the beginning of the deployment. Moreover, a large quantity of mud was present in the codend of the net. About 26 kg of specimens, in fair condition were counted, weighed and preserved. The net was repaired and the third catch was rich in clinker but poor in animals, with only about 16 kg of specimens, mostly badly damaged by the clinker. The fourth and last catch was the best, it contained about 97 kg of megafauna in excellent condition (see table below).

Joelle Galeron & Philippe Crassous

Table of megabenthos data from otter trawl hauls (see preceding text for details)

Station	13200#9		13200#27		13200#35		13200#60	
	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)	Sample weight (g)	Biomass (g/ha)
Taxon								
Porifera	17	1.42	9	0.55		0.00	28	1.57
Umbellula	275	22.99	8	0.49	9	0.42	22	1.23
Pennatulacea	1	0.08		0.00		0.00		0.00
Actinauge	163	13.63	232	14.27	596	27.81	655	36.73
Amphianthus	79	6.61	74	4.55	84	3.92	132	7.40
Daontesia	23	1.92	13	0.80	46	2.15	110	6.17
Iosactis	7	0.59	9	0.55	12	0.56	57	3.20
Kadosactis	5	0.42	46	2.83	73	3.41	54	3.03
Segonzactis	12	1.00	12	0.74	14	0.65	32	1.79
Sicyonis	555	46.41		0.00		0.00	379	21.25
Actiniaria indet		0.00	1	0.06	9	0.42	1	0.06
Madreporaria	14	1.17	26	1.60	30	1.40	31	1.74
Zoanthidea	32	2.68	9	0.55	43	2.01	57	3.20
Echiura	109	9.11	65	4.00	206	9.61	512	28.71
Sipuncula	3	0.25	22	1.35	7	0.33	11	0.62
Turbellaria		0.00		0.00		0.00	+	
Vermes		0.00		0.00	1	0.05		0.00
Annelida	112	9.37	83	5.11	59	2.75	138	7.74
Worm tubes	++		++		++		++	
Cirripedia	6	0.50	8	0.49	23	1.07	10	0.56
Mysidacea	1	0.08	5	0.31	1	0.05	5	0.28
Isopoda		0.00		0.00	1	0.05	+	
Amphipoda		0.00		0.00		0.00	+	
Benthesicymus		0.00	158	9.72	10	0.47	86	4.82
Plesiopenaeus	78	6.52	198	12.18	61	2.85		0.00
Natantia (contaminants)	++		++		++		++	
Stereomastis	25	2.09	27	1.66	40	1.87	77	4.32
Munidopsis	14	1.17	71	4.37	219	10.22	134	7.51
Parapagurus/Epizoanthus		0.00		0.00		0.00	8	0.45
Colossendeis	2	0.17	7	0.43	5	0.23	18	1.01
Gastropoda	6	0.50	1	0.06	21	0.98	6	0.34
Bivalvia	7	0.59	9	0.55	5	0.23	8	0.45
Cephalopoda	69	5.77	3700	227.60		0.00		0.00
Dytaster	123	10.28	201	12.36	213	9.94	495	27.76
Freyella	8	0.67	15	0.92	26	1.21	27	1.51
Hyphalaster	59	4.93	54	3.32	327	15.26	913	51.19
Styracaster	36	3.01	45	2.77	152	7.09	450	25.23
Asteroidea indet		0.00	21	1.29	29	1.35		0.00
Ophiuroidea	21	1.76	32	1.97	29	1.35	100	5.61
Echinoidea		0.00		0.00		0.00	1	0.06
Amperima	9200	769.28	3706	227.97	23450	1094.15	14550	815.87
Benthodytes	4200	351.19	2000	123.03	2323	108.39		0.00
Deima	324	27.09	402	24.73	1014	47.31	788	44.19
Kolga+Ellipinion	827	69.15	228	14.03	1820	84.92	1745	97.85
Mesothuria	599	50.09	463	28.48	1251	58.37	572	32.07
Molpadia	37	3.09	147	9.04	279	13.02	728	40.82
Oneirophanta	16265	1360.04	22718	1397.46	31805	1483.99	19170	1074.93
Paroriza	2400	200.68	3793	233.32	11100	517.91	6410	359.43
Peniagone	99	8.28	70	4.31	50	2.33	45	2.52
Pseudostichopus villosus	8111	678.22	16807	1033.86	25128	1172.45	16920	948.76
Pseudostichopus sp	1314	109.87	1250	76.89	2238	104.42	3132	175.62
Pseudostichopus indet	181	15.13	186	11.44		0.00		0.00
Psychropotes longicauda	24216	2024.88	9474	582.78	22550	1052.16	27500	1542.02
Psychropotes semperiana	321	26.84		0.00	125	5.83	170	9.53
Holothurioidea misc	20	1.67	17	1.05	25	1.17	44	2.47
Crinoidea	1	0.08	1	0.06	1	0.05	2	0.11
Culeolus	69	5.77	29	1.78	32	1.49	69	3.87
Enigmatic	11	0.92	5	0.31	2	0.09		
Total invertebrates	70057	5858.00	66457	4088.00	125544	5857.76	96402	5405.58
Total holothurians	68114	5695.53	61261	3768.38	123158	5746.43	91774	5146.07
Total non-Holothurioidea	1943	162.47	5196	319.62	2386	111.33	4628	259.51
Fish	19261	1610.56	23805	1464.33	307	14.32	801	44.91

MSP - Marine Snow Profiler

The Marine Snow Profiler, a camera system designed to quantify the distribution of particulates in the water column, was deployed twice during the cruise. The first deployment (13200#98) was carried out in the vicinity of the central station (nominally: 48° 50′ N 16° 30′ W) and the second (13201#6) in the vicinity of the redeployed SOC sediment trap array (approximately 48° 56′ N 16° 12′ W). Both deployments were made to near-bottom (10mab) in soundings of 4848 m, and appeared to have been successful.

Brian Bett

SAPS - Stand-Alone Pumping System

During the cruise three SAPS units were deployed conventionally (i.e. warp mounted) on three occasions and a single unit was deployed on the DEMAR mooring (see accounts elsewhere in this report) on one occasion. The arrangement of the conventional deployments was as follows:

Station	SAPS1	SAPS2	SAPS3	Pumping time
13200#19	100m	1000m	3000m	2 hours
13200#44	40m	1000m	3000m	2 hours
13200#56	100mab	100mab	80mab	2 hours

The SAP deployed on the DEMAR rig (13201#3) was mounted to place the intake within 1 m of the seafloor and was at the seafloor for approximately one hour and forty minutes before the two hour pumping period commenced (i.e. to allow any resuspended sediment to disperse).

Michael Carton & Donal Eardly

WASP - Wide-Angle Seabed Photography (see figure 5)

The WASP vehicle was deployed on four occasions during the cruise and produced good, useful photographs each time; however, the system had two significant faults. No pressure trace was observed on the first or subsequent deployments (this was readily explained post-cruise by the absence of a pressure sensor !). Although not essential to the operation of the system, given that altimeter telemetry is only available at altitudes of less than 25 m, seafloor close-approach must be done carefully without the benefit of pressure telemetry. More significantly, no altimeter data was printed to the film, this resulted from an inappropriate software set-up that could not be rectified at sea. Fortunately good paper records of altimeter telemetry are available, while these can not realistically be used to scale individual photographs, they will nevertheless permit a sufficiently accurate quantification of megabenthos over each deployment as a whole.

Brian Bett