I.O.S.

RRS CHALLENGER

CRUISE 6/83

7 APRIL – 8 MAY 1983

BENTHIC AND MID-WATER BIOLOGY OF THE PORCUPINE SEABIGHT

CRUISE REPORT NO. 159
1984

INSTITUTE OF OCEANOGRAPHIC SCIENCES

NATURAL ENVIRONMENT RESEARCH COUNCIL

INSTITUTE OF OCEANOGRAPHIC SCIENCES

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INSTITUTE OF OCEANOGRAPHIC SCIENCES

WORMLEY

RRS CHALLENGER

Cruise 6/83

(IOS Cruise 517)

7 April - 8 May 1983

Benthic and mid-water biology of the Porcupine Seabight

Principal Scientist

A.L. Rice

CRUISE REPORT NO. 159

1984

CONTENTS

ITINERARY

Depart Falmouth	1240 GMT 7 April 1983
Arrive Falmouth	19 April 1983
Depart Falmouth	0900 GMT 21 April 1983
Arrive Falmouth	1815 GMT 8 May 1983

SCIENTIFIC PERSONNEL

D.S.M. Billett	IOS Wormley
P.A. Domanski	" "
M.J. Fasham	" "
I. Jenkinson	Galway (Leg 2 only)
R.S. Lampitt	IOS Wormley
D. Lewis	RVS Barry
R. Lloyd	" "
G.R.G. Phillips	IOS Wormley
A.L. Rice	" " (Principal Scientist)
J. Smithers	" "
P. Wallin	" "
J. Watson	SMBA, Oban

SHIP'S OFFICERS

P. MacDermott	Master
K. Avery	Chief Officer (Leg 1)
A. Moore	" " (Leg 2)
R. Hagley	2nd Officer (Leg 1)
T. Morse	" " (Leg 2)
A. Louch	3rd Officer
I. MacGill	Chief Engineer (Leg 1)
C. Harman	" " (Leg 2)
D. Hornsby	2nd Engineer
B. Entwistle	3rd Engineer (Leg 1)
P. March	3rd Engineer (Leg 2)

OBJECTIVES

1. To investigate the development of the spring phytoplankton bloom and its ultimate collapse, resulting in a rapid sinking of phytodetritus to the benthos.

2. To attempt to detect and sample the sinking material.

3. To deploy two bathysnaps to record the arrival of the phytodetritus on the sea floor.

4. To obtain a time series of SMBA multiple corer samples at a number of stations before and after the arrival of the phytodetritus.

5. To obtain epibenthic sledge samples of a hexactinellid sponge community at around 1250m depth, and miscellaneous invertebrates at 1500m.

6. To obtain long photographic transects using the epibenthic sledge as a photosled, without nets.

NARRATIVE

Leg 1

Challenger sailed from Falmouth at 1240/7 into light SW winds and the PES fish was streamed at 1300/8. The first station (51701), at approximately 58°14'N: 11°05'W on the eastern side of the Seabight, was reached at midnight/8 and a multiple corer was successfully completed by 0110/9.

Challenger now made for the 4000m station at approximately 49°50'N: 14°00'W for gear tests and a multiple corer sample.

A trial Seasoar deployment, bathysnap wire test and multiple core (51702#1) were successfully completed by 2130/9, but a failure of the power supply to the CTD fluorometer prevented the use of this gear and bathysnap was therefore prepared for deployment. Two deployment attempts failed due to the release mechanisms operating prematurely, but bathysnap was successfully

deployed in 4040m by 0330/10 (51702#2).

In freshening northerly winds Challenger now headed for what was to be the main station position of the cruise, at a depth of 2000m at 51°N: 13°W, arriving at 1940/10. Weather conditions were not suitable for the first CTD cast of the cruise and a multiple corer sample (51703#1) was obtained instead. During this haul an unforeseen problem arose when the power supply to the computer failed; it turned out that the lab. kettle, toaster and the computer could not all be used at the same time! Although the weather conditions had not improved significantly, the wind still gusting to 30+ kts, a CTD cast was successfully completed by 0218/11 (51703#2). A bathysnap deployment was again thwarted by release problems and Challenger headed for an intended 500m station at 51°30'N: 13°W.

This station was reached by 1200/11 and a multiple core sample (51704#1) and a CTD cast (51704#2) were completed by 1335/11, the latter revealing a well-mixed layer to about 300m and an attenuation peak at about 400m.

Challenger now returned to the 2000m station and, in rapidly improving weather conditions, a series of 8 CTD casts (51705#1-8) were completed by 0945/12, collecting water samples for the first series of analyses of suspended organic material.

During the night a scaffold pole and string monstrosity to carry the mid-water cameras (see separate report) had been erected on the after deck and an attempt was made to use the system as the final item at this station. Unfortunately, a flash unit fault prevented this and the station was abandoned at 1130/12.

The Seasoar system was not yet operational and, in any case, the water column was showing no signs of developing any significant stratification. With the improving weather conditions such stratification was now (unjustifiably) anticipated, so that while work continued on Seasoar the water column was to be monitored by fairly frequent CTDs. In the meantime some benthic sampling, unrelated to the main purposes of the cruise, was to be attempted. Accordingly, the ship made for the 1200m transponder station (see Cruise report 135 (IOS Cruise 512)), but with the intention of testing the mid-water camera system during the passage. This was achieved between 1200 and 1310/12, the camera being used successfully to a depth of 1000m (51706#1) and a CTD cast at the same

station (51706#2) was completed by 1510/12.

Challenger now proceeded to the transponder station and completed an epibenthic sledge haul (51707#1) and a deep CTD (51707#2) by 2330/12.

The next intended station was at a depth of c. 1500m (51°30'N: 13° 00'W) where we hoped to collect more specimens of the holothurian Kolga hyalina; a deep CTD (51708#1) and an epibenthic sledge haul at this station were completed by 0842/13.

Challenger now returned to the transponder station for a long photographic transect on the Pheronema ground. Using thin-based film and a 15 sec. inter-frame interval the gear has a total duration of some 6 hours, but on this occasion there was a problem with the monitor switch so that the camera photographed continuously from the surface. The gear was therefore towed on the bottom for only about 4 hours (51709#1) and the station was completed at 1740/13 by a CTD (51709#2).

