CRUISE REPORT
Challenger 128/96 (SES 7)

July 10 to August 8 1996

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1) Aims and objectives

This cruise was the last of six cruises under the LOIS Shelf Edge Study (SES) aimed at defining the nature of the processes occurring at the shelf edge, their seasonal variability and their impact on the fluxes of nutrients and carbon across the shelf and into the seabed sediments.

The central aim of this particular cruise was to observe the summer regime at the shelf edge with the survey strategy used in previous cruises but with particular emphasis on the following specific objectives:

a) Survey of the slope current along the slope to the north and south of the SES box to determine the spatial structure and variability of the current.

b) Observations of the internal tide at the shelf edge, soliton development and associated dissipation in propagation onto the shelf

c) Completion of the of the sampling programme for of seabed sediments by coring at selected sites in the SES box over the seasonal cycle

d) Final recovery of the SES mooring array.

The cruise was divided into two legs The first leg was mainly concerned with measuring the water column structure and velocity field in the shelf edge regime while the second concentrated on coring of the seabed sediments and the final recovery of all components of the SES mooring array. The central thrust of the cruise programme was towards the study of physical processes but the usual full of set measurements in the biological and chemical aspects of SES was also incorporated into the programme.

2) Cruise Participants

Officers and Crew

R.A. Bourne	Master
P.A. Burridge	C/O
R.M. Atkinson	2/O
P.C. Reynolds	3/O
B.J. McDonald	C/E
A.F. James	2/E
C.J. Phillips	3/E
K.M. Connor	3/E
M. Trevaskis	CPO(D)
C. Vrettos	PO(D)
J.R. Perkins	SG1A
R.L. Leitch	SG1B
T.R. Edwards	SG1A
G. Crabb	SG1A
K. Pringle	MM1A
C.J. Elliot	SCM
G.A. Welch	Chef
T.W. Kennedy	Stwd
G.M. Mingay	Stwd

Scientists

(Leg A)

Prof. J. Simpson	(PS)	UWB
T. Rippeth		UWB
Harikrishnan**		UWB
M. Inall		UWB
D. Boon		UWB
R. Wilton		UWB
R. McCandliss		UWB
P. Smith		UWB
K. Jones		DML
A. Harrison*		POL
T. Banaczek*		POL
L. Gilpin		QUB
C. McKay		IOS
D. Cummings**		PML
B. Miller		RVS
A. Taylor		RVS

(* 1st half; ** 2nd half)

(Leg B)

M. Harvey	(PS)	DML
J. Watson		DML
K. Black		DML
N. McDougall	DML	
I. Ezzi		DML
F. Perez		UWB
A. Harrison		POL
G. Ballard		POL
T. Bananczek		POL
J. Foster		U Edinb.
D. Neave		BODC
A. Geary		SOC
A. Taylor		RVS
R. Powell		RVS

3) Cruise Narrative

In this section we shall describe briefly the progress of the cruise, highlight the main events and indicate some of the problems that arose. Diagrams showing the cruise tracks for each leg are shown in figures 1 and 2 respectively. Full details of all scientific operations in chronological order are presented in Appendix 1 which is the Diary of Events agreed by the Captain and Principal Scientist for leg B..

3.1) Leg A (10-26/7/96; JHS)

This leg was favoured by generally good weather with light winds for much of the period. In the second week, we experienced warm sunny weather for three days (16-18/7) during the highest July anticyclone on record when the ship's barograph recorded 1036.7 mb. Winds in the working area exceeded 25 kts only for two short periods (on 13/7 and 21/7).

The passage out to the SES area from Fairlie was slowed by a strong swell and headwinds so we accomplished only three of the planned shelf stations. We arrived 6 hours late in the SES area but managed to complete the deployment of two of the new moorings (N300 and S300) by nightfall. These moorings along with others at S140, S140E (50km to the east) and bottom mounted ADCPs at S140, S140E, S400 and S600 were deployed with all instruments set to fast sampling in preparation for the internal tide/soliton observations to be made in conjunction with the FLY profiler series. After a delays due to adverse weather on 13/7, and the need to manufacture new battery packs for the RVS ADCP, which had unexpectedly failed, the new array was completed by 14/7. We also serviced the toroid at S300 but deferred recovery of the S140 toroid, the tower of which had been damaged. During this period of mooring operations, night time was devoted to CTD surveys and water sampling, including pre-dawn samples for incubation, on the R and P lines.

The first FLY time series at S140 for the spring tide period commenced at 2030 on 14/7. After initial problems with computer malfunctions, the system performed well and continuous profiling continued for 16 hours with short breaks for CTD profiles. On the 15/7 we recovered the Met Buoy, which needed new batteries to be fitted at Barra, and the damaged toroid at S140. The instrument packages on the toroid were removed and it was redeployed as a marker to protect the S300 mooring. We then returned to FLY profiling, working a continuous 25 hour FLY time series at S140E. The remaining time, prior to our port call at Barra on 17/7, was used to survey a cross-shelf CTD section extending the S line in to Barra Head.

At Barra, there was a change of personnel, the Met buoy was serviced and we also took delivery of a replacement for the CTD altimeter which was not functional. Unfortunately the second unit also failed, so we were left without an accurate means to monitor the CTD height relative to the bottom for the rest of the programme.

We returned to the SES working area late on 17/7, re-deployed the Met buoy at S140 before dark and commenced on the detailed CTD section on the S line which involved extensive water sampling for nutrients, pigments, primary production, phytoplankton species and particulates. We also took advantage of the calm conditions with full sun to obtain a number of profiles of optical properties with the PRR radiometer. During this phase of the work, substantial numbers of pilot whales and dolphins were observed in the vicinity of the ship although rarely close enough to identify the dolphin

species.

Having completed sampling on the S line we proceeded north to survey two sections across the slope current (lines HC and HA). CTD profiles from 140m to 1000m were first taken to define the T/S structure on the section and this was followed by repeated passes along the line to observe the current structure with the ship's ADCP. The ADCP bottom track was operating to 500+m so, with calm sea conditions, we were able to obtain high quality data out to this depth. In deeper water, however, where we were dependent on DGPS tracking to give the ship speed, the data was apparently less reliable.

On completion of the HA and HC slope current sections, we moved south, late on 20/7, to the N line to work the standard pattern of CTD stations and water sampling. In spite of strong southerly winds on the morning of 21/7, we were able to complete the section successfully. After trials of the both FLY probes (FLY4 and the new SOS version), we surveyed a further slope current section on line HD south of the SES box.

The second (neap tides) set of FLY observations commenced with an 18 hour series of profiles at S140 during which some significant internal wave activity was apparent on the echo-sounder. A second series alongside the S140E mooring continued for 13 hours finishing at 0800/24 after which the mooring was recovered. Because of the wind direction (northerly) the U mooring could only be approached after the guard buoy, marking the ADCP, had been recovered, so it was decided to lift the POL ADCP and clear the site. We took more optical profiles in conditions of bright sun and light winds before proceeding to S500 for particulate sampling and the start of the final FLY series at the top of the slope on the S line. This series was successfully concluded on the morning of 25/7 leaving time for recovery of the S400 ADCP and the fast-sampling mooring at S140, both with some difficulty because of severely restricted visibility.

3.2) Leg B (26/7- 8/8/96; MH)

Apart from the bad weather experienced on 30-31st July, conditions throughout the cruise were mostly on the right side of marginal.

27/7/96 The ship sailed from the MOD pier, Fairlie, in the morning, in sunshine and light winds. A noticeable swell developed as we rounded the Mull of Kintyre, but our progress was not impeded. A series of stations was worked across the shelf, collecting water for SURRC. During the night the DML multi corer and bedhop camera were successfully deployed at S5, in approximately 170 m water depth.
28/7/96 The SES box was reached in the morning. The S140 ADCP and 'U' mooring were recovered, and the ship proceeded to S300 where the pop-up current meter mooring was recovered. Once this was completed the ship proceeded to R1000, the second coring site.
29/7/96 In the early hours of the morning the snow camera was deployed at S1000 and S700. Mooring recoveries carried out during the day were the toroid buoy at S700, the ADCP at S600 and the pop-up current meter mooring at N300. During the morning one, and later three, sunfish (*Mola mola*) were seen close to the ship; it was generally agreed that this was a most unusual sighting.

After the mooring recoveries were completed the ship returned to S700 for deployment of the corer and bedhop camera.

30/7/96 Once the coring was finished the rest of the night was spent deploying the snow camera at S500, S140, S200 and S300. Wind and sea state deteriorated overnight, wind speed reaching 30 kts by 0700Z. An acoustic search was initiated for the S700 pop-up current meter mooring. A signal received from its ARGOS beacon indicated that it had been brought to the surface. The ship searched for and located the mooring 10 miles south of its deployment position but the heavy swell prevented its being brought inboard. The ship was therefore obliged to keep a watch over the mooring for the remainder of the day and night.

31/7/96 Conditions remained very poor throughout the day, and the time was spent maintaining the watch over the mooring which was drifting slowly northwards. By 2200Z, owing to the failing light and continuing high seas, the vessel hove to.

1/8/96 During the night the ship had travelled to the west. The weather was improving and in the early hours the ship returned to the vicinity of the mooring and commenced searching. The mooring was located again without difficulty and by 1245Z its recovery had been completed. We then proceeded to S1000, the next coring station. Through the night the snow camera was deployed at S1500 and N1500, the bedhop camera was also used at the latter station. Two CTD dips were also carried out here to obtain water for radionuclide profiles.

2/8/96 During the day the sediment trap mooring at N1500 and the pop-up current meter mooring at P1500 were recovered. The ship then proceeded to N1000 for coring and snow camera deployment.

3/8/96 Through the early hours the ship sailed eastwards along the 'N' line and snow camera was deployed at N700 (bedhop camera also at this station), N500, N300, N200 and N140. At N140 the 'U' current meter and BPR moorings were recovered. The ship then proceeded to S140 where dragging operations for the mooring deployed on CD93 were commenced. After several attempts the mooring was grappled, but during retrieval the weak link parted, losing both mooring and grapnel. A further attempt caught the mooring again, which was recovered along with the lost grapnel. During the evening the final coring station was worked at P1000.

4/8/96 Acoustic searches were carried out along the 200 m contour through the day. In the evening the bedhop camera was deployed at R700 and R1000. Worsening weather prevented the intended CTD dip at S700.

5/8/96 Acoustic searching was recommenced in the early morning, breaking off to recover the toroid at S300 and the Met buoy at N140. Following this the ship set a course for N2000, where the CTD was used to obtain water for radionuclide profiles, and the bedhop camera deployed.

6/8/96 The ship returned to a position south of the 'S' line where the acoustic searches had detected the presence of moorings. During the day two moorings were successfully grappled and recovered. The ship then proceeded to S700 where the CTD was deployed to obtain water for radionuclide profiles, and thence to P700 and N140 for bedhop camera deployments.

7/8/96 An attempt to grapple a mooring at S700 failed and, because of the time and uncertainty involved in deploying the grapnel at this depth, we decided against doing so a second time. The scientific endeavours of this cruise therefore ended at 0855Z, and the ship set a homeward course.

4) Individual Project Summaries

4.1 CTD Survey and Sampling (Ken Jones and Denise Cummings)

Full CTD profiles were obtained at all stations on the four priority lines (S,N,P,R) of the SES box. Measurements on the HA,HC and HD lines, and in support of the FLY programme, brought the total of CTD casts to 88.

4.2 Chlorophyll (Ken Jones, Paul Smith, Linda Gilpin, Robin McCandliss)

Water samples were collected from within and just below the euphotic zone during most CTD casts to calibrate the *in situ* fluorescence sensor on the CTD package. Samples were filtered onto GF/F filters and stored frozen pending analysis at Dunstaffnage at a later date. Samples were also routinely taken from the ship's non-toxic seawater supply and treated similarly to above to provide calibration for the fluorescence sensor mounted in the deck tank monitoring near-surface chlorophyll fluorescence.

