Proudman
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An inventory of data collected during the NERC's North Sea Community Research Project 1987-1992

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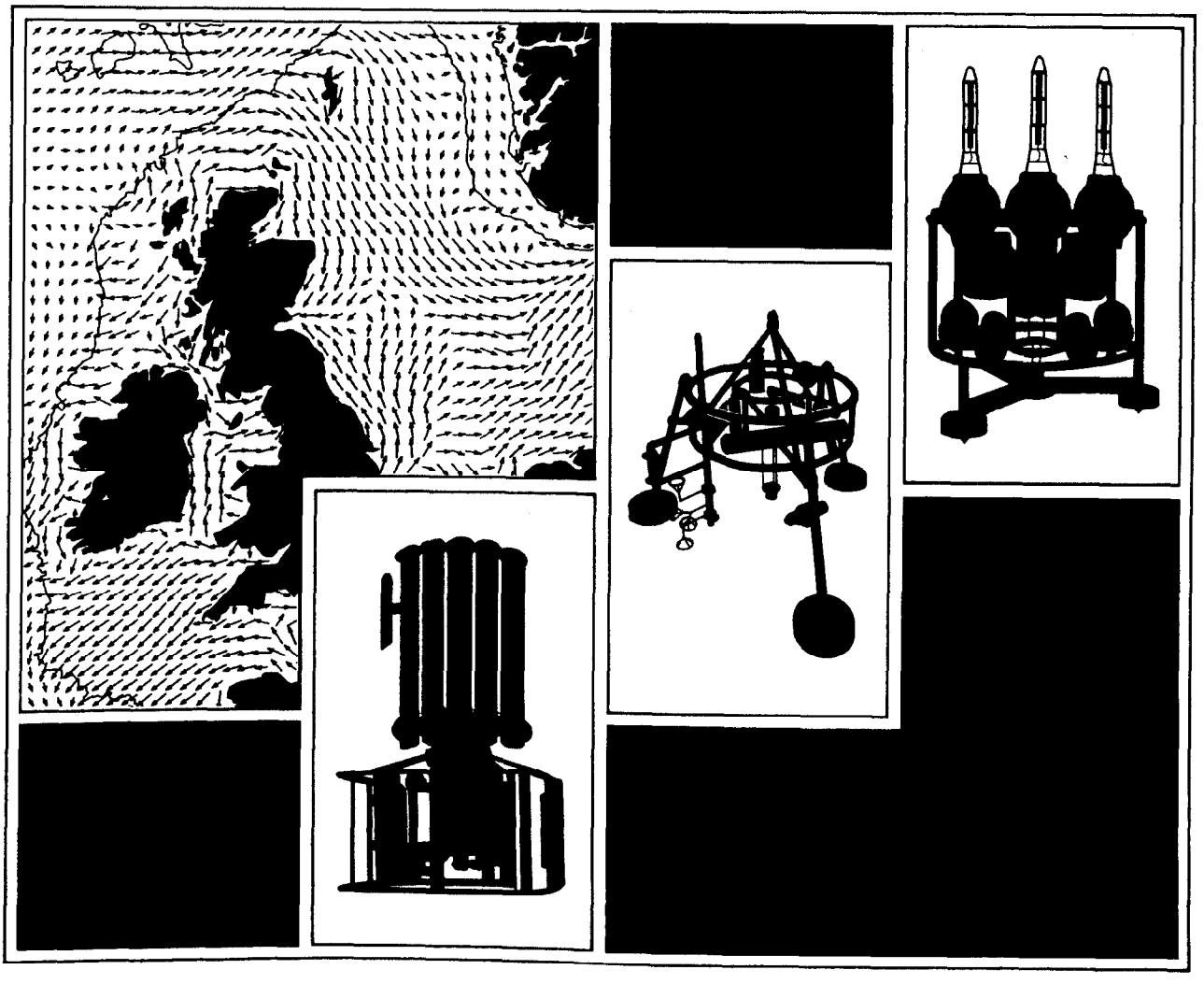
Report No 21



Natural Environment Research Council

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ABSTRACT

This report describes the data gathered as part of the NERC's North Sea Community Research Project 1987-1992, hosted by the Proudman Oceanographic Laboratory. It covers the initial Shakedown cruise, the 15 Survey cruises and 15 Process study cruises between August 1988 - October 1989. Also included are the eight follow-up cruises which took place in 1989 and 1990. The majority of the data has now been lodged with BODC and unrestricted access will be given to the data when the Project finally ends on 1 April 1992.