Challenger now headed for a 600m station at 51°12'N: 13°50'W for the first of an intended series of CTDs out to the 2000m station which we hoped to reach by noon/14 for the first C_{14} experiment. The 600m station was reached at 2300/13 and two CTDs (51710#1 and 2) and a mid-water camera dip (51710#3) were completed by 0800/14. The two CTDs both showed an interesting attenuation peak at about 400m, but with no corresponding fluorescence maximum, suggesting the presence of resuspended material. However, we were unable to investigate this further since we had already lost time due to a problem with a fuel feed in the engine room and a further two hours were lost during the passage to the 2000m station because of steering gear problems.

We reached the station at 1300/14 and by 1530/14 two CTDs to 600m (51711#1 and 2) were completed, obtaining samples for the C_{14} experiment, and bathysnap was deployed (51711#3).

The Seasoar system was now launched (51712) for a roughly triangular survey of about 270nm intended to run up onto the Porcupine Bank to a depth of about 350m, then to cross the Seabight to a similar depth on the eastern side, and finally to return to the 2000m station.

Apart from a failure to log navigational data for roughly the first half of the survey because of a fault on the gyro interface, all went well until 1200/15 when the Seasoar records began to get very noisy. The fish was brought inboard at 1440/15 but no fault was found. The fish was redeployed at 1650/15 and the survey continued, the 2000m station being reached at 0500/16 and the survey being completed by a small box survey around this station ending at 0830/16.

During the Seasoar survey the fluorometer had shown a consistent sub-surface maximum with a decrease in the near-surface layer which became thinner during the night and rather thicker during the day. A CTD (51713#1) following the survey showed a high transmissometer trace in the near-surface fluorescence minimum, suggesting the presence here of phytoplankton containing little chlorophyll. A second CTD cast (51713#2) was therefore made with Niskins at the surface and at 15m to collect water for C_{14} uptake determinations in the low and high chlorophyll layers.

A third CTD dip was now made with the Flygt pump inlet attached to the frame (51713#3) but the pipe became detached in the heavy swell. After retrieval of the CTD the ship hove to awaiting an improvement in the weather.

Conditions improved in the evening of the 16th and a CTD dip (51713#4) was completed, with some difficulty, by 2120/16. Further over-the-side work was abandoned until 0900/17 when, with the WNW wind still gusting 20-25kts a multiple core cast was made (51713#5), but only 3 cores were obtained and the wire jumped off the main sheave as the ship pitched during retrieval. A second, successful, multiple core sample (51713#6) and a final CTD (51713#7) completed this station at 1240/17.

Challenger now made for the 500m station once more to obtain a second multiple core sample at this locality (51714#1) and a CTD dip (51714#2) which was completed by 2045/17.

The weather had by now moderated considerably, but from the CTD results it was clear that the recent high winds had restirred the water column and stopped the development of the bloom. It therefore seemed advisable to return to Falmouth at this stage, hoping that improved conditions would lead to a bloom development during the second leg of the cruise. On the way in, and

since the weather was quite good, Challenger made for a 1500m station to attempt collection of the holothurian Kolga and to make a night-time launch of the mid-water camera. The station position was reached at 0200/18 and the mid-water camera drop (51715#1) completed at 0400/18. A camera switch problem delayed deployment of the sledge until 0600/18, but the haul (51715#2) was successfully completed by 0840/18 when the ship proceeded towards Falmouth, docking in the evening of April 19th.

Leg 2

Challenger left Falmouth at 0900/21 into overcast conditions with fairly strong SE winds. Over the next 24 hours the wind increased to force 8-9 and veered to NE. Since the forecast was for further bad weather Challenger made for shelter in Bantry Bay where we spent most of 23 April.

By 1730/23 the weather had improved somewhat and Challenger made for the 2000m station, deploying Seasoar (51716) from the shelf edge at 0030/24 until the station position was reached at 0800/24. The Seasoar results revealed a rather complicated structure in the water column, but with a generally mixed layer to c 200m and no sign of significant bloom development.

Bathysnap (51711#3) was released at 0900/24 and brought aboard by 1017/24. A multiple core drop (51717#1) and an epibenthic sledge haul (51717#2) were successfully completed, but the CTD (51717#3) developed a fault in the sea-cable at 500m and the cast had to be curtailed.

At 2010/24 Challenger headed for the 500m station for the third multiple core sample at this position, but by the time we reached the station at 0300/25, 30-35kt NE winds prevented any overside work and the ship returned to the 2000m station. During the passage a problem with the ship's autopilot threatened to curtail the work severely but, in any case, by the time we reached the station position conditions were still too bad for work and Challenger therefore made for Mizzen Head where a new autopilot unit might have to be collected.

By 1440/26, and after several telephone calls and a great deal of effort by Derek Lewis, the autopilot seemed to be OK, but with a consistent small error. Challenger therefore headed for the 2000m station once more, Seasoaring from

the shelf edge from 1740/26 and carrying out a small survey around the station position from 0330 to 0930/27 (51718).

Although there was still little evidence of any stratification in the water column, the weather was improving rapidly, the forecast was good and, for the first time since the beginning of the cruise, we had brilliant sunshine for a time. The ship therefore remained at the 2000m station until 0330/30, achieving one bathysnap deployment (51719#1), 16 CTDs to depths ranging from 20m to 5m from the bottom (51719#2, 4-9, 14-17, 22-24, 26, 27), including water collection for suspended matter and C_{14} uptake experiments, 9 RMTs (51719#3, 10, 11, 18-21, 29* and 30) sampling each 100m horizon down to 800m (with one failure*), one multiple core (51719#12), one gravity core (51719#13), one photosledge (51719#25) and one mid-water camera (51719#28).

During this station the usual crop of calamities occurred, the most serious being a fairly severe thump to the transmissometer during recovery of 51719#7 (see separate report) and a two-hour loss of winch control due to an air leak which caused the mid-water camera cast to be aborted.