4.3 Dissolved Inorganic Nutrients (Ken Jones)

Water samples from 72 stations along the S, N, P & R lines and ADCP transect lines to the north and south of the SES area were analysed, during the cruise, for ammonium, phosphate, silicate and nitrate + nitrite using flow-injection autoanalysis (Lachat Quickchem 8000)

Preliminary analysis suggests nitrate, phosphate and silicate concentrations were generally low above the thermocline throughout the SES area, reflecting utilisation by phytoplankton. Silicate and phosphate concentrations were at the limits of detection in the surface waters at offshore stations on the S line whilst nitrate concentrations here were relatively high (0.6-1.2 μmol l^{-1}) suggesting silicate (or perhaps phosphate) limitation of algal growth. In contrast, at the shelf break on the S line, silicate concentrations were higher (c. 0.2-0.4 μmol l-1) and the nitrate:silicate ratio (N:Si) more evenly balanced. The N:Si ratio transects on the N line and slope current sections to the north and south of the SES area suggest that nitrogen may have become more limiting later in the cruise. The observed changes in nitrogen:silicate ratios across the shelf slope region and in time may be due to changes in population structure and grazing levels and may have also been influenced by increased surface mixing in poorer weather conditions in mid-cruise.

Nitrate, phosphate and silicate concentrations increased rapidly with depth through the thermocline region, then only slowly down to the seabed at stations shallower than 700m. At deeper stations on the S line, silicate and phosphate concentrations continued to increase down to about 1300m and then remained uniform at greater depths. Nitrate concentrations, however, continued to increase to a depth of 1500m. Maximum concentrations were observed at the 1500m station where deep water concentrations of phosphate, silicate and nitrate were 1.1, 13.3 and 15.6 μmol l^{-1} respectively. Ammonia concentrations were higher over the shelf than seaward of the shelf break where they were usually in the range of <0.1-0.2 μmol l-1. However sometimes maxima of up to 1.0 μmol l-1 were observed in the vicinity of the thermocline possibly as a result of grazing activity and low dispersion in this region.

4.4 Production and size-fractionated chlorophyll (Linda Gilpin)

The object of this work was to determine the species composition, size distribution and photosynthetic characteristics of the phytoplankton assemblages located. Stations were sampled across the survey area to provide spatial coverage of the on shelf, shelf break and oceanic regions; special emphasis was placed on a study of the S and N lines.

The photosynthetic characteristics of the planktonic assemblages were determined from a photosynthesis versus irradiance (P:I) curve produced following sample inoculation with ^{14}C sodium bicarbonate and incubation under a range of irradiances using a photosynthetron. Following the incubation, any remaining ^{14}C was displaced using acidification and agitation. The incorporation of ^{14}C in the particulate component will be measured using a scintillation counter back in the lab. A time series P:I study was carried out; a 4 litre sample was incubated on deck with seven subsamples collected between dawn and dusk for the determination of P:I characteristics, chlorophyll concentration and plankton taxonomy.

Primary production in the euphotic zone was determined at four stations using 24hr incubations in an on-deck incubator. At station S140, where the euphotic zone was well mixed, a sample was collected at 15m from a predawn CTD cast. The depth of the euphotic zone at stations S1500 and N1500 was unknown at the time of sampling so 5m samples were collected. However, at station S700 water samples were collected from a pre-dawn CTD cast at 10 depths selected to represent 97, 55, 33,20,14,7,5,3,2 and 1% surface incident irradiance; the light levels simulated in the incubator. Triplicate 60 ml samples and one dark bottle were inoculated with ^{14}C bicarbonate in subdued light and incubated at each of the ten light levels in the on deck incubator. Following incubation, samples were fractionated under minimal vacuum using 18, 2 and 0.2µm polycarbonate membrane filters and the particulate incorporation of labelled bicarbonate will be measured using a scintillation counter. The resulting profiles of carbon uptake per day will be used to determine depth integrated primary production over the euphotic zone at each station.

Size-fractionated chlorophyll measurements were made for each water sample collected during the cruise. Samples were size-fractionated using 18, 2 and 0.2µm membrane filters and the chlorophyll concentration determined fluorometrically following acetone extraction. Duplicate plankton samples from each station were preserved in 50ml amber bottles using Lugol iodine and glutaraldehyde solutions.

4.5 Bio-optical measurements (Paul Smith,)

A total of 7 full optical stations were worked; each comprised an optical profile and an accompanying CTD cast at pre-determined depths, dependant on the fluorescence maximum and the attenuation of light through the water column. Stations were concentrated along the south line to calibrate the optical moorings deployed at S140, S200 and S700. Five fast optical stations were also undertaken along the south and north lines.

Two profiling radiometers (PRR-600 and CS21) and an integrating natural fluorometer(INF 300) were deployed from the hydro wire to a depth of 50 metres. At each of up to 12 depths, chlorophyll a and phaeopigment were determined fluorometrically. Spectrophotometric measurements included (i) Phytoplankton / Total Particulates,(ii) Yellow substance,(iii) Extracted Pigments ,(iv) Acidified

Extracted Pigments. Samples were also collected for HPLC analysis (to determine phytoplankton pigment composition), Suspended Sediment Concentration and Phytoplankton Taxonomic Analysis.

Fluorometric results show the first week of the cruise coincided with a mixed phytoplankton population, concentrations reaching a maximum of 2.5 mg / m^3. Concentrations remained stable during the S-line survey, with *Ceratium* dominating the population at the shelf break. The phytoplankton population then decreased to 0.5 - 1.5 mg / m^3 for the remainder of the cruise with flagellates and *Ceratium* the most common.

4.6 Internal tide/soliton and dissipation observations (Mark Inall and Tom Rippeth)

The object here was to measure the onshelf propagation and dissipation of the internal tide. Two pairs of moorings were deployed, one at S140 and the other at a site 50 km due east (S140E). Each pair consisted of a seabed ADCP and a U mooring with current meters at approximately 10 and 100 m above and below a 76 m thermistor chain. A major feature observed during the SES 3/CH121 cruise was the presence of internal solitons. In order that the features are resolved the moored instruments were set to a fast sample rate (2 minutes). All of the instruments were successfully deployed and recovered. Analysis of the ship board ADCP indicates approximately 75% of the internal tide kinetic energy is dissipated between the two sites.

Turbulent energy dissipation measurements were made at both the springs and neaps phases of the tide using the FLY free-fall shear probe at both the S140 and S140E mooring sites. The time series obtained, in each case, spanned more than 12.5 hours (the dominant tidal period). This data will provide a direct measurement of the dissipation of tidal energy. Further data was collected over a 12.5 hour period, along an off-shelf line (180-280m), which will provide information on the dissipation associated with the tide flowing on and off shelf.

4.7 The Slope Current Survey (Harikrishnan)

The present survey is a continuation of the SES3 (CH121) Slope Current experiment mainly aimed at determining the along slope structure and continuity of the slope current. We did CTD surveys on lines HA (57°25'N), HC (56° 50'N), S, and HD (56°00'N) (figs. 3 and 4) in addition to repeated current measurements over a semi-diurnal cycle (~12.5 hours) using the ship mounted ADCP (fig 5). Much of the data was acquired using the bottom track mode. Satisfactory bottom tracking was maintained usually to 450m depth. In deeper water we had to use DGPS navigational tracking and this appears to have been less satisfactory with inconsistencies between measurements before and after turns of the ship. The cause of this is thought to be related to the settling time of the ship's gyro compass.

The new CTD sections and ADCP observations will be complemented by the time-series measurements from the SES moorings. The resulting data sets will be analysed to reveal the along-slope changes in the current and T/S structure and to test for possible meandering behaviour. The new data should also enable us to examine the correlation between velocity and the salinity anomaly which appears to be associated with the slope and to assess the degree of cross slope mixing.

4.8 Particulates (Robin McCandliss)

In order to calibrate the CTD-mounted transmissometer, 137 samples were collected from GO-FLO bottles during CTD surveys and filtered through pre-weighed 47mm GF/C filters. Between 8 and 10 litres of water were filtered for each sample.

A total of 5 deployments of the UWB Settling Velocity Tube (SVT) samplers were successfully carried out. Samples were taken between 10 and 20 metres, within the fluorescence maximum, in order to determine settling rates of the phytoplankton. Performance of the tube triggering system was much improved since the last cruise. Upon recovery from the water, the tubes were set upright on a stand and subsamples were withdrawn from the base of the tube at 2, 10, 20, 40, 80, 160, 320, 440 and 600 minutes. 100 ml aliquots from each sample were filtered through GF/F filters and then frozen prior to acetone extraction of the chlorophyll and determination of chlorophyll concentration using the Turner Fluorometer on board the ship.

The SVTs were deployed at the following stations: S140, S140E, S500, S300, and S1300. Due to the continuing malfunction of the Galai laser and video micro-imager unit, it was not possible to perform any particle size or shape analysis during this cruise.

4.9 Sediment coring (Martyn Harvey, Jim Watson, Kenny Black)

Six stations were sampled successfully using the DML multicorer.
Station S5 (water depth approximately 170 m) had been identified as a potential coring site on the basis of photographs obtained by the bedhop camera on SES 6B. This was confirmed by examination of sediment retrieved by the Day grab, and a three deployments of the multicorer produced cores which were to be used for the following measurements:

Oxygen uptake rate
Sulphate reduction rate
Porosity
Particle size
Organic geochemistry
^{210}Pb
Organic carbon, stable isotope, fatty acids
Meiofauna

Stations R1000 and S700 were sampled as part of the study of seasonal variability in the parameters listed above.
Cores were obtained from stations S1000, N1000 and P1000 so that along slope variability of sediment properties and processes could be assessed.

4.10 Fluorometers and Nitrate Analysers (Ivan Ezzi)

Two fluorometers were used on or from the ship, one attached to the CTD and one in the deck tank being fed from non-toxic sea water supply for continuous underway sampling. In order to calibrate the CTD instrument, water samples were taken from 5m and 30/60m alternately from

CTD dips and filtered/frozen for later extraction and measurement at DML. The deck tank fluorometer was calibrated using water samples taken from the tank at regular intervals.

In situ Fluorometers.
Three fluorometers were recovered from moorings laid on cruise CH126A and data was recovered successfully. A fourth, deployed at the same time, was on a mooring which had been displaced, presumably trawled. This instrument was damaged and yielded data only for the first four days of deployment.

In situ Nitrate Analysers.
Four NAS nitrate analysers were recovered, two on leg A and two on leg B. Three of these had been deployed on cruise CH126A and one on CD93 on 9/5/95. Of the three deployed on CH126A two showed promising data, the third had failed. The fourth, which had been missing since May 1995, was undamaged but had no data after the first three days when it presumably was trawled. The battery pack showed some damage to wires and fuse holder suggesting a severe impact, resulting in loss of power.

My main activities during this cruise were related to the recovering of the sediment traps at station N1500 and handling of the samples. Also, water sampling at selected mooring locations for analysis of particulate organic carbon was carried out.

4.11 Sediment Traps and POC (Fernando Perez)

The recovery of the sediment trap array on station N1500, deployed in cruise CH126-B (SES-6), was successful. A reasonable quantity of material was collected in the 14 bottles in both traps through the 14 weeks on the mooring. The bottles were removed and the material was allowed to settle, then 30 ml of the supernatant was decanted off. Finally, 1 ml of formaldehyde was added to the samples to ensure their preservation.

To complement the sediment trap experiment, seawater samples were taken for the analysis of particulate organic carbon (POC). Vertical water column profiles were taken in duplicate from selected CTD Casts. For each sample, 800 ml of seawater were filtered through pre-combusted GF/F fibre glass filters. The filters were frozen and brought back to DML for further analysis. During leg B, a total of seven POC water column profiles were made.

4.12 Radionuclides, SPM's and Bed-hop camera (Jane Foster)

Approximately 20 litres of water were collected at 6-9 depths from stations N1500, N2000, R1000, S200 and S700. Each sample was filtered to remove the particulate fraction (>0.45 μm). The dissolved fraction (<0.45 μm) was collected via a precipitate of APDC (ammonium salt) and cobalt nitrate, after the addition of a known quantity of ^{208}Po and ^{206}Pb for yield determination, and filtered through a 3mm filter. These filter papers will be analysed for ^{210}Po (half life - 138 days) and ^{210}Pb (half life - 22 years) to determine the extent of disequilibria of these natural radionuclides between the particulate and dissolved phases in the water column.