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CONTENTS

PAGE

5 FOLLOW UP CRUISES

6 BACKGROUND DATA

1. INTRODUCTION

1.1 Background

The North Sea is an important resource shared by many nations with a wide range of potentially conflicting activities. Effective management requires an improved scientific understanding of the sea, incorporated in computer based models able to predict the impact of man's activities and, for example, climatic changes under various scenarios. The NERC North Sea Project addresses this need in respect of physical properties, a wide range of dissolved and particulate constituents in the water and mobile sediments.

The project evolved from a NERC review of shelf sea research, which identified the need for a concerted multidisciplinary study of circulation, transport and production. Ideas were developed through a working group and a workshop of UK marine scientists, with the result that the project was adopted by NERC as their first Marine Sciences Community Research Project to run from 1987 to 1992. A scientific steering group was appointed and £780k assigned to a Special Topic. The project was hosted by the Proudman Oceanographic Laboratory, Birkenhead, and involved over 200 scientists and support staff from NERC and other Government funded laboratories and eight universities and polytechnics.

This UK observational programme has been complemented by Danish and Norwegian surveys in more northern waters. Further collaboration is also ongoing through the International Council for the Exploration of the Sea (ICES) and other scientific organisations in Germany, Holland, Belgium and France.

Including support of the work at the four NERC marine laboratories and the associated work of the MAFF Fisheries Laboratory and university scientists, the full economic cost of the project is expected to exceed £15M over the five years.

1.2 Aims

The ultimate aim of the NERC North Sea Project is a series of prognostic water quality models to aid management of the North Sea. To progress towards water quality models, three intermediate objectives are being pursued in parallel:

i) production of a 3 dimensional transport model for any conservative passive constituent, incorporating improved representations of the necessary physics - hydrodynamics and dispersion,

ii) identifying and quantifying non-conservative processes - sources and sinks determining the cycling and fate of individual constituents,

iii) defining a complete seasonal cycle as a data base for all the observational studies needed to formulate, drive and test models.

1.3 The Survey

The survey was planned to cover a 15 month period needed to resolve the seasonal cycle. Seasonal changes dominate events within the North Sea (i.e. winter storms, spring floods, summer sunshine). Understanding the effects of these phenomena is essential for the development of water quality models.

Within the constraints of a survey cruise, a track was chosen that crossed all areas of concern, the summer stratified waters of the north, the homogeneous waters in the Southern Bight, the major estuaries of the Tyne, Tees, Humber, Thames, Rhine, Ems, Weser and Elbe, possible sources of pollutants and the oceanic water masses of the Channel and northern North Sea.

RRS Challenger followed this 12-day 1800 nautical mile track, Figure 1, sampling more than 100 stations in each of the 15 months, Figure 2. These profiles and underway sampling at 30 second intervals (a total of 500,000 data cycles) provided three dimensional distributions of conductivity (for salinity), temperature, depth, dissolved oxygen, transmittance (for suspended sediment concentration), fluorescence (for chlorophyll) and irradiance. Nutrients were obtained from bottle samples at each station. Samples for trace metal analysis were taken at the majority of stations in August 1988, January 1989, early May 1989 and October 1989. Rain samples were collected and large volumes of air filtered for trace metal/organic compound determination. Zooplankton samples were taken at half the stations on all surveys bar one, by colleagues from the Netherlands Institute for Sea Research.

Current profiles were recorded at 10 minute intervals underway by the shipborne ADCP (Acoustic Doppler Current Profiler). Six current profiler moorings were maintained (Figure 2), augmented, during the stratification season, with thermistor chain moorings at the two stratified northerly sites and two sites in the region of transition to homogeneous waters in the south. Data recovery from the moorings was about 80%.

Sediment cores for the estimation of sea bed chemical fluxes were taken regularly (on eight cruises) at six sites (Figure 2) on the survey track.

