Challenger 118C/95

[LOIS RACS(C)]

27 April to 12 May 1995

Cruise Report

P.G. Watson
Plymouth Marine Laboratory

1. OBJECTIVES

1.1 To quantify hydrodynamical transports and the processes affecting transformations, interactions and fates of particles, biogeochemically important elements and representative contaminants from land sources to the coastal zone.

1.2 To provide the first integrated environmental data base for a UK coastal region covering seasonal cycles and interannual variability and incorporating measurements of the fluxes of materials and rates of biological productivity.

1.3 To generate new quantitative understanding of estuarine and coastal zone processes controlling the flux and reactivities of both natural and anthropogenic materials.

1.4 To provide integratable models of these processes as building blocks for comprehensive coastal zone models which will realistically predict the effects of future environmental change.

2. SPECIFIC CRUISE OBJECTIVES

2.1 To quantify the rates and processes of sediment-water exchange of nutrients, trace metals and oxygen in the sediments of the Humber/Wash, Tyne and Tweed regions.

2.2 To quantify pore water concentration gradients of nutrients and trace metals, the distributions of naturally occurring radionuclides, and the rates of denitrification/nitrification and sulphate reduction within the surficial zone of these sediments.

2.3 To determine the population density of bioturbating macrofauna within these sediments.

2.4 To map the distribution of dissolved nutrients, chlorophyll, salinity, temperature, turbidity and fluorescence in the LOIS RACS(C) region.

2.5 To determine methane concentrations and the abundance of methanotrophic bacteria in the water column.

3. PERSONNEL

P.G. Watson	(PML)	Principal Scientist
R. Bellerby	(PML)	
J. Barnes	(University of Newcastle upon Tyne)	
R.J. Clifton	(PML)	
H. Cussen	(IOSDL)	
R. Downer	(BODC)	
A. Fern	(RVS)	
T. Frickers	(PML)	
C. Harris	(PML)	
A. Jones	(RVS)	
D. Smallman	(DML)	
S. Starr	(University of Newcastle upon Tyne)	
S. Widdicombe	(PML)	

4. ITINERARY

This leg of cruise CH118/95 followed two earlier legs (CH118A/95, CH118B/95) which were directed towards water column determinations. This leg was primarily concerned with sediment sampling and analysis. In addition to this underway mapping of dissolved nutrients and water column characteristics was carried out where possible, but this work was constrained by the need to stay on coring stations for long periods and by limited man power resources for nutrient analysis and CTD deployment.

All times are BST

Wednesday 26 April 1995: Scientific party joined the ship at Grimsby (apart from R. Downer, A. Jones and S. Widdicombe who had been on the previous leg). Loaded and began setting up scientific equipment until 20.00.

Thursday 27 April 1995: Continued setting up equipment; at 10.00 scientists meeting to finalise plans for process studies, survey work and data logging procedures. Ship sailed at 14.06 into a moderate swell with N/NW wind force 3-4 en route for the sediment sampling transect north of the Tyne.

Friday 28 April 1995: 07.48 at coring station T2; wind N force 3-4, swell decreasing. Commenced coring at 08.15; initial Day grab to check the nature of the sediment, small and large box cores, multicore and CTD for water column profile and samples for incubation work and gas chromatographic analysis. Station T2 completed at 14.00, proceeded to station T1, arriving at 14.43. Exploratory coring completed at 15.52. Boat drill at 16.15. Remained in the vicinity of station T1 overnight, sample processing and analysis continued until 20.30.

Saturday 29 April 1995: 08.00 at coring station T1; sea calm, sunny with light variable winds expected to veer to the SE. Limited box coring with small corer completed by 10.40. Proceeded to station T2 for one large box core and then to station T6, arriving at 13.15. Coring from 13.40 to 17.00. Then set course for C19, 20, 21 & 22 with continuous underway monitoring (nutrients: nitrate, nitrite, phosphate and silicate; salinity, temperature, transmission and fluorescence), CTD deployment, discrete sampling for SPM by gravimetry and filtered water samples for chlorophyll from CTD or non-toxic and water samples for Gas chromatographic analysis (GCA) from CTD. Sampling completed at 22.43 and then set course for coring station T5. Processing and analysis completed at 24.00.

Sunday 30 April 1995: 08.00 at coring station T5. Dull,cloudy with SE wind force 3-4. Completed coring at 11.38 and moved on to coring station T4, arriving at 13.00. All possible coring finished by 16.31 (station to be completed tomorrow). At 16.45 proceed to C19 arriving at 17.30 and then carrying out continuous underway monitoring through stations C18, 17, 16 & 15 (nitrate channel not working). Wind rising during this period S/SE force 4-5 so that it was necessary to ensure that all equipment was secured. Grid completed at 23.56 and set course for station T4. Processing and analytical work completed at 01.00.

Monday 1 May 1995: 08.00 at coring station T4 weather sunny with calm sea and light winds. Coring work completed at 10.08, proceeded to coring station T3, arriving at 11.07. Work with large box corer impeded by failiure of the spade to seal to the box. The problem seemed to be that the spade was not swinging forward far enough so that the front edge of the box caught on the leading edge of the spade. Eventually completed sampling with the large corer at 15.30 and then worked with the small box corer until one of the spade securing bolts sheared. Coring work suspended at 16.56 for repairs by the ships engineers. Remained in the vicinity of station T3 overnight, incubation work and sample processing continued until 21.00.

Tuesday 2 May 1995: 08.00 at coring station T3. Weather sunny, sea calm, forecast wind S/SE force 3-4. Small box corer and multi corer deployed, work completed at 10.24. Sediment sampling now completed at transect north of the Tyne. Set course to C22, at 10.35 total power failiure, restored at 11.00 and underway again by 11.35 reaching C22 at 13.05 and then carrying out continuous underway monitoring through stations C23, 24, 25, 26, 27 & 28 (nitrate channel still not working). Ships engineers repaired box from large corer which had been damaged by fouling on leading edge of spade (spare front panels were oversize for replacement on either of the two boxes supplied). Final grid station sampled at 00.30, nutrient analysis complete at 02.00. Proceed to coring station T7 off Tweed.

Wednesday 3 May 1995: 08.00 at coring station T7 off Tweed. Weather sunny, sea calm, forecast S/SW wind force 3-4. Large box corer deployed with some success but then spade/box sealing problems repeated. Problem seemed to be wear in the spade pivot pin locations. Ships engineers welded in plates to take up wear. Coring at T7 completed with small box corer by 10.30, proceed to coring station T8 2 miles off St.Abb's Head arriving at 11.55. Coring attempted but had to be suspended due to damage to the box of the large corer, and to the central pillar support of the small box corer, caused by large stones. Day grabs and previous coring work at this site had revealed only soft muds. At 15.28 set course for C29 arriving at 16.24 and then carrying out continuous underway monitoring through stations C30, 31, 32, 15 & reaching C14 by 05.14. As the nitrate channel was still not working discrete samples were collected at hourly intervals and at fixed stations, from the non toxic water supply. Then proceeded to coring station T9 off the Tees.

Thursday 4 May 1995: 08.00 at coring station T9. Weather fine with sunshine but haze limiting visibility, sea calm, SW wind forecast force 3-4. Coring work with large box corer affected by failiure of spade/box seal, although yesterdays work on the pivot location has restored the full travel of the spade. The problem now seems to be discrepancies in the match between the spade and box profile. Small adjustments made by ships engineers by grinding the edges of the box. This improved the sealing (though not completely) so that by 14.03 three cores were obtained which met all requirements at this station. The sediment surface was 'broken' in all three cores, possibly due to the very mobile nature which may be the result of extensive trawling in this region. At 14.12 underway to C13 arriving at 15.10 and then carrying out continuous underway monitoring through stations C32, 33, 34 (nitrate channel now operative) and reaching C35 by 22.55. Continued onto Humber/Wash grid through stations HW2, 1, 3, 4, 6 & reaching HW8 at 06.25 and then to coring station HW/S4 (Silver Pit).

Friday 5 May 1995: 08.00 at coring station HW/S4. Weather fine with hazy sunshine, calm seas and light W'ly winds. Took Day grabs at station and to NE using grab data obtained on CH117B/95, difficult to locate the sedimentary material expected from previous work but most similar was found at the location of DG25 on CH117B/95 (muddy sand with some shell and chalk fragments). At 11.17 deployed box corer, collecting only one large cobble which caused damage to the front panel of the box. Decided to abandon this station and move to HW/S5 where Day grabbing revealed coarse sand with some shell and small rounded gravel. Deployed box corer with replacement front panel (ground to fit by ships engineers) and sucessfully obtained 6 cores by 16.00. Set course for HW7 arriving at 18.30 carrying out continuous underway monitoring through stations HW7, 9, 10 and reaching HW11 at 23.00. Then proceeded on course towards Humber mouth.

Saturday 6 May 1995: 07.14 at anchor at Bull Fort Sands in Humber mouth, coring station HW/S6. Weather fine and sunny with calm sea and light winds. 08.08 Day grab revealed muddy fine sand as expected. Limited success with large box core due to inexplicable failiure of the spade to close properly. Eventually 5 cores obtained leaving two more needed for macrofaunal sampling. Multicore worked very well obtaining a maximum 4 cores at each of two deployments. On line nutrient analysis maintained during anchorage. At 15.44 anchor aweigh and underway to HW6 arriving at 18.43 and carrying out continuous underway monitoring through stations HW8, 15 (at 22.35) and then to HW18 and HW17 arriving at 04.17. Then proceeded on course to coring station HW/S8.

Sunday 7 May 1995: 08.00 at coring station HW/S8 - 20 miles off NE Norfolk coast; weather fine and sunny with light winds and calm seas. Day grab revealed soft muds as expected. Large box corer operated reasonably satisfactorily and 7 cores taken and sub-sampled by 14.08.

Then set course for HW18 arriving at 15.14 and carrying out continuous underway monitoring through stations HW17, 16, 15, 14 (at 23.05) & arriving at HW12 at 01.41. Then set course for coring station HW/S1.

Monday 8 May 1995 (50th anniversary of VE day): 08.00 at coring station HW/S1, weather cooler, intermittent sun, NW wind force 4-5, forecast to increase to 6-7. Day grab revealed muddy sand with some old, friable shell. Moved ~0.1mile to the east, Day grab similar, returned to original position to attempt box coring. One good core obtained but others were slumped possibly due to tilting of the corer as it was pulled out of the sediment. At 11.15 proceeded to coring station HW/S9 in the approaches to the Wash. At this station Day grabs revealed muddy sand with some modiolus shells. One acceptable box core obtained, but other attempts failed due to shell trapped at the edge of the box preventing sealing. At 15.18 abandoned coring and proceeded to HW13 (arriving at 16.43) and carrying out continuous underway monitoring through stations HW12 & 10 (completed at 19.39). Then set course for coring station HW/S8. Sample processing, nutrient analysis *etc.*, proceeded until 22.30.

Tuesday 9 May 1995: 08.00 at coring station HW/S8. Weather cloudy with sunny intervals, sea state moderate. Commenced Day grab survey on SW transect to Sizewell Bank, starting at 0.2mile intervals and increasing through 0.5, 1, 2 to 3mile intervals. Grab survey completed at 16.40 and set course for HW18 and continued through HW15, 8, 6 to HW4 arriving at 07.00 (Wednesday)

Wednesday 10 May 1995: 07.00 at HW4, weather cloudy with intermittent sun wind forecast NW veering NE force 3-4. CTD deployed and set up nutrient analyser, then set course for C1, arriving at 08.40 and carrying out continuous underway monitoring, CTD and GC sampling through stations C2, C3, C4, C5, C6, C7, C8, C9, C10, C11 & C12 to complete Humber/Tweed grid by 03.45. Then proceeded via C.33, 34 and towards C.35 leaving grid to continue towards HW2.

Thursday 11 May 1995: Proceeding towards HW2 arriving at 11.50. Weather forecast for Humber region, N/NE wind force 4 occ. 5 with showers and good visibility. Further south in the Dover region forecast is NE 5/6 occ. 7 later. Continued along HW grid through stations HW1 and HW3 carrying out continuous underway monitoring, CTD and GC sampling, completed at 15.45. Then proceeded to Bull anchorage, and to lock at Grimsby at 00.30.

Friday 12 May 1995: 02.48 alongside at Grimsby Royal Dock. Laboratories cleared of equipment and unloaded from ship. All scientific party left by 12.15.

5. INDIVIDUAL CRUISE REPORTS

5.1 NUTRIENT ANALYSIS

Bekkqi Bellerby

Continuous on-line nutrient analyses were carried out using 3 different analysers over sections of the Coastal and Humber/Wash grids. A Technicon AA II system, developed at PML, and set up to measure nitrate, nitrite, silicate and phosphate was used. This was normally deployed during the night while steaming between sediment sampling sites. Water, supplied to the laboratory, from the ships non-toxic system was used. Upon reaching the autoanalyser water was passed through a continuous filter block, with a 0.45μm Millipore filter. Nitrite was not measured due to the failure of the colorimeter power-board. This was not of major significance as the 'nitrite' channel on the chart recorder was frequently used with the new ammonia analyser, see below.

Discrete analyses were carried out on sediment pore water and flux samples in support of on-board sediment core experiments. Nitrate, nitrite, silicate and phosphate were analysed using an Alpkem auto-analyser and ammonia samples analysed using a new ammonia analyser (set-up by Malcolm Woodward prior to sailing). In addition to the samples generated at sea, a number of stored, frozen nutrient samples (the majority for ammonia) were analysed. The new ammonia analyser proved to be a vast improvement on the previous one used on CH117B and no problems were encountered with it. The only inconvenience was that no auto-sampler was available, so that manual sampling had to be used. An auto-sampler is strongly recommended for CH119B.

Nutrient calibration was effected by running standards made up in low nutrient sea water (Ocean Science International - OSI). Standards were run for the on-line analysis at the beginning and end of each run.. Milli-Q water was used as a reagent blank and low nutrient sea water as a standard zero. Working standards used were as follows: nitrate 2.5, 5.0, 7.5, 10.0μM, silicate 2.5, 5.0, 7.5, 10.0μM, and phosphate 0.5, 1.0, 1.5, 2.0μM.

Standards for discrete analyses were run once or twice depending on the length of analyses, and were as follows: nitrate 5, 10, 15, 20μM, nitrite 0.25, 0.5, 0.75, 1.0μM, silicate 5, 10, 15, 20μM and 15, 30, 45, 60μM, phosphate 2, 4, 6, 8μM and 4, 8, 12, 16μM and ammonia 5, 10, 15, 20μM.

<u>**Chlorophyll Samples**</u>

Samples collected for chlorophyll analysis during CH118B/95 and CH118C/95 were analysed on board using a fluorometric technique.

5.2 NITROUS OXIDE & METHANE IN HYDROCASTS

Jon Barnes

The dissolved seawater concentrations of two important greenhouse biogases, nitrous oxide (N_20) and methane (CH_4), were determined simultaneously, to high precision, using a fully automated headspace equilibration gas chromatographic technique. Data has been collected from all CTD hydrocasts along the Coastal, Humber/Wash grids and all coring stations. Although this will require detailed examination several interesting preliminary observations can be made. Firstly the North sea is saturated with nitrous oxide and methane with respect to the atmosphere suggesting an efflux of these gases i.e. the North sea acts as a source. Secondly and of particular relevance to LOIS are the high nitrous oxide levels (saturated by 125%/11.5nmol l^{-1}) found in the water column at HW/S6 (Humber mouth). This is probably associated with high denitrification rates occuring in the water column as a result of freshwater input (lower salinity 31.3 ppt) increased nitrate levels and higher temperatures. The high turbidity probably provides the micro-anaerobic sites necessary for denitrification. In general nitrous oxide concentrations are high in the water column in the Humber/Wash region (typical values of 100% saturation/9.5 nmol l^{-1}) and decrease along the coastal grid (7-9 nmol l^{-1}).

DENITRIFICATION IN SEDIMENTS

In addition to gas chromatographic work, core samples were taken at fixed stations for measurement of nitrification/denitrification rates using ^{15}N and acetylene block techniques. These samples (collected as discrete gas samples) will be analysed using isotope ratio mass spectrometry and gas chromatography on return to Newcastle.

5.3 SEDIMENT MIXING/ACCRETION & SULPHATE REDUCTION RATES

Bob Clifton

Objectives:

(a) To determine mixing/accretion rates in selected sediment deposits off the N.E.Coast of England.

(b) To attempt to determine residence times of suspended particulate material in the water column in the same areas as (a).

(c) To determine sulphate reduction rates in the same sediment deposits as those described in (a).

Methodology and sites studied.

(a) Mixing and/or accretion rates are determined from the sediment-depth profiles of a suite of radionuclides found in the sediment deposits of the North Sea i.e. ^{7}Be, ^{60}Co, ^{137}Cs, ^{210}Pb, and ^{226}Ra. To study sediment dynamics over the short-term (up to 100 days) the top 6 sediment horizons at 1cm intervals were sampled using a series of 'scrapes'. These 'scrapes' sample an area of approximately $0.1m^2$ in order to give a significant ^{7}Be signal. At depths greater than 6cm, sediment samples were obtained using an 18cm diameter stainless-steel corer. The sites sampled are listed in Table (i) below.

(b) Samples of suspended particulate material were obtained by filtering water obtained from the ship's non-toxic supply through 15cm GFF filters. In order to obtain a significant ^{234}Th signal it was necessary to filter large volumes of water (>100litres) - this was only possible at sites with a low SPM (see Table (i) below).

(c) Samples for sulphate reduction rates were taken from 6cm sub-cores obtained from the large box-corer. Sulphate reduction rates are to be determined in the sediment sub-samples which were incubated with the radioactive tracer ($Na_2{}^{35}SO_4$) for approximately 24hrs. The stable sulphate content of the pore waters obtained from these sub-samples was also determined. (See table (i) below for sites).

(d) Sediment samples taken from HW/Station 8 on previous cruises have produced a significant ^{60}Co signal. The most probable source of this ^{60}Co is the nuclear power stations at Sizewell, situated on the Suffolk coast, approximately 50km to the South East of HW/Station 8. The sediment deposits at HW/Station 8 have also been shown to have high sulphate reduction rates and very high oxygen consumption rates (Dave Smallman). These data would suggest that Station 8 is a 'focus' for the input of a variety materials and contaminants, including carbon. In order to gain insight into the dynamics of the transfer of these materials to HW/Station 8, a series of grab samples were taken along a transect from HW/Station 8 towards the Sizewell Bank. Initially the grab samples were taken at 2 cable intervals in the 'muddy' sites and this was increased to 1, 2 and finally 3 mile intervals at the more 'sandy' sites. The transect terminated approximately 7 miles from the Sizewell bank.

Table (i) Sample sites and samples taken for mixing/accretion, sulphate reduction and SPM studies

STN	Radio-Nuclides		Stable SO_4- SO_4 reduced	SPM for ^{234}Th
	'Scrapes'	Core sections		
T1	Small BC	No	No	No
T2	Yes	Yes	Yes	Yes
T3	Yes	Yes	Yes	Yes
T4	Yes	Yes	Yes	Yes
T5	Yes	Yes	Yes	Yes
T6	Yes	Yes	Yes	Yes
T7	No	Yes	Yes	Yes
T8	No	No	No	No
T9	No	Yes	Yes	Yes
S4	No	No	No	No
S5	Yes	Yes	Yes	No
S6	Yes	Yes	No	No
S8	Yes	Yes	Yes	Yes

5.4 SEDIMENTARY DISSOLVED OXYGEN, REDOX POTENTIAL AND ^{210}PB DISTRIBUTIONS

Helen Cussen

As part of an investigation into the sediment geochemistry and bioturbation, dissolved oxygen, redox potential (Eh) and resistivity were measured on sediments recovered using the box corer and the multi-corer. Samples were also taken for subsequent radio-nuclide (^{210}Pb) analysis on return to the laboratory.