Following completion of the 2000m station Challenger moved to the 4000m station, releasing bathysnap 51702#2 and recovering it at 1614/30. A series of CTDs (51720#1, 2, 4 and 6), a multiple core sample (51720#3) and a gravity core (51720#5) were obtained while bathysnap was being serviced and the station was completed by a redeployment of bathysnap which reached the bottom at 2356/30 (51720#7).

Seasoar was deployed (51721) for the run back to the 2000m station, but had to be brought in after only 3 hours because of a faulty cable connection. The ship continued towards the 2000m position, but was hove to from 0700-0830/1 to collect water for photo-inhibition and C_{14} uptake experiments and for organic carbon determinations (51722), finally arriving at the 2000m station at 1330.

Seasoar was again deployed at 1430/1 (51723) for a run through the 650m station at 51°12'N: 13°50'W and then to the transponder station which was reached at 0040/2. A photosledge at this station (51724) was completed by 0550 and another Seasoar survey was made during the return run to the 2000m

station (51725 and 51726), interrupted from 0830/2 to 1210/2 for repair to a faulty termination.

On reaching the 2000m station a series of 3 RMTs (51727#1-3), 11 CTDs (51727#4-14) and one mid-water camera (51727#15) were completed by 0730/4.

At 1230/4 Seasoar was launched for an intended 10x10nm survey around the station, to be followed by a run to the north to examine a front indicated by the previous survey results and then to return to the 2000m station. However, because of force 5-6 SE winds the ship could not make sufficient speed on southerly courses and the survey (51728) was therefore restricted to the northerly run to 51°56'N: 12°59'W, where Seasoar was brought in, and Challenger returned to the 2000m station, arriving 0600/5.

Because of strengthening winds an attempt to CTD (51729#1) had to be abandoned at 0700/5 and the vessel was hove to until 1200/5 when conditions had improved sufficiently to allow a multiple core sample (51729#2) to be obtained.

Challenger now headed NW to a station in 1200m at 51°18'N: 13°25'W which was reached at 1600/5. A multiple core sample (51730#1) and a shallow CTD (51730#2) were followed by a photosledge towed on the bottom for almost 3½ hours, from 1170m to 1430m and over a distance of 4698m (51730#3). A second CTD, this time to close to the bottom (51730#4), completed this station at 0036/6.

This CTD was the first of a short series up onto the shelf edge, intended to follow the deep attenuation peak found consistently at 700-800m in the CTDs at the 2000m station and thought to be connected with the similar peak near the bottom at the 500m station. The other CTDs in the series were at 797m (51731), 700m (51732) and 460m (51733#1) and seemed to support the suggestion that the peak represents resuspended material advected along a density surface (see transmissometer report).

A final multiple core sample (51733#2) was obtained at the last of these CTD stations for comparison with the three samples taken in this area earlier in the cruise.

It had been clear for some days that because of the unsettled weather conditions we were not going to see a significant development of the spring bloom before the end of the cruise. Although we still wished to make a final visit to the 2000m station, a little time in hand allowed a photosledge haul (51734) between 1200m and 1000m and covering 5750m more or less mid-way between the transponder station and the photosledge at station 51730.

This haul was completed at 0600/6 and the 2000m station was reached for the last time at 2140/6. A multiple core sample (51735#1), an RMT from 1850 to 1350m (51735#2) and two CTDs (51736#1 and 2) were completed by 0800/7 when Challenger headed for Falmouth, docking at 1815/8.

Epilogue

The cruise was very disappointing since, despite a great deal of effort, the main objectives were not achieved simply because the weather conditions did not allow the hoped for development of the spring bloom during our working time in the Seabight. With the benefit of hindsight provided by the shamefully long delay in producing this report, we now know from the bathysnap results that the phytodetritus did not reach the bottom at 4000m until mid-June 1983 (later than usual?), though because of the failure to retrieve the 2000m bathysnap we have no idea when it reached this shallower depth.

The two final objectives, that is to obtain epibenthic sledge samples and photosledge transects unrelated to the phytodetritus problem, were amply fulfilled; this seems a poor reward for all the effort expended.

COMPUTING EQUIPMENT

A Seasoar fast data acquisition and processing system was installed on Challenger for this cruise. The purpose of the system was to acquire data from the CTD and its associated instruments, a variety of shipborne instruments and the ships navigation aids; to provide displays of the data and navigation in the form of graphs, profile plots and track charts.

This was the first time that the system had been installed on Challenger, though a similar system has been used successfully on Discovery. Several

modifications had been made to the Challenger version, both in hardware and software, some of which caused problems. Once these problems were overcome the system performed its functions well.

Only one breakdown of the system occurred, a failure of part of the computer memory, which was rectified during the mid-cruise call, though on three occasions the computer was 'disabled' by mains supply failure caused by other users on a common mains spur.

D. Lewis
R. Lloyd

SEASOR SURVEYS

Altogether 7 Seasoar surveys were made of which 3 crossed the continental margin. The chlorophyll values on the continental shelf were generally higher than in the Porcupine Seabight and a hydrographic front was found at the shelf edge. In the Seabight there were no major frontal features and surface chlorophyll concentrations were generally correlated with the degree of water column stability. Before the development of the shallow 30m pycnocline some isopycnals were observed dipping down from near the surface to around 200m and sinking plumes of chlorophyll were found to be associated with them.

TEMPORAL CHANGE IN CHLOROPHYLL DISTRIBUTION

Throughout the cruise the surface chlorophyll a distribution varied from 0.2 mg m^{-3} to 3 mg m^{-3} and showed a close correlation with the stability of the water column. At the beginning of the cruise wind speeds were in excess of 20 knots, the mixed layer was about 300m deep and chlorophyll concentration was less than 0.2 mg m^{-3} throughout the water column. Over the next four days (10-14 April) the wind dropped to less than ten knots resulting in the development of a thermocline at 30m and the consequent increase in surface chlorophyll to 0.8 mg m^{-3}. However, for the rest of the first leg of the cruise and the first few days of the second (up to the 27th of April) wind speeds were above 15 knots resulting in the erosion of the shallow thermocline and the halting of the chlorophyll bloom. From this time until the end of the cruise wind speeds were generally less than 15 knots and the 30m thermocline was re-established. This enabled a second

chlorophyll bloom to develop reaching values as high as 3 mg m^{-3}.