Approximately 10 litres of water were collected from eight depths at stations N1500, R1000, S200 and S700. Around 3 litres from each sample were filtered through a 0.4 μm Nucleopore filter. The major element composition of the particles on these filters will be determined by thin- film XRF analysis. The remainder of each sample was filtered through glass fibre filters, which will be analysed for organic carbon using a C-N analyser.

Deployed nine times: N140, N700, N1500, N2000, P700, R700, R1000, S5 and S700.
25 shots at each station except P700 (deployment curtailed after 10 shots only due to loss of weight).
Films to be processed at POL by John Humphery.

4.14 Marine snow camera (Andy Geary)

Marine snow is accepted as being particles of >0.5mm, generally of biogenic origin. These large particles are formed in the upper mixed layer during periods of phytoplankton abundance as well as being resuspended due to advective processes operating on the sea floor. Interest in particles of this nature, lies primarily in their role in the biogeochemical cycling of the oceans and particularly carbon cycling.

An Ocean Instrumentation Ltd Mk7 Camera was set up in 'CTD mode'. This involved constructing a scaffold frame onto which is attached the camera, 14V power supply, a 300 microsecond Metz high power flash and a Fresnel lens. The flash is placed a set distance behind the lens which when triggered creates a collimated beam of light. The camera is set at right angles to the beam, a given distance from the centre of the lens. This enables the analysis of frames for a known water volume. Photographs are taken at 15 second intervals throughout the water column, enabling the construction of high resolution profiles of spatial/temporal particle distribution. If any features of interest are noted on the CTD screen, then stops of 2 minutes (8 frames) are made at these depths.
A total of 14 drops were made on CH128B covering depths from 140m to 1500m on both North (N) and South (S) transects. This will give between 100 and 400 photographs at each station depending on depth. Profiles were carried out at night to allow mooring work during daylight hours. All deployments appeared successful. Exposed films will be returned to SOC for processing. Particle distribution profiles are then constructed by subjecting the photographs to image analysis.

5) PSOs' Perspective

Both parts of this cruise were successful with regard to the achievement of the scientific objectives. In particular the survey of the slope current and its variation along the shelf was satisfactorily accomplished and the strategy of repeated ADCP sections has allowed a separation of the tidal and residual flow components in a way which was not possible with the 96 survey. We have also been able acquire an extensive series of observations of the internal tide and its dissipation at a the top of the slope and also at a remote site on the shelf.

The sampling requirements for sediment cores and the water column were accomplished in full thus completing the SES seasonal cycle of observations. All of the moorings in known positions were recovered and, as a bonus, nine moorings missing from previous deployments were located and three of these were recovered by dragging operations.

Overall this was a most satisfactory conclusion to the SES cruise programme. The successful outcome of the cruise was due in no small measure to the master, Richard Bourne, his officers and crew. The help and support they gave us, and their unfailing good humour, during even the most demanding of circumstances, made our tasks much easier, and contributed greatly to the positive atmosphere which prevailed on the ship. We owe them a considerable debt of gratitude.

Appendix 1, Diary of Events (from Richard Bourne)

Leg B

Saturday 27th. July '96.

Times in BST

0812 - Mooring Gang Arrive from Fairlie Depot; Standby Engines, Commenced Singling Up.
0816 - All Gone and Clear, Vessel Leaving Berth.
0820 - Vessel Clear of Berth and Swinging Head to Sea.
0830 - Vessel Passing Hunsterston Terminal. VHF Message Received from Fairlie Depot with information that they had a Package for the Challenger.
0835 - Principal Scientist consulted; Estuary Control Informed, and Vessel turning back.
0855 - Vessel Hove To off Fairlie Jetty; Lifeboat Lowered to Water and taken away.
0909 - Life Boat Recovered, and Vessel Turning Head to Sea.
0944 - Vessel Clears Hunsterston Channel.
0948 - Full Away on Passage, Set Course 190 True.

Times Now UTC for Scientific Purposes:

1010 - Lat: 55 29.4 N. Long: 04 58.9 W. Pillar Rock Point Brg: 300 True at 3.0 miles.
1050 - Lat: 55 24.5 N. Long: 05 05.4 W. Pladda Island L/H. Brg: 319 True at 1.3 miles.
1243 - Lat: 55 15.0 N. Long: 05 35.4 W. Sanda Island Abeam.
1330 - Lat: 55 15.8 N. Long: 05 49.9 W. Vessel off Mull of Kintyre.
1602 - 1631 - Lat: 55 26.7 N. Long: 06 19.0 W. CTD #91 Deployed to 101 metres at E32.
2104 - 2123 - Lat: 55 40.4 N. Long: 07 10.5 W. CTD #92 Deployed to 55 metres at AS1.

Sunday 28th. July '96.

0050 - 0102 - Lat: 55 54.9 N. Long: 07 59.8 W. Grab Deployed at Station S5.
0107 - 0126 - Lat: 55 55.0 N. Long: 07 59.9 W. CTD #93 Deployed to 167 metres at S5.
0145 - 0208 - Lat: 55 55.2 N. Long: 07 59.8 W. CTD #94 Deployed to 166 metres at S5.
0225 - 0237 - Lat: 55 55.1 N. Long: 07 59.9 W. Multicore MC#01 Deployed in 177m. at S5.
0249 - 0302 - Lat: 55 55.0 N. Long: 07 59.8 W. Multicore MC#02 Deployed in 176m. at S5.
0317 - 0331 - Lat: 55 55.1 N. Long: 07 59.3 W. Multicore MC#03 Deployed in 176m. at S5.
0353 - 0405 - Lat: 55 55.0 N. Long: 08 00.0 W. Multicore MC#04 Deployed in 177m. at S5.
0417 - 0503 - Lat: 55 55.0 N. Long: 07 59.8 W. Bed-Hop Camera Deployed to 170 m. at S5.
0753 - 0809 - Lat: 56 10.0 N. Long: 08 31.8 W. CTD #95 Deployed to 115 metres at AS2.
1126 - Lat: 56 27.7 N. Long: 08 57.6 W. POL ADCP Pop-Up Mooring Recovered at S140.
1220 - Lat: 56 28.0 N. Long: 08 57.7 W. Toroid Marker Buoy Recovered at S140.
1440 - Lat: 56 27.8 N. Long: 08 57.5 W. Toroid and Subsurface U-Shaped, Current Meter/ Thermistor Chain Mooring Recovered at S140.
1631 - Lat: 56 27.3 N. Long: 09 03.8 W. Sub-Surface Current Meter/Thermistor Chain Mooring Recovered at S300.
1832 - 1934 - Lat: 56 31.1 N. Long: 09 18.2 W. CTD #96 Deployed to 1005 m. at R1000.
1941 - 2013 - Lat: 56 31.4 N. Long: 09 18.7 W. Multicore MC#05 Deployed in 1037 metres.
2043 - 2113 - Lat: 56 31.0 N. Long: 09 17.7 W. Multicore MC#06 Deployed in 1002 metres.
2127 - 2157 - Lat: 56 31.0 N. Long: 09 17.8 W. Multicore MC#07 Deployed in 1007m;Failed.
2200 - 2229 - Lat: 56 31.2 N. Long: 09 17.7 W. Multicore MC#08 Deployed in 1003 metres.
2243 - Lat: 56 31.0 N. Long: 09 17.9 W. CTD #97 Deployed to 1020 metres at R1000.

Monday 29th. July '96.

0008 - Lat: 56 31.3 N. Long: 09 19.0 W. CTD Recovered.
0026 - 0156 - Lat: 56 31.6 N. Long: 09 19.1 W. CTD #98 Deployed to 1056 m. at R1000.
0316 - 0424 - Lat: 56 28.2 N. Long: 09 18.0 W. CTD #99 Deployed to 1000 metres at S1000, with Snow Camera.
0520 - 0611 - Lat: 56 27.0 N. Long: 09 09.4 W. CTD #100 Deployed to 689 metres at S700, with Snow Camera.
0719 - 0834 - Lat: 56 27.5 N. Long: 09 07.7 W. Attempting to Release Sub-Surface Current Meter/Thermistor Chain Mooring at S700. Not Responding to Commands, and Abandoned for the present.
1005 - Lat: 56 28.3 N. Long: 09 09.9 W. Instrumented Toroid Buoy Recovered at S700.
1220 - Lat: 56 28.0 N. Long: 09 07.8 W. POL Sea-Bed Mounted Pop-Up ADCP Mooring Recovered at Station S600.
1434 - Lat: 56 37.4 N. Long: 09 00.9 W. Spar Marker Buoy Recovered at N300.
1533 - Lat: 56 37.6 N. Long: 09 00.6 W. Sub-Surface Current Meter Mooring Recovered at Station N300.
1605 - All Secure; Set Course 205 True, for Station S700.
1639 - 1653 - Lat: 56 33.3 N. Long: 09 03.9 W. Vessel Hove To, for Acoustic Search.
1808 - 1911 - Lat: 56 26.4 N. Long: 09 09.5 W. CTD #101 Deployed to 680 metres at S700.
1926 - 1947 - Lat: 56 26.5 N. Long: 09 09.7 W. Multicore MC#09 Deployed in 711 metres.
2000 - 2023 - Lat: 56 26.4 N. Long: 09 07.7 W. Multicore MC#10 Deployed in 705 metres.
2035 - 2058 - Lat: 56 26.4 N. Long: 09 09.8 W. Multicore MC#11 Deployed in 709 metres.
2111 - 2132 - Lat: 56 26.4 N. Long: 09 09.8 W. Multicore MC#12 Deployed in 710 metres.
2141 - 2308 - Lat: 56 26.3 N. Long: 09 09.9 W. Bed-Hop Camera Deployed to 704 m.at S700.
2344 - Lat: 56 27.7 N. Long: 09 05.7 W. CTD #102 Deployed to 470 metres, with Snow Camera, at S500.

Tuesday 30th. July '96.
0023 - Lat: 56 27.7 N. Long: 09 05.7 W. CTD #102 Recovered at Station S500.
0100 - 0120 - Lat: 56 27.7 N. Long: 08 57.9 W. CTD #103 Deployed to 140 metres with Snow Camera, at Station S140.
0153 - 0222 - Lat: 56 27.1 N. Long: 09 02.9 W. CTD #104 Deployed to 201 metres with Snow Camera, at Station S200.
0246 - 0316 - Lat: 56 28.0 N. Long: 09 03.1 W. CTD #105 Deployed to 253 metres with Snow Camera, at Station S300.
0700 - Lat: 56 26.1 N. Long: 09 02.3 W. Vessel Hove To; Awaiting Weather to Moderate.
1100 - Lat: 56 21.5 N. Long: 09 08.0 W. Wind: 245 True. 20 Knots. Baro: 1002.9. Vessel Pitching Heavily to Rough Head Sea and Heavy Swell.
Noon Position: Lat: 56 20.6 N. Long: 09 08.9 W.
1300 - Lat: 56 19.7 N. Long: 09 09.8 W. Dunking Transducer Deployed, Commenced Acoustic Search for Lost Subsurface Current Meter Mooring from S700 Site.
1333 - Lat: 56 19.3 N. Long: 09 10.3 W. Bridge Informed that Missing Mooring had Received the Release Code from the Acoustic System. Commenced Search Pattern.
1500 - Lat: 56 17.6 N. Long: 09 13.0 W. Wind: 270 True. 20 Knots. Baro: 1004.9. Mooring Located on Surface.
1600 - Position of Drifting Mooring Determined by Cross Bearings.
1700 - Lat: 56 17.9 N. Long: 09 14.9 W. Clyde Coastguard Contacted and Informed that the Vessel was Standing By a Drifting Sub-Surface Mooring Considered a Hazard to

Navigation. WZ Message to be Issued.
1900 - Lat: 56 19.0 N. Long: 09 12.3 W. Wind: 270 True. 15/20 Knots. Baro: 1008.2.
2300 - Lat: 56 20.1 N. Long: 09 08.3 W. Wind: 240 True. 15/20 Knots. Baro: 1008.2.
Vessel Pitching to Rough Head Sea and Heavy Swell.