Sub-cores taken from box cores at sites T2, T3, T4, T5, T6, T7, T9 and HW/S8, and multi-cores from sites T2, T3 and HW/S6 were profiled for dissolved oxygen using a robust dissolved oxygen electrode. The box cores were sub-cored into 10cm diameter clear plastic multi-core tubes and 2-3cm depth of bottom water was retained over the sediment to reduce the effect of oxygen diffusion into the core. The cores were immediately transferred to the constant temperature laboratory (8°C) where a computer controlled profiling device was used to push the oxygen electrode into the sub-core from above in steps of 1mm. The computer monitored the readings from the electrode at each step and when it considered the reading to be stable, logged the value for that depth increment. A plot of the data was displayed in real-time as the profile proceeded.

For most of the cores oxygen penetrated to between 20 and 60mm in depth. The multi-core from station T3 had a layer of fluff approximately 20mm thick overlying the sediment which had not been visible in the box core from the same station. The oxygen profile for this core shows a very steep gradient falling to zero at 6mm into the fluff layer where as that for the box core shows oxygen penetrating to a depth of 30mm.
At all the stations listed above a second sub-core was taken for redox potential (Eh), resistivity and radio-nuclide measurements. This core was spilt and half was sampled at 1cm resolution for radio-nuclide analysis on return to the Institute of Oceanographic Sciences (IOS). Eh and resistivity measurements were made every centimetre on the other half of the core using a Kent-Taylor combined redox microelectrode and a prototype resistivity probe which was made at IOS. The tip of the Eh electrode was acid cleaned before use and a measurement was taken in a standard ferrocyanate solution to assess the electrode drift. Initially the readings within the sediments were very variable and drifted dramatically but the performance seemed to improve on later cores where definite trends in both the Eh and resistivity could be seen.

5.5 DATA COLLECTION

Richard Downer

The primary objective of BODC staff on scientific cruises is to ensure that a comprehensive record of all scientific activities is produced and maintained. This record contains accurate times and systematic sample identification.
A 'rough' log has been maintained throughout the duration of the cruise from which various infirmation has been extracted into specific spreadsheets. Seperate spreadsheets have been produced for:-

- **CTD casts and samples taken from the water bottles;**
- **Non-toxic pumped supply samples;**
- **Boxcores with a listing of subcoring activities;**
- **Multicores with description of sampling activities;**
- **Day grabs with a description of sediment type and samples taken;**
- **Nutrient analysis record.**

In addition the rough log has been transcribed into a further 'master' spreadsheet containing the times, positions, water depths and stations of all the scientific activities recorded. In summary, there have been 72 boxcores, 9 multicores, 39 Day grabs, 52 CTD's and 50 non-toxic supply samples recorded. Also microcomputer assistance has been made available to the scientists on the cruise, as well as general help with sampling.

5.6 SEDIMENT WATER EXCHANGE

Trish Frickers

Objectives

1. To quantify the effect macro-benthic animals have on the sediment-water exchange of nutrients (nitrate, phosphate, silicate and ammonia) and trace metals (iron, manganese, nickel, zinc, copper, cadmium and lead) in the Humber plume and Wash region at sites established during previous cruises. DOE contract no PECD/7/7/423.

2. To continue the investigation of sediment-water exchange (of nutrients and metals) at sites along the 'Tyne' transect established during cruise CH115B/94 and sampled during cruise CH117B/94

3. As objective 2 but at sites off the Tees (54 46.10N 1 0.61W) and south of the Tweed (55 48.52N 1 50.79W) previously sampled during CH108B/93.

Achievements

1. Box cores were collected at 5 sites in the Humber/Wash region i.e. HW/Stations 1, 5, 6, 8 and 9, at all the six sites across the 'Tyne' transect (T1-6), the Tweed (T7) and Tees (T9) sites.

2. The SMBA box cores were sub-cored for duplicate large cores for pore water sampling and incubation in a ship board microcosm. Duplicate small cores were taken for redox, a third small core was taken for porosity and carbon and nitrogen analysis and a fourth small core for particle size analysis.

3. Ship board analysis was carried out on flux samples and pore waters for nutrients, on pore waters and overlying waters for alkalinity and on sediment cores for redox.

4. The pore waters and filtered flux samples for trace metals determinations were acidified and stored. (Analysis will be carried out at PML).

5. On completion of the chemistry, all the microcosm cores were sieved to enumerate their macro-faunal content.

5.7 SEDIMENT-WATER EXCHANGE OF OXYGEN

David Smallman

Objective

The overall aim of the study, together with denitrification rates (University of Newcastle), sulphate reduction measurements (PML) and diffusive flux predictions based on oxygen measurements made with an electrode profiling system (IOS), is to obtain a qualitative and quantitative profile of coastal early diagenetic processes along the North-East coastline of the UK. Subsequently it is intended to create a model of these processes with respect to organic inputs into the sediments at varying sites.

Acheivements

Marine sediments situated in the Humber/Wash region and off the Tyne, Tees and Tweed estuaries were examined to determine sediment-water exchange processes, particularly oxygen fluxes. Sediments were collected utilising two different sampling procedures.

5.7.1. Undisturbed cores, in which the sediment-water interface remains intact, were obtained using a Bowers & Connelly mini-corer. The corer was configured so that two 65mm id and two 100mm id cores may be sampled from each deployment. The larger diameter cores were used in the oxygen flux measurements. In both cases a sediment column of between 15-20cm in height was obtained, the remainder of the core tube being filled with the water which overlay the sediment.

5.7.2. 100mm id cores were sub-sampled from a box-corer and used to determine the same paramaters as above.

Sediment incubation studies were carried out after immersing the cores from each sampling station in water which overlay the sediment at that site. In the case of the cores sub-sampled from the box-core, overlying water was gently dripped onto the surface of the core until the tube was full (a depth of 15cm was typical). The overlying water was collected at each site using the RVS CTD Rosette system.

The immersed cores were acclimatised for approximately 6 hours and then sealed with PTFE inserts (taking care to avoid introducing any bubbles) incorporating an impellor (4rpm) to maintain a diffusive boundary layer of between 180-400mm at the sediment-water interface. The temperature of the water was maintained at 8°C in a constant temperature room. Oxygen fluxes were calculated according to the rate of diminishment of oxygen in the isolated water column of the core tube, measured by a standard potentiometric Winkler titration using an automatic titrator (Radiometer).

Traditionally, sediment flux measurements have been made from box-core derived material. In this study a comparison of box-core and multicore samples were made to assess which gave the most accurate measurement.

Sampling sites

Tyne Transect	Stations T2, T3, T4, T5, T6 & T7
Humber/Wash	HW/Stations S5, S6 & S8
Tweed	Station T7
Tees	Station T9

Table (ii) The number of samples taken at each station: large cores (L) using the multicorer (MC) or boxcorer (BC), and the associated CTD deployment from which the overlying water was obtained.

Station	Multicore samples	Boxcore samples	CTD No.
T2	MC1:2L	BC1:2L	1
T3	MC4:2L	BC47:2L	10
T4	MC3:2L	BC38:2L	9
T5	MC2:2L	BC27:2L	6
T6	*nd*	BC17:2L	3
T7	*nd*	BC48:2L	14
T9	MC5+6:2L	BC50:2L	18
HW/S8	MC9:1L	BC64:2L	34
HW/S6	MC7:2L	BC60:2L	29
HW/S5	*nd*	BC53:2L	14

nd = not done

5.8 THE ABUNDANCE AND DISTRIBUTION OF METHANOTROPHS IN THE MARINE ENVIRONMENT RELATIVE TO METHANE CONCENTRATIONS

Sean M. Starr

Methane concentrations in the marine environment tend to be supersaturated with respect to atmospheric concentrations. This phenomena has been attributed to *in situ* production of methane by methanogenic bacteria. However this environment contributes a small percentage of methane to the atmosphere compared to other sources (i.e. freshwater environments and paddy fields). The only process in which methane is oxidised, in this aquatic environment, is by microbial action from methanotrophic bacteria. Any methane that is not oxidised by this process is released into the atmosphere. There are two types of methanotrophic bacteria, type I and type II. This characterisation is dependent on biochemical pathways and other molecular characteristics. At present only type I has been found in the marine environment. The enzyme associated with methane oxidation is methane monoxygenase. This enzyme can occur in two forms soluble and particulate. The enzyme which is expressed is dependent on copper availability. However, the soluble form is only associated with type II bacteria, where as the particulate from is found in all methantrophic bacteria. As this particular enzyme is unique to methanotrophs, gene specific probes for detection of this bacteria in the environment have been constructed.
The main objective in this preliminary study, is to observe any correlation between methane concentration and the presence of methanotrophic bacteria. Furthermore, to determine the relative abundance of these bacteria with respect to both concentration of methane and in the microbiological population. This was achieved by:-

- Observations of methane concentrations in the water column at the Tyne transect over a variety of depths (at coring stations T1, T2, T5 and T6) and at coastal stations (C14-C28), by a liquid-gas chromatography technique using a modified Shimadu gas chromatograph.
- Water samples from the same sites were filtered using Sterivex™-GS filter units (Millipore). In the laboratory samples will be probed using phylogenetic and gene specific probes for methanotrophic bacteria using semi- quantitative PCR.

5.9 BENTHIC FAUNA

Steve Widdicombe

AIMS:

- To collect faunal samples at the sites established during CH99/92 and revisited during CH108/94, CH115/94 and CH117/95, in order to provide seasonal data for the sediment heterogeneity study within the Humber Plume Zone (**HPZ**).
- To collect faunal samples at sites along the Tyne Transect (**TT**) established during CH115/94 and sampled during CH117/95.

STATIONS:

(S1), (S4)*, S5, S6#, S8, (S9). **HPZ**

T1, T2, T3, T4, T5 ,T6. **TT**

( ) Cores recovered for sediment-water exchange (see para 5.6) but not for biota.

( )* No cores recovered.

\# Cores recovered for sediment-water exchange (see para 5.6) but only 2 replicates for biota.

ACHEIVEMENTS

At each site four $0.1m^2$ box cores were deployed. Each sample was sieved for macrofauna on a 0.5mm square mesh sieve and the residue preserved in 10% formaldehyde solution. The fauna from the sediment-water exchange (see para 5.6) microcosm cores was extracted and preserved in the same way. Surface sediment samples for Caroline Ingram (UCNW) were also preserved.

NOTES

1. The $0.1m^2$ box corer was damaged at a station off St Abbs Head so all samples in the HPZ were sub sampled from the $0.25m^2$ box corer.

2. Due to the large corer failing to seal, only 2 replicate samples were obtained from station HW/S6. This problem also prevented faunal cores from being obtained at stations HW/S1, S4 & S9.

6. REPORT

Summary and assessment of achievements

6.1 Figure 1 shows the complete cruise track and Table 1 is a complete log of events.

6.2 The majority of the cruise objectives were met, with the exception that a full set of sediment samples could not be obtained at some sites. This was primarily due to the mixed nature of the sediments.

6.3 Fifteen sediment sites (6 in the Tyne, 2 in the Tweed, 1 in the Tees and 6 in the Humber/Wash regions) were sampled, in all 72 box cores (see Table 2; Figures 2 & 3) and 9 sets of multicores (see Table 3; Figures 4 & 5) were collected.

6.4 Further investigations of sediment type and distribution were made by Day grab sampling (see Table 4; Figures 6 & 7). An additional Day grab survey was carried out on a SW transect from HW/S8 towards the Sizewell Bank to investigate possible sources of inputs to this coring station.

6.5 Sediment cores were analysed on board ship or prepared for subsequent laboratory analysis to provide a comprehensive investigation of physical, chemical and biological sedimentary processes. These included: vertical pore water gradients and sediment-water exchange of nutrients and trace metals, rates of nitrification/denitrification and sulphate reduction, dissolved oxygen profiles and sediment oxygen uptake, sediment mixing/accretion rates and mixing depth, redox, particle size distribution and porosity.

6.6 CTD casts were made at 52 stations (Tables 5 & 6; Figures 8 & 9) supported by sampling from the non-toxic supply (Table 7) for calibration purposes. Main parameters were depth, temperature, salinity, transmittance and fluorescence.

6.7 On-line water column nutrient sampling was carried out over the northern and southern parts of the LOIS sampling grid (Figure 10) and analyses carried out for nitrate, phosphate, silicate and when possible also for ammonia.

6.8 A complimentary suite of supporting water column variables (fluorescence, temperature, salinity and transmission) were measured.

6.9 The dissolved seawater concentrations of two important greenhouse biogases, nitrous oxide and methane were determined at sites in the coastal and Humber/Wash regions and at all coring sites. Additionally samples of particulate material were collected for semiquantitative analysis of methanotrophic bacteria. Initial results indicate high concentrations of nitrous oxide and methane in the Humber/Wash region decreasing along the coastal grid (paras 5.2 & 5.8)

6.10 Sedimentary dissolved oxygen was determined at the 'Tyne' transect, Tees, Tweed and Humber/Wash coring sites. Marked differences in oxygen profiles were observed between samples with and without surficial floc layers.
6.11 The weather was good for the entire cruise, although hazy conditions limited visibility during the first few days.

Ship operations and facilities

6.10 As usual RVS Challenger was efficiently and professionally run, and the support from the ships officers, crew and from RVS personnel was excellent.
6.11 The laboratory facilities were satisfactory. There was a loss of AC power for a short while necessitating resetting of instrumentation and computers.
6.12 The large SMBA box corer gave adequate service enabling the major objectives of the cruise to be met. However, failiure of the spade to fully swing across resulted in poor sealing and loss of cores on several occasions. This resulted in delays rather than failiure to meet objectives (see 6.3 above). This problem appeared to be due to wear in the locations of the spade pivot pins and it is recommended that this part of the equipment be serviced in preparation for further use.

TABLES

FIGURES

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
29/04/95	17:00	C19	55.208	-1.020	91	Started grid track
29/04/95	17:17	-	-	-	-	Nutrients online
29/04/95	18:30	C20	55.219	-1.439	45.5	PG001 & PG037
29/04/95	20:00	C21	55.343	-1.061	94	CTD5
29/04/95	21:45	C22	55.396	-1.496	45.4	PG002 & PG038
29/04/95	21:55	C22	55.396	-1.496	45.4	Nutrients Offline
30/04/95	07:07	T5	55.150	-1.083	93	BC23
30/04/95	07:22	T5	55.152	-1.083	92	BC24
30/04/95	07:37	T5	55.152	-1.089	92	BC25
30/04/95	07:54	T5	55.152	-1.087	92	BC26
30/04/95	08:10	T5	55.154	-1.083	92	CTD6
30/04/95	08:10	T5	55.154	-1.083	92	PG031
30/04/95	08:12	T5	55.154	-1.083	92	PG111
30/04/95	08:37	T5	55.154	-1.078	92.5	BC27
30/04/95	09:39	T5	55.151	-1.083	91	BC28
30/04/95	09:50	T5	55.151	-1.083	91	Declined multicore
30/04/95	10:15	T5	55.150	-1.086	91.5	BC29
30/04/95	10:27	T5	55.150	-1.088	91	MC2
30/04/95	12:20	T4	55.149	-1.187	86	BC30
30/04/95	12:47	T4	55.150	-1.177	86	BC31
30/04/95	12:55	T4	55.151	-1.177	86.5	BC32
30/04/95	13:08	T4	55.151	-1.172	86.5	BC33
30/04/95	13:37	T4	55.149	-1.179	86.5	BC34
30/04/95	14:53	T4	55.150	-1.178	87.5	BC35
30/04/95	15:20	T4	55.150	-1.173	88	BC36
30/04/95	16:26	C19	55.207	-1.025	91	PG003 & PG039
30/04/95	16:55	-	55.153	-1.114	93	Nutrients online
30/04/95	18:05	C18	55.014	-1.366	22.5	PG004 & PG040
30/04/95	19:20	C17	55.084	-1.044	90	CTD7
30/04/95	21:10	C16	54.934	-1.306	28.5	PG005 & PG041
30/04/95	22:35	C15	54.950	-0.917	75	CTD8
30/04/95	22:50	C15	54.959	-0.915	74	Nutrient Offline
01/05/95	07:45	T4	55.151	-1.175	85.5	CTD9
01/05/95	08:00	T4	55.153	-1.174	85.5	PG112
01/05/95	08:03	T4	55.153	-1.174	85.5	BC37
01/05/95	08:32	T4	55.154	-1.167	85.5	MC3
01/05/95	08:53	T4	55.154	-1.167	85.5	T/S trans 4.749 : 0.000
01/05/95	09:00	T4	55.153	-1.167	85	BC38
01/05/95	09:05	T4	55.153	-1.167	85	CTD trans 4.648 : -0.002
01/05/95	10:32	T3	55.153	-1.288	59	Failed Boxcore
01/05/95	10:42	T3	55.153	-1.288	59	BC39
01/05/95	12:21	T3	55.152	-1.286	59	Failed Boxcore
01/05/95	12:37	T3	55.150	-1.286	59.5	Failed Boxcore
01/05/95	13:01	T3	55.148	-1.289	59	Failed Boxcore
01/05/95	13:13	T3	55.148	-1.285	60.5	BC40
01/05/95	13:46	T3	55.148	-1.287	60.5	Failed Boxcore
01/05/95	13:57	T3	55.149	-1.285	61	Failed Boxcore
01/05/95	14:13	T3	55.150	-1.280	62.5	BC41

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
01/05/95	15:19	T3	55.150	-1.279	64	BC42
01/05/95	15:35	T3	55.147	-1.288	61.5	BC43
01/05/95	15:50	T3	55.147	-1.285	62	BC44
01/05/95	16:04	T3	55.146	-1.280	63	Failed Boxcore
01/05/95	16:13	T3	55.146	-1.280	63	PG113
02/05/95	07:15	T3	55.148	-1.293	58.5	BC45
02/05/95	07:30	T3	55.148	-1.294	58	CTD10
02/05/95	07:47	T3	55.146	-1.295	57.5	Failed Boxcore
02/05/95	07:54	T3	55.145	-1.293	57.5	Failed Boxcore
02/05/95	08:15	T3	55.144	-1.291	57.5	PG006
02/05/95	08:22	T3	55.142	-1.290	57	Failed Boxcore
02/05/95	08:34	T3	55.144	-1.291	57	MC4
02/05/95	08:47	T3	55.144	-1.291	57	BC46
02/05/95	09:10	T3	55.148	-1.294	57	PG006
02/05/95	09:11	T3	55.148	-1.294	57	BC47
02/05/95	09:35	-	-	-	-	Complete power failure
02/05/95	09:40	-	-	-	-	Power resumed
02/05/95	12:05	C22	-	-	-	PG007 & PG042
02/05/95	12:40	-	55.435	-1.322	59	Nutrients online - no NO3-
02/05/95	13:42	C23	55.491	-1.062	98	CTD11
02/05/95	15:50	C24	55.566	-1.550	40	PG008
02/05/95	17:23	C25	55.743	-1.242	73	CTD12
02/05/95	20:00	C26	55.769	-1.932	35	PG009
02/05/95	21:30	-	-	-	-	PG032
02/05/95	21:36	C27	55.915	-1.582	67	CTD13
02/05/95	23:30	C28	55.915	-2.087	-	Nutrients offline
02/05/95	23:30	C28	55.915	-2.087	-	PG010
03/05/95	07:00	T7	55.809	-1.847	69	PG114
03/05/95	07:02	T7	55.809	-1.847	69	CTD14
03/05/95	07:37	T7	55.809	-1.848	68.5	BC48
03/05/95	08:26	T7	55.810	-1.851	67.5	Failed Boxcore
03/05/95	08:47	T7	55.806	-1.851	65	Failed Boxcore
03/05/95	09:07	T7	55.807	-1.854	67.5	Failed Boxcore
03/05/95	09:19	T7	55.807	-1.857	67.5	BC49
03/05/95	11:00	T8	55.919	-2.084	67.5	CTD15
03/05/95	11:06	T8	55.919	-2.084	67.5	PG033
03/05/95	12:13	T8	55.918	-2.093	67.5	Failed Boxcore
03/05/95	12:36	T8	55.918	-2.092	67.5	Failed Boxcore
03/05/95	12:45	T8	55.918	-2.092	67.5	Small Boxcore f'd
03/05/95	13:40	T8	55.916	-2.080	71	DG3
03/05/95	14:12	-	-	-	-	Nutrients online
03/05/95	14:42	u/w	-	-	-	PG073
03/05/95	15:30	T8	55.910	-2.080	71	Started grid track
03/05/95	15:35	u/w	-	-	-	PG074
03/05/95	16:16	u/w	-	-	-	PG075
03/05/95	16:40	C29	56.002	-2.258	64.5	PG011
03/05/95	17:37	C30	56.001	-1.595	80.5	PG076
03/05/95	17:38	C30	56.001	-1.595	80.5	CTD16