1.4 Process studies

In between the survey cruises, a process study cruise looked at some particular aspect of the science of the North Sea. These studies covered the following - fronts (nearshore, circulation and mixing) - sand waves - sandbanks - sediment resuspension - plumes (Humber, Wash, Thames and Rhine) - air/sea exchange - production - blooms/chemistry. Where possible data from these cruises will be incorporated into the North Sea database.

1.5 Cruises with North Sea Project interest in 1990

Eight follow-up cruises have taken place during 1990 including two 'survey' cruises and six process study cruises - the latter covering the following areas of interest: blooms, plumes (Humber, Wash, Rhine), sand waves and flux of contaminants through the Dover Strait.

1.6 Data Management

Each of the 30 or so cruises returned surface underway data and CTD casts. Also water bottle samples were collected and, on some cruises, net hauls for zooplankton and sediment samples were taken. In addition a variety of moored instruments were deployed and recovered. The result is a large and diverse data set with complex interrelationships in space and time. An essential aspect of the North Sea Project is the assembly of a North Sea data set containing all the good quality data collected during the project. Data collected during the project are being managed by the British Oceanographic Data Centre (BODC), concentrating primarily on the survey cruise data. Managing the data includes working up and quality controlling the data coming from the shipboard computer system. The work is being carried out in close collaboration with the principal investigators responsible for collecting the data. Effort has concentrated on three major data sets associated with survey and process study cruises. They are worked up on a cruise by cruise basis.

The data management problems posed by the data collection exercise were twofold. First there was a requirement to work up and quality control a large diverse data set to the highest possible standards but under strict time constraints. Secondly there was the requirement to bring together the data into a coherent data base so that the relationships between individual components of the data set might be readily examined.

The conventional practice where scientists take data from a cruise, work it up and then submit it to a data centre did not hold great promise due to the number of scientists from different laboratories participating in each cruise. For example, responsibility for calibration and quality control of the CTD sensors was divided between two NERC institutes and two university departments. The result would have been massive duplication of software development effort and a great danger of inconsistencies creeping into the data set which the data centre would

have great difficulty in resolving.

The solution adopted was to centralise the data processing at BODC liaising as closely as possible with the participating scientists. Effort has been concentrated on the three major data sets associated with the survey and process study cruises - the CTD database, the samples database and the underway database. High throughput systems utilising the available main-frame resources and graphics workstation technology were put together to despike and calibrate the underway and CTD data. As a consequence a usable underway data set and a fully worked up CTD data set (comprising over 2900 CTD casts) were available within 4 months of the completion of the data collection phase.

Once worked up the data were brought together into a coherent data base. A relational schema was devised and implemented under the Oracle RDBMS. Due to physical constraints the data base was restricted to CTD and sample data. The database now contains all the CTD and zooplankton together with all the currently available water bottle and sediment core data.

Benthic and atmospheric flux data are being added as they become available. Other data types (e.g. moored instruments, shipborne ADCP data, river input, supporting meteorological data sets) are being compiled into supporting databases.

The data collected during the observational phase of the North Sea Project comprises one of the most detailed sets of observations ever undertaken in any shallow shelf sea.

On March 1st 1990 the database was made available over the JANET network to scientists participating in the project. The database may either be interrogated interactively using SQL query language or by means of retrieval programs including graphical presentation software. The data sets collected during the North Sea Project will continue to be of great value beyond the life-time of the Project. BODC are archiving the data together with sufficient documentation to render them useful to future generations of scientists. In order that this archive be readily accessible, BODC are building the archive using CD-ROM technology and developing user-friendly software to allow the archive to be distributed to the scientist's desktop. Access to North Sea Project data is restricted to project participants until 1st April 1992, after which they will be available to scientists not participating in the Project.

2. NORTH SEA PROJECT DATABASE

The remainder of this report is given over to an inventory of the data collected during the North Sea Project. It includes 16 survey cruises, 15 process study cruises and 8 follow-up cruises. Firstly summaries of the three standard sets of measurements are given. These are based on the data currently available from the database - i.e. CTDs, underway measurements and water bottle sample data. These are described together for survey, process study and follow-up cruises. Following this, the remaining data collected on the survey cruises are described. Next the process study data are described - these are grouped by the process being studied. Finally the data collected during the follow-up cruises are described.