M.J. Fasham

OBSERVATIONS WITH SEA TECH TRANSMISSOMETER

(a) Details of use

The Sea Tech transmissometer measures the transmittance of red light over a 1m path length and was sampled in conjunction either with the deep CTD or the shallow CTD and Chelsea in situ fluorometer. In the PDP 1134 computer system transmittance values were converted to attenuation coefficiants because this quantity should show a close correlation with phytoplankton or particle density. Good results were obtained up until station 51719#6 when the instrument was unfortunately knocked on the side of the ship. After this the instrument suffered from loss of sensitivity although the air calibration value remained the same. By comparing deep values of transmittance before and after the knock it has been possible to estimate the new sensitivity.

(b) The deep attentuation peak

On a number of the deep casts of the transmissometer at the 2000m station a small consistent peak in attenuation was observed between 700m and 800m. On the 14th of April a shallow CTD cast to 580m was made on the Porcupine Bank and the transmissometer results revealed a pronounced nepheloid layer close to the bottom. Later in the cruise it was realized that the water in this layer had the same potential density as the water at the depth of the deep attenuance maximum noted at the 2000m station. This suggested the possibility that this maximum resulted from resuspended sediment being advected along density surfaces off the bank and into the Porcupine Bight. In order to test this a series of deep CTD casts were made from near the 2000m station up on to the bank (51730#4 to 51733#1) and the results supported the theory.

(c) Relationship of attenuation coefficient to phytoplankton chlorophyll

When the transmissometer was used in conjunction with the Chelsea in situ fluorometer it was apparent that below 10m there was a good correlation between the attenuation coefficient measured by the transmissometer and phytoplankton

chlorophyll a measured by the fluorometer. However, above 10m this correlation was only found at night due to the marked reduction of phytoplankton fluorescence during the day. This phenomenon has been previously reported and is due to the photoinhibition of fluorescence at photosystem II by high light levels. A time series of shallow CTD dips was made to investigate this in more detail (51720#2 - 51720#6).

M.J. Fasham

PRODUCTIVITY

The gross production of phytoplankton was measured six times during the cruise using the standard ^{14}C uptake technique. Apart from providing productivity measurements for comparison with the quantity of material sedimenting to the benthos, it was hoped to study changes in the production parameters during the development of the spring bloom and the adaptation of deep-living phytoplankton to low light levels.

Samples were taken using 7ℓ water bottles which had been scrupulously washed beforehand to avoid trace metal contamination. Light saturation curves were prepared for two depths at each station, except St. 51711#1, by incubating the phytoplankton in 40 light bottles for 3 hours over a gradation of light levels ranging from 1 to 350 Wm^{-2}.

Sampling and incubation data

Station	Date	Sample depth (m)	Time of Incubation	Temp °C	pH
51711#1	14:IV:83	40	1637-1937	12.0	8.24
51713#2	16:IV:83	3	1500-1800	12.0	8.27
		15			
51719#24	29:IV:83	20	1230-1530	12.3	8.31
		100			
51722#1	1:V:83	20	1200-1500	12.5	no data
		100			
51727#5	3:V:83	25	1145-1445	12.0	no data
		50			
51736#2	6:V:83	25	1104-1404	12.2	8.13
		60			

The sample at St. 51711#1 was taken at 40m in the centre of the chlorophyll maximum, as determined from the fluorometer profile. The two samples at St. 51713#2 were taken to investigate the apparent inhibition of photosynthesis in surface waters. Four stations were sampled on the second leg during the development of the major spring bloom. At each of these stations one sample was taken in the chlorophyll maximum while the other was taken at a greater depth to investigate the adaptation of phytoplankton to low light levels. Samples from each station were filtered through 10μm mesh to determine the major species present.

Approximately 2ℓ were drawn off each water sample used in the productivity determinations for identification and enumeration of phytoplankton species. These samples were concentrated using 10μm mesh and preserved in 5% buffered formaldehyde solution. In addition, daily phytoplankton samples were taken from the non-toxic sea water supply to monitor changes in the phytoplankton population throughout the period of the cruise.

D.S.M. Billett

P.A. Domanski

ORGANIC ANALYSES

Water samples for organic carbon, organic nitrogen and chloroplastic pigment analyses were taken using 7ℓ Niskin water bottles and the rosette of 1.8ℓ water bottles attached to the CTD. Duplicate samples were filtered gently through fine glass-fibre filters. The objectives were to use the chloroplastic pigments as an indicator of phytoplankton sedimentation and to assess the rate of degradation of chlorophyll during sedimentation.

Three vertical transects, nominally at 10, 25, 50, 100, 250, 500, 1000, 1500 and 2000m, were made at the same locality in the centre of the Seabight during the cruise. The first transect was made before the onset of the spring bloom, the second following mixing of an initial phytoplankton bloom, predominantly of Ditylum brightwelli, and the third at the end of the cruise following the development of another phytoplankton bloom. Details of the samples are given in the accompanying table.

Water bottle samples filtered for organic and chloroplastic pigment analyses

Station	Water Bottle*	Volume filtered ℓ	Depth (m)
51704#2	A	3	10
51705#1	A	7	4
51705#3	A	7	10
	B	9	500
51705#4	A	7	25
	B	8	1500
51705#5	A	7	50
	B	8	250
51705#6	B	9	1000
51705#7	B	7	100
51705#8	B	8	1973
51711#1	A	5	40
51713#2	A	5	2
	A	5	15
51719#2	A	7	1960
51719#4	B	8	1982
51719#5	A	5	10
	B	8	1500
51719#6	A	5	25
	B	8	762
51719#7	A	5	50
	B	8	500
51719#8	B	5	250
51719#9	B	5	100
51719#24	A	5	20
	A	8	100
51722#1	A	5	20
	A	7	100
51727#5	A	5	25
	A	5	50
51727#9	B	7	250
51727#10	B	7	500
51727#11	B	7	100
51727#12	B	7	833
51727#13	B	7	1871
51727#14	B	7	1500
51733#1	B	7	445
	B	5	445
51736#2	A	5	25
	A	8	60

*A = 7ℓ Niskin
B = 1.8ℓ CTD rosette

In addition, qualitative samples of phytoplankton for pigment analyses were taken from a net mesh 68μm (dinoflagellate net, DN, see station listing), to provide a series of samples in 100m bands from 0 to 1000m. On a finer scale, samples from 10m horizons were taken using a submersible pump from 5 to 95m. Samples for organic and chloroplastic analysis were also taken from the superficial sediment on the second leg.