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
03/05/95	18:43	u/w	-	-	-	PG076
03/05/95	19:38	u/w	-	-	-	PG077
03/05/95	20:20	C31	55.699	-1.051	81	Nutrients Offline
03/05/95	20:23	C31	55.699	-1.051	81	CTD17
03/05/95	20:25	C31	55.699	-1.051	81	PG079
03/05/95	21:21	-	-	-	-	Nutrients online
04/05/95	01:48	C32	-	-	-	PG080
04/05/95	01:49	C32	-	-	66.8	PG012
04/05/95	02:30	C15	-	-	77.5	PG013
04/05/95	02:30	C15	-	-	77.5	PG081
04/05/95	04:12	C14A	54.721	-1.102	38.9	PG082
04/05/95	04:14	C14A	54.721	-1.102	38.9	PG014
04/05/95	07:06	T9	54.769	-1.006	54	DG4
04/05/95	07:18	T9	54.770	-1.008	54	CTD18
04/05/95	07:36	T9	54.771	-1.009	54	Failed boxcore
04/05/95	07:45	T9	54.772	-1.009	54	Failed boxcore
04/05/95	08:07	T9	54.772	-1.008	54	Failed boxcore
04/05/95	08:25	T9	54.770	-1.007	53.5	Failed boxcore
04/05/95	09:35	T9	54.769	-1.010	52	Nutrients Offline
04/05/95	09:49	T9	54.771	-1.010	52	BC50
04/05/95	10:22	T9	54.770	-1.011	51.5	Failed boxcore
04/05/95	10:33	T9	54.769	-1.010	51.5	BC51
04/05/95	10:45	T9	54.769	-1.012	51	MC5
04/05/95	11:05	T9	54.769	-1.012	50.5	MC6
04/05/95	11:58	T9	54.767	-1.012	50.5	CTD19
04/05/95	12:36	T9	54.768	-1.011	50.5	Failed boxcore
04/05/95	12:57	T9	54.769	-1.010	50.5	BC52
04/05/95	13:37	-	54.830	-0.931	-	Nutrients online
04/05/95	14:10	C13	58.879	-0.821	64	PG015
04/05/95	14:34	C32	54.892	-0.747	67.5	CTD20
04/05/95	16:42	C33	54.751	-0.319	67	CTD21
04/05/95	18:40	C34	54.525	0.047	66.5	CTD22
04/05/95	21:54	C35	54.000	0.030	55	CTD23
04/05/95	22:10	-	-	-	-	Nutrients offline
04/05/95	00:16	-	-	-	-	Nutrients online
05/05/95	07:14	S4	53.549	0.715	82	DG5
05/05/95	07:34	S4	53.548	0.723	75.5	Failed Day grab
05/05/95	07:44	S4	53.546	0.723	76	DG6
05/05/95	08:17	S4	53.552	0.722	76	DG7
05/05/95	08:44	S4	53.555	0.723	71.5	DG8
05/05/95	09:04	S4	53.555	0.725	71	DG9
05/05/95	09:05	S4	53.555	0.725	71	Nutrients offline
05/05/95	09:23	S4	53.551	0.722	73	DG10
05/05/95	09:52	S4	53.550	0.721	75	Failed Day grab
05/05/95	10:03	S4	53.551	0.722	77	DG11
05/05/95	10:15	S4	53.551	0.722	77	Failed boxcore
05/05/95	11:44	S5	53.588	0.866	25.5	DG12
05/05/95	12:04	S5	53.588	0.880	25	BC53

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
05/05/95	12:32	S5	53.589	0.882	25	BC54
05/05/95	13:10	S5	53.588	0.881	24.5	BC55
05/05/95	13:35	S5	53.590	0.880	23	BC56
05/05/95	13:45	S5	53.590	0.880	23	Nutrients online
05/05/95	14:35	S5	53.588	0.881	23	BC57
05/05/95	14:57	S5	53.588	0.880	23	BC58
05/05/95	15:12	S5	53.590	0.880	23	CTD24
05/05/95	17:29	HW7	53.467	0.400	14	CTD25
05/05/95	18:41	HW9	53.323	0.410	17.5	CTD26
05/05/95	20:30	HW10	53.416	0.767	22.5	CTD27
05/05/95	22:00	HW11	53.482	1.002	23.5	CTD28
05/05/95	22:04	HW11	53.482	1.002	23.5	Nutrients offline
05/05/95	23:20	S6	53.547	0.101	15.6	Nutrients online
06/05/95	07:00	S6	53.547	0.101	15.6	Nutrients offline
06/05/95	07:07	S6	53.547	0.101	15.6	DG13
06/05/95	07:17	S6	53.547	0.101	15.5	Failed boxcore
06/05/95	07:25	S6	53.547	0.101	15.9	Failed boxcore
06/05/95	08:18	S6	53.547	0.101	16.3	Failed boxcore
06/05/95	08:32	S6	53.547	0.101	16.3	BC59
06/05/95	09:00	S6	53.547	0.101	16.4	CTD29
06/05/95	09:10	S6	53.547	0.101	16.4	PG034
06/05/95	09:20	S6	53.547	0.101	16.3	BC60
06/05/95	10:00	S6	53.547	0.102	16.1	MC7
06/05/95	10:20	S6	53.547	0.102	16	BC61
06/05/95	10:30	S6	53.547	0.102	15.9	MC8
06/05/95	10:47	S6	53.547	0.102	15.9	BC62
06/05/95	12:20	S6	53.547	0.102	14.7	Failed boxcore
06/05/95	12:27	S6	53.547	0.103	14.5	Failed boxcore
06/05/95	12:33	S6	53.547	0.103	14.3	Failed boxcore
06/05/95	12:59	S6	53.547	0.103	13.8	BC63
06/05/95	13:22	S6	53.547	0.103	13.5	CTD30
06/05/95	14:13	S6	53.547	0.103	13.1	Failed boxcore
06/05/95	14:20	S6	53.547	0.103	13	Failed boxcore
06/05/95	14:45	S6	53.547	0.103	13	Start track - HW5,6,8,15,18,17
06/05/95	17:44	HW6	53.767	0.831	31	CTD31
06/05/95	18:45	HW8	53.652	0.968	25.3	CTD32
06/05/95	21:14	-	-	-	-	Nutrients Online
06/05/95	21:32	HW15	53.289	1.341	24	CTD33
07/05/95	07:12	S8	52.695	2.300	46	DG14
07/05/95	07:18	S8	52.695	2.300	46	BC64
07/05/95	07:45	S8	52.696	2.300	46.7	PG115
07/05/95	07:55	S8	52.696	2.300	46.7	BC65
07/05/95	08:00	S8	52.696	2.300	46.7	Nutrients offline
07/05/95	08:08	S8	52.690	2.300	45.9	CTD34
07/05/95	08:39	S8	52.695	2.302	46.7	BC66
07/05/95	09:10	S8	52.696	2.302	46.6	MC9
07/05/95	09:45	S8	52.693	2.305	47.9	BC67
07/05/95	10:18	S8	52.696	2.307	48.7	BC68

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
07/05/95	10:32	S8	52.696	2.307	48.7	Failed boxcore
07/05/95	12:11	S8	52.694	2.304	47.6	BC69
07/05/95	12:45	S8	52.695	2.304	47.4	Failed boxcore
07/05/95	13:05	S8	52.695	2.302	47	BC70
07/05/95	13:18	S8	52.695	2.302	47	Start track - HW18,17,16,15,14,12
07/05/95	13:45	-	-	-	-	Nutrients online
07/05/95	14:12	HW18	52.781	2.203	45.2	PG035
07/05/95	14:14	HW18	52.781	2.203	45.2	CTD35
07/05/95	15:55	HW17	52.717	1.816	34	CTD36
07/05/95	17:27	HW16	52.910	1.505	18	CTD37
07/05/95	18:25	-	-	-	-	Nutrients offline
07/05/95	19:40	-	-	-	-	Nutrients online
07/05/95	19:52	HW15	53.291	1.350	23.4	CTD38
07/05/95	22:04	HW14	53.000	1.068	-	CTD39
07/05/95	23:19	-	-	-	-	Nutrients offline
08/05/95	07:05	S1	53.071	1.008	19.8	Failed Day grab
08/05/95	07:10	S1	53.071	1.008	19.9	DG15
08/05/95	07:41	S1	53.071	1.007	19.5	DG16
08/05/95	07:45	S1	53.071	1.006	19.8	DG17
08/05/95	08:11	S1	53.071	1.012	20.8	DG18
08/05/95	08:16	S1	53.072	1.011	20.2	BC71
08/05/95	08:44	S1	53.072	1.015	21.3	Failed boxcore
08/05/95	08:49	S1	53.071	1.014	21.4	Failed boxcore
08/05/95	09:05	S1	53.070	1.013	22	Failed boxcore
08/05/95	09:12	S1	53.070	1.013	21.5	Failed boxcore
08/05/95	10:03	S1	53.071	1.013	22	Failed boxcore
08/05/95	13:20	S9	53.136	0.558	32.3	DG19
08/05/95	13:40	S9	53.136	0.558	33.3	BC72
08/05/95	14:14	S9	53.135	0.558	32.7	Failed boxcore
08/05/95	15:42	HW13	53.001	0.401	29	CTD40
08/05/95	17:26	HW12	53.237	0.662	28.3	CTD41
08/05/95	18:38	HW10	53.417	0.767	20	PG?
09/05/95	07:00	SZ1	52.695	2.301	48	Start Sizewell Day grab transect
09/05/95	07:03	SZ1	52.695	2.301	48	DG20
09/05/95	07:22	SZ2	52.692	2.300	45	DG21
09/05/95	07:39	SZ3	52.690	2.300	45.6	DG22
09/05/95	08:00	SZ4	52.687	2.295	42.6	DG23
09/05/95	08:20	SZ5	52.685	2.291	39.3	DG24
09/05/95	08:40	SZ6	52.681	2.287	36.5	DG25
09/05/95	09:00	SZ7	52.679	2.284	37	DG26
09/05/95	09:20	SZ8	52.677	2.281	39	DG27
09/05/95	10:12	SZ9	52.670	2.274	40.7	DG28
09/05/95	10:37	SZ10	52.657	2.257	-	DG29
09/05/95	11:08	SZ11	52.630	2.224	35	DG30
09/05/95	11:43	SZ12	52.604	2.191	35.1	DG31
09/05/95	12:17	SZ13	52.564	2.141	34.2	DG32
09/05/95	12:51	SZ14	52.523	2.092	34.5	DG33
09/05/95	13:23	SZ15	52.482	2.040	34	DG34

CH118C Event Log

Date	Time	Station	Latitude	Longitude	Wdepth	Event
09/05/95	13:54	SZ16	52.441	1.990	34	DG35
09/05/95	14:25	SZ17A	52.403	1.941	35	Failed Day grab
09/05/95	14:30	SZ17A	52.402	1.940	36.5	DG36
09/05/95	14:48	SZ17	52.390	1.926	36.2	DG37
09/05/95	15:10	SZ18	52.363	1.895	36.5	Declined Day grab
09/05/95	15:15	SZ18	52.361	1.893	36.4	DG38
09/05/95	15:40	SZ19	52.322	1.848	30	DG39
10/05/95	05:55	HW4	53.888	0.675	43	Start of coastal track
10/05/95	05:58	HW4	53.888	0.675	43	CTD42
10/05/95	06:12	-	-	-	-	Nutrients online
10/05/95	07:37	C1	53.752	0.408	31.4	CTD43
10/05/95	09:09	C2	53.863	0.066	23.8	CTD44
10/05/95	10:41	C3	-	-	-	PG016
10/05/95	12:00	C4	54.052	0.045	25.6	CTD45
10/05/95	13:25	C5	54.125	0.234	58	CTD46
10/05/95	15:14	C6	54.197	0.190	32.6	PG017
10/05/95	16:47	C7	54.383	0.049	62	CTD47
10/05/95	18:34	C8	54.397	-0.426	41	CTD48
10/05/95	18:47	C8	54.397	-0.426	41	PG036
10/05/95	20:44	C9	54.642	-0.216	66	PG018
10/05/95	20:51	-	-	-	-	Nutrients Offline
10/05/95	22:10	-	-	-	-	Nutrients Online
10/05/95	22:34	C10	54.561	-0.730	36.9	CTD49
11/05/95	10:50	HW2	54.033	0.517	51.6	CTD50
11/05/95	11:00	HW2	54.033	0.517	51.6	Nutrients Offline
11/05/95	11:28	-	-	-	-	Nutrients Online
11/05/95	13:29	HW1	53.859	-0.006	19	CTD51
11/05/95	14:36	HW3	53.725	0.133	20.9	CTD52
11/05/95	14:42	HW3	53.725	0.133	20.9	PG029
11/05/95	14:52	-	53.716	0.138	19.7	Nutrients Offline
11/05/95	16:30	-	53.551	0.132	19.2	Anchored
11/05/95	16:45	-	53.551	0.132	19.2	Logging Stopped
11/05/95	16:50	-	53.551	0.132	19.2	ADCP Off
11/05/95	a.m.	-	-	-	-	Dock Grimsby

Table 2 Box core positions,depths and components analysed

CHALLENGER 118C Box Cores

1 J Barnes, S Starr : University of Newcastle
2 B Clifton : PML
3 H Cussen : IOSDL
4 T Frickers, C Harris : PML
5 D Smallman : DML
6 S Widdecombe : PML
7 C Ingrams : UCNW
8 J Dixon : University of Plymouth

Core	Time o/b	i/b	Stn	Lat.	Long.	Wdepth	Comments
BC1	28/04/95 07:27	07:35	T2	55.153	-1.419	40	1 core microcosm incubation (4) 4 small:particle size,porosity,nutrient flux(4) 1 core sulphate red. 1 core radionuclides (2) 1 core/overlying water for oxygen (3) 2 x 100mm cores: oxygen uptake (5)
BC2	28/04/95 08:22	08:25	T2	55.157	-1.428	40	1 core microcosm incubation (4) 4 small:particle size,porosity,nutrient flux(4) 1 large core sulphate reduction (2) 1 scrape for microfossils (7)
BC3	28/04/95 09:35	09:42	T2	55.154	-1.412	42	6 x 1cm scrapes for radionuclides (2)
BC4	28/04/95 10:55	11:00	T2	55.147	-1.411	43	Biota (6)
BC5	28/04/95 12:08	12:12	T2	55.149	-1.410	44	Biota (6)
BC6	28/04/95 12:21	12:25	T2	55.149	-1.410	44.5	Biota (6)
BC7	28/04/95 12:34	12:38	T2	55.150	-1.410	45	Biota (6)
BC8	28/04/95 14:22	14:25	T1	55.152	-1.491	18	3 small: particle size, porosity, redox (4)
BC9	28/04/95 14:46	14:49	T1	55.153	-1.492	17.5	Biota (6)
BC10	29/04/95 07:07	07:10	T1	55.150	-1.488	15.5	Biota (6)
BC11	29/04/95 07:28	07:30	T1	55.152	-1.491	14.5	1 large core: microcosm incubation (4) 2 small cores: porosity, particle size (4)
BC12	29/04/95 07:43	07:45	T1	55.152	-1.492	14	Biota (6)
BC13	29/04/95 08:11	08:13	T1	55.152	-1.492	13.5	Biota (6)
BC14	29/04/95 08:43	08:45	T1	55.152	-1.493	13.5	1 large core: microcosm incubation (4) 6 x 1cm scrapes for radionuclides (2)
BC15	29/04/95 10:05	10:09	T2	55.149	-1.413	41.5	12 cores for denitrification (1)
BC16	29/04/95 12:42	12:47	T6	55.149	-1.000	90.5	2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 1 scrape for microfossils (7)
BC17	29/04/95 13:17	13:22	T6	55.149	-1.000	90.5	2 cores for oxygen consumption (5) 1 large core: microcosm incubation (4) 1 core sulphate red., 1 core radionuclides (2)
BC18	29/04/95 14:05	14:12	T6	55.149	-1.001	91.5	6 x 1cm scrapes for radionuclides (2) 1 large core radionuclides (2)

CHALLENGER 118C Box Cores

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6 S Widdecombe : PML
7 C Ingrams : UCNW
8 J Dixon : University of Plymouth

Core	Time o/b	l/b	Stn	Lat.	Long.	Wdepth	Comments
BC19	29/04/95 14:34	14:40	T6	55.148	-0.997	91	Biota (6)
BC20	29/04/95 15:23	15:28	T6	55.150	-0.998	91	Biota (6)
BC21	29/04/95 15:35	15:41	T6	55.150	-0.998	91	Biota (6)
BC22	29/04/95 15:48	15:54	T6	55.151	-0.998	91	Biota (6)
BC23	30/04/95 07:07	07:12	T5	55.150	-1.083	93	Biota (6)
BC24	30/04/95 07:22	07:30	T5	55.152	-1.083	92	Biota (6)
BC25	30/04/95 07:37	07:42	T5	55.152	-1.089	92	Biota (6)
BC26	30/04/95 07:54	08:00	T5	55.152	-1.087	92	Biota (6)
BC27	30/04/95 08:37	08:42	T5	55.154	-1.078	92.5	2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 2 cores for oxygen consumption (5) 1 scrape for microfossils (7)
BC28	30/04/95 09:39	09:47	T5	55.151	-1.083	91	1 core/overlying water for oxygen (3) 1 core sulphate reduction (2) 2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 12 cores for denitrification (1)
BC29	30/04/95 10:15	10:21	T5	55.150	-1.086	91.5	6 x 1 cm scrapes for radionuclides (2) 1 large core radionuclides (2)
BC30	30/04/95 12:20	12:25	T4	55.149	-1.187	86	Biota (6)
BC31	30/04/95 12:42	12:47	T4	55.150	-1.178	86	Biota (6)
BC32	30/04/95 12:55	13:00	T4	55.151	-1.177	86.5	Biota (6)
BC33	30/04/95 13:08	13:13	T4	55.151	-1.172	86.5	Biota (6)
BC34	30/04/95 13:37	13:43	T4	55.149	-1.179	86.5	2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 1 core sulphate reduction (2)
BC35	30/04/95 14:53	14:59	T4	55.150	-1.178	87.5	2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 1 scrape for microfossils (7) 1 core sulphate reduction (2)

CHALLENGER 118C Box Cores

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7 C Ingrams : UCNW
8 J Dixon : University of Plymouth

Core	Time o/b	i/b	Stn	Lat.	Long.	Wdepth	Comments
BC36	30/04/95 15:20	15:40	T4	55.150	-1.173	88	6 x 1cm scrapes for radionuclides (2) 1 large core radionuclides (2)
BC37	01/05/95 08:03	08:07	T4	55.153	-1.174	85.5	12 cores for denitrification (1)
BC38	01/05/95 09:00	09:08	T4	55.153	-1.167	85	2 cores for oxygen consumption (5)
BC39	01/05/95 10:42	10:47	T3	55.153	-1.288	59	1 large core: microcosm incubation (4) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 1 core sulphate reduction (2)
BC40	01/05/95 13:13	13:20	T3	55.148	-1.285	60.5	2 redox, 1 porosity, 1 particle size (4) 1 large core: microcosm incubation (4) 1 scrape for microfossils (7) 1 core sulphate reduction (2)
BC41	01/05/95 14:13	14:18	T3	55.150	-1.280	62.5	6 x 1cm scrapes for radionuclides (2) 1 large core radionuclides (2)
BC42	01/05/95 15:19	15:25	T3	55.150	-1.279	64	Biota (6)
BC43	01/05/95 15:35	15:41	T3	55.147	-1.288	61.5	Biota (6)
BC44	01/05/95 15:50	15:55	T3	55.147	-1.285	62	Biota (6)
BC45	02/05/95 07:15	07:20	T3	55.148	-1.293	58.5	Biota (6)
BC46	02/05/95 08:47	08:53	T3	55.144	-1.291	57	12 cores for denitrification (1)
BC47	02/05/95 09:11	09:16	T3	55.148	-1.294	57	2 cores for oxygen consumption (5) 1 scrape for trace metals (8)
BC48	03/05/95 07:37	07:43	T7	55.809	-1.848	68.5	2 redox, 1 porosity, 1 particle size (4) 2 large core: microcosm incubation (4) 1 scrape for microfossils (7) 1 core sulphate reduction (2) 2 cores for oxygen consumption (5) 1 large core for radionuclides (2)
BC49	03/05/95 09:19	09:25	T7	55.807	-1.857	64.5	12 cores for denitrification (1)
BC50	04/05/95 09:49	09:54	T9	54.771	-1.010	52	1 redox, 1 particle size (4) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 1 core for oxygen consumption (5) 1 core for sulphate reduction (2)