2.1 Surface underway data

Surface underway data were collected on all survey cruises and most process study cruises. Data were collected at 30 second intervals, so each cruise contains 30,000 - 40,000 data cycles and between 8 and 12 channels. Date and time and the master navigation data are included with the surface underway data. Other parameters included are:

echo-sounder (i.e. bathymetry)
temperature
conductivity/salinity
transmittance
fluorescence
dissolved oxygen
light (10 minute values)
irradiance

Other channels are produced after calibration (i.e. transmittance gives sediment load, fluorescence gives chlorophyll). Plots of the cruise tracks for all of the survey cruises and areas covered by the process study cruises can be found in Appendix 1.

2.2 CTD Database

Approximately 100 CTD casts were taken on each survey cruise. In addition to temperature, conductivity and pressure the following parameters were recorded:

dissolved oxygen
fluorescence (for chlorophyll)
transmittance/attenuance
upwelling irradiance
downwelling irradiance

The tables below detail the number of CTD casts taken on a cruise by cruise basis. A 'Y' in a parameter column shows that all of the casts taken have recorded that parameter. When one or more casts has failed to return data the number of valid casts is given. A blank indicates that the sensor returned no good data for that cruise. Altogether 1788 CTD casts were collected during the 15 survey cruises plus the shakedown cruise (an average of 111 CTD casts per

cruise). The number of casts made on process study cruises was more variable, with 1065 casts taken altogether, an average of 71 CTD casts per cruise.

Survey cruises

Cruise No.	No. of CTDs	Temp	Salinity	Oxygen	Chlorophyll	Attenuance	Upwelling Irradiance	Downwelling Irradiance
CH28	163	Y	Y		Y	Y	Y	Y
CH33	114	Y	Y	Y	106	Y	Y	Y
CH35	109	Y	Y	Y	Y	Y	Y	Y
CH37	75	Y	Y	Y	Y	Y	Y	Y
CH39	113	Y	Y	Y	72	Y	Y	Y
CH41	70	Y	Y	Y	49	Y	Y	Y
CH43	110	Y	Y	Y	Y	Y	Y	Y
CH45	110	Y	Y		76	Y	Y	Y
CH47	135	Y	Y	Y	Y	Y	Y	29
CH49	89	Y	Y	72	Y	Y	Y	Y
CH51	119	Y	Y	Y	Y	Y	Y	Y
CH53	119	Y	Y	Y	Y	Y	Y	Y
CH55	123	Y	Y	87	Y	Y	Y	Y
CH57	109	Y	Y	38	Y	Y	Y	Y
CH59	114	Y	Y	Y	Y	Y	Y	Y
CH61	116	Y	Y	Y	Y	Y	Y	Y
Total	1788	1788	1788	1391	1684	1788	1788	1682

Process Study Cruises

Cruise No.	No. of CTDs	Temp	Salinity	Oxygen	Chlorophyll	Attenuance	Upwelling Irradiance	Downwelling Irradiance
CH34	258	Y	Y	Y	Y	Y		
CH36	89	Y	Y		Y	Y		
CH38								
CH40	54	Y	Y			Y		
CH42	76	Y	Y	Y	Y	48	Y	Y
CH44	40	Y	Y		Y	Y	Y	Y
CH46	48	Y	Y		Y	23	Y	Y
CH48	27	Y	Y		Y	Y	12	15
CH50	55	Y	Y	44	Y	Y	Y	Y
CH52	115	Y	Y	Y	Y	Y	Y	Y
CH54	91	Y	Y	85	Y	Y	Y	Y
CH56	51	Y	Y		Y	35		
CH58	30	Y	Y		Y	Y		
CH60	84	Y	Y		Y	Y	Y	Y
CH62	47	Y	Y	Y	Y	Y	Y	Y
Total	1065	1065	1065	625	1011	996	568	571

Follow-up Cruises

Cruise No.	No. of CTDs	Temp	Salinity	Oxygen	Chlorophyll	Attenuance	Upwelling Irradiance	Downwelling Irradiance
CH62A	13	Y	Y	Y	Y	Y	Y	Y
CH64	50	Y	Y		Y	Y	7	49
CH65	77	70	70		Y	Y		Y
CH66A	88	Y	Y		Y	Y		Y
CH66B	341	Y	Y		Y	Y		Y
CH69	50	Y	Y		Y	Y		Y
CH72A	93	Y	Y	Y	Y	Y	Y	Y
CH72B								
CH72C	226	Y	Y	Y	Y	Y	Y	Y
Total	915	908	908	332	915	915	339	914

2.3 Water Bottle Database

Water bottle samples were collected on almost all CTD casts, usually with bottles being fired at the bottom, middle and top of a cast. Many different parameters have been measured from these water samples. These are given below in several different tables.