Wednesday 31st. July '96.
0300 - Lat: 56 21.3 N. Long: 09 09.8 W. Wind: 240 True. 20/25 Knots. Baro: 1005.2.
Vessel Pitching to Rough Head Sea and Heavy Swell.
0700 - Lat: 56 23.6 N. Long: 09 05.0 W. Wind: 240 True. 20/25 Knots. Baro: 1003.3.
Vessel Pitching Heavily in Heavy W'ly. Swell and Rough Sea. Vessel Standing By Drifting Mooring.
1100 - Lat: 56 23.5 N. Long: 09 05.1 W. Wind: 250 True. 25/30 Knots. Baro: 1002.7.
Vessel Pitching Heavily to Heavy W'ly. Swell and Rough Sea. Vessel Steaming Head to Wind and Swell; Maintaining Steerage Way in Adverse Weather Conditions.
1500 - Lat: 56 24.4 N. Long: 09 15.7 W. Wind: 260 True. 35/40 Knots. Baro: 1002.4.
Vessel Pitching Mod/Heavily, Shipping and Spraying Water For'd.
1900 - Lat: 56 21.9 N. Long: 09 33.3 W. Wind: 270 True. 25/37 Knots. Baro: 1003.0.
Vessel Pitching Heavily in Heavy W'ly. Swell. Taking Occasional Seas For'd, and Spraying Overall. Clyde Coastguard Contacted with Argos Position Update of Drifting Sub-Surface Mooring S700.
2300 - Lat: 56 19.8 N. Long: 09 58.7 W. Wind: 270 True. 20/28 Knots. Baro: 1004.4.
Vessel Pitching Heavily to Rough Head Sea and Heavy Westerly Swell, Occasionally Shipping Water For'd.

Thursday 1st. August '96.
0300 - Lat: 56 20.0 N. Long: 10 17.2 W. Wind: 280 True. 15/20 Knots. Baro: 1005.5.
Vessel Pitching Moderately/Heavily into W'ly Swell, and Occ'ly Spraying For'd.
0500 - Lat: 56 20.7 N. Long: 10 25.4 W. Sea and Swell Moderated Sufficiently to Alter Course and Head for last Reported Argos Position of Drifting Mooring S700.
0700 - Lat: 56 22.7 N. Long: 09 55.8 W. Wind: 290 True. 12/17 Knots. Baro: 1007.0.
Vessel Moving Easily in Following Sea and Swell.
1023 - Lat: 56 26.9 N. Long: 09 03.0 W. Vessel Homing In on last Argos Position of Rig.
1045 - Lat: 56 26.6 N. Long: 08 58.8 W. Drifting Mooring Sighted.
1121 - Lat: 56 27.1 N. Long: 08 58.8 W. S700 Mooring Grappled near S140 Met Buoy.
1246 - Lat: 56 27.4 N. Long: 09 01.2 W. S700 Sub-Surface Current Meter/Thermistor Chain Mooring Completely Recovered. Originally Deployed on 18th. April '96 in Position:- Lat: 56 27.70 N. Long: 09 09.75 W. and Trawled approx. 10 miles SSW.
1440 - 1551 - Lat: 56 27.8 N. Long: 09 18.2 W. CTD #106 Deployed to 995 metres at S1000.
1612 - 1640 - Lat: 56 27.7 N. Long: 09 17.9 W. Multicore MC#13 Deployed in 995 metres.
1653 - 1724 - Lat: 56 27.8 N. Long: 09 17.7 W. Multicore MC#14 Deployed in 996 metres.
1739 - 1809 - Lat: 56 27.6 N. Long: 09 17.9 W. Multicore MC#15 Deployed in 993 metres.
2042 - 2204 - Lat: 56 27.3 N. Long: 09 39.4 W. CTD #107 Deployed to 1511 metres with Snow Camera, at S1500.

Friday 2nd. August '96.
0114 - 0301 - Lat: 56 43.5 N. Long: 09 24.6 W. Bed-Hop Camera Deployed to 1497 metres, at Station N1500.

0311 - 0425 - Lat: 56 42.9 N. Long: 09 26.2 W. CTD #108 Deployed to 1486 m. at N1500.
0447 - 0556 - Lat: 56 42.7 N. Long: 09 27.2 W. CTD #109 Deployed to 1485 m. at N1500.
0619 - 0643 - Lat: 56 42.8 N. Long: 09 28.5 W. CTD #110 Deployed to 500 m. at N1500.
0907 - Lat: 56 42.6 N. Long: 09 24.5 W. Sub-Surface Sediment Trap Recovered at N1500.
1018 - 1038 - Lat: 56 43.0 N. Long: 09 24.2 W. CTD #111 Deployed to 20 metres, for Flourimeter Calibration.
1213 - Lat: 56 38.7 N. Long: 09 35.4 W. Sub-Surface Current Meter Mooring Recovered, at Station P1500.
1318 - 1515 - Lat: 56 37.4 N. Long: 09 36.0 W. CTD #112 Deployed to 1440 m. at P1500.
1725 - 1840 - Lat: 56 40.3 N. Long: 09 12.1 W. CTD #113 Deployed to 1000 m. at N1000.
1850 - 1920 - Lat: 56 40.3 N. Long: 09 12.3 W. Multicore MC#16 Deployed in 1021 metres.
1933 - 2000 - Lat: 56 40.3 N. Long: 09 11.6 W. Multicore MC#17 Deployed in 1012 metres.
2004 - 2033 - Lat: 56 40.3 N. Long: 09 11.7 W. Multicore MC#18 Deployed in 1013 metres.
2045 - 2113 - Lat: 56 40.3 N. Long: 09 11.6 W. Multicore MC#19 Deployed in 1011 metres.
2123 - 2152 - Lat: 56 40.2 N. Long: 09 12.1 W. Multicore MC#20 Deployed in 1015 metres.
2203 - 2231 - Lat: 56 40.3 N. Long: 09 12.0 W. Multicore MC#21 Deployed in 1017 metres.
2320 - Lat: 56 38.9 N. Long: 09 06.8 W. Bed-Hop Camera Deployed at N700, in 712 metres.

Saturday 3rd. August '96.
0036 - Lat: 56 38.4 N. Long: 09 08.0 W. Bed-Hop Camera Recovered at N700.
0056 - 0137 - Lat: 56 39.0 N. Long: 09 09.7 W. CTD #114 Deployed to 766 metres, With Snow Camera, at Station N700.
0215 - 0240 - Lat: 56 38.1 N. Long: 09 04.4 W. CTD #115 Deployed to 509 metres at N500.
0310 - 0331 - Lat: 56 37.5 N. Long: 09 01.1 W. CTD #116 Deployed to 291 metres at N300.
0354 - 0410 - Lat: 56 37.3 N. Long: 09 00.1 W. CTD #117 Deployed to 183 metres at N200.
0440 - 0458 - Lat: 56 36.8 N. Long: 08 56.3 W. CTD #118 Deployed to 123 metres at N140.
0803 - Lat: 56 36.2 N. Long: 08 55.3 W. Sub-Surface Pop-Up Pressure Recorder Mooring Recovered at N140.
0907 - Lat: 56 36.3 N. Long: 08 55.8 W. Sub-Surface Current Meter Mooring Recovered,N140. (Subsurface Buoy and Instrumentation only Recovered from this U-Shaped Mooring).
0930 - Lat: 56 36.1 N. Long: 08 56.2 W. Commenced Acoustic Search for Lost Moorings.
1046 - Lat: 56 36.0 N. Long: 08 55.6 W. Gifford Grapnel #1 Deployed; Comm. Dragging.
1150 - Lat: 56 35.9 N. Long: 08 55.8 W. Grapnel Contact, 2 Tonne Load; Comm. Hauling.
1202 - Lat: 56 35.7 N. Long: 08 55.5 W. Weight Released; Commenced Hauling In.
1212 - Lat: 56 35.6 N. Long: 08 55.6 W. Warp Inboard, Weak-Link Sheared, Grapnel Lost.
1303 - Lat: 56 36.2 N. Long: 08 55.2 W. Gifford Grapnel #2 Deployed; Resumed Dragging.
1340 - Lat: 56 36.4 N. Long: 08 55.7 W. Grapnel Contact, 2 Tonne Load; Comm. Hauling.
1423 - Lat: 56 36.3 N. Long: 08 55.7 W. Grapnel #2 Recovered with Mooring Ground-Line.
1559 - Lat: 56 35.3 N. Long: 08 56.5 W. Grapnel #1 Recovered on Mooring Ground-Line!.
1631 - Lat: 56 34.6 N. Long: 08 56.5 W. All Inboard; 2 Anchor Clumps, Acoustic Release, 2 Thermistor Loggers, 3 Current Meters, and 1 Nitrate Analyser.
(U-Shape Mooring Deployed at S140, on CD 93, on 9th. May 1995.)
1816 - Lat: 56 34.8 N. Long: 09 01.1 W. Commenced Acoustic Search for S300 Lost Mooring in Vicinity of N300.
1839 - Lat: 56 34.7 N. Long: 09 01.0 W. S300 Mooring Detected, 1.8 Kms. from this Pos'n.
2100 - 2143 - Lat: 56 36.1 N. Long: 09 17.3 W. CTD #119 Deployed to 976 metres at P1000.
2155 - 2226 - Lat: 56 36.1 N. Long: 09 17.3 W. Multicore MC#22 Deployed in 999 metres.

2241 - 2315 - Lat: 56 35.9 N. Long: 09 17.5 W. Multicore MC#23 Deployed in 1003 metres.
2335 - Lat: 56 36.2 N. Long: 09 17.2 W. Multicore MC#24 Deployed in 1000 metres.

Sunday 4th. August '96.
0011 - Lat: 56 36.1 N. Long: 09 17.4 W. Multicore MC#24 Recovered at Station P1000.
0210 - 0235 - Lat: 56 27.1 N. Long: 09 03.3 W. CTD #120 Deployed to 205 Metres at S200.
0238 - 0301 - Lat: 56 27.2 N. Long: 09 03.8 W. Dunking Transducer Deployed for Acoustic Search of Lost Moorings at S200.
0323 - 0348 - Lat: 56 26.7 N. Long: 09 03.5 W. CTD #121 Deployed to 230 metres at S200.
0432 - 0451 - Lat: 56 24.4 N. Long: 09 04.8 W. Dunking Transducer Deployed; Vessel Following 200 metre Contour Southwards in Acoustic Search.
0528 - 0614 - Lat: 56 21.4 N. Long: 09 06.6 W. Dunking Transducer Deployed.
0655 - 0734 - Lat: 56 18.3 N. Long: 09 09.1 W. Dunking Transducer Deployed.
0757 - 0835 - Lat: 56 15.8 N. Long: 09 09.3 W. Dunking Transducer Deployed.
0910 - 0944 - Lat: 56 13.1 N. Long: 09 09.5 W. Dunking Transducer Deployed.
1014 - 1038 - Lat: 56 10.5 N. Long: 09 11.7 W. Dunking Transducer Deployed.
1110 - 1130 - Lat: 56 07.8 N. Long: 09 14.9 W. Dunking Transducer Deployed.
1211 - 1223 - Lat: 56 05.1 N. Long: 09 12.0 W. Dunking Transducer Deployed.
1339 - 1353 - Lat: 56 14.2 N. Long: 09 09.8 W. Dunking Transducer Deployed.
1455 - Lat: 56 14.1 N. Long: 09 07.7 W. Position of Lost Pinger P260 Identified.
1530 - 1546 - Lat: 56 14.9 N. Long: 09 10.2 W. Dunking Transducer Deployed.
1632 - Lat: 56 14.74 N. Long: 09 08.52 W. Position of Lost Pinger P254 Identified.
1732 - 1747 - Lat: 56 21.4 N. Long: 09 06.5 W. Dunking Transducer Deployed; Complete Acoustic Search.
1918 - 2021 - Lat: 56 30.9 N. Long: 09 10.5 W. Bed-Hop Camera Deployed at R700 in 702m.
2102 - 2219 - Lat: 56 31.0 N. Long: 09 17.3 W. Bed-Hop Camera Deployed at R1000 in 1004m.
2330 - Lat: 56 26.7 N. Long: 09 09.7 W. Vessel Hove To at S700; CTD Abandoned Due to Adverse Weather; Resumed Acoustic Search for Missing Moorings.