CHALLENGER 118C Box Cores

1 J Barnes, S Starr : University of Newcastle
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6 S Widdecombe : PML
7 C Ingrams : UCNW
8 J Dixon : University of Plymouth

Core	Time o/b	I/b	Stn	Lat.	Long.	Wdepth	Comments
BC51	04/05/95 10:33	10:37	T9	54.769	-1.010	51.5	1 large core for radionuclides (2) 2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4) 1 scrape for microfossils (7)
BC52	04/05/95 12:57	13:01	T9	54.769	-1.010	50.5	3 cores for denitrification (1)
BC53	05/05/95 12:04	12:08	S5	53.588	0.880	25	2 cores for oxygen consumption (5)
BC54	05/05/95 12:32	12:36	S5	53.589	0.882	25	2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4) 1 large core for radionuclides (2)
BC55	05/05/95 13:10	13:13	S5	53.588	0.881	24.5	Biota (6) 1 scrape for microfossils (7) 1 scrape for trace metals (8)
BC56	05/05/95 13:35	13:40	S5	53.590	0.880	23	Biota (6)
BC57	05/05/95 14:35	14:38	S5	53.588	0.881	23	Biota (6)
BC58	05/05/95 14:57	15:00	S5	53.588	0.880	23	Biota (6)
BC59	06/05/95 08:32	08:36	S6	53.547	0.101	16.3	2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4) 1 scrape for microfossils (7)
BC60	06/05/95 09:20	09:24	S6	53.547	0.101	16.3	1 core/overlying water for oxygen (3) 1 core for resistivity (3) 2 cores for oxygen consumption (5) 1 core for sulphate reduction (2) 1 large core for radionuclides (2) 1 scrape for trace metals (8) 3 cores for denitrification (1)
BC61	06/05/95 10:20	10:23	S6	53.547	0.102	16	6 x 1 cm scrapes for radionuclides (2)
BC62	06/05/95 10:47	10:50	S6	53.547	0.102	15.9	Biota (6)
BC63	06/05/95 12:59	13:02	S6	53.547	0.103	13.8	Biota (6)
BC64	07/05/95 07:18	07:22	S8	52.695	2.300	46	1 scrape for microfossils (7) 1 core/overlying water for oxygen (3) 1 core for resistivity (3) 2 cores for oxygen consumption (5) 1 core for sulphate reduction (2) 1 large core : microcosm incubation (4)

CHALLENGER 118C Box Cores

1 J Barnes, S Starr : University of Newcastle
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4 T Frickers, C Harris : PML
5 D Smallman : DML
6 S Widdecombe : PML
7 C Ingrams : UCNW
8 J Dixon : University of Plymouth

Core	Time o/b	i/b	Stn	Lat.	Long.	Wdepth	Comments
BC65	07/05/95 07:55	08:00	S8	52.696	2.303	46.7	2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4) 3 cores for denitrification (1) 1 large core for radionuclides (2) 1 scrape for trace metals (8)
BC66	07/05/95 08:39	08:44	S8	52.695	2.302	46.7	6 x 1 cm scrapes for radionuclides (2)
BC67	07/05/95 09:45	09:50	S8	52.693	2.305	47.9	Biota (6)
BC68	07/05/95 10:18	10:22	S8	52.696	2.307	48.7	Biota (6)
BC69	07/05/95 12:11	12:15	S8	52.694	2.304	47.6	Biota (6)
BC70	07/05/95 13:05	13:08	S8	52.695	2.302	47	Biota (6)
BC71	08/05/95 08:16	08:21	S1	53.072	1.011	20.2	2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4)
BC72	08/05/95 13:40	13:45	S9	53.136	0.558	33.3	2 large cores : microcosm incubation (4) 2 redox, 1 porosity, 1 particle size (4)

Challenger 118C Multi Core Stations

Table 3   Multicore positions and depths

Core #	Lat	Lon	Depth
MC1 T2	55 8.88N	1 24.74W	43.3
MC2 T5	55 8.98N	1 5.31W	91.3
MC3 T4	55 9.22N	1 10.01W	85.5
MC4 T3	55 8.67N	1 17.50W	57.0
MC5 T9	54 46.09N	1 0.69W	50.9
MC6 T9	54 46.04N	1 0.74W	50.5
MC7 S6	53 32.82N	0 6.13E	16.1
MC8 S6	53 32.84N	0 6.10E	16.0

Table 4 Day grab positions,depths and components analysed

CH118C DAY GRABS

Sample	Date/time	Station	Latitude	Longitude	Depth	Comments
DG1	28/04/95 07:10	T2	55.153	-1.419	40	Sandy mud (trace metals)
DG2	28/04/95 14:00	T1	55.152	-1.491	18	Fine sand
DG3	03/05/95 13:40	T8	55.916	-2.080	71	Shell/sandy mud(trace metals/fossils)
DG4	04/05/95 07:05	T9	54.769	-1.006	54	Soft mud
DG5	05/05/95 07:14	S4	53.549	0.715	82	Sandy mud with shell
DG6	05/05/95 07:42	S4	53.546	0.723	76	Large stone (10 x10 x 10 cm)
DG7	05/05/95 08:17	S4	53.552	0.722	76	Muddy sand with some shell
DG8	05/05/95 08:44	S4	53.555	0.723	71.5	Lone cobble
DG9	05/05/95 09:04	S4	53.555	0.725	71	Sandy mud and shell
DG10	05/05/95 09:23	S4	53.551	0.722	73	Stone
DG11	05/05/95 10:03	S4	53.551	0.722	77	Muddy sand, shell & chalk (?)
DG12	05/05/95 11:44	S5	53.588	0.866	25.5	Sand
DG13	06/05/95 07:07	S6	53.547	0.101	15.6	Sandy mud with pebbles
DG14	07/05/95 07:12	S8	52.695	2.300	46	Soft mud
DG15	08/05/95 07:10	S1	53.071	1.008	19.9	Sand and large shells
DG16	08/05/95 07:41	S1	53.071	1.007	19.5	Large shells
DG17	08/05/95 07:45	S1	53.071	1.006	19.8	Sand and large shells
DG18	08/05/95 08:11	S1	53.071	1.012	20.8	Shell and sand
DG19	08/05/95 13:20	S1	53.136	0.558	32.3	Sand and shell
DG20	09/05/95 07:03	SZ1	52.695	2.301	48	Soft silty mud (radionuclides)
DG21	09/05/95 07:22	SZ2	52.692	2.300	45	Sandy mud with anoxic (rad's)
DG22	09/05/95 07:39	SZ3	52.690	2.300	45.6	Sandy with mud (radionuclides)
DG23	09/05/95 08:00	SZ4	52.687	2.295	42.6	Muddy sand (radionuclides)
DG24	09/05/95 08:20	SZ5	52.685	2.291	39.3	Sand (radionuclides)
DG25	09/05/95 08:40	SZ6	52.681	2.287	36.5	Sand (radionuclides)
DG26	09/05/95 09:00	SZ7	52.679	2.284	37	Sand (radionuclides)
DG27	09/05/95 09:20	SZ8	52.677	2.281	39	Sand/some small shell (rad's)
DG28	09/05/95 10:12	SZ9	52.670	2.274	40.7	Sand with small amount shell (rad's)
DG29	09/05/95 10:37	SZ10	52.657	2.256	40	Sand/shell/small stones (rad's)
DG30	09/05/95 11:08	SZ11	52.630	2.224	35	Slightly muddy sand (radionuclides)
DG31	09/05/95 11:43	SZ12	52.604	2.191	35.1	Slightly muddy sand (radionuclides)
DG32	09/05/95 12:17	SZ13	52.564	2.141	34.2	Medium sand, some stone/shell (rad)
DG33	09/05/95 12:51	SZ14	52.523	2.092	34.5	Soft mud/silt (radionuclides)
DG34	09/05/95 13:23	SZ15	52.482	2.040	34	Sand with shell (radionuclides)
DG35	09/05/95 13:54	SZ16	52.441	1.990	34	Med. sand with some shell (rad's)
DG36	09/05/95 14:30	SZ17A	52.402	1.940	36.5	No sample
DG37	09/05/95 14:48	SZ17	52.390	1.926	36.2	Sand with small stones (radionuclides)
DG38	09/05/95 15:15	SZ18	52.361	1.893	36.4	Medium/coarse sand (radionuclides)
DG39	09/05/95 15:40	SZ19	52.322	1.848	30	Shelly sand (radionuclides)

Table 5 CTD casts positions and depths

Challenger 118C CTD stations

Station #		Lat	Lon	Depth
CTD001	T2	55 9.41N	1 25.50W	40.7
CTD002	T1	55 9.15N	1 29.61W	12.7
CTD003	T6	55 9.07N	0 59.89W	89.4
CTD004	C19	55 12.50N	1 1.14W	91.4
CTD005	C21	55 20.62N	1 3.71W	95.0
CTD006	T5	55 9.18N	1 5.00W	91.3
CTD007	C17	55 5.11N	1 2.52W	88.6
CTD008	C15	54 57.14N	0 54.90W	76.1
CTD009	T4	55 9.08N	1 10.52W	85.7
CTD010	T3	55 8.87N	1 17.54W	58.7
CTD011	C23	55 29.45N	1 3.78W	98.0
CTD012	C25	55 44.86N	1 14.63W	73.9
CTD013	C27	55 54.94N	1 34.90W	67.6
CTD014	T7	55 48.54N	1 50.84W	69.1
CTD015	T8	55 54.98N	2 4.79W	67.9
CTD016	C30	56 0.05N	1 35.75W	80.2
CTD017	C31	55 41.97N	1 3.03W	81.0
CTD018	T9	54 46.18N	1 0.51W	54.0
CTD019	T9	54 46.03N	1 0.83W	50.1
CTD020	C32	54 53.59N	0 44.85W	67.6
CTD021	C33	54 45.11N	0 17.90W	67.8
CTD022	C34	54 31.47N	0 2.89E	66.8
CTD023	C35	53 59.83N	0 23.08E	55.7
CTD024	S5	53 35.55N	0 52.63E	22.5
CTD025	HW7	53 29.01N	0 24.03E	14.4
CTD026	HW9	53 19.31N	0 24.56E	16.8
CTD027	HW10	53 24.94N	0 46.06E	22.6
CTD028	HW11	53 28.95N	1 0.18E	23.1
CTD029	S6	53 32.86N	0 6.05E	16.4
CTD030	S6	53 32.82N	0 6.17E	13.5
CTD031	HW6	53 46.03N	0 49.85E	31.2
CTD032	HW8	53 39.14N	0 58.05E	25.3
CTD033	HW15	53 17.69N	1 20.82E	24.3
CTD034	S8	52 41.71N	2 18.00E	45.7
CTD035	HW18	52 46.85N	2 12.18E	45.7
CTD036	HW17	52 43.03N	1 48.99E	33.9
CTD037	HW16	52 54.12N	1 30.80E	20.0
CTD038	HW15	53 17.38N	1 21.07E	23.1

Challenger 118C CTD stations

Station #		Lat		Lon		Depth
CTD039	HW14	53	0.14N	1	4.22E	18.5
CTD040	HW13	53	0.03N	0	24.15E	26.7
CTD041	HW12	53	14.25N	0	39.77E	27.4
CTD042	HW4	53	53.58N	0	40.75E	43.6
CTD043	C1	53	45.15N	0	24.39E	32.4
CTD044	C2	53	51.78N	0	3.94E	23.7
CTD045	C4	54	3.02N	0	2.68W	25.9
CTD046	C5	54	7.49N	0	14.07E	58.6
CTD047	C7	54	23.06N	0	2.91E	62.6
CTD048	C8	54	23.85N	0	25.66W	39.6
CTD049	C10	54	33.63N	0	43.85W	37.2
CTD050	HW2	54	1.99N	0	31.03E	51.4
CTD051	HW1	53	51.88N	0	0.54W	19.3
CTD052	HW3	53	43.51N	0	7.98E	21.0

Table 6 CTD casts: components analysed

CTD Casts

Cruise	Cast id	Date/Time	Time l/b	Station	Wdepth	Comments
CH118C	CTD1	28/04/95 07:50	08:00	T2	40	CH4 and NO2, O2 incubations
CH118C	CTD2	29/04/95 08:31	08:37	T1	13.5	CH4 and NO2
CH118C	CTD3	29/04/95 12:17	12:36	T6	89	CH4 and NO2, O2 incubations
CH118C	CTD4	29/04/95 16:28	16:43	C19	91	CH4, NO2, chlorophyll, SPM
CH118C	CTD5	29/04/95 20:00	20:15	C21	94	CH4, NO2, chlorophyll, SPM
CH118C	CTD6	30/04/95 08:10	08:20	T5	92	CH4 and NO2, O2 incubations
CH118C	CTD7	30/04/95 19:20	19:36	C17	90	CH4, NO2, chlorophyll, SPM
CH118C	CTD8	30/04/95 22:35	22:44	C15	75	CH4, NO2, chlorophyll, SPM
CH118C	CTD9	01/05/95 07:45	07:57	T4	85.5	CH4 and NO2, incubations
CH118C	CTD10	02/05/95 07:30	07:37	T3	58	CH4 and NO2, incubations
CH118C	CTD11	02/05/95 13:42	13:53	C23	98	CH4, NO2, chlorophyll, SPM
CH118C	CTD12	02/05/95 17:23	17:30	C25	73	CH4, NO2, chlorophyll, SPM
CH118C	CTD13	02/05/95 21:36	21:46	C27	67	CH4, NO2, chlorophyll, SPM
CH118C	CTD14	03/05/95 07:02	07:14	T7	69	CH4 and NO2, incubations
CH118C	CTD15	03/05/95 11:00	11:17	T8	67.5	CH4 and NO2
CH118C	CTD16	03/05/95 17:38	17:54	C30	80.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD17	03/05/95 20:23	20:34	C31	81	Chlorophyll, SPM
CH118C	CTD18	04/05/95 07:18	07:30	T9	54	Incubations
CH118C	CTD19	04/05/95 11:58	12:07	T9	50.5	CH4 and NO2
CH118C	CTD20	04/05/95 14:34	14:46	C32	67.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD21	04/05/95 16:42	16:48	C33	67	CH4, NO2, chlorophyll, SPM
CH118C	CTD22	04/05/95 18:40	18:47	C34	66.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD23	04/05/95 21:54	22:03	C35	55	CH4, NO2, chlorophyll, SPM
CH118C	CTD24	05/05/95 15:12	15:20	S5	23	CH4, NO2, chlorophyll, SPM
CH118C	CTD25	05/05/95 17:29	17:34	HW7	14	CH4, NO2, chlorophyll, SPM
CH118C	CTD26	05/05/95 18:41	18:48	HW9	17.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD27	05/05/95 20:30	20:36	HW10	22.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD28	05/05/95 22:00	22:06	HW11	23.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD29	06/05/95 09:00	09:11	S6	16.4	CH4 and NO2, incubations
CH118C	CTD30	06/05/95 13:22	13:26	S6	13.5	CH4, NO2, chlorophyll, SPM
CH118C	CTD31	06/05/95 17:44	17:48	HW6	31	CH4, NO2, chlorophyll, SPM
CH118C	CTD32	06/05/95 18:45	18:52	HW8	25.3	CH4, NO2, chlorophyll, SPM
CH118C	CTD33	06/05/95 21:32	21:45	HW15	24	CH4, NO2, chlorophyll, SPM
CH118C	CTD34	07/05/95 08:08	08:21	S8	45.9	CH4 and NO2, incubations
CH118C	CTD35	07/05/95 14:14	14:18	HW18	45.2	CH4, NO2, chlorophyll, SPM
CH118C	CTD36	07/05/95 15:55	16:05	HW17	34	CH4, NO2, chlorophyll, SPM

CTD Casts

Cruise	Cast id	Date/Time	Time i/b	Station	Wdepth	Comments
CH118C	CTD37	07/05/95 17:27	17:35	HW16	18	CH4, NO2, chlorophyll, SPM
CH118C	CTD38	07/05/95 19:52	19:59	HW15	23.4	CH4, NO2, chlorophyll, SPM
CH118C	CTD39	07/05/95 22:04	22:10	HW14	-	CH4, NO2, chlorophyll, SPM
CH118C	CTD40	08/05/95 15:42	15:50	HW13	29	CH4, NO2, chlorophyll, SPM
CH118C	CTD41	08/05/95 17:26	17:35	HW12	28.3	CH4, NO2, chlorophyll, SPM
CH118C	CTD42	10/05/95 05:58	06:05	HW4	43	CH4, NO2, chlorophyll, SPM
CH118C	CTD43	10/05/95 07:37	07:44	C1	31.4	CH4, NO2, chlorophyll, SPM
CH118C	CTD44	10/05/95 09:09	09:17	C2	23.8	CH4, NO2, chlorophyll, SPM
CH118C	CTD45	10/05/95 12:00	12:11	C4	25	CH4, NO2, chlorophyll, SPM
CH118C	CTD46	10/05/95 13:25	13:31	C5	58	CH4, NO2, chlorophyll, SPM
CH118C	CTD47	10/05/95 16:47	16:57	C7	62	CH4, NO2, chlorophyll, SPM
CH118C	CTD48	10/05/95 18:34	18:49	C8	41	CH4, NO2, chlorophyll, SPM
CH118C	CTD49	10/05/95 22:34	22:42	C10	36.9	CH4, NO2, chlorophyll, SPM
CH118C	CTD50	11/05/95 10:50	11:01	HW2	51.6	CH4, NO2, chlorophyll, SPM
CH118C	CTD51	11/05/95 13:29	13:36	HW1	19	CH4, NO2, chlorophyll, SPM
CH118C	CTD52	11/05/95 14:36	14:45	HW3	20.9	CH4, NO2, chlorophyll, SPM