2.3.1 Temperature, salinity and dissolved oxygen

Temperatures from reversing thermometers, salinities and dissolved oxygen measurements have been taken for calibration of the CTD sensors. The oxygen values have been determined by Winkler titrations and have been used to calibrate the oxygen sensors. The number of determinations of each parameter is given below; first for the survey cruises and secondly for the process study cruises and finally for the follow-up cruises.

Survey cruises - temperature, salinity and dissolved oxygen

Cruise	No. of Stations	Salinity	Temperature	Dissolved Oxygen
CH28	166	143	147	
CH33	115	105	99	37
CH35	109	86	105	15
CH37	75	63	72	24
CH39	115	106	109	90
CH41	70	66	68	
CH43	111	101	99	30
CH45	114	103	109	27
CH47	135	119	128	
CH49	90	78	86	
CH51	114	106	107	
CH53	119	101	108	19
CH55	126	116	119	26
CH57	110	93	98	26
CH59	117	110	104	53
CH61	116	110	104	28
Total	1802	1606	1662	375

Process study cruises - temperature, salinity and dissolved oxygen

Cruise	No. of Stations	Salinity	Temperature	Dissolved Oxygen
CH34	109	97	86	
CH36	64	49	56	
CH40	43	53	33	
CH42	76	67	72	
CH44	40	33	36	
CH46	41	37	39	
CH48	27	19	24	
CH50	55	42	50	136
CH52	135	11	107	61
CH54	55			52
CH56	24	21	18	
CH60	85	77	79	
CH62	48	41	44	
Total	802	547	644	249

Follow-up cruises - temperature, salinity and dissolved oxygen

Cruise	No. of Stations	Salinity	Temperature	Dissolved Oxygen
CH62A	13	13	13	
CH64	50	46	47	
CH65	77	73	67	
CH66A	88	56	81	
CH66B	303	170	163	
CH69	51	48	49	
CH72A	92	89	66	
CH72C	173	150	166	
Total	847	645	652	

2.3.2 Chlorophyll and phaeopigment

Spectrophotometric chlorophyll and phaeopigment determinations have been carried out on the water bottle samples as detailed below, which again give the number of measurements on a cruise by cruise basis. The chlorophyll values for a cruise have been used to calibrate the CTD fluorometer for that cruise. In addition fluorometric chlorophyll and phaeopigment determinations have been made on some cruises from the water bottle samples.

Survey cruises - chlorophyll and phaeopigment

Cruise	No. of Stations	Chlorophyll	Phaeopigment	Fluorometric Chlorophyll	Fluorometric Phaeopigment
CH28	166				
CH33	115	358	319		
CH35	109	261			
CH37	75	212	212		
CH39	115	350	319		
CH41	70	197	182		
CH43	111	343	321		
CH45	114	292	262		
CH47	135	365	343		
CH49	90	233	212		
CH51	114	258	206		
CH53	119	286	256		
CH55	126	375	295	12	
CH57	110	335	299		28
CH59	117	372	357		
CH61	116	373	335		
Total	1802	4610	3918	12	28

Process study cruises - chlorophyll and phaeopigment

Cruise	No. of Stations	Chlorophyll	Phaeopigment	Fluorometric Chlorophyll	Fluorometric Phaeopigment
CH34	109				
CH36	64				
CH40	43				
CH42	76				
CH44	40	5			
CH46	41				
CH48	27				
CH50	55	41	1	163	158
CH52	135	27	24	135	21
CH54	55	66			
CH56	24				
CH60	85	7	7		
CH62	48			38	37
Total	802	146	32	336	216

Follow-up cruises - chlorophyll and phaeopigment

Cruise	No. of Stations	Chlorophyll	Phaeopigment	Fluorometric Chlorophyll	Fluorometric Phaeopigment
CH62A	13			13	9
CH64	50			90	
CH65	77	81	72		
CH66A	88				
CH66B	303				
CH69	51	50	50		
CH72A	92				
CH72C	173				
Total	847	131	122	103	9

2.3.3 Nutrients

Nutrients were determined from water bottle samples using an autoanalyser. A report (Hydes and Edmunds, 1989) has been prepared showing distributions of nutrients collected on the survey cruises. The number of samples for each nutrient determined for each cruise is given below.