A sub-sample of the phytoplankton sampled using the 68μm "dinoflagellate" net (DN) was resuspended and kept in the cold room for 11 days to monitor the breakdown of the chlorophyll over that period.

D.S.M. Billett

BATHYSNAP

Both Bathysnaps were again used on this cruise with few handling problems. As the photographs from Challenger cruise 10/82 were inferior to those previously obtained, the camera angle was changed back to 30° below horizontal, the lens height to 80cm above the sea bed and the flash gun to 60cm above. This gives a sea bed coverage of $2m^2$. As the main objective was to record the arrival of phytodetritus on the sea bed, colour film was used throughout. Both modules were deployed and recovered once during the cruise at 4040m and 2020m depth. They were then redeployed at the same depths with frame intervals of 512 mins and it is hoped that these will be recovered in September. No film or current meter tape has yet been examined. (See epilogue).

R.S. Lampitt

NUTRIENTS

Water samples were taken from CTD casts for analysis of nitrate, silicate and phosphate. In spite of problems with the Automatic Chemistry Unit, the spectrophotometer and the printer, silicate concentration was measured during the cruise in 10 vertical profiles and 2 horizontal transects across fronts. Most of the phosphate and all of the nitrate samples were frozen for analysis on shore.

R.S. Lampitt

SEDIMENT SAMPLES

The SMBA multiple corer was used on 16 occasions to provide a time series of samples of superficial sediment. It was hoped that during this series, deposition of phytodetritus from the spring bloom would begin. Stations at depths of approximately 460, 2000 and 4000m were selected and repeatedly sampled to provide material for analysis of chloroplastic pigment, radioisotopes, organic carbon and microbiology. Overlying water was taken on several occasions for nutrient analysis.

The 2m gravity corer was used twice to provide material for the radioisotopic estimation of sedimentation rate and a micropaleontological assessment of the long term history of the Porcupine Seabight. On both attempts good cores greater than 1.5m long were obtained using entry speeds of 40 and 70m/min.

R.S. Lampitt

MID WATER STEREO PHOTOGRAPHY

Large aggregates (1-10mm diameter) may be very important in the sedimentation of phytodetritus. A mid water stereo camera frame was therefore constructed which would enable such particles to be counted and measured. Two IOS Mk IV cameras were mounted 60cm apart and parallel to each other. Two flash guns 3.5m apart faced each other on a plane 1.8m from the plane of the camera lenses. An appropriately marked length of string was stretched between the flash guns to facilitate subsequent photogrammetric analysis. An acoustic beacon was mounted between the cameras to indicate depth and height above the sea bed.

Although a somewhat ungainly item, few handling problems were encountered. Five casts were made and, apart from an LED problem on one of the cameras, the gear appeared to perform as intended. However, careful analysis of the film is needed before it usefulness can be determined.

R.S. Lampitt

SUBMERSIBLE PUMP

The submersible Flygt pump with 100m of pipe was used on 3 occasions to sample particulate matter. The intake pipe was attached to the CTD frame and

outflow was passed through a 20μm plankton net. The material obtained was either frozen or preserved in lugols for subsequent analysis of radioisotopes, calorific value, elemental composition, chloroplastic pigments and species. The gear is awkward to use on Challenger and on one occasion the pipe parted and no material was obtained.

R.S. Lampitt

MICROBIOLOGY

During the cruise three vertical series of water samples were taken using the CTD rosette for analysis of the microbiota. Several individual samples of water, filtered phytoplankton or sediment were also taken and all were fixed in gluteraldehyde.

R.S. Lampitt

UNDERWATER CAMERAS

The reliability of IOS cameras on this cruise was generally good.

Bathysnap was deployed each time with Kodak Vericolor II colour negative film. New Tadiran lithium cells were fitted to all bathysnap cameras to overcome the failure of the LED display experienced on earlier deployments due to low battery voltages. Although the early LEDs will be overexposed, the use of the new cells was necessary to allow for voltage drop with time. For some, as yet unexplained, reason the batteries ran flat after only 290 frames (15 weeks) on station 51720#7. The photographs are also out of focus at this station except for the very near field.

The mid-water camera system used a pair of cameras, to produce stereograms of mid-water particles. The system generally operated successfully except that on the first deployment one LED display was inverted.

The shuttered camera used on the multiple corer failed to operate on some occasions due to the weight falling off the bottom switches, and also due to the shutter jamming because of pressure exerted by the window on the lens and shutter mechanism. Both of these problems were overcome during the cruise. A standard camera was used on two multiple corer hauls, but because it had to run continuously

there was no certainty of obtaining a good photograph before sediment obscured the bottom. Even the most successful photographs obtained with this technique were underexposed due to sediment obscuring the flash unit.

The new ½ frame 35mm camera was used on the photosledge hauls. This camera has a capacity of 1600 frames on thin-based film, that is twice the capacity of a standard camera. On the first deployment, using the new glass window, the lens was too far from the window and the corners of the frames were therefore obscured. In the early sledge hauls the net monitor tilt switch failed to operate correctly, resulting in fewer photographs than expected. This was not apparent during the hauls since the new event sensor, activated by the flash operation and producing a signal on the Mufax, was not fitted.