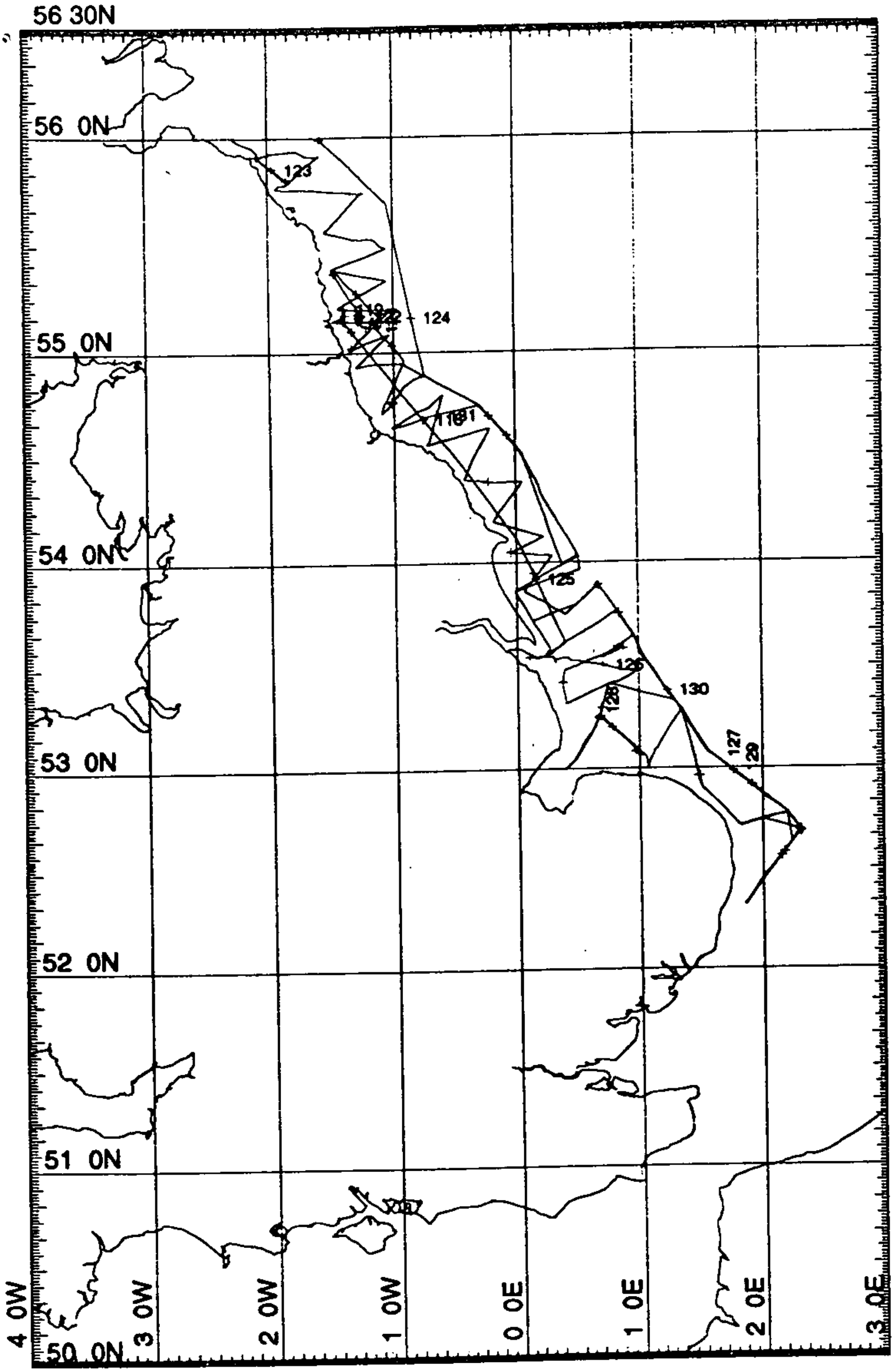
Table 7 Water samples from non-toxic supply: determinants

General Non-toxic Supply Samples

Cruise	Sample	Date/Time	Station	Determinants	Comments
CH118C	PG001	29/04/95 18:30	C20	SPM/Chlorophyll	
CH118C	PG002	29/04/95 21:45	C22	SPM/Chlorophyll	
CH118C	PG003	30/04/95 16:26	C19	SPM/Chlorophyll	
CH118C	PG004	30/04/95 18:05	C18	SPM/Chlorophyll	
CH118C	PG005	30/04/95 21:11	C16	SPM/Chlorophyll	
CH118C	PG006	02/05/95 09:10	T3	N2O / CH4	
CH118C	PG007	02/05/95 12:15	C22	SPM/Chlorophyll	
CH118C	PG008	02/05/95 16:00	C23	SPM/Chlorophyll	
CH118C	PG009	02/05/95 20:00	C26	SPM/Chlorophyll	
CH118C	PG010	02/05/95 23:30	C28	SPM/Chlorophyll	
CH118C	PG011	03/05/95 16:40	C29	SPM/Chlorophyll	
CH118C	PG012	04/05/95 01:49	C32	SPM/Chlorophyll	
CH118C	PG013	04/05/95 02:30	C15	SPM/Chlorophyll	
CH118C	PG014	04/05/95 04:15	C14	SPM/Chlorophyll	
CH118C	PG015	04/05/95 14:11	C11	SPM/Chlorophyll	
CH118C	PG016	10/05/95 10:41	C3	SPM/Chlorophyll	
CH118C	PG017	10/05/95 15:14	C6	SPM/Chlorophyll	
CH118C	PG018	10/05/95 20:44	C9	SPM/Chlorophyll	
CH118C	PG029	11/05/95 14:42	HW3	Salinity	T/S calibration
CH118C	PG030	29/04/95 12:35	T6	Salinity	T/S calibration
CH118C	PG031	30/04/95 08:10	T5	Salinity	T/S calibration
CH118C	PG032	02/05/95 21:30	U/W	Salinity	T/S calibration
CH118C	PG033	03/05/95 11:06	T8	Salinity	T/S calibration
CH118C	PG034	06/05/95 09:10	S6	Salinity	T/S calibration
CH118C	PG035	07/05/95 14:12	HW18	Salinity	T/S calibration
CH118C	PG036	10/05/95 18:47	C8	Salinity	T/S calibration
CH118C	PG037	29/04/95 08:30	C20	N2O / CH4	
CH118C	PG038	29/04/95 21:45	C22	N2O / CH4	
CH118C	PG039	30/04/95 16:26	C19	N2O / CH4	
CH118C	PG040	30/04/95 18:05	C18	N2O / CH4	
CH118C	PG041	30/04/95 21:11	C16	N2O / CH4	
CH118C	PG042	02/05/95 09:19	C22	N2O / CH4	
CH118C	PG073	03/05/95 14:42	U/W	NO2/NO3 discretes	No continuous analyser
CH118C	PG074	03/05/95 15:35	C29	NO2/NO3 discretes	No continuous analyser
CH118C	PG075	03/05/95 16:16	U/W	NO2/NO3 discretes	No continuous analyser
CH118C	PG076	03/05/95 17:37	C30	NO2/NO3 discretes	No continuous analyser

General Non-toxic Supply Samples

Cruise	Sample	Date/Time	Station	Determinants	Comments
CH118C	PG077	03/05/95 18:43	U/W	NO2/NO3 discretes	No continuous analyser
CH118C	PG078	03/05/95 19:38	U/W	NO2/NO3 discretes	No continuous analyser
CH118C	PG079	03/05/95 20:25	C31	NO2/NO3 discretes	No continuous analyser
CH118C	PG080	04/05/95 01:48	C32	NO2/NO3 discretes	No continuous analyser
CH118C	PG081	04/05/95 02:30	C15	NO2/NO3 discretes	No continuous analyser
CH118C	PG082	04/05/95 04:12	C14A	NO2/NO3 discretes	No continuous analyser
CH118C	PG109	8/04/95 09:40-10:0	T2	234 Th	75 litres filtered
CH118C	PG110	9/04/95 13:15-14:2	T6	234 Th	250 litres filtered
CH118C	PG111	0/04/95 08:12-11:3	T5	234 Th	275 litres filtered
CH118C	PG112	1/05/95 08:00-09:1	T4	234 Th	300 litres filtered
CH118C	PG113	1/05/95 16:13-17:0	T3	234 Th	160 litres filtered
CH118C	PG114	3/05/95 07:00-08:2	T7	234 Th	200 litres filtered
CH118C	PG115	7/05/95 07:45-12:1	S8	234 Th	120 litres filtered



MERCATOR PROJECTION

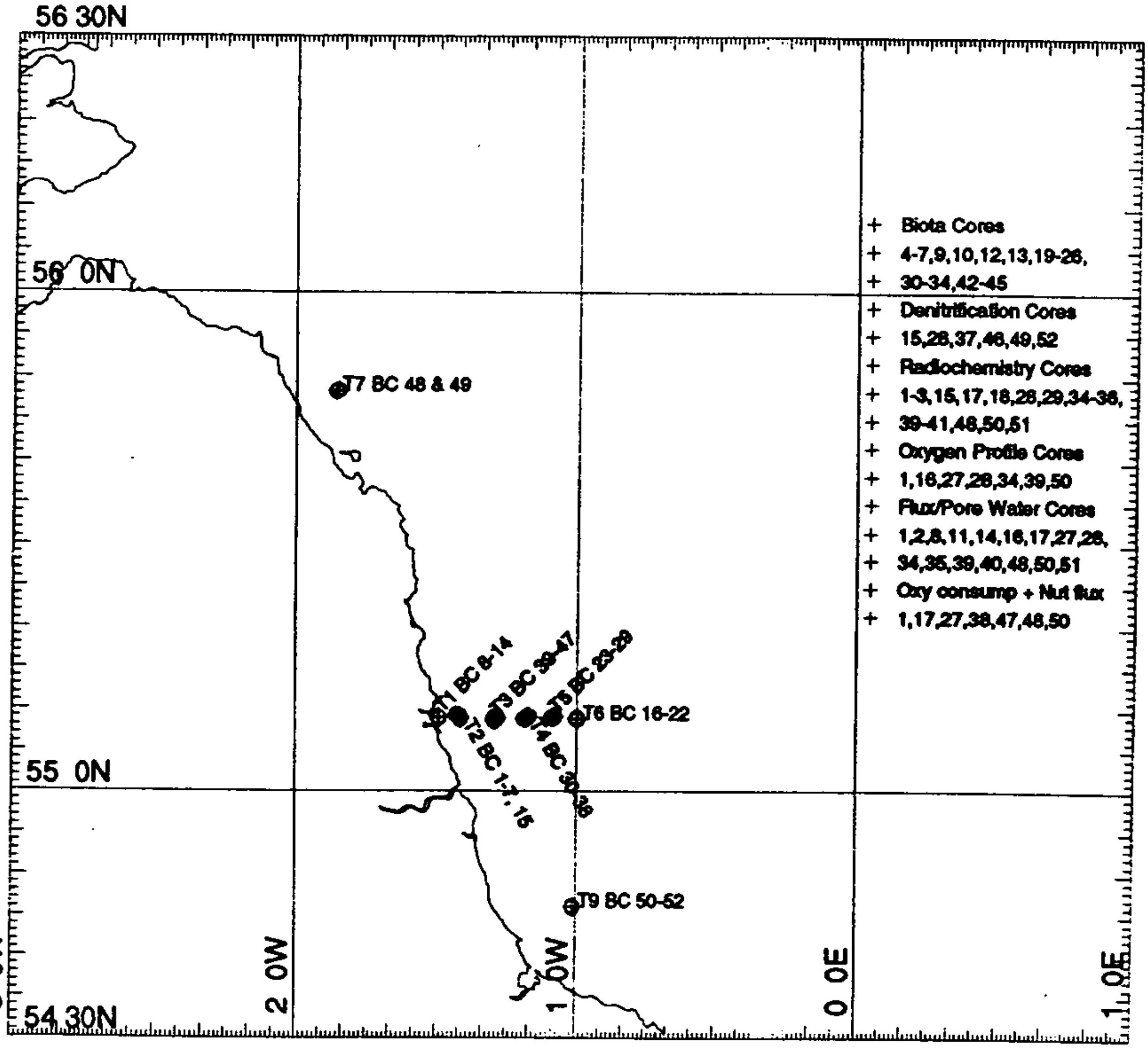
GRID NO. 1

SCALE 1 TO 5500000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

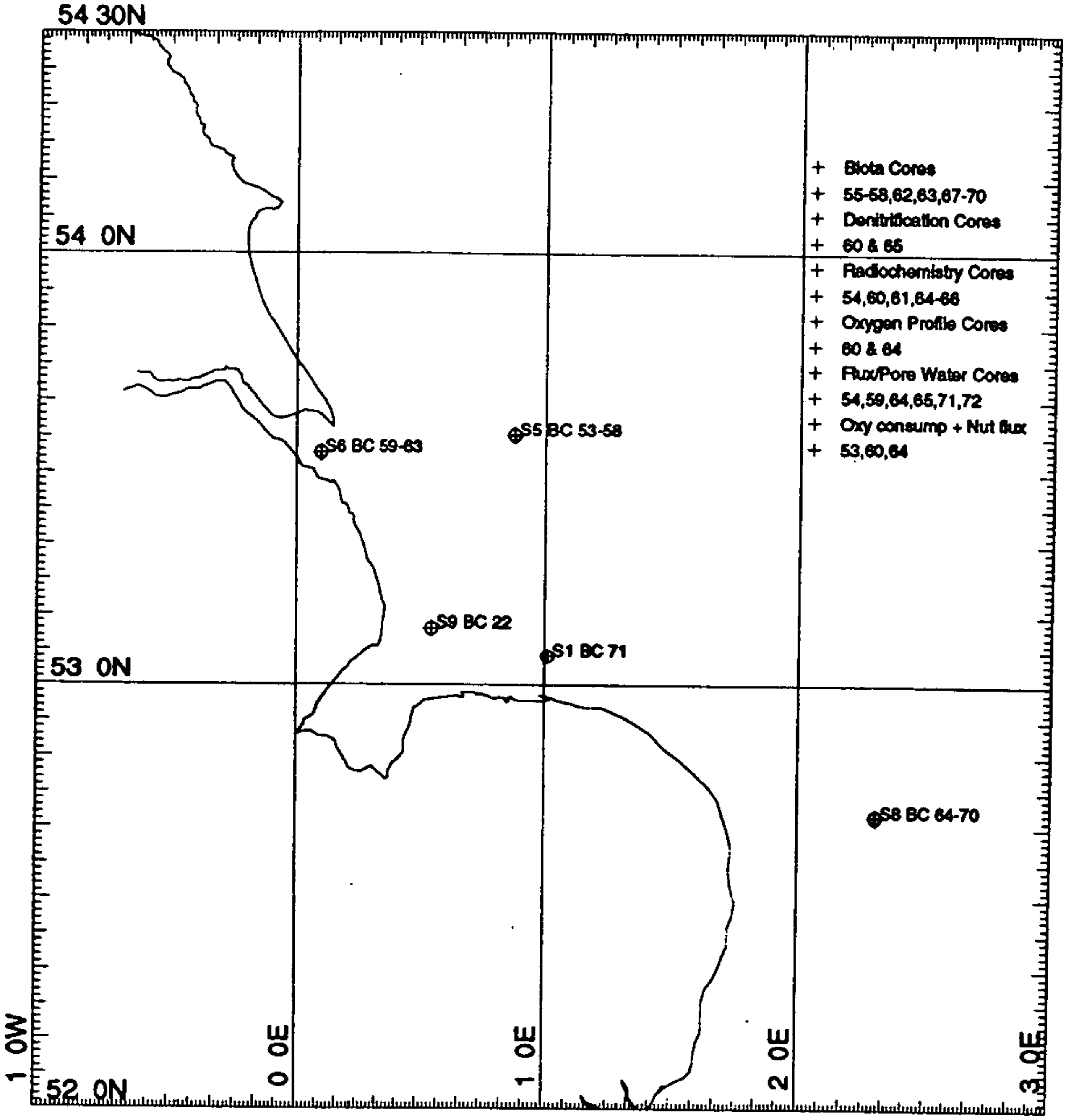
Challenger 118C Cruise Track

Figure 1 Cruise track



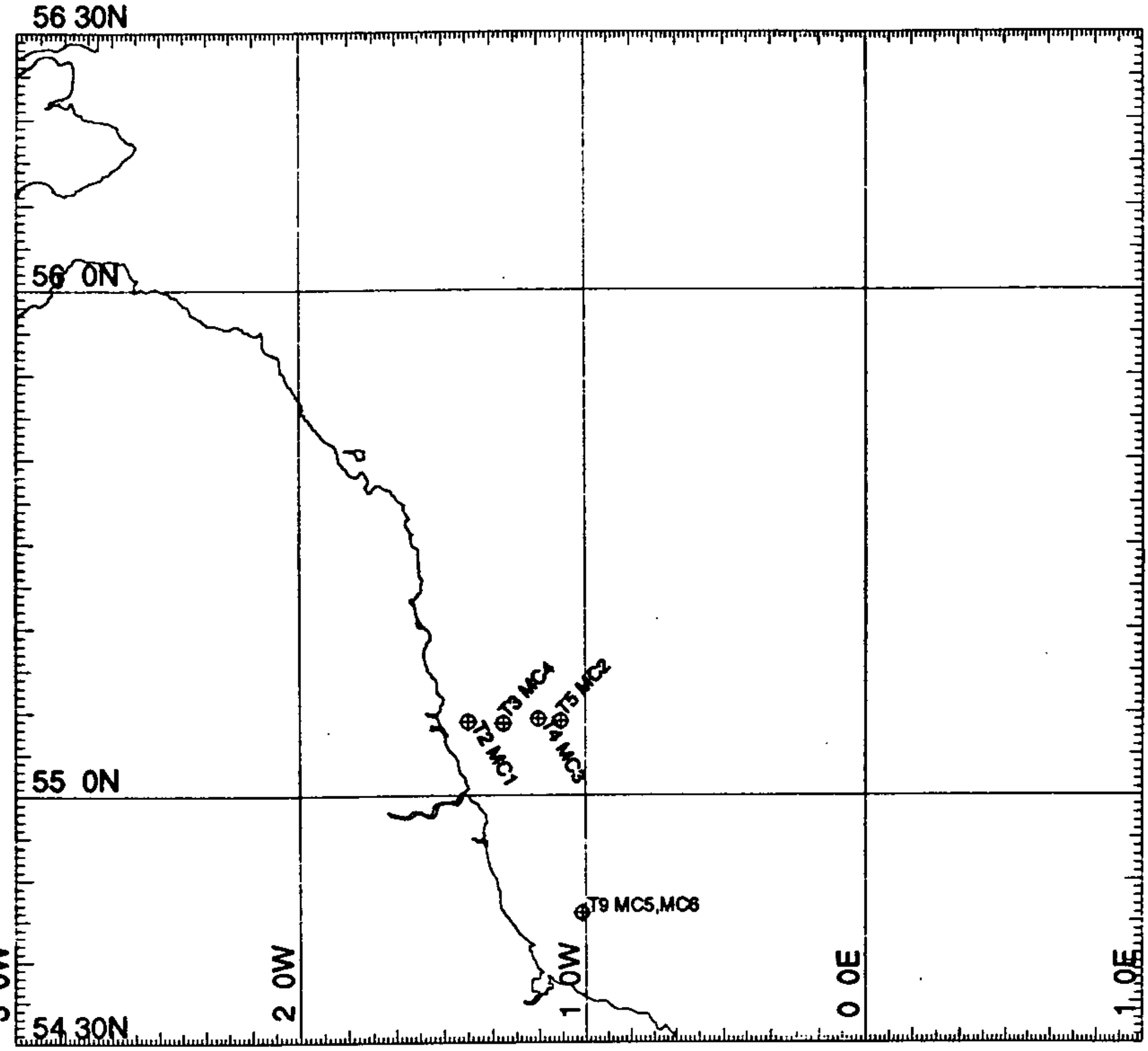
Challenger 118c Box Core Stations

Figure 2 **Box-core stations (north) & components measured**



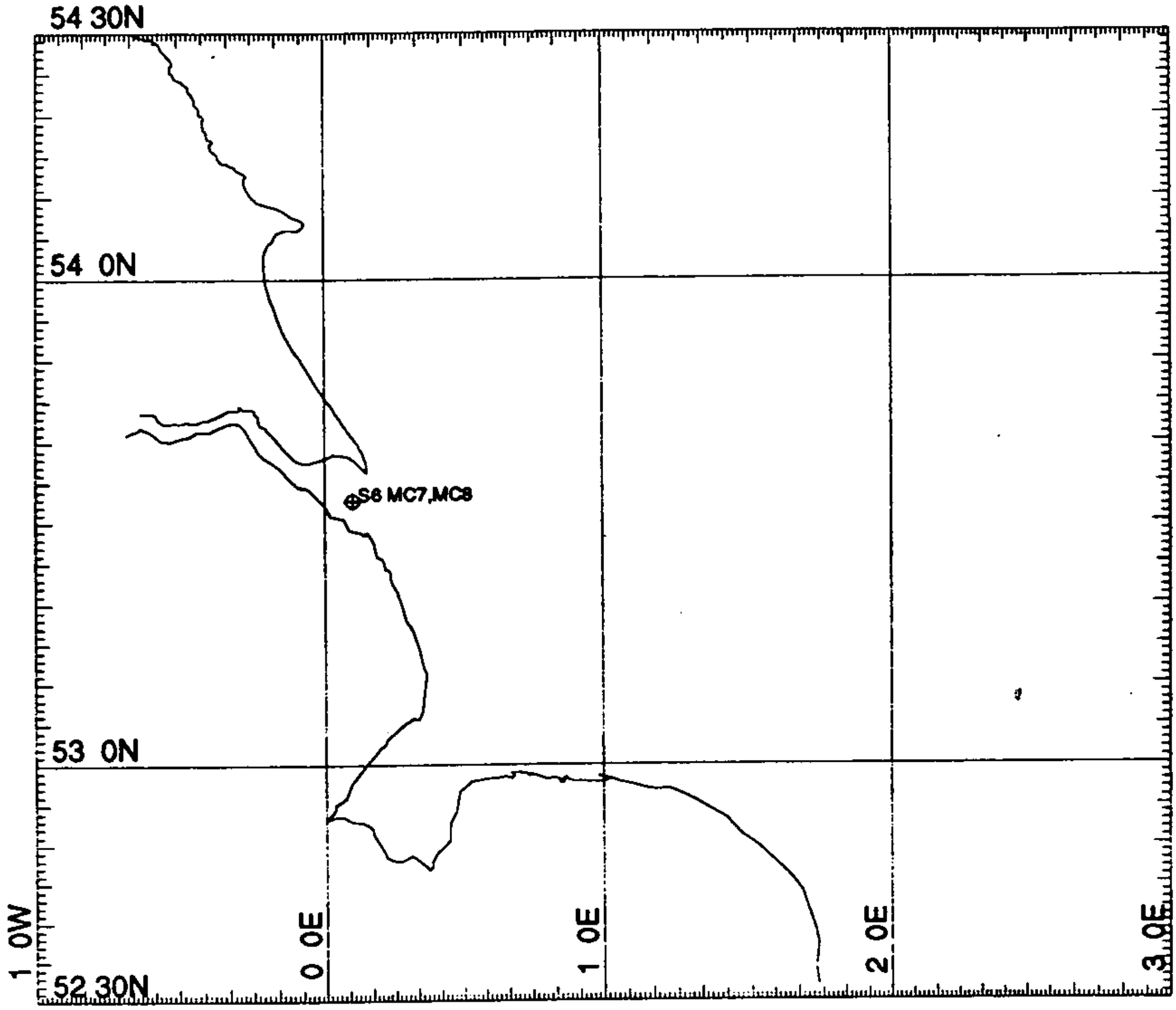
Challenger 118c Box Core Stations (south)