Survey cruises - nutrients

Cruise	No. of Stations	Phosphate	Nitrite	Nitrate	Silicate	Ammonia
CH28	166					
CH33	115	490	465	475	479	
CH35	109	304	301	304	303	
CH37	75	231	231	225	230	
CH39	115	351	351	351	351	351
CH41	70	192	192	192	192	178
CH43	111	410	403	410	410	383
CH45	114	299	297	299	299	297
CH47	135	375	375	375	375	366
CH49	90	236	236	236	236	236
CH51	114	325	323	320	325	325
CH53	119	334	334	334	334	334
CH55	126	359	359	347	359	359
CH57	110	330	324	330	330	330
CH59	117	357	357	357	357	357
CH61	116	394	394	393	394	392
Total	1802	4987	4942	4948	4974	3908

Process study cruises - nutrients

Cruise	No. of Stations	Phosphate	Nitrite	Nitrate	Silicate	Ammonia
CH34	109					
CH36	64					
CH40	43					
CH42	76					
CH44	40	117	92	117	117	
CH46	41					
CH48	27	61	62	60	50	
CH50	55	194	178	194	35	
CH52	135	330	312	272	326	329
CH54	55					
CH56	24					
CH60	85	206	205	177	204	168
CH62	48	122	123	123	111	
Total	802	1030	972	943	843	497

Follow-up cruises - nutrients

Cruise	No. of Stations	Phosphate	Nitrite	Nitrate	Silicate	Ammonia
CH62A	13					
CH64	50					
CH65	77					
CH66A	88					
CH66B	303					
CH69	51					
CH72A	92	261	261	261	261	261
CH72C	173					
Total	847	261	261	261	261	261

2.3.4 Suspended sediment

Water bottle samples were taken for determination of sediment content. These values could then be used to calibrate the transmissometer used on the CTD and that used for the underway measurements. The table shows the number of determinations for total, organic and inorganic sediments on a cruise by cruise basis.

Survey cruises - suspended sediment

Cruise	No. of Stations	Total Sediment	Organic Sediment	Inorganic Sediment
CH28	166			
CH33	115	286		
CH35	109	220		
CH37	75	127		
CH39	115	263		
CH41	70	172	162	162
CH43	111	298	278	278
CH45	114	245	241	241
CH47	135	297	295	295
CH49	90	186	165	165
CH51	114	176	176	176
CH53	119	183	158	158
CH55	126	254	226	226
CH57	110	225	201	201
CH59	117	261	226	226
CH61	116	319	303	303
Total	1082	3512	2431	2431

Process study cruises - suspended sediment

Cruise	No. of Stations	Total Sediment
CH42	76	70
CH46	41	28
CH50	55	29
CH60	85	59
Total	257	186

Follow-up cruises - suspended sediment

Cruise	No. of Stations	Total Sediment	Organic Sediment	Inorganic Sediment
CH62A	13	9		
CH64	50	88		
CH65	77	73		
CH66A	88	71	71	71
CH66B	303	21	21	21
CH69	51	39		
CH72A	92			
CH72C	173			
Total	847	301	92	92

2.3.5 DMS, DMSp and other halocarbons

On eight of the survey cruises (between February and October 1989) measurements were made of dimethyl sulphide (DMS) and its cellular precursor dimethyl sulphoniopropionate (DMSp). The number of measurements made are given in the table below. These determinations have been carried out using gas chromatography. Where no DMS value exists, then the values of total DMSp and dissolved DMSp will be an over estimate as no value of DMS was available to correct them. In addition to the DMS measurements, other halocarbons have been detected, as noted below.