P.I. Wallin

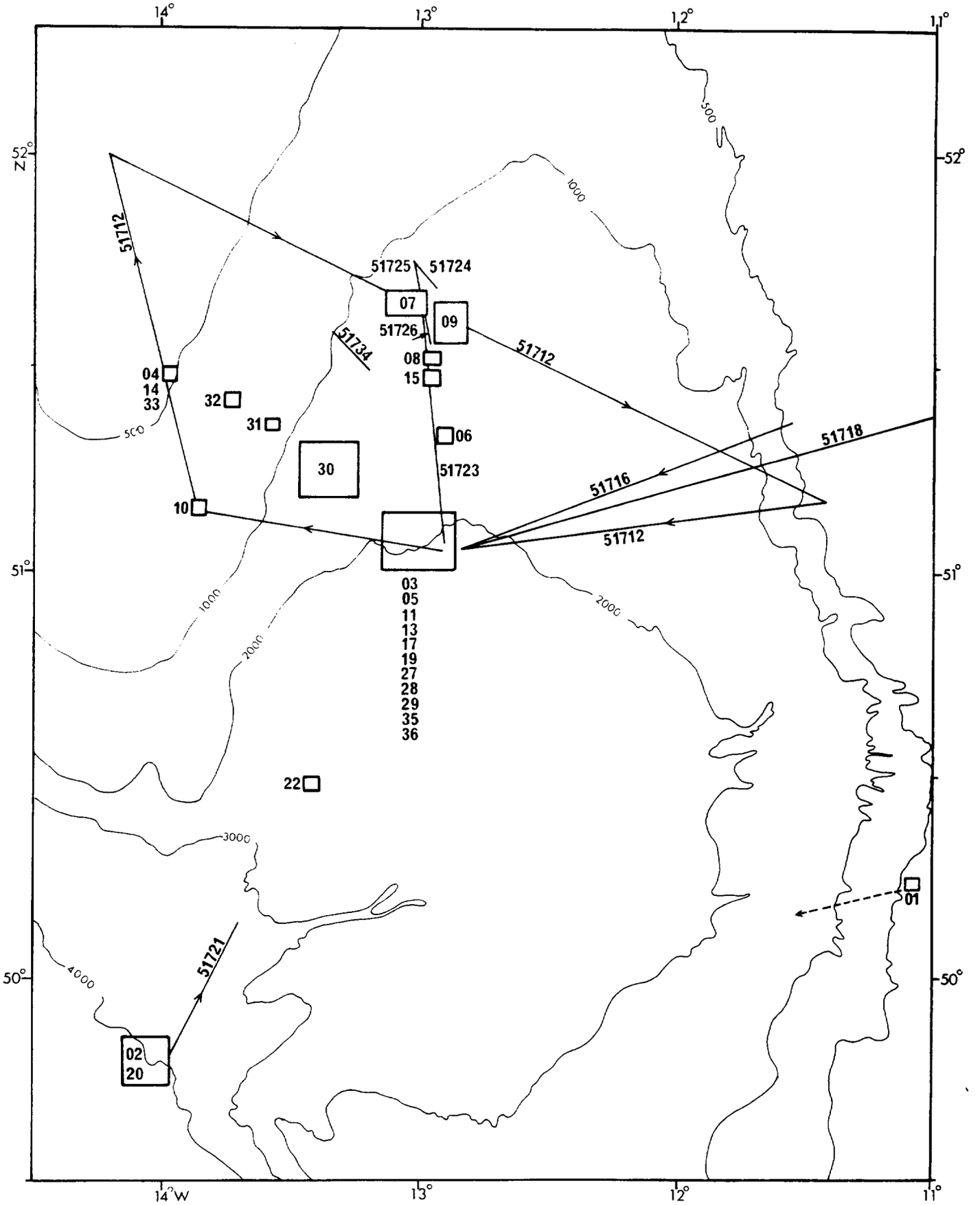
STATION LIST

STATION	DATE 1983	POSITION START N	W	POSITION END N	W	GEAR	SAMPLER DEPTH (M)	DURATION (GMT)	DISTANCE RUN (M) ODOMETER	CALCULATED	SOUNDING (M)	REMARKS
51701	9:IV	50°14.3	11°05.6			MC	463	0057			463	
51702#1	9:IV	49°49.1	14°07.4			MC	4045	2037			4045	
51702#2	10:IV	49°46.7	14°02.0			BSNAP	4055	0327/10:IV-			4055	
51703#1	10:IV	51° 0.5	13°05.2			MC	2075	2228			2075	
51703#2	11:IV	51° 4.0	13°09.5			CTD	500	0155-0215			c.2000	
51704#1	11:IV	51°29.8	13°59.0			MC	470	1227			470	
51704#2	11:IV	51°29.7	13°59.4			CTD	420	1253-1331			c. 500	
51705#1	11:IV	51°05.5	12°54.4			CTD	632	2002-2052			c.2000	
51705#2	11:IV	51°05.5	12°54.4			CTD	635	2103-2128			c.2000	
51705#3	11:IV	51°06.4	12°52.3			CTD	508	2342-0019			c.2000	
51705#4	12:IV	51°07.2	12°51.6			CTD					c.2000	
51705#5	12:IV	51°07.7	12°51.8			CTD					c.2000	
51705#6	12:IV	51°08.4	12°51.6			CTD					c.2000	
51705#7	12:IV	51°09.1	12°51.5			CTD					c.2000	
51705#8	12:IV	51°08.1	12°50.7			CTD	2000	0823-0944			c.2012	
51706#1	12:IV	51°19.6	12°54.1			MWC	1090				1770	
51706#2	12:IV	51°20.1	12°55.3			CTD	1515	1325-1510			1770	
51707#1	12:IV	51°39.9	13°00.0	51°39.2	13° 3.4	BN1.5C	1230-1205	2024-2120	-	4153		
51707#2	12:IV	51°37.6	13°07.9			CTD	1006	2223-2318			c.1250	
51708#1	13:IV	51°31.9	12°52.4			CTD	857	0114-0206			c.1500	Abandoned
51708#2	13:IV	51°31.3	12°58.4	51°31.0	13° 0.3	BN1.5/3M	1470-1430	0718-0757	943	2242		
51709#1	13:IV	51°40.4	12°57.5	51°34.1	12°52.9	BN1.5/P	1250-1490	1134-1600	5550	12837		
51709#2	13:IV	51°33.4	12°52.1			CTD	640	1713-1737			c.1600	
51710#1	13:IV	51°12.5	13°49.1			CTD	?	2319-2331			c. 650	Abandoned
51710#2	13:IV	51°12.7	13°49.6			CTD	220	0516-0558			c. 650	
51710#3	14:IV	51°12.5	13°48.9			MWC	670	0725			c. 680	
51711#1	14:IV	51°04.3	12°54.3			CTD	625	1316-1403			c.2000	
51711#2	14:IV	51°03.7	12°55.7			CTD	575	1453-1530			c.2000	
51711#3	14:IV	51°04.3	12°54.6			BSNAP	2020	1517			2020	Recovery failed
51712	14-16:IV	51°03.0	12°53.1	51°12.6	13°50.0	SEASOAR		1823-2330/14			2000-600	
		51°12.6	13°50.0	52°00.0	14°12.0			2330/14-0530/15			600-350	
		52°00.0	14°12.0	51°10.0	11°27.0			0530-2200/15			350-350	
		51°10.0	11°27.0	51°03.0	12°56.0			2200/15-0820/16			350-2000	