Figure 3 **Box-core stations (south) & components measured**



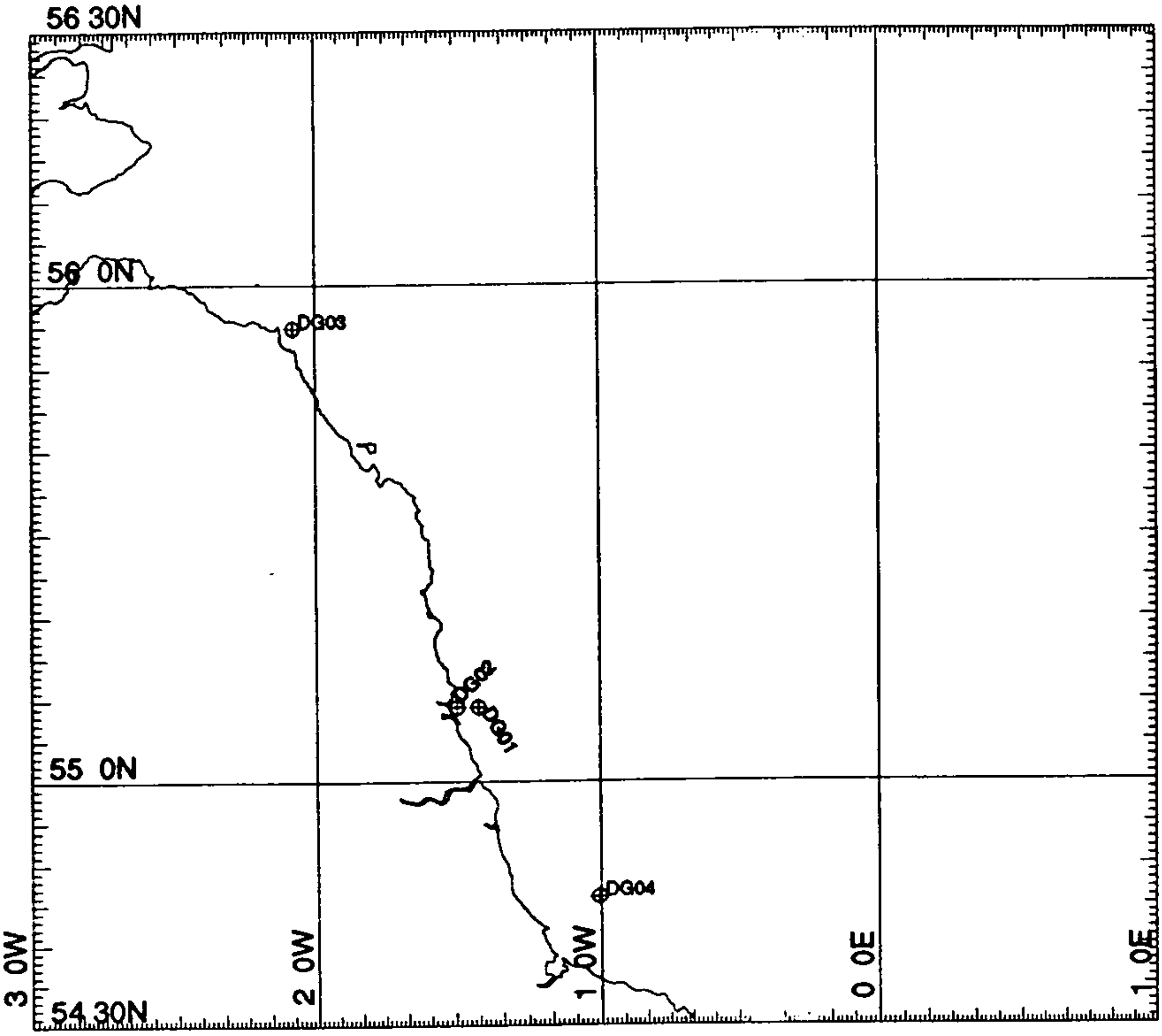
Challenger 118c Multi Core Stations (north)

Figure 4 **Multi-core stations (north)**



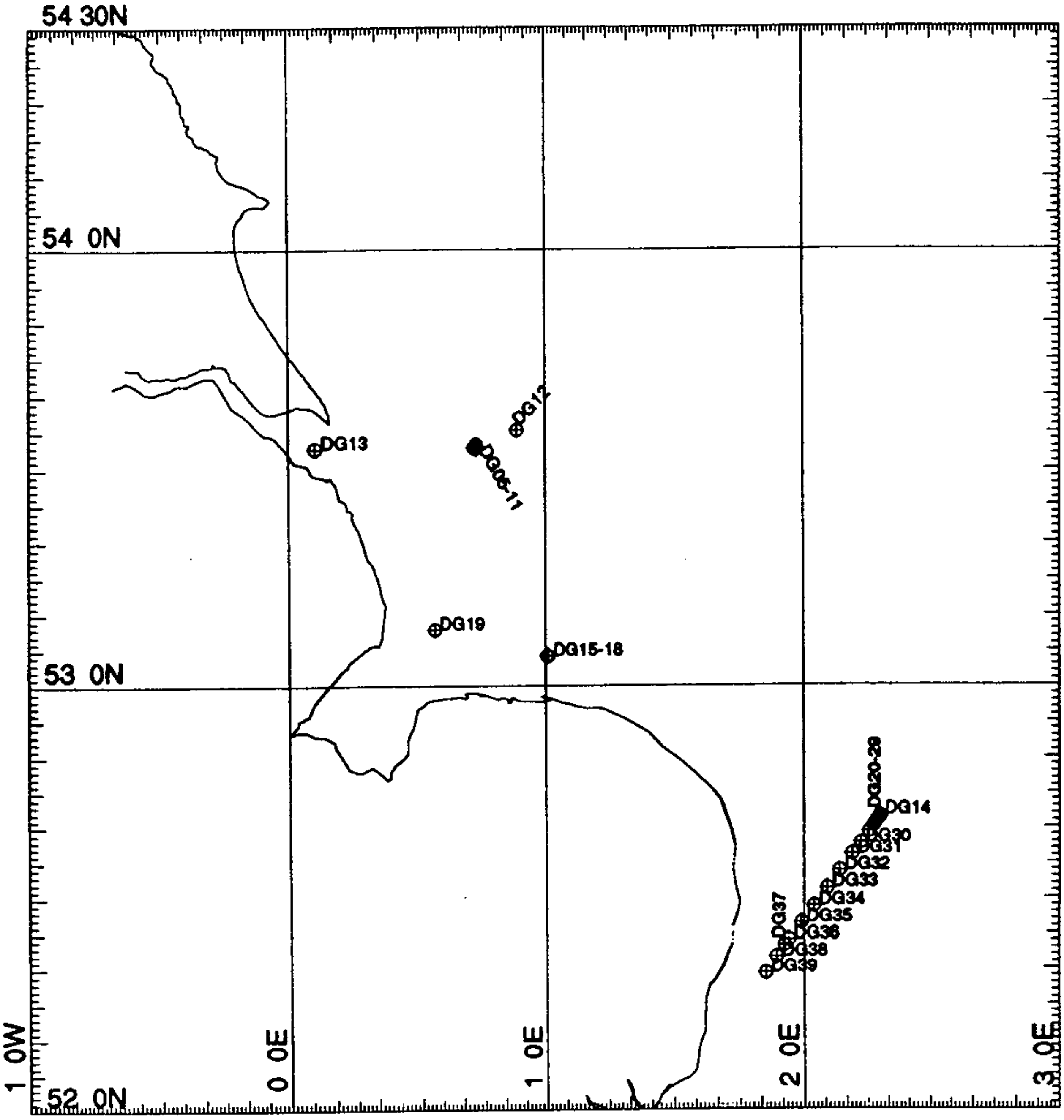
Challenger 118c Multi Core Stations (south)

Figure 5 **Multi-core stations (south)**



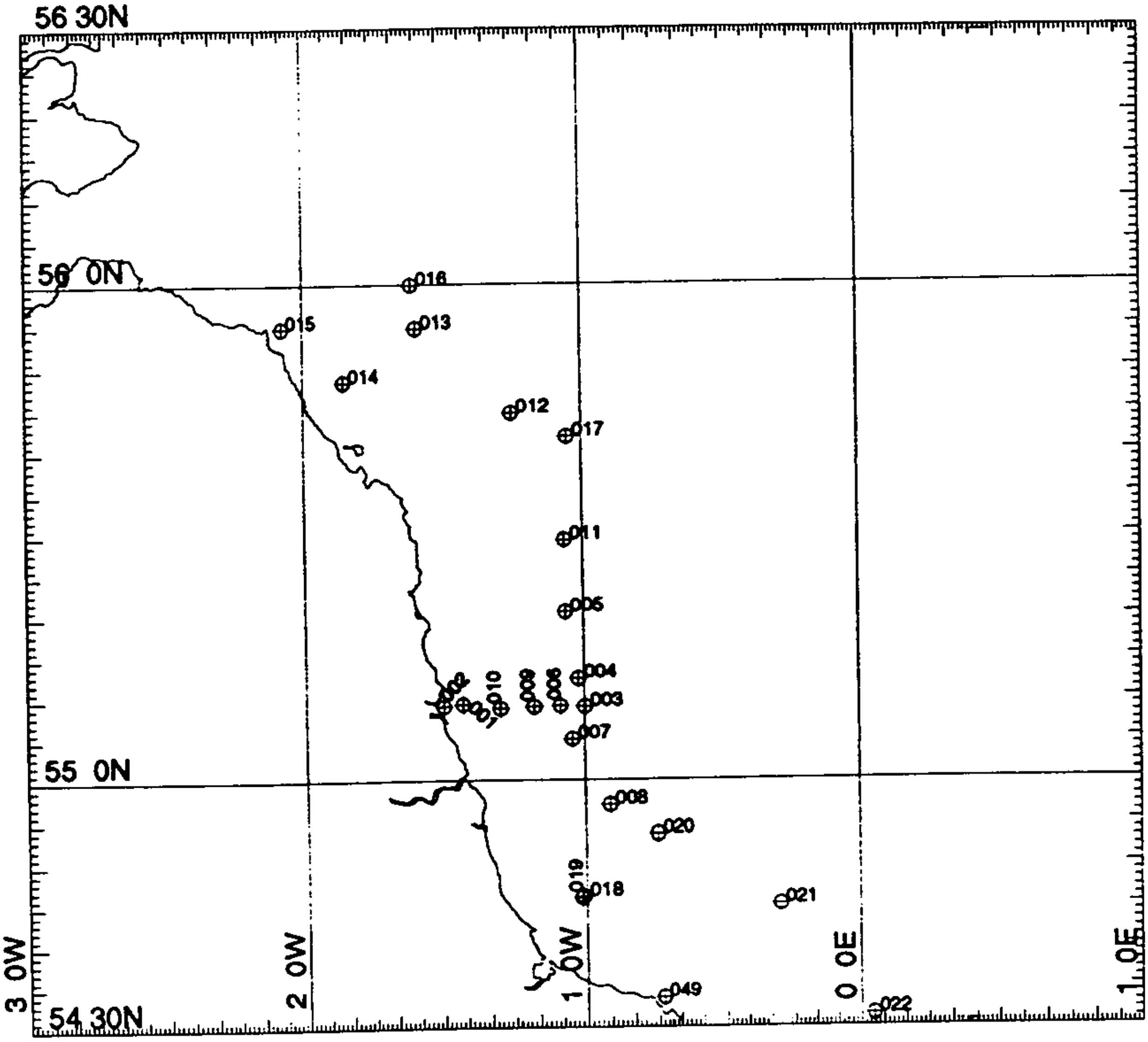
Challenger 118c Day Grab Stations (north)

Figure 6 Day grab sites (north)



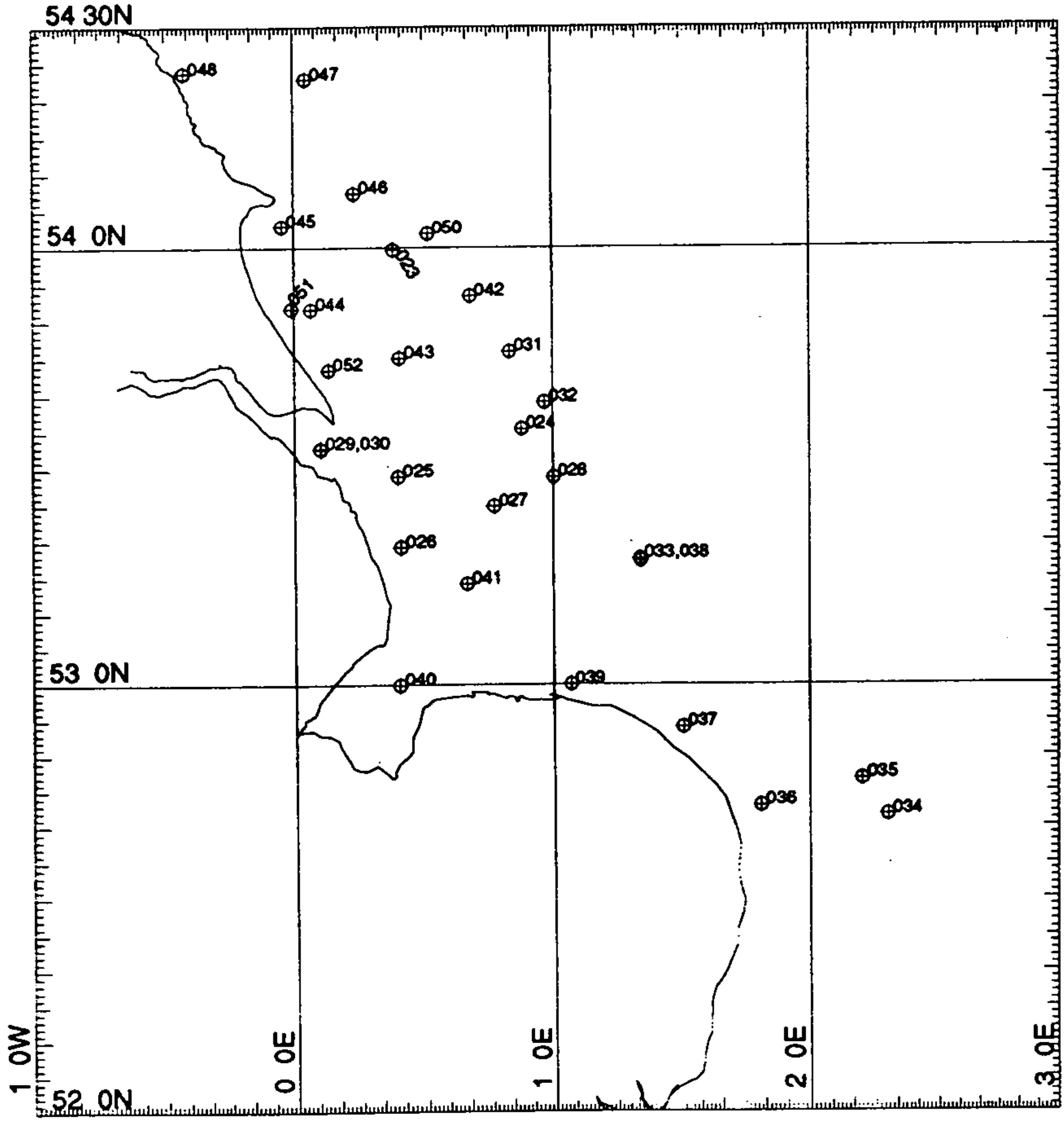
Challenger 118c Day Grab Stations (south)

Figure 7 Day grab sites (south)



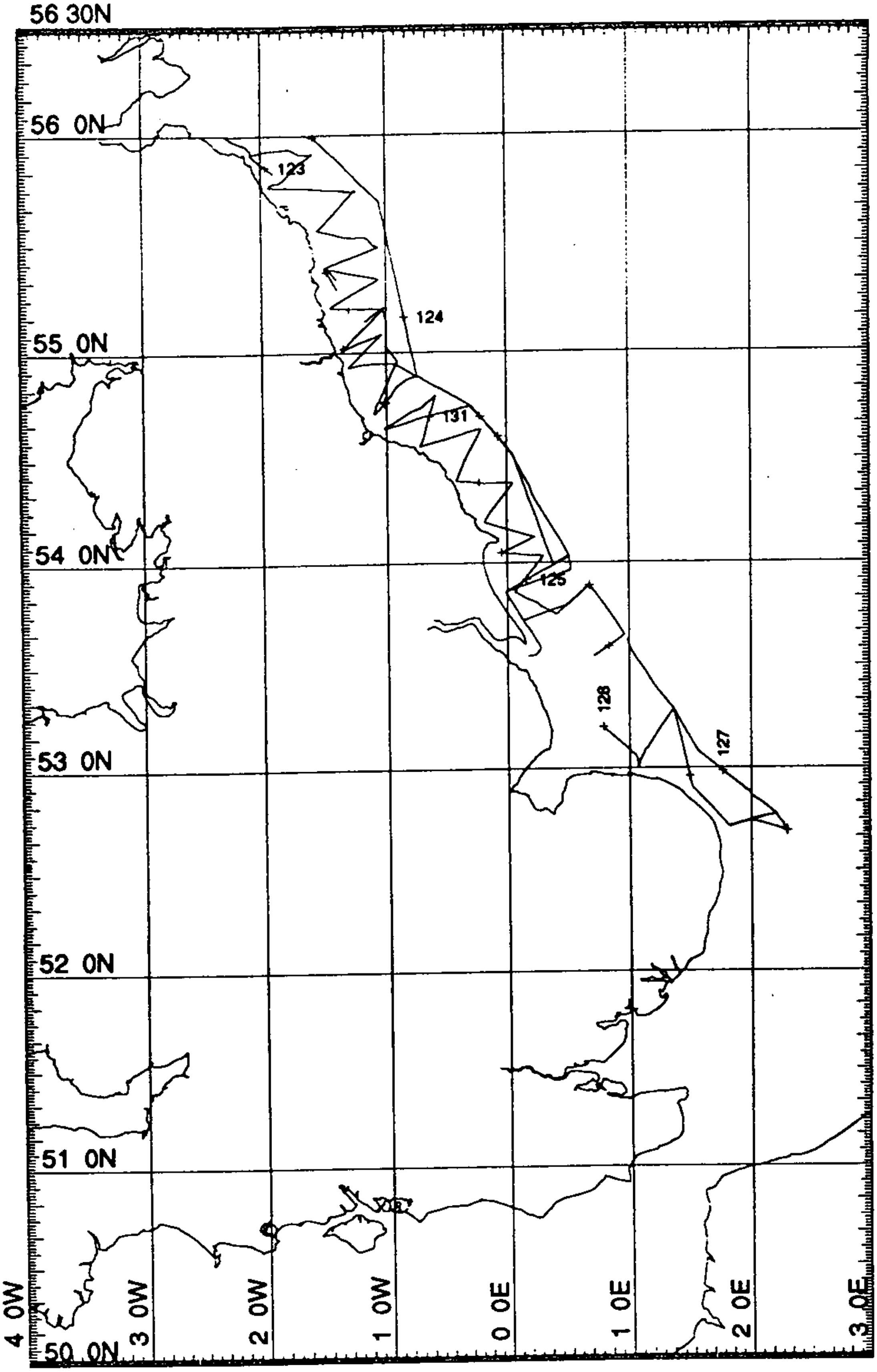
Challenger 118c CTD Stations (north)