Survey cruises - dissolved and particulate DMSp

Cruise	No. of Stations	dissolved DMSp	particulate DMSp
CH45	77	73	73
CH47	96	66	66
CH49	71	67	66
CH51	112	101	101
CH53	101	97	95
CH55	120	117	116
CH57	47	44	44
CH59	112	105	105
CH61	114	106	105
Total	1216	776	771

Survey cruises - DMS, total DMSp and other halocarbons

Cruise	No. of Stations	DMS	Total DMSp	Halocarbons	
CH45	114	68	75		
CH47	135	80	92	90	16 halocarbons detected
CH49	90	64	69		
CH51	114	101	104	~100	9 halocarbons detected plus 10 other gases
CH53	119	100	95	110	
CH55	126	120	118	>100	20 halocarbons detected
CH57	110	44	44	61	
CH59	117	112	110	100	
CH61	116	109	106	112	20 halocarbons detected
Total	1041	798	813		

2.3.6 Dissolved and particulate trace metals

Trace metals were measured on the following survey cruises: CH28, CH33, CH39, CH43, CH51 and CH61. Samples were also taken on some process study cruises (CH42, CH44, CH46, CH50, CH52, CH60) and some follow-up cruises (CH65, CH66B, CH72C). The measurements already worked up and handed over to BODC are presented in two sets of tables - the first showing dissolved trace metals and the second particulate trace metals.

Survey cruises - Dissolved trace metals

Cruise	No. of Stations	Mn	Cu	Pb	Zn	Cd	Co	Ni	Fe	Total Hg	Reactive Hg
CH28	29	29	29	29	29	29	28	29			
CH33	98	79	138	138	138	138	133	138	56		
CH43	116	116	116	112	116	116	116	116	113		
CH51	112		79	80		80				56	61
Total	355	224	362	359	283	363	282	283	169	56	61

Cruise	No. of Stations	Inorganic As	Monomethyl As	Dimethyl As	Al	Unfiltered total Hg
CH33	98				393	
CH51	112				312	103
CH61	114	40	40	40		
Total	324	40	40	40	705	103

Process study cruises - dissolved trace metals

Cruise	No. of Stations	Mn	Cu	Pb	Zn	Cd	Co	Ni	Fe	Total Hg	Reactive Hg
CH42	42	42	42	42	42	42	42	42	31	34	37
CH46	22	19	20	20	11	11	17				
CH50	48	48	48	47	48	48	48	47	33		
	112	90	109	109	90	110	90	89	64	45	48

Cruise	No. of Stations	Inorganic As	Al	Unfiltered total Hg
CH42	42	35	65	40
CH44	40		117	
CH46	22	17		7
CH52	135		242	
Total	241	52	424	47

Follow-up cruises - dissolved trace metals

Cruise	No. of Stations	Inorganic As	Monomethyl As	Dimethyl As
CH65	33	35		31
CH69	13	13	13	13
Total	46	48	13	44

Survey cruises - Particulate trace metals

Cruise	No. of Stations	Sed. mass	Sed. conc	Fe	Mn	Cu	Pb	Zn	Cd
CH28	25								
CH33	98	48	49	49	49	34	49	47	48
CH43	105	56	56	55	56	43	56	56	39
CH51	112	52	52	52	52	40	52	52	52
Total	340	156	157	156	157	117	157	155	139

Process study cruises - particulate trace metals

Cruise	No. of Stations	Sed. mass	Sed. conc	Fe	Mn	Cu	Pb	Zn	Cd	Ni	Cr	Co	Al
CH42	44	33	33	33	33	32	26	33	14	30	30	25	24
CH46	22	16	16	16	16	16	16	16	12	16	16	16	14
Total	66	49	49	49	49	48	42	49	26	46	46	51	38

2.4 Survey Cruises - Sediment Cores for microbial activity

Sediment cores for the estimation of sea-bed chemical fluxes were taken on eight survey cruises at six sites around the survey track (Figure 2) using a multicorer. The sites were at the following locations:-

51° 45.36'N 2° 59.96'E

53° 37.10'N 4° 35.70'E

55° 30.00'N 6° 06.10'E

55° 29.90'N 0° 54.50'E

54° 39.16'N 0° 31.06'E

53° 30.78'N 2° 59.33'E

At each of these sites the following environmental and sedimentary characteristics were measured or noted:

Position of site
Depth of water
Temperature of water immediately above sediment
Oxygen concentration in the overlying water
Percentage of organic matter present within the sediment
Water content of the sediment
Particle size of the sediment (i.e. % of sand and silt)
Concentration of nutrients in the pore water within the sediment
Concentration of sulphate in the pore water within the sediment
Concentration of sulphide within the sediment
Visual description of sediment - sediment type (muddy/sandy)
presence and depth of anoxic zones
presence of invertebrates (mixing)
surface flocculence

The number of each type of measurement for each cruise is given in the two tables below.