Monday 5th. August '96.
0026 - 0047 - Lat: 56 25.1 N. Long: 09 05.0 W. Dunking Transducer Deployed.
0117 - 0133 - Lat: 56 27.5 N. Long: 09 05.1 W. Dunking Transducer Deployed.
0208 - 0228 - Lat: 56 30.3 N. Long: 09 04.5 W. Dunking Transducer Deployed.
0300 - 0318 - Lat: 56 32.9 N. Long: 09 04.6 W. Dunking Transducer Deployed.
0355 - 0407 - Lat: 56 35.9 N. Long: 09 02.9 W. Dunking Transducer Deployed.
0443 - 0458 - Lat: 56 38.9 N. Long: 08 59.6 W. Dunking Transducer Deployed.
0523 - 0544 - Lat: 56 41.6 N. Long: 08 59.4 W. Dunking Transducer Deployed.
0555 - 0609 - Lat: 56 42.9 N. Long: 09 00.3 W. Dunking Transducer Deployed.
0631 - 0650 - Lat: 56 45.7 N. Long: 09 01.4 W. Dunking Transducer Deployed.
0709 - 0755 - Lat: 56 48.9 N. Long: 09 02.8 W. Dunking Transducer Deployed.
0952 - 1003 - Lat: 56 34.9 N. Long: 09 01.4 W. Dunking Transducer Deployed.
1130 - Lat: 56 27.5 N. Long: 09 03.7 W. Toroid Marker Buoy Recovered at S300.
1255 - Lat: 56 27.2 N. Long: 08 57.7 W. Met Buoy Recovered at S140; Set Co. 314 True.
1858 - 2028 - Lat: 56 59.9 N. Long: 09 59.9 W. CTD #122 Deployed to 2045 m. at N2000.
CTD #123 was in Instrumentation/Equipment Test; with Package on Deck.
2110 - 2238 - Lat: 56 59.9 N. Long: 09 59.8 W. CTD #124 Deployed to 2045 m. at N2000.
2258 - 2323 - Lat: 56 59.8 N. Long: 10 00.2 W. CTD #125 Deployed to 100 m. at N2000.

2326 - Lat: 56 59.8 N. Long: 10 00.3 W. Bed- Hop Camera Deployed at N2000 in 2061 m.

Tuesday 6th. August '96.

0125 - Lat: 56 59.7 N. Long: 10 01.7 W. Bed-Hop Camera Recovered; Set Course 147 True.
0719 - 0730 - Lat: 56 15.9 N. Long: 09 09.3 W. Dunking Transducer Deployed.
0757 - Lat: 56 14.0 N. Long: 09 07.1 N. Gifford Grapnel Deployed; Commenced Dragging.
1100 - Lat: 56 14.9 N. Long: 09 09.3 W. Grapnel Contact; Commenced Hauling Main Warp.
1150 - Lat: 56 15.0 N. Long: 09 09.5 W. All Inboard; 2 Anchor Clumps, Acoustic Release, and Gimbals of 1 Current Meter. Recovered in 207 metres of Water.
(Originally Deployed on Cruise CH121 at S200, on __-__-'9_.)
1252 - Lat: 56 14.2 N. Long: 09 10.1 W. Gifford Grapnel Deployed; Commenced Dragging.
1450 - Lat: 56 14.9 N. Long: 09 09.4 W. Grapnel Contact; Commenced Hauling Main Warp.
1620 - Lat: 56 15.7 N. Long: 09 12.6 W. All Inboard; 2 Anchor Clumps, Acoustic Release, 1 Current Meter & Transmisometer, and 1 Nitrate Analyser. Recovered in 240 metres.
(Originally Deployed on Cruise CD93 at S200, on __-04-'95.)
1803 - 1905 - Lat: 56 27.1 N. Long: 09 10.0 W. Acoustic Search for Lost Mooring at S700.
1925 - 2008 - Lat: 56 26.5 N. Long: 09 10.2 W. CTD #126 Deployed to 720 metres at S700.
2037 - 2113 - Lat: 56 26.5 N. Long: 09 09.8 W. CTD #127 Deployed to 716 metres at S700.
2222 - 2241 - Lat: 56 35.2 N. Long: 09 10.9 W. Bed-Hop Camera deployed at P700 in 703 m. Trigger weight lost after 10 exposures.

Wednesday 7th. August '96.

0025 - 0100 - Lat: 56 36.2 N. Long: 08 55.1 W. Bed-Hop Camera deployed to 135 metres at N140.
0100 - Lat: 56 35.9N. Long: 06 19.7 W. Bed-Hop camera inboard.
0330 - Lat: 56 27.6 N. Long: 08 54.9 W. Vessel lying ahull at dragging site (S700).
0410 - Lat: 56 27.6 N. Long: 09 08.8 W. Search commenced.
0539 - Lat: 56 27.6 N. Long: 09 09.7 W. Vessel hove to. Dunking transducer deployed.
0608 - Lat: 56 27.5 N. Long: 09 09.8 W. Commenced grapnel deployment. Up to 3300 m main warp in a circle.
0844 - Lat: 56 26.9 N. Long: 09 09.7 W. Main warp inboard.
0854 - Lat: 56 26.9 N. Long: 09 09.7 W. End of science. Set course for Greenock.
2130 - Lat: 55 22.8 N. Long: 06 19.7 W. Surface water sample taken (replacement for sample taken at E32 on outward voyage).
All times now BST
2325 - Lat: 55 20.4 N. Long: 06 07.4 W. Altacarry Head Brg: 217.5 True at 2.8 miles.

Figures/tables

1) Cruise track leg A

2) Cruise track leg B

3) Temperature continuity sections

4) Salinity continuity sections

5) Velocity continuity sections

6) Table of CTD stations leg A

7) Table of CTD stations leg B

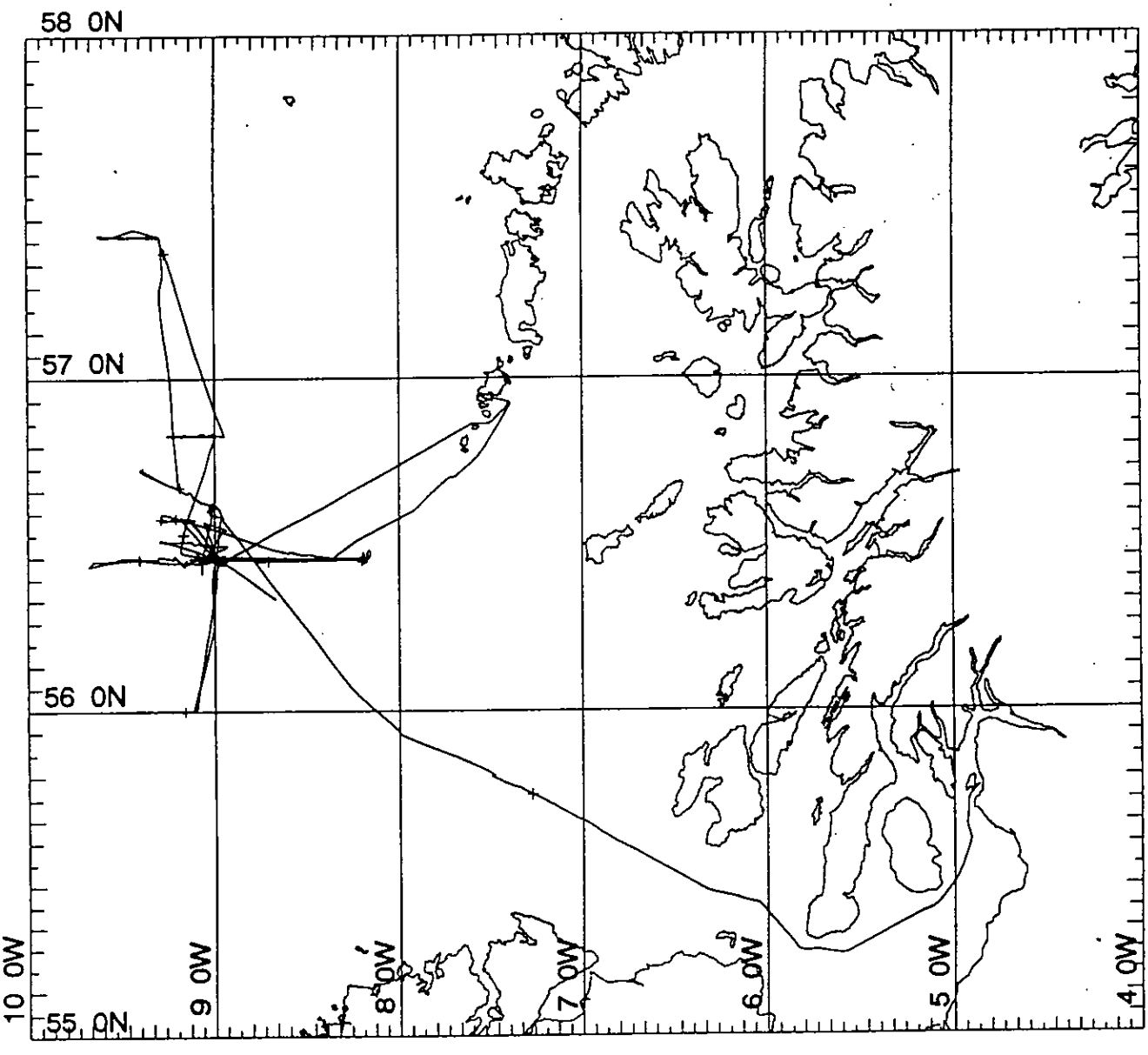
8) Table of Fly profiles.