Figure 8 **CTD stations (north)**



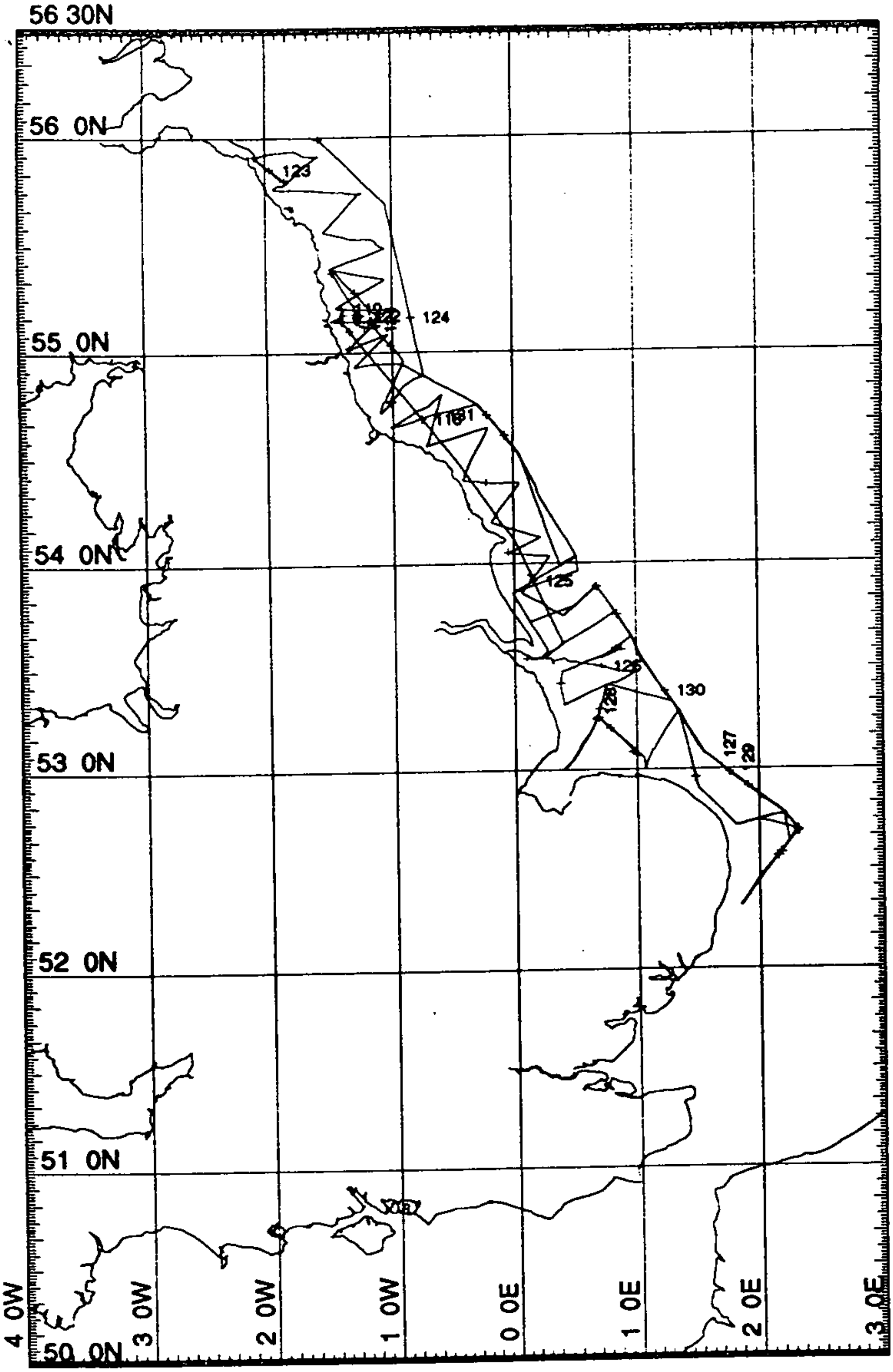
Challenger 118c CTD Stations (south)

Figure 9 CTD stations (south)



Challenger 118c Continuous nutrient analyses

Figure 10 Continuous nutrient analysis track



MERCATOR PROJECTION

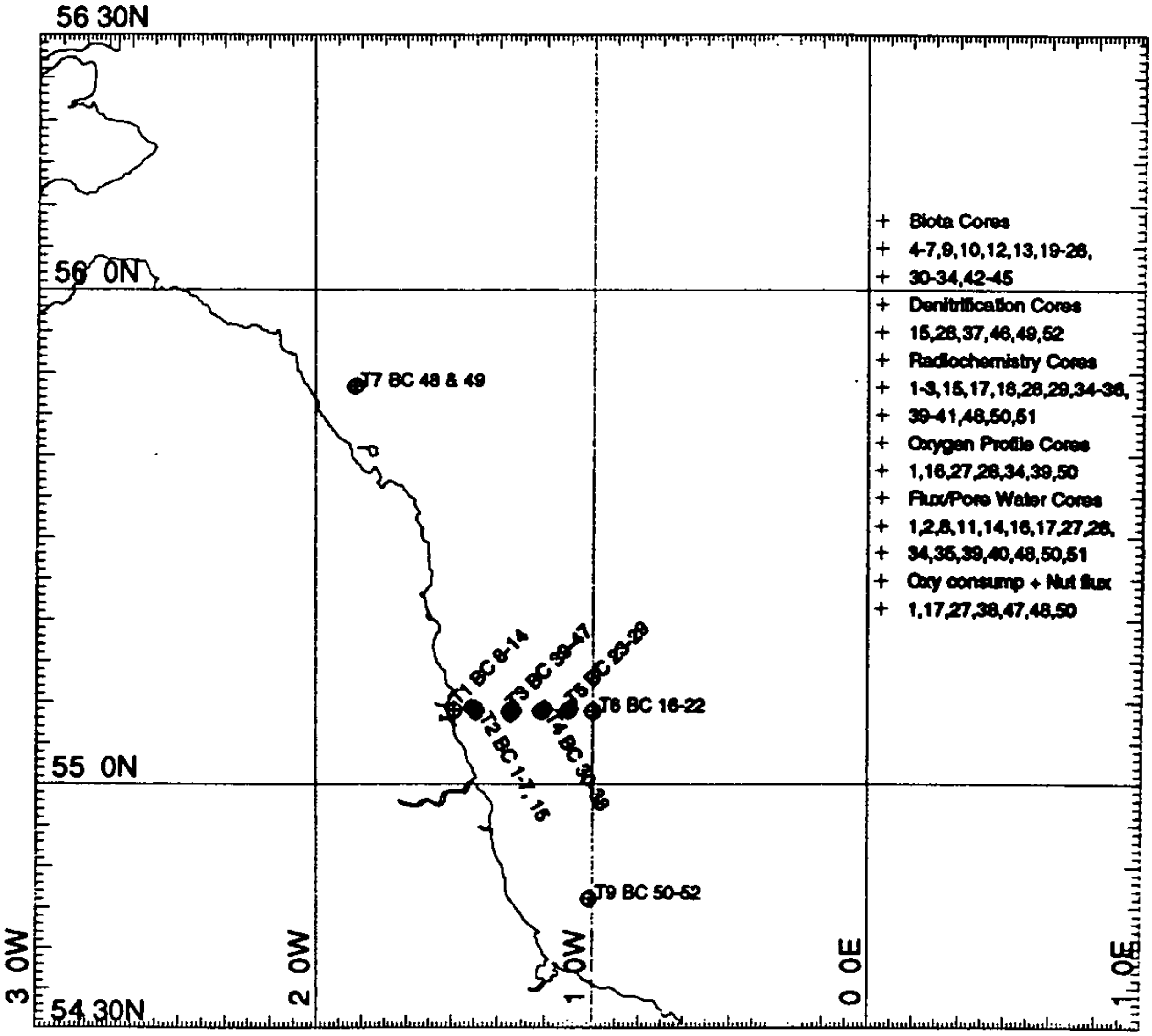
GRID NO. 1

SCALE 1 TO 5500000 (NATURAL SCALE AT LAT. 0)

INTERNATIONAL SPHEROID PROJECTED AT LATITUDE 0

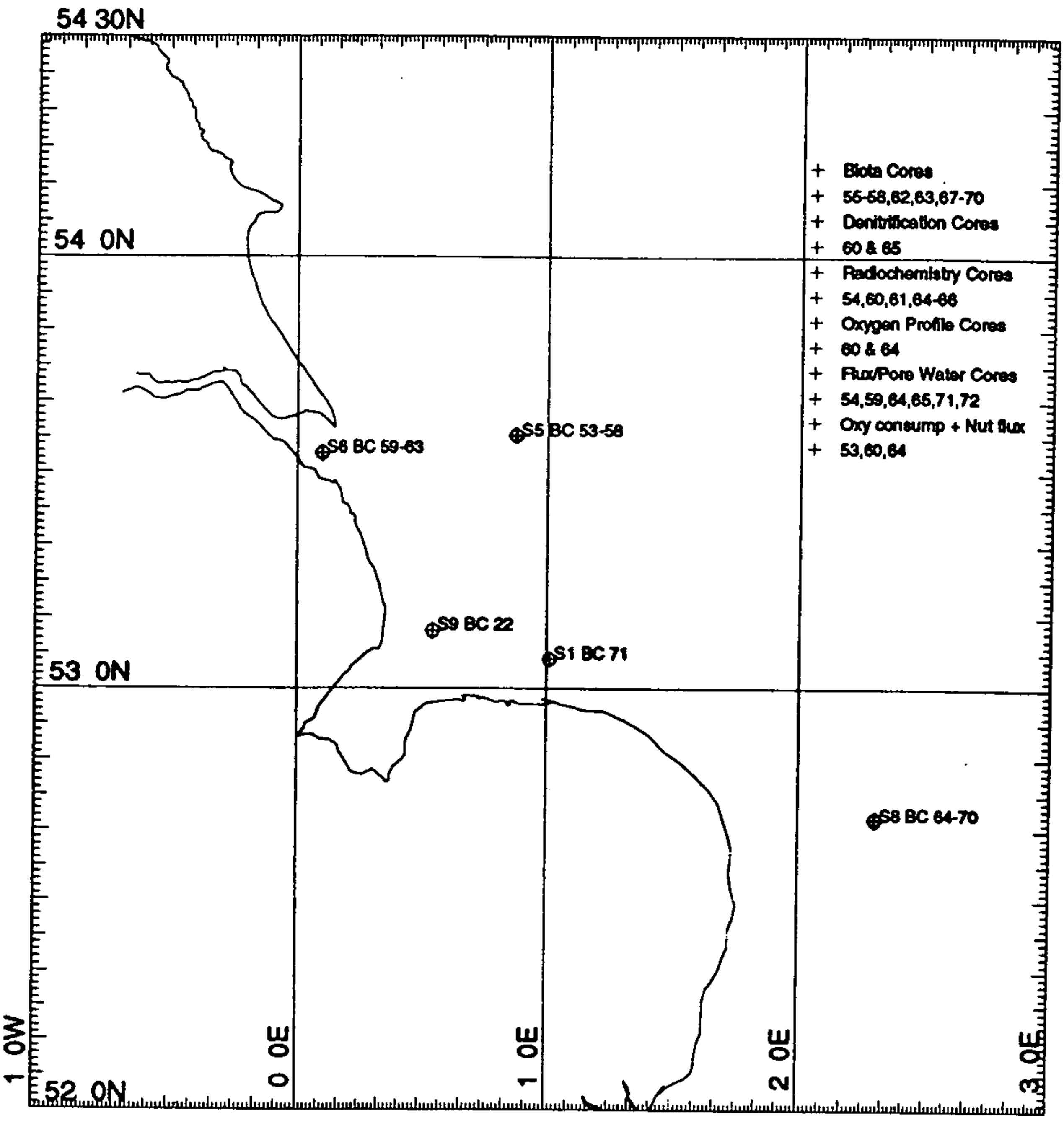
Challenger 118C Cruise Track

Figure 1 **Cruise track**



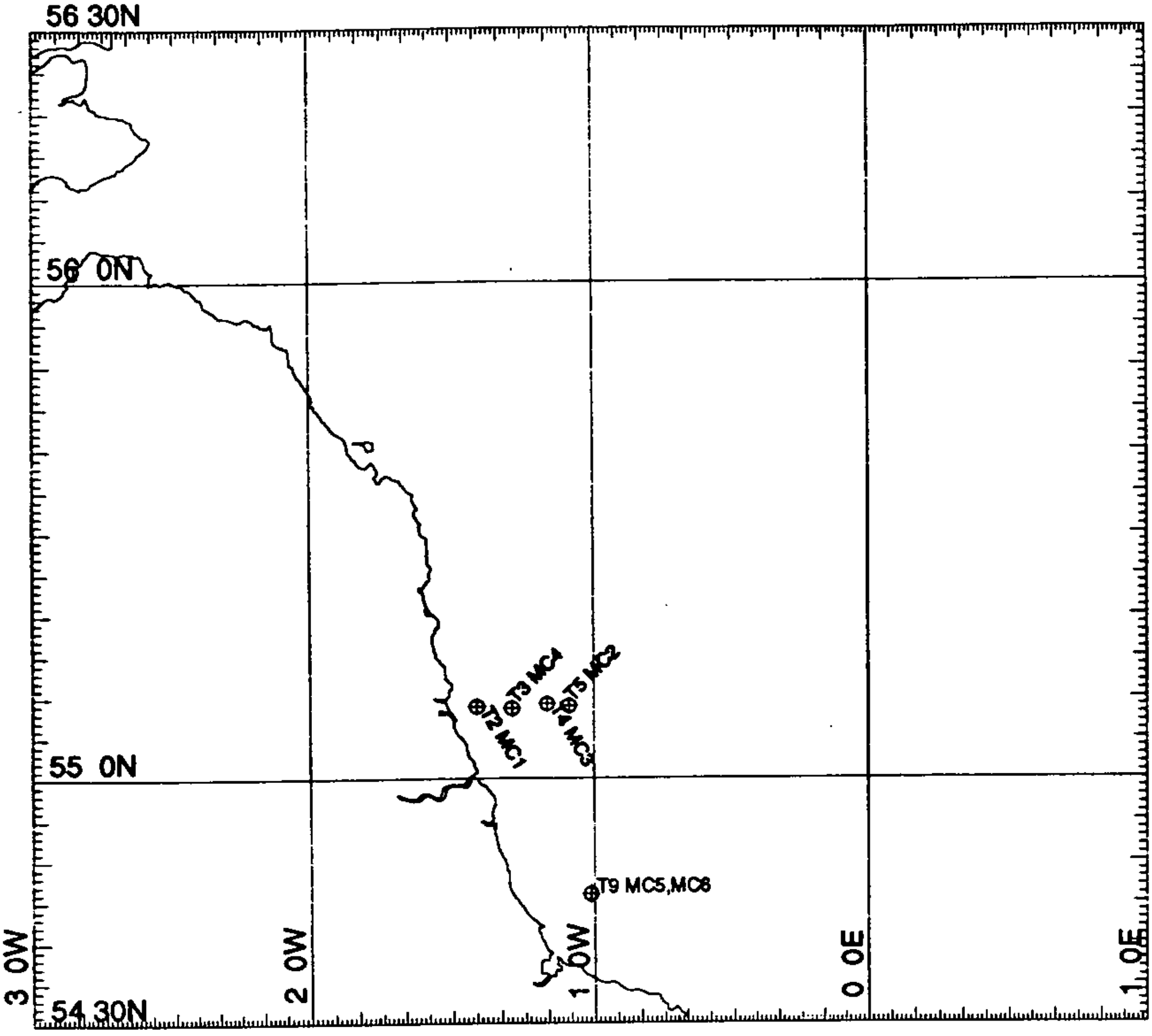
Challenger 118c Box Core Stations

Figure 2 Box-core stations (north) & components measured



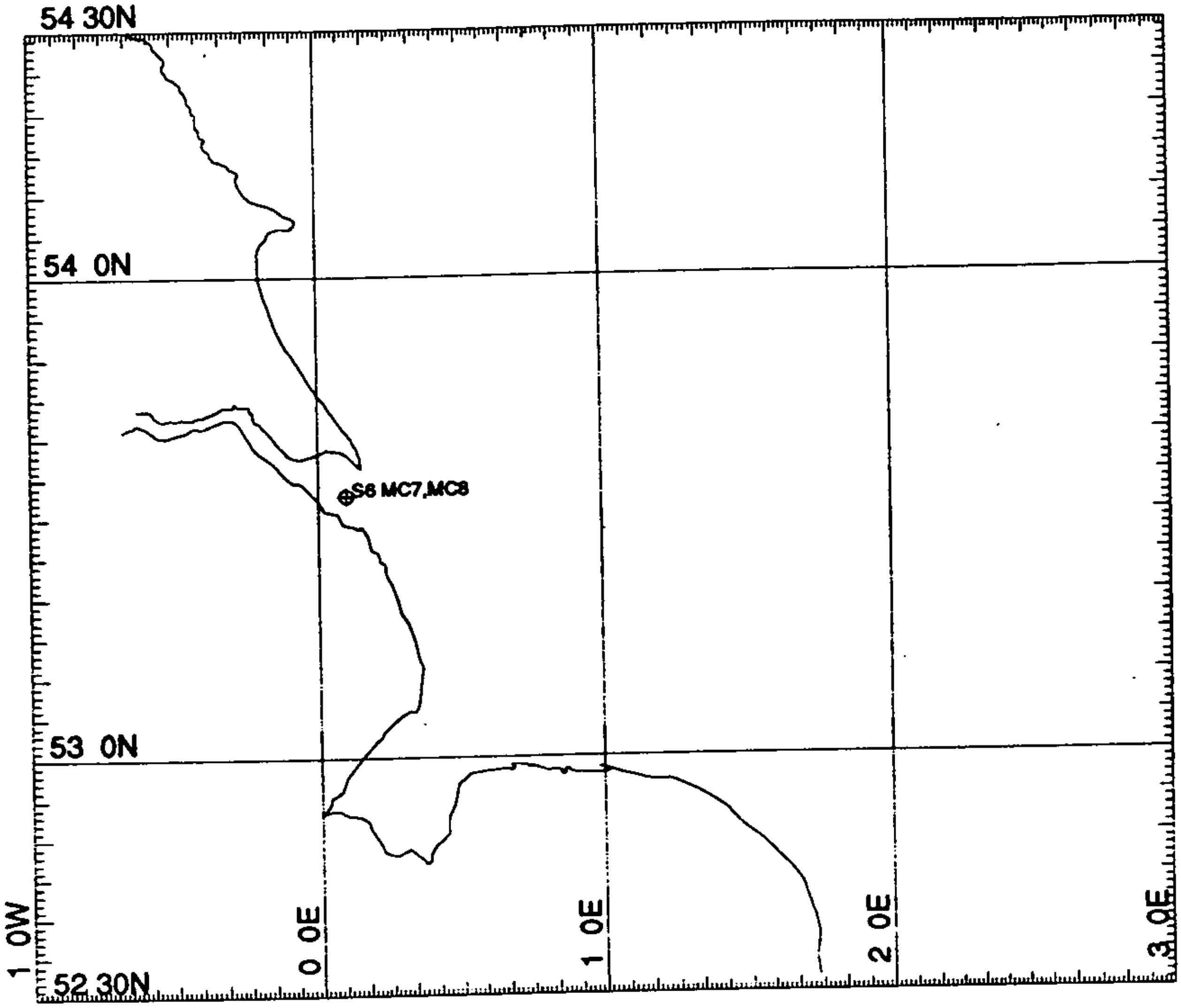
Challenger 118c Box Core Stations (south)