STATION	DATE 1983	POSITION START N	W	POSITION END N	W	GEAR	SAMPLER DEPTH (M)	DURATION (GMT)	DISTANCE RUN (M) ODOMETER	CALCULATED	SOUNDING (M)	REMARKS
51713#1	16:IV	51°01.7	12°56.7			CTD	600	0928-1044			c.2000	
51713#2	16:IV	51°00.7	12°58.9			CTD	15	1107-1212			c.2000	7ℓ bottles
51713#3	16:IV	50°59.0	13°01.8			PUMP	0-100	1432-1548			c.2000	Aborted, hose detached
51713#4	16:IV	51°02.3	12°55.7			CTD	620	2058-2120			c.2000	
51713#5	17:IV	51°03.0	12°57.7			MC	2020	0945			2020	Warp jumped off main sheave
51713#6	17:IV	51°01.9	13°00.3			MC	2020	1115			2020	
51713#7	17:IV	51°01.4	13°00.9			CTD	600	1149-1245			c.2000	
51714#1	17:IV	51°30.1	14°00.1			MC	462	1948			462	
51714#2	17:IV	51°30.2	14°00.5			CTD	417	2026-2045			c. 460	
51715#1	18:IV	51°28.5	12°55.0			MWC	0-700	0230-0400			1645	
51715#2	18:IV	51°29.4	12°58.8	51°30.5	13°00.5	BN1.5/3M	1535-1450	0703-0748	-	2899		
51716	24:IV	51°22.4	11°34.4	51°01.5	12°55.2	SEASOAR		0040-0803			380-2000	
51717#1	24:IV	51°03.5	12°57.2			MC	2012	1307			2012	
51717#2	24:IV	51°04.7	12°55.9	51°05.2	12°55.5	BN1.5/C	1980-1970	1546-1616	700	995		
51717#3	24:IV	51°08.2	12°51.7			CTD	1922	1832-1955			c.2000	
51718	26/27: IV	51°23.6	10°58.2	51°03.1	12°57.3	SEASOAR		1711/26-1018/27			183-2000	
51719#1	27:IV	51°04.5	12°55.3			BSNAP	2010	1250			2010	
51719#2	27:IV	51°04.5	12°55.2			CTD	2027	1204-1440			2037	10m from bottom
51719#3	27:IV	51°05.9	12°54.6	51°04.9	12°55.6	RMT1 + DN	10-100	1536-1636		39f.u.	c.2000	
51719#4	27:IV	51°03.9	12°54.5			CTD	2010	1736-1853			2030	20m from bottom
51719#5	27:IV	51°04.9	12°55.6			CTD	1520	1935-2041			c.2000	
51719#6	27:IV	51°04.1	12°55.0			CTD	768	2127-2207			c.2000	Transmissometer damaged
51719#7	27:IV	51°04.0	12°54.6			CTD	563	2249-2330			c.2000	
51719#8	28:IV	51°04.0	12°54.6			CTD	251	0004-0044			c.2000	
51719#9	28:IV	51°03.9	12°54.8			CTD	100	0148-0200			c.2000	
51719#10	28:IV	51°04.3	12°53.5	51°05.1	12°50.8	RMT1 + DN	700-800	0256-0356		36f.u.	c.2000	
51719#11	28:IV	51°06.5	12°50.0	51°05.5	12°53.0	RMT1 + DN	10-100	0502-0602		44f.u.	c.2000	
51719#12	28:IV	51°04.1	12°55.1			MC	2010	0723			2010	
51719#13	28:IV	51°03.5	12°54.7			GC	2025	0936			2025	
51719#14	28:IV	51°04.1	12°56.1			CTD	600	1305-1417			c.2000	
51719#15	28:IV	51°04.1	12°57.4			CTD	596	1449-1521			c.2000	
51719#16	28:IV	51°04.3	13°03.0			PUMP	0-98	1707-1936			c.2000	
51719#17	28:IV	51°03.9	13°03.7			CTD	21	1955-2036			c.2000	
51719#18	28:IV	51°04.3	12°54.1	51°05.9	12°55.8	RMT1 + DN	590-700	2208-2308		38f.u.	c.2000	
51719#19	29:IV	51°06.3	12°55.1	51°04.3	12°54.7	RMT1 + DN	490-600	0036-0136		37.5f.u.	c.2000	