9) Table of mooring deployments and recoveries

10) Table of Coring positions

11) Table of bedhop camera positions

12) Table of marine snow camera positions



MERCATOR PROJECTION

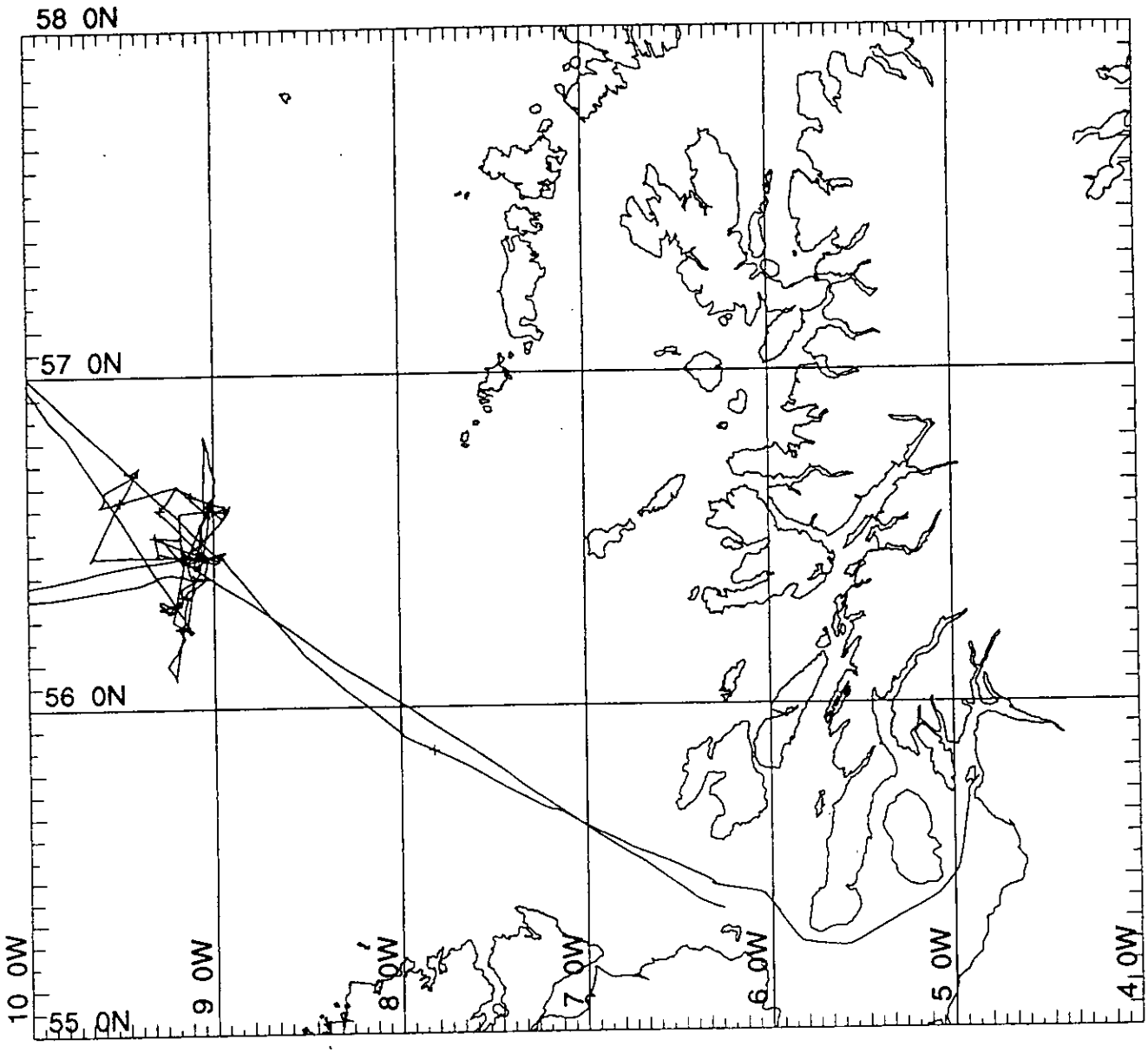
GRID NO. 1

SCALE 1 TO 4000000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 55

RRS Challenger - Cruise 128a

1) Cruise track leg A



MERCATOR PROJECTION

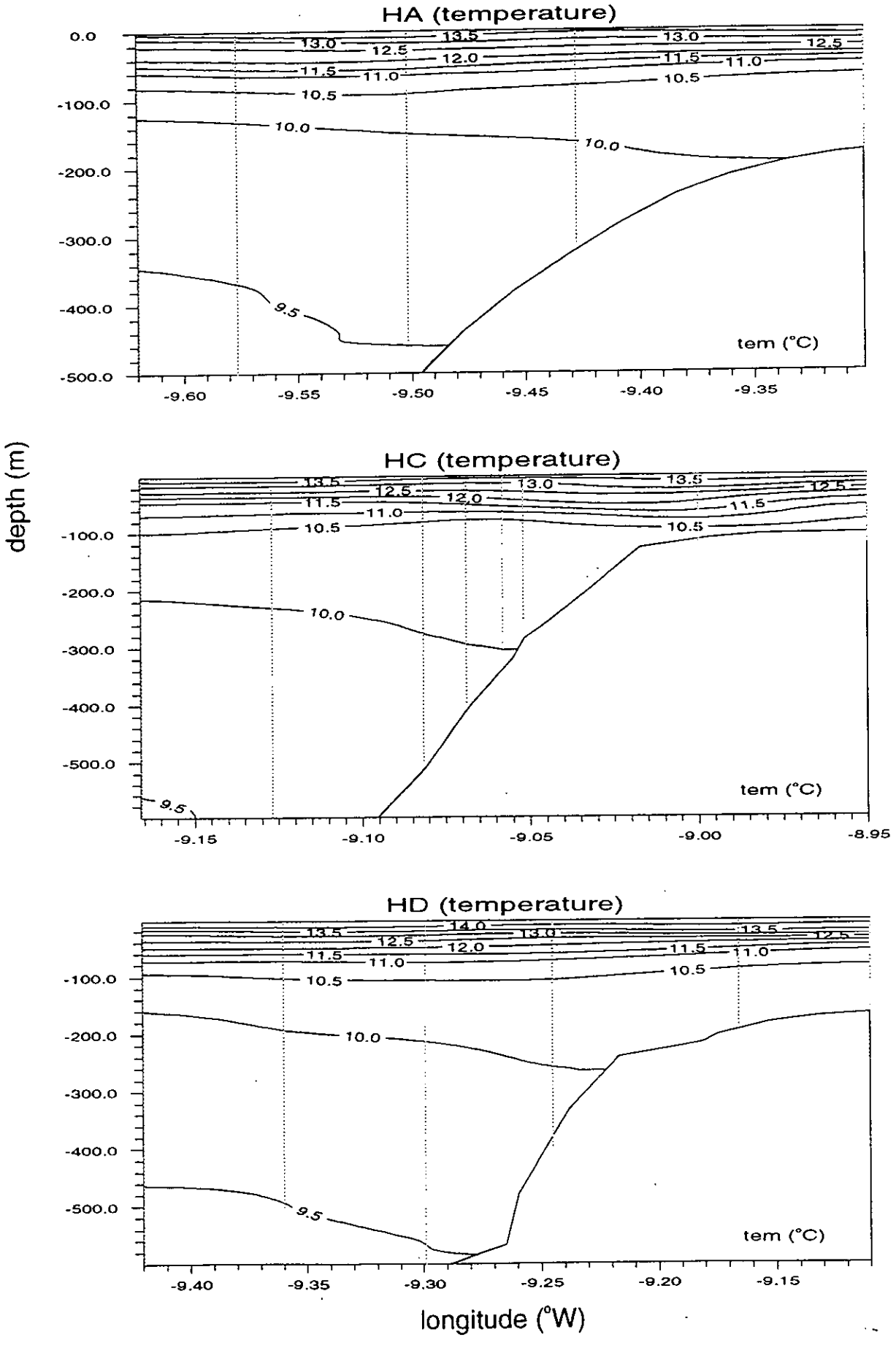
GRID NO. 1

SCALE 1 TO 4000000 (NATURAL SCALE AT LAT. 0)

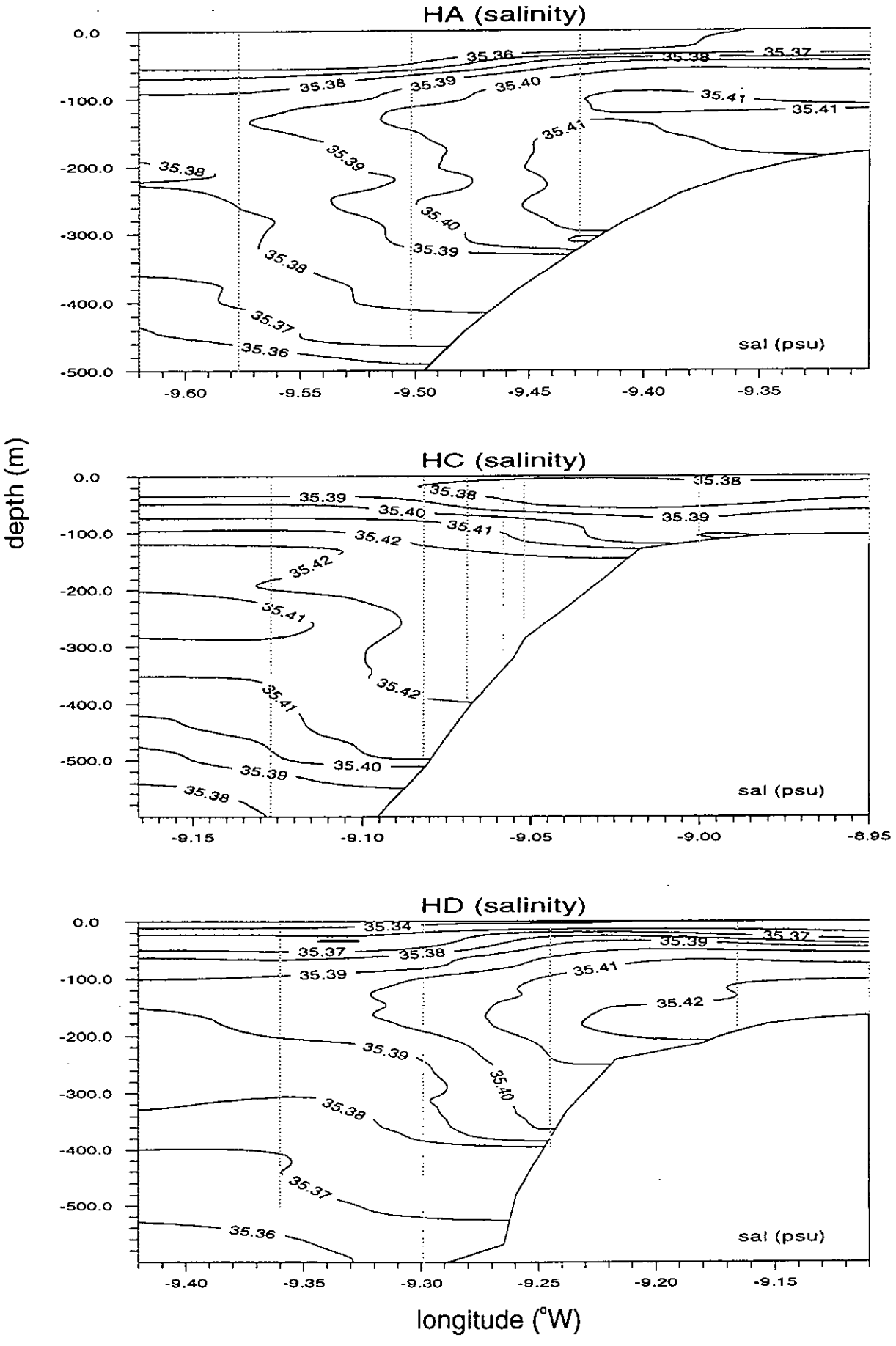
INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 55

RRS Challenger - Cruise 128b

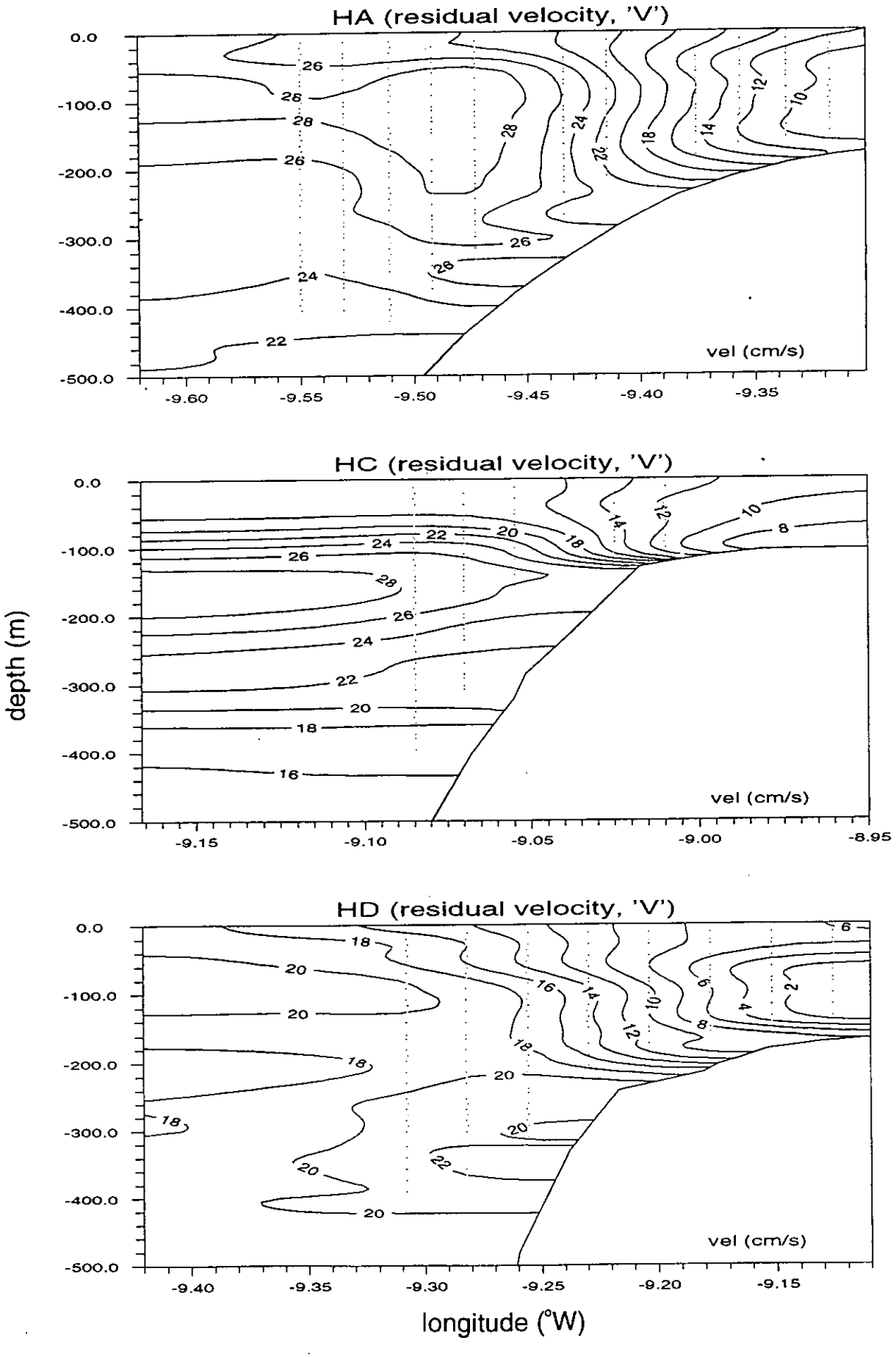
2) Cruise track leg B



3) Temperature continuity sections



4) Salinity continuity sections



5) Velocity continuity sections

6) Table of CTD deployments (leg A)