Figure 3 **Box-core stations (south) & components measured**



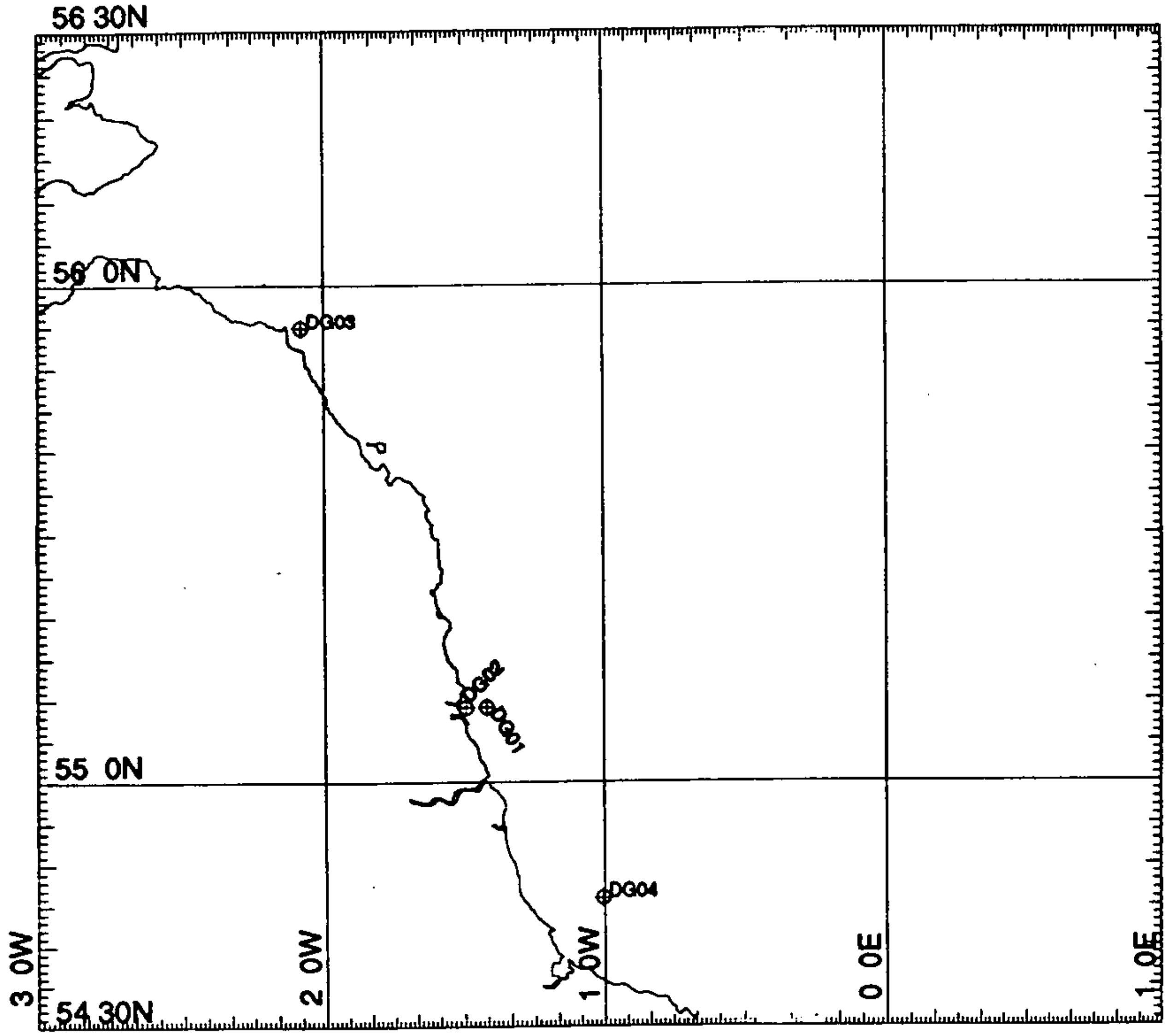
Challenger 118c Multi Core Stations (north)

Figure 4 **Multi-core stations (north)**



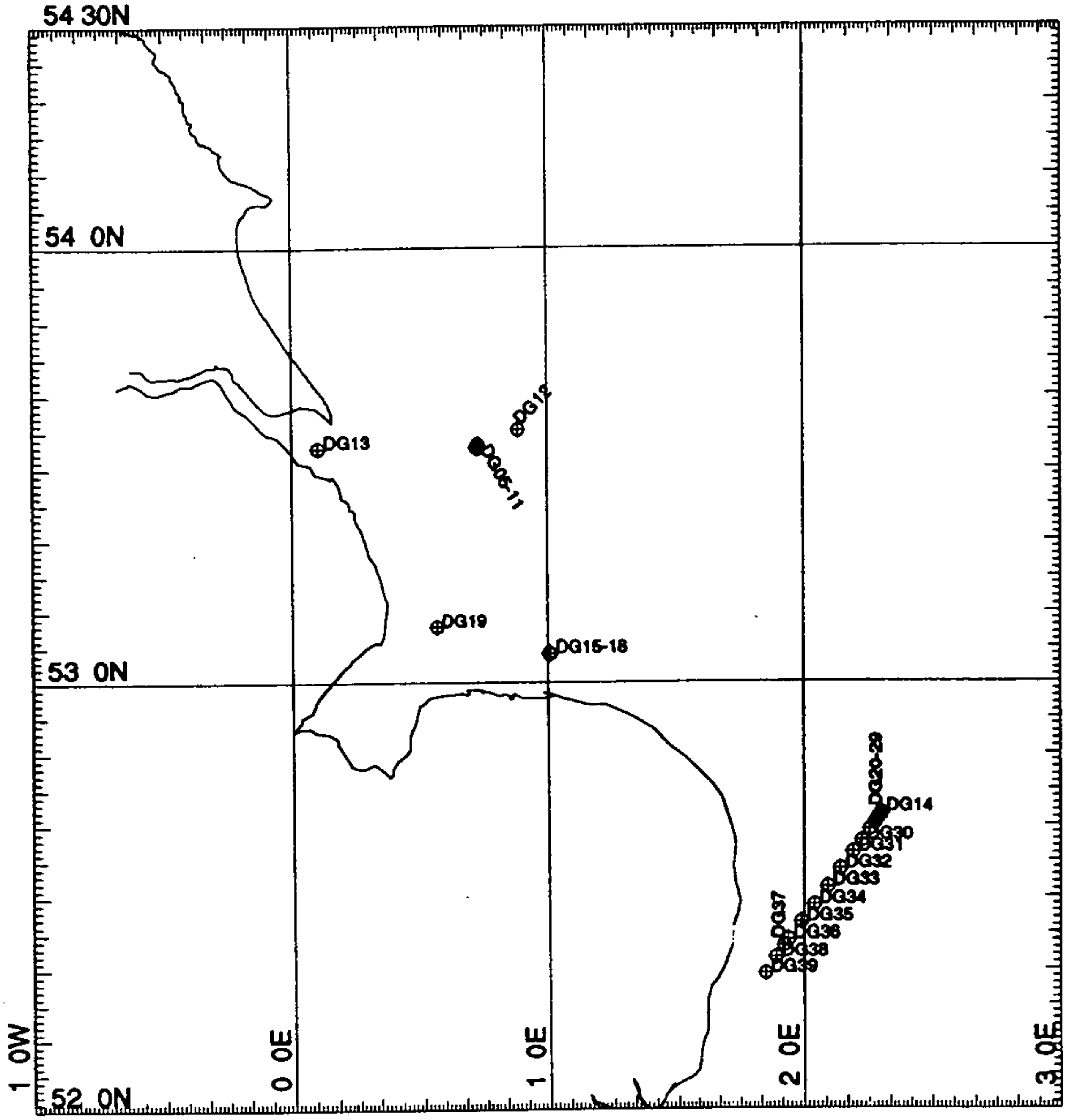
Challenger 118c Multi Core Stations (south)

Figure 5 **Multi-core stations (south)**



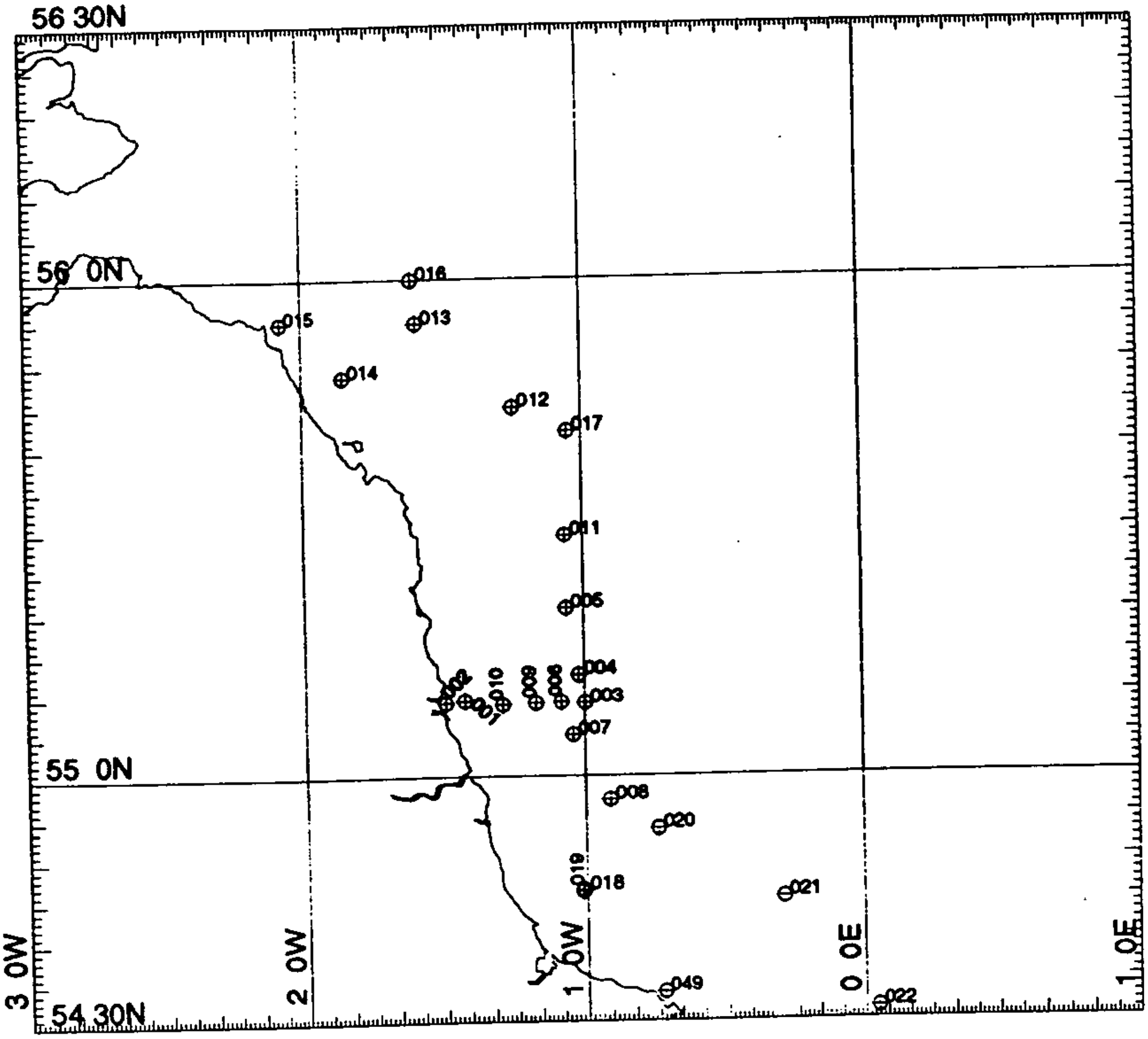
Challenger 118c Day Grab Stations (north)

Figure 6 Day grab sites (north)



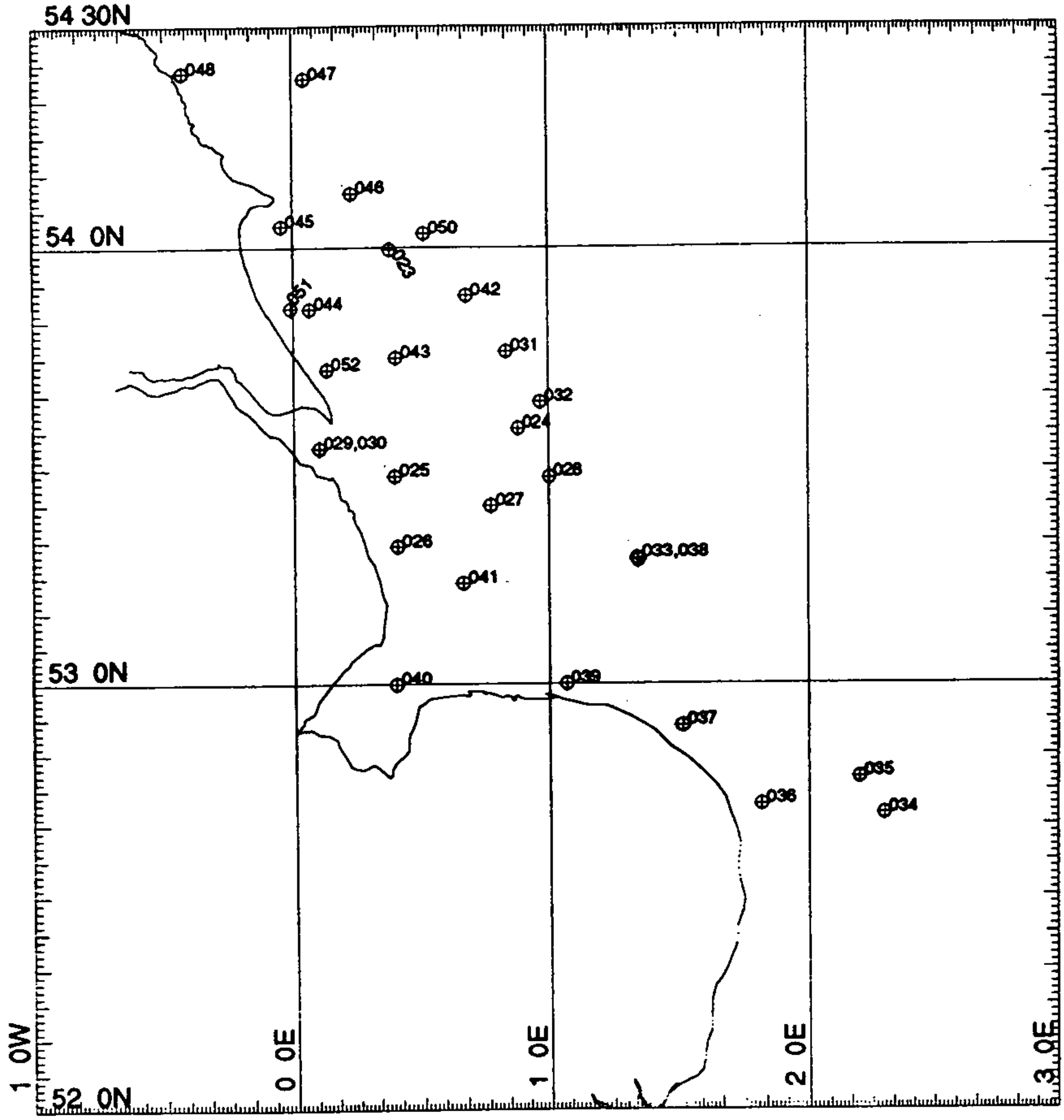
Challenger 118c Day Grab Stations (south)

Figure 7 **Day grab sites (south)**



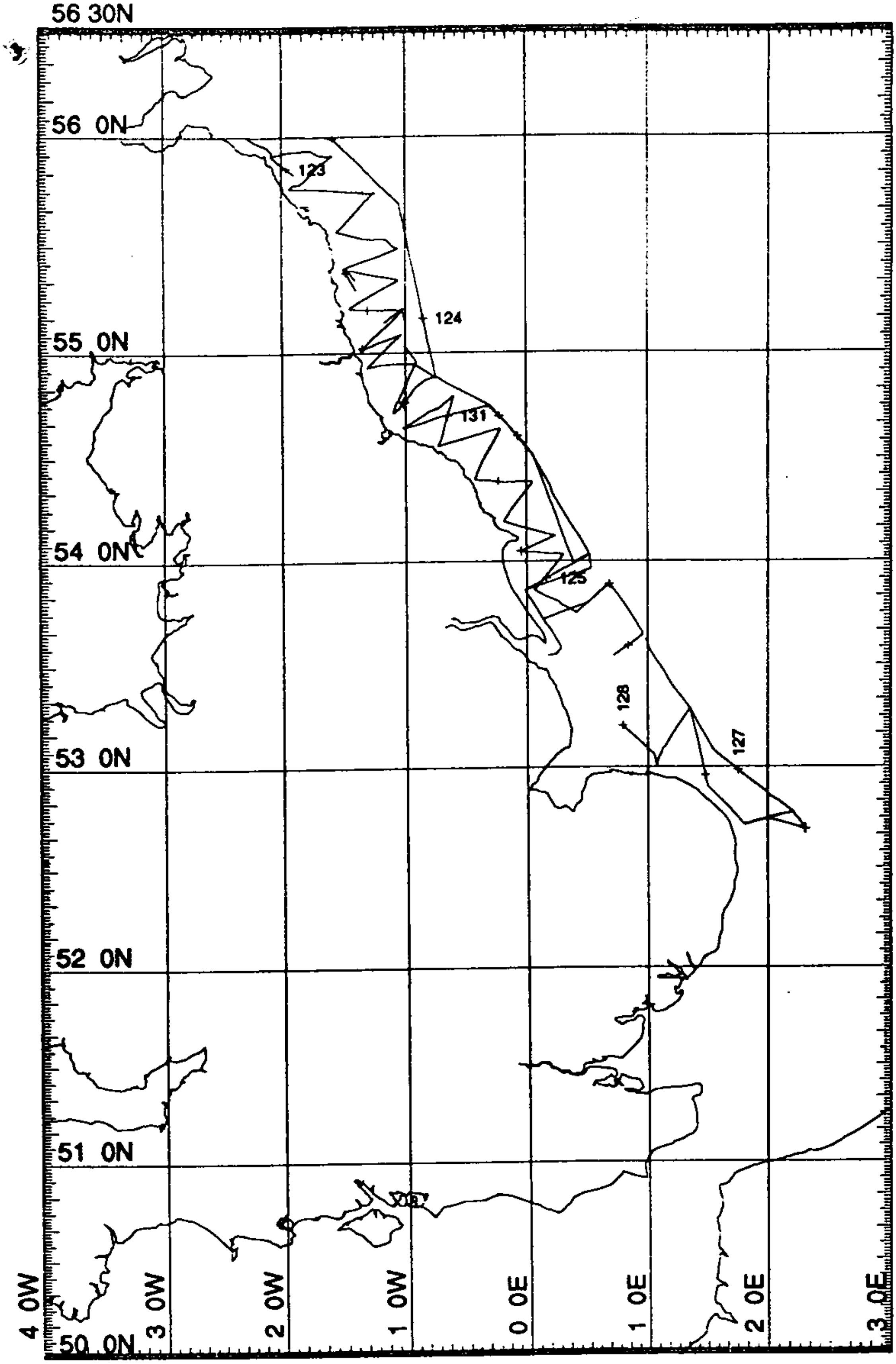
Challenger 118c CTD Stations (north)

Figure 8 CTD stations (north)



Challenger 118c CTD Stations (south)

Figure 9 **CTD stations (south)**



Challenger 118c Continuous nutrient analyses

Figure 10 Continuous nutrient analysis track