STATION	DATE 1983	POSITION START N	W	POSITION END N	W	GEAR	SAMPLER DEPTH (M)	DURATION (GMT)	DISTANCE RUN (M) ODOMETER	CALCULATED	SOUNDING (M)	REMARKS
51719#20	29:IV	51°03.6	12°55.4	51°04.9	12°53.0	RMT1 + DN	395-500	0220-0320		36.5f.u.	c.2000	
51719#21	29:IV	51°04.1	12°54.9	51°02.9	12°56.8	RMT1 + DN	300-400	0401-0501		43f.u.	c.2000	DN side wire raised.
51719#22	29:IV	51°03.5	12°56.2			CTD	595	0617-0654			c.2000	
51719#23	29:IV	51°03.6	12°56.3			CTD	200	0715-0738			c.2000	
51719#24	29:IV	51°04.0	12°54.6			CTD	119	0807-0905			c.2000	
51719#25	29:IV	51°06.4	12°54.9	51°01.4	12°53.1	BN1.5/P	2030-1940	1220-1442		9460		
51719#26	29:IV	51°10.5	12°53.8			CTD	171	1616-1631			c.2000	
51719#27	29:IV	51°11.9	12°57.8			CTD	320	1745-1811			c.2000	
51719#28	29:IV	51°14.0	12°59.3			MWC	-	1945-2003			c.2000	Aborted - winch problems
51719#29	30:IV	51°11.4	12°58.5	51°09.6	12°57.7	RMT1 + DN	0-90	0012-0112		41f.u.	c.2000	Net failed to close
51719#30	30:IV	51°08.7	12°59.1	51°07.7	12°58.6	RMT1 + DN	105-200	0244-0314		19f.u.	c.2000	
51720#1	30:IV	49°46.9	14°04.1			CTD	302	1431-1453			c.4000	
51720#2	30:IV	49°47.0	14°03.8			CTD	320	1700-1718			c.4000	
51720#3	30:IV	49°47.0	14°03.9			MC	4010	1810			4010	
51720#4	30:IV	49°47.2	14°01.6			CTD		1911-1928			c.4000	
51720#5	30:IV	49°47.2	14°01.3			GC	4010	2017			4010	
51720#6	30:IV	49°47.2	14°01.2			CTD	107	2111-2137			c.4000	
51720#7	30:IV	49°46.2	14°01.9			BSNAP	4025	2356			4025	Recovered on cruise 518
51721	1:V	49°47.7	14°00.0	50°07.1	13°41.0	SEASOAR		0045-0343				Cable failure
51722	1:V	50°28.8	13°24.3			CTD	100	0718-0824			2585	C_{14}
51723	1:V	51°04.2	12°54.2			SEASOAR		1450/1			c.2000	
	2:V	51°39.7	13°00.4					0030/2			c.1200	
51724	2:V	51°40.9	12°58.3	51°45.0	13°01.9	BN/P	1230-1065	0238-0511	5050	8626		
51725	2:V	51°44.8	13°02.2	51°32.9	12°59.4	SEASOAR		0657-0827			1100-	Cable failure
51726	2:V	51°35.2	12°58.6	51°01.7	12°47.1	SEASOAR		1236-1945				Cable failure
51727#1	2:V	51°05.1	12°55.8	51°03.5	12°53.8	RMT1 + DN	200-300	2152-2252		42f.u.	c.2000	
51727#2	3:V	51°05.0	12°55.9	51°07.0	12°58.7	RMT1 + DN	920-810	0017-0117		48f.u.	c.2000	
51727#3	3:V	51°08.0	13°00.1	51°06.7	12°58.5	RMT1 + DN	900-1020	0242-0342		26f.u.	c.2000	
51727#4	3:V	51°04.2	12°55.5			CTD	310	0637-0656			c.2000	
51727#5	3:V	51°04.7	12°55.8			CTD	70	0734-0833			c.2000	Water for filtration
51727#6	3:V					CTD	300	0837-0913			c.2000	
51727#7	3:V	51°04.0	12°55.0			CTD	320	1245-1313			c.2000	
51727#8	3:V	51°06.2	12°59.2			PUMP	5-22	1446-1640			c.2000	
51727#9	3:V	51°07.6	13°00.8			CTD	250	1903-1927			c.2000	

STATION	DATE 1983	POSITION START N	W	POSITION END N	W	GEAR	SAMPLER DEPTH (M)	DURATION (GMT)	DISTANCE RUN (M) ODOMETER	CALCULATED	SOUNDING (M)	REMARKS
51727#10	3:V	51°06.1	12°58.5			CTD	507	2011-2030			c.2000	
51727#11	3:V	51°06.1	12°57.7			CTD	99	2101-2118			c.2000	
51727#12	3:V	51°08.8	12°56.1			CTD	846	2233-2343			c.2000	
51727#13	4:V	51°08.6	12°57.9			CTD	1873	0027-0114			1915	
51727#14	4:V	51°08.5	12°58.3			CTD	1499	0149-0217			c.2000	
51727#15	4:V	51°09.7	12°57.4	51°11.2	12°54.8	MWC	0-1980	0354-0641			1895-1985	
51728	4:V	51°03.1	12°54.8	51°00.4	12°54.5	SEASOAR		1248-1323				
		51°00.4	12°54.5	50°59.0	13°02.5			1323-1400				
		50°59.0	13°02.5	51°55.6	12°58.5			1400-2041				
51729#1	5:V	51°03.4	12°54.5			CTD	14	0702-0725			c.2000	Aborted, bad weather
51729#2	5:V	51°03.7	12°56.3			MC	2010	1223			2010	
51730#1	5:V	51°18.0	13°25.1			MC	1130	1621			1130	
51730#2	5:V	51°18.2	13°25.9			CTD	311	1714-1745			1130	
51730#3	5:V	51°17.9	13°25.2	51°15.4	13°18.9	BN/P	1170-1430	1907-2224	4698	8680		
51730#4	5:V	51°14.3	13°16.0			CTD	1496	2349/5-0032/6			1510	
51731	6:V	51°22.4	13°36.5			CTD	792	0246-0311			797	
51732	6:V	51°24.5	13°41.1			CTD	694	0406-0427			700	
51733#1	6:V	51°30.0	14°00.6			CTD	445	0630-0705			450	
51733#2	6:V	51°30.1	14°00.8			MC	460	0724			460	
51734#1	6:V	51°29.7	13°12.2	51°35.3	13°18.2	BN/P	1200-995	1238-1551	5750	12539		
51735#1	6:V	51°05.2	12°54.6			MC	2005	2206			2005	
51735#2	7:V	51°08.2	12°58.5	51°11.5	13°03.7	RMT1 + DN	1800-1350	0033-0141		63f.u.	1910	
51736#1	7:V	51°07.0	12°57.0			CTD	322	0541-0617			c.2000	
51736#2	7:V	51°07.5	12°59.2			CTD	92	0620-0700			c.2000	Water for filtration



CHALLENGER CRUISE 517, STATION POSITIONS