Dip no.	Site	Date	Time	Lat.(N)	Lon. (E)	Depth (m)	Type
1	SH1	07/10/96	22:16:00	55.67101	-7.00864	46.7	Shelf station
2	SH3	07/11/96	02:25:00	55.80359	-7.48917	71.8	Shelf station
3	SH5	07/11/96	06:41:00	55.93403	-8.00174	172	Shelf Station
4	N300	07/11/96	16:00:00	56.63151	-9.00916	318.1	SES BOX
5	S300	07/11/96	21:15:00	56.46774	-9.05535	264.3	SES BOX
6	R140	07/11/96	22:34:00	56.50187	-8.93308	141.5	SES BOX
7	R200	07/11/96	23:31:00	56.50611	-9.0461	236.7	SES BOX
8	R300	07/12/96	00:25:00	56.50771	-9.06142	310.3	SES BOX
9	R500	07/12/96	01:38:00	56.512	-9.11353	482.6	SES BOX
10	R1000	07/12/96	03:22:00	56.51842	-9.29173	995.7	SES BOX
11	S140E	07/12/96	14:32:00	56.47571	-8.20369	155	SES BOX
12	L1	07/12/96	19:09:00	56.48309	-8.5992	142.6	
13	P1000	07/12/96	22:35:00	56.59105	-9.28359	988.2	SES BOX
14	S140	13/07/96	20:37:00	56.46361	-8.97625	147.4	SES BOX
15	P700	13/07/96	22:45:00	56.58217	-9.19037	722.2	SES BOX
16	P500	14/07/96	00:40:00	56.57894	-9.12346	529.4	SES BOX
17	S140	14/07/96	03:21:00	56.44778	-8.96442	146.7	SES BOX
18	P300	14/07/96	04:56:00	56.5728	-9.0552	316	SES BOX
19	P200	14/07/96	06:10:00	56.56648	-9.03061	203.4	SES BOX
20	P140	14/07/96	07:19:00	56.55145	-8.93623	138.6	SES BOX
21	S140	14/07/96	12:17:00	56.47223	-8.97834	146.9	SES BOX
22	S200	14/07/96	17:33:00	56.45451	-9.04679	200.7	SES BOX
23	S200	14/07/96	17:47:00	56.45476	-9.04714	202.7	SES BOX
24	S140	15/07/96	01:46:00	56.4529	-8.98178	145.3	Internal waves
25	S140	15/07/96	11:37:00	56.46105	-8.9845	145.7	Internal Waves
26	S140E	15/07/96	18:15:00	56.46836	-8.193	152	Internal Waves
27	S140E	16/07/96	02:42:00	56.46564	-8.19773	153.1	Internal Waves
28	S140E	16/07/96	06:40:00	56.45196	-8.19664	146.1	Internal Waves
29	S140E	16/07/96	13:26:00	56.45334	-8.18572	141.5	Internal waves
30	SH1	16/07/96	22:52:00	56.45663	-8.76012	141.3	Shelf station
31	SH2	17/07/96	00:46:00	56.45977	-8.55002	129	Shelf station
32	SH3	17/07/96	02:24:00	56.46576	-8.35385	153.7	Shelf station
33	SH4	17/07/96	04:41:00	56.6055	-7.92894	115.1	Shelf Station
34	SH5	17/07/96	06:03:00	56.7068	-7.71339	61.7	Shelf station
35	S140	17/07/96	20:51:00	56.45373	-8.98275	146.9	SES BOX
36	S1150	17/07/96	23:24:00	56.46127	-9.40367	1142.3	SES BOX
37	S1500	18/07/96	01:43:00	56.45253	-9.658		SES BOX
38	S1500	18/07/96	03:51:00	56.44236	-9.67537		SES BOX
39	S1300	18/07/96	05:07:00	56.45822	-9.52454	1307.9	SES BOX
40	S1300	18/07/96	07:10:00	56.459	-9.52201	1304.1	SES BOX
41	S1000	18/07/96	09:25:00	56.46549	-9.30317	1000.8	SES BOX
42	S850	18/07/96	11:48:00	56.46788	-9.21874	837.8	SES BOX
43	S700	18/07/96	14:04:00	56.45747	-9.15317	659.2	SES BOX
44	S700	18/07/96	14:44:00	56.44489	-9.15708	693.5	SES BOX
45	S500	18/07/96	16:17:00	56.46429	-9.08774	454.9	SES BOX
46	S300	18/07/96	18:53:00	56.46711	-9.0376	187	SES BOX
47	S300	18/07/96	19:43:00	56.4668	-9.06039	303.5	SES BOX
48	S200	18/07/96	20:30:00	56.46774	-9.04046	196.3	SES BOX
49	S140	18/07/96	21:36:00	56.47064	-8.97756	148.1	SES BOX
50	S700	18/07/96	23:12:00	56.48144	-9.1746	718.9	SES BOX
51	HC140	19/07/96	03:18:00	56.83634	-9.00022	125.5	Continuity
52	HC200	19/07/96	03:52:00	56.83365	-9.05203	276	Continuity
53	HC300	19/07/96	04:24:00	56.83836	-9.05788	321.3	Continuity
54	HC400	19/07/96	04:54:00	56.83932	-9.06918	397	Continuity
55	HC500	19/07/96	05:38:00	56.83613	-9.08172	507.8	Continuity

Dip no.	Site	Date	Time	Lat.(N)	Lon. (E)	Depth (m)	Type
56	HC800	19/07/96	07:02:00	56.83409	-9.12756	843.3	Continuity
57	HC1000	19/07/96	17:53:00	56.8373	-9.16558	966.7	Continuity
58	HC120B	19/07/96	20:05:00	56.83188	-8.9496	127.9	Continuity
59	HA180	20/07/96	00:31:00	57.41599	-9.30215	178.5	Continuity
60	HA300	20/07/96	01:31:00	57.41533	-9.42802	316	Continuity
61	HA500	20/07/96	02:25:00	57.41366	-9.50204	514	Continuity
62	HA800	20/07/96	04:22:00	57.41409	-9.57674	795.8	Continuity
64	HA1000	20/07/96	05:30:00	57.41798	-9.61969	1070.1	Continuity
65	N1000	20/07/96	23:14:00	56.67783	-9.19072	1005.9	SES BOX
66	N1500	21/07/96	02:04:00	56.73483	-9.3958		SES BOX
67	N1500	21/07/96	03:14:00	56.73447	-9.39044	1486.8	SES BOX
68	N850	21/07/96	06:49:00	56.66285	-9.14221	861.8	SES BOX
69	N700	21/07/96	08:58:00	56.64815	-9.1113	703.9	SES BOX
70	N500	21/07/96	10:39:00	56.63494	-9.07228	510.9	SES BOX
71	N300	21/07/96	12:31:00	56.61861	-9.02645	325.1	SES BOX
72	N200	21/07/96	14:43:00	56.61663	-9.01293	227.7	SES BOX
73	N140	21/07/96	16:24:00	56.58792	-8.95419	137.1	SES BOX
74	HD160	21/07/96	22:34:00	56.00182	-9.10999	165.9	Continuity
75	HD200	21/07/96	23:34:00	55.99805	-9.16548	191.3	Continuity
76	HD400	22/07/96	00:33:00	56.00164	-9.24536	381.9	Continuity
77	HD600	22/07/96	01:51:00	56.00214	-9.29882	633.1	Continuity
78	HD850	22/07/96	03:27:00	56.00256	-9.36	843.3	Continuity
80	HD1000	22/07/96	04:45:00	56.00427	-9.42024	1022.6	Continuity
81	S140	22/07/96	19:20:00	56.45416	-8.98053	146.9	Internal Waves
82	S140	23/07/96	01:35:00	56.45289	-8.98388	147.5	Internal Waves
83	S140	23/07/96	06:54:00	56.45515	-8.9796	146.8	Internal Waves
84	S140	23/07/96	13:09:00	56.46254	-8.97145	147	Internal Wave
85	S140E	23/07/96	17:18:00	56.46974	-8.19789	151.3	Internal Waves
86	S140E	24/07/96	01:23:00	56.46825	-8.19954	153.4	Internal Waves
87	S140E	24/07/96	06:45:00	56.47858	-8.20037	142.4	Internal Waves
88	S140E	24/07/96	12:38:00	56.45459	-8.1793	145	Internal Waves
89	S500	24/07/96	17:48:00	56.48313	-9.09704	446	Internal Waves
90	S140	25/07/96	06:21:00	56.47165	-9.0179	157.8	Internal Waves

7) Table of CTD deployments (leg B)

Dip no.	Station	Date	Time	Lat. (N)	Long. (W)	Depth (m)	Purpose
91	E32	27/07/96	16:04	55 26.82	06 19.64	106	SURRC water samples
92	AS1	27/07/96	21:05	55 40.87	07 10.32	55	SURRC water samples
93	S5	28/07/96	01:08	55 54.95	07 59.87	174	SURRC water samples
94	S5	28/07/96	01:48	55 55.20	07 59.73	174	Core Incubations
95	AS2	28/07/96	07:54	56 10.00	08 31.76	123	SURRC water samples
96	R1000	28/07/96	18:31	56 30.89	09 17.26	1023	Core incubations
97	R1000	28/07/96	22:44	56 30.94	09 17.93	1028	Radionuclides
98	R1000	29/07/96	00:27	56 31.38	09 19.11	1056	Radionuclides, POC
99	S1000	29/07/96	03:16	56 27.61	09 17.98	1000	Snow camera
100	S700	29/07/96	05:19	56 26.99	09 09.34	689	Snow camera
101	S700	29/07/96	18:09	56 26.45	09 09.39	696	Core incubations
102	S500	29/07/96	23:41	56 27.71	09 05.75	-	Snow camera
103	S140	30/07/96	00:59	56 27.72	08 57.93	138	Snow camera, POC
104	S200	30/07/96	01:55	56 27.16	09 03.04	-	Snow camera, SURRC water samples
105	S300	30/07/96	02:44	56 27.96	09 03.57	-	Snow camera, POC
106	S1000	30/07/96	14:40	56 27.39	09 18.00	995	Core incubations
107	S1500	01/08/96	20:42	56 27.59	09 38.93	1526	Snow camera
108	N1500	02/08/96	03:10	56 43.09	09 25.64	1501	Snow camera, radionuclides, POC
109	N1500	02/08/96	04:47	56 42.68	09 26.99	1492	Radionuclides
110	N1500	02/08/96	06.19	56 42.84	09 28.37	1514	Radionuclides

Dip no.	Station	Date	Time	Lat. (N)	Long. (W)	Depth (m)	Purpose
111	N1500	02/08/96	10:17	56 42.97	09 24.25	1500	Transmissometer calibration
112	P1500	02/08/96	13:18	56 37.83	09 35.41	1460	Transmissometer calibration, POC
113	N1000	02/08/96	17:25	56 40.32	09 11.88	1018	Core incubations, snow camera
114	N700	03/08/96	00:59	59 39.00	09 02.09	734	Snow camera
115	N500	03/08/96	02:13	56 38.05	09 04.35	507	Snow camera
116	N300	03/08/96	03:13	56 37.62	09 01.20	302	Snow camera
117	N200	03/08/96	03:56	56 37.35	09 00.12	191	Snow camera
118	N140	03/08/96	04:42	56 36.81	08 56.21	133	Snow camera
119	P1000	03/08/96	20:59	56 36.07	09 17.32	999	Core incubations
120	S200	04/08/96	02:09	56 27.16	09 03.10	214	Radionuclides
121	S200	04/08/96	03:23	56 26.71	09 03.40	230	Radionuclides
122	N2000	05/08/96	18:58	56 59.92	10 00.07	2056	Radionuclides
123	TEST						
124	N2000	05/08/96	21:12	56 59.91	09 59.61	2055	Radionuclides
125	N2000	05/08/96	23:00	56 59.75	10 00.31	2061	Radionuclides
126	S700	06/08/96	19:27	56 26.44	09 09.94	718	Radionuclides, POC
127	S700	06/08/96	20:37	56 26.47	09 09.81	714	Radionuclides

8) Table of fly profiles

Dip no.	Date	Time
FLY000	14/07/96	19:38:56
FLY001	14/07/96	20:30:33
FLY002	14/07/96	22:08:14
FLY003	14/07/96	23:23:19
FLY004	15/07/96	00:18:02
FLY005	15/07/96	02:27:54
FLY006	15/07/96	03:13:00
FLY007	15/07/96	04:16:00
FLY008	15/07/96	05:05:00
FLY009	15/07/96	06:21:00
FLY010	15/07/96	07:17:00
FLY011	15/07/96	08:18:00
FLY012	15/07/96	09:21:00
FLY013	15/07/96	10:10:14
FLY014	15/07/96	11:11:19
FLY015	15/07/96	18:54:00
FLY016	15/07/96	19:30:00
FLY017	15/07/96	20:31:00
FLY018	15/07/96	20:59:00
FLY019	15/07/96	22:08:00
FLY020	15/07/96	22:29:00
FLY021	15/07/96	23:28:46
FLY022	16/07/96	00:11:05
FLY023	16/07/96	00:56:47
FLY024	16/07/96	01:37:00
FLY025	16/07/96	02:16:10
FLY026	16/07/96	03:14:00
FLY027	16/07/96	03:50:00
FLY028	16/07/96	04:26:00
FLY029	16/07/96	05:14:00
FLY030	16/07/96	05:54:00
FLY031	16/07/96	07:16:00
FLY032	16/07/96	08:08:00
FLY033	16/07/96	09:02:00
FLY034	16/07/96	09:40:00

Dip no.	Date	Time
FLY035	16/07/96	10:39:00
FLY036	16/07/96	11:34:54
FLY037	16/07/96	14:20:22
FLY038	16/07/96	15:00:00
FLY039	16/07/96	16:34:00
FLY040	16/07/96	17:07:16
FLY041	16/07/96	18:01:43
FLY042	16/07/96	18:42:26
FLY043	16/07/96	19:14:00
FLY046	22/07/96	20:03:00
FLY047	22/07/96	20:41:38
FLY048	22/07/96	21:57:45
FLY049	22/07/96	22:42:50
FLY050	23/07/96	00:11:24
FLY051	23/07/96	00:44:13
FLY052	23/07/96	02:11:16
FLY053	23/07/96	03:04:15
FLY054	23/07/96	03:40:39
FLY055	23/07/96	04:31:15
FLY056	23/07/96	05:27:26
FLY057	23/07/96	06:01:28
FLY058	23/07/96	07:21:01
FLY059	23/07/96	07:46:27
FLY060	23/07/96	08:56:46
FLY061	23/07/96	09:31:22
FLY062	23/07/96	11:07:43
FLY063	23/07/96	11:31:03
FLY064	23/07/96	12:17:39
FLY065	23/07/96	17:54:02
FLY066	23/07/96	18:34:39
FLY067	23/07/96	19:22:32
FLY068	23/07/96	19:58:14
FLY069	23/07/96	21:07:45
FLY070	23/07/96	21:30:41
FLY071	23/07/96	22:36:08
FLY072	23/07/96	22:59:33
FLY073	23/07/96	23:57:00
FLY074	24/07/96	00:40:00
FLY075	24/07/96	02:03:28
FLY076	24/07/96	02:47:33
FLY077	24/07/96	03:36:19
FLY078	24/07/96	04:07:05
FLY079	24/07/96	05:03:11
FLY080	24/07/96	05:32:51
FLY081	24/07/96	19:20:06
FLY082	24/07/96	21:42:25
FLY083	24/07/96	22:15:15
FLY084	24/07/96	23:30:44
FLY085	25/07/96	00:23:29
FLY086	25/07/96	01:05:12
FLY087	25/07/96	02:54:29
FLY088	25/07/96	03:30:45
FLY089	25/07/96	04:48:09

9) Table of mooring deployments and recoveries

	Site	Date	Time	Lat. (N)	Long. (W)	Depth (m)	Type
Deployed:	N300	11/07/96	14:07	56 37.25	08 59.15	299.5	Sub surface current meter mooring
	S300	11/07/96	18:32	56 27.32	09 03.89	303	Sub surface current meter mooring
	S140	12/07/96	12:03	56 27.50	08 11.07	149	'U' shaped fast sampling mooring (M.Innal)
	S140	12/07/96	15:58	56 27.68	08 11.23	149	Broad band RDI ADCP
	S140	12/07/96	16:49	56 27.71	08 11.46	149	Toroid marker buoy
	S140	13/07/96	12:25	56 27.57	08 57.68	146	Broad band RDI ADCP
	S140	13/07/96	14:58	56 27.39	08 57.72	147	'U' shaped fast sampling mooring (M.Innal)
	S600	13/07/96	17:38	56 27.77	09 07.58	595	Experimental 80KHz ADCP
	S400	14/07/96	15:18	56 27.30	09 04.91	419	RVS RDI ADCP s/n394
	S140	17/07/96	20:12	56 27.21	08 57.81	147	Met buoy
Recovered:	S140	12/07/96	07:18	56 27.53	08 57.65	149	Broad band RDI ADCP
	S300	13/07/96	18:49	56 27.80	09 03.54	290	Surface instrumented toroid
	S140	15/07/96	12:40	56 27.22	08 57.79	146	Met buoy
	S140	15/07/96	14:00	56 28.03	08 57.76	147	Toroid mooring
	S140	24/07/96	10:12	56 27.60	08 00.20		Toroid buoy +TC + CM
	S400	25/07/96	09:42	56 27.90	09 04.40		ADCP
	S140	25/07/96	11:53	56 27.40	08 57.90		
	S140	28/07/96	11:18	56 27.70	08 57.60	146	ADCP
	S140	28/07/96	14:17	56 27.90	08 57.11	142	'U' shaped; chain parted 1315; 1355 mooring released
	S300	28/07/96	15:49	56 27.30	09 03.80	254	Sub-surface
	S700	29/07/96	09:25	56 28.35	09 09.87	693	Toroid buoy
	S600	29/07/96	11:57	56 28.00	09 07.80		ADCP
	N300	29/07/96	15:12	56 37.64	09 00.63	296.1	Pop-up CM mooring
	S700	30/07/96	13:33	56 19.30	09 10.30		Released, but unable to retrieve until 01/08/96 11:25
	N1500	02/08/96	08:25	56 42.37	09 24.52	1432	Sediment traps
	P1500	02/08/96	12:03	56 38.83	09 35.49	1492	Pop-up current meters
	N140	03/08/96	07:56	56 36.22	08 55.30	136.1	Bottom pressure recorder
	N140	03/08/96	08:50	56 36.29	08 55.83		Pop-up current meters
	S140	03/08/96	16:18	56 34.60	08 56.50		Dredged - 1 nitrare analyser + 3 wrecked RCMs + 2 TCs
	S300	05/08/96	11:15	56 27.38	09 03.59	266	Toroid marker buoy
	S140	05/08/96	12:40	56 27.23	08 57.68	146	Toroid meteorological buoy
	S200	06/08/96	16:00	56 14.92	09 09.88	240	Dredged bottom of rig; rest recovered earlier cruise

10) Table of Coring positions

Site	Ref	Date	Lat. (N)	Long. (W)	Depth (m)	No. obtained
S5	MC1	28/07/96	55 55.05	07 59.90	177	9/10
S5	MC2	28/07/96	55 55.04	07 59.74	176	10/10
S5	MC3	28/07/96	55 55.09	07 59.19	176	5/5
S5	MC4	28/07/96	55 54.98	08 00.07	176	7/7
R1000	MC5	28/07/96	56 31.34	09 18.62	1037	9/10
R1000	MC6	28/07/96	56 30.90	09 17.69	1002	9/10
R1000	MC7	28/07/96	56 30.95	09 17.86	1007	0/10
R1000	MC8	28/07/96	56 31.08	09 17.70	1003	10/10
S700	MC9	29/07/96	56 26.45	09 09.73	711	10/10
S700	MC10	29/07/96	5626.38	09 09.67	705	10/10
S700	MC11	29/07/96	56 26.42	09 09.75	709	3/10
S700	MC12	29/07/96	56 26.41	09 09.80	710	7/8
S1000	MC13	01/08/96	56 27.66	09 17.94	995	10/10
S1000	MC14	01/08/96	56 27.73	09 17.89	996	10/10
S1000	MC15	01/08/96	56 27.66	09 17.82	993	10/10
N1000	MC16	02/08/96	56 40.39	09 12.32	1021	10/10
N1000	MC17	02/08/96	56 40.31	09 11.64	1012	0/10
N1000	MC18	02/08/96	5640.29	09 11.67	1013	1/10
N1000	MC19	02/08/96	56 40.35	09 11.60	1011	0/8
N1000	MC20	02/08/96	56 40.24	09 12.03	1015	7/7
N1000	MC21	02/08/96	56 40.27	09 12.00	1017	0/8
P1000	MC22	03/08/96	56 36.06	09 17.33	999	8/9
P1000	MC23	03/08/96	56 35.95	09 17.51	1003	10/10
P1000	MC24	03/08/96	56 36.24	09 17.20	1000	8/8

11) Table of bedhop camera positions

Station	Date	Time	Lat. (N)	Long. (W)	Depth (m)	No. of shots
S5	27/07/96	04:16	55 54.95	07 59.84	-	25
S700	29/07/96	21:40	56 26.40	09 09.84	704	25
N1500	02/08/96	01:59	56 43.96	09 23.79	1497	25
N700	02/08/96	23:21	56 38.83	09 06.93	712	25
R700	04/08/96	19:18	56 30.85	09 10.73	702	25
R1000	04/08/96	21:02	56 31.00	09 17.67	1004	25
N2000	06/08/96	23:26	56 59.75	10 00.31	2061	25
P700	06/08/96	22:22	56 35.22	09 10.88	703	10
N140	07/08/96	00:25	56 36.19	08 55.12	135	25

12) Table of marine snow camera positions

Dip no.	Station	Date	Time	Lat. (N)	Long. (W)	Depth (m)
99	S1000	29/07/96	03:16	56 27.61	09 17.98	1000
100	S700	29/07/96	05:19	56 26.99	09 09.34	690
102	S500	29/07/96	23:41	56 27.71	09 05.75	475
103	S140	30/07/96	00:59	56 27.72	08 57.93	140
104	S200	30/07/96	02:55	56 27.16	09 03.04	201
105	S300	30/07/96	03:44	56 27.96	09 03.57	253
107	S1500	01/08/96	20:42	56 27.59	09 38.93	1511
108	N1500	02/08/96	03:10	56 43.03	09 25.81	1486
113	N1000	02/08/96	17:25	56 40.32	09 11.88	1000
114	N700	03/08/96	00:59	56 39.00	09 07.12	766
115	N500	03/08/96	02:13	56 38.05	09 04.35	502
116	N300	03/08/96	03:13	56 37.55	09 01.17	291
117	N200	03/08/96	03:56	56 37.21	09 00.08	183
118	N140	03/08/96	04:42	56 36.50	08 56.13	127