Cruise Number	No. of cores	Water temp.	oxygen conc.	Sand (%)	Silt (%)	Integrated sulphate reduction	Depth of sulphate reduction	Sulphate reduction due to AVS
CH28	6	6						
CH35	5	5	5			5	5	5
CH37	5	5	5	4	4	5	5	5
CH41	6	6	6	6	6	6	6	6
CH45	5	5	5	5	5	5	5	5
CH49	5	5	5	5	5	5	5	4
CH53	6	6	6	6	6	6	6	6
CH57	6	6	6	6	4	4	4	4
CH59	6	6	6		4	4	4	

Cruise Number	Nitrate		Nitrite		Ammonia		Phosphate		Silicate	
	conc	flux	conc	flux	conc	flux	conc	flux	conc	flux
CH35	5	5	5	5			5	5	5	5
CH37	5	4	5	4			5	4	5	4
CH41	6	4	6	4	6	4	6	4	6	3
CH45	5	5	5	5	5	5	5	5	5	5
CH49	4	5	5	5	5	5	5	5	4	5
CH53	6	6	6	6	6	6	6	6	6	6
CH57	4	4	4	4	4	4	4	4	4	4
CH59	4	4	4	4	4	4	4	4	4	4

Measurements were also made of profiles through the cores. The number of each type of measurement is given in the table below. The measurements were either made by dividing up the core into segments of equal length and analyzing each segment or a measuring probe was inserted into the core at intervals.

Cruise	No. of segments	Water content	Organic matter	Sulphate Reduction	Pore water concentrations NO_3	NO_2	NH_4	PO_4	Si	Fe
CH28	8	6	6							5
CH35	26	25	25	19	18	18		18	18	
CH37	14	14	14	14	14	14		14	14	1
CH41	27	24	24	23	23	23	23	23	23	
CH45	21	19	18	19	17	17	17	17	17	
CH49	22	21	19	19	20	20	20	20	20	
CH53	30	26	26	23	24	24	24	24	24	4
CH57	28	25	25	18	15	15	15	15	15	3
CH59	30	27	27	18	15	15	15	15	15	14

2.4.1 Foraminiferal analysis

A total of 75 samples from the sediment cores have been examined from cruises CH28, CH35, CH37, CH41, CH45, CH49 and CH53 in order to study the distribution and population dynamics of benthic forams in the southern North Sea.

2.4.2 Isotope analysis

Certain fine grained cores are undergoing isotope analysis. This will enable isotope inventories and the mixing of sediments (both physical and bioturbation processes) to be examined. Analyses are being carried out for Pb, U, Th, Pu and Cs.

2.5 Zooplankton

Zooplankton net hauls were made on almost all of the survey cruises, by the Netherlands Institute for Sea Research. The first of the two tables shows how many net hauls were taken on each cruise and the second, the species which were counted. The database therefore includes the number for each of these species per net haul and also notes whether the species listed under 'Others' was present. A net of mesh size 300 micrometres and area 0.384 square metres was used. On some survey cruises a small vertical net (diameter 18cm, mesh width 50 micrometres) was also used.

Cruise Number	Number of Stations
CH33	58
CH35	56
CH37	42
CH39	59
CH41	44
CH43	64
CH45	62
CH47	73
CH49	42
CH51	47
CH53	61
CH55	70
CH57	70
Total	748

Name of species counted:

temora longicornis female
temora longicornis male
acartia clausi female
acartia clausi male
pseudocalanus elongatus female
pseudocalanus elongatus male
centropages hamatus female
centropages hamatus male
centropages typicus female
centropages typicus male
oithona species
chaetognatha species
copepods per m**3
calanus finmarchius/helgolanchius female
calanus finmarchius/helgolanchius male
other species *see below

Parcalanus in Pseudocalanus.

* Other species include: Candacia, Oncaea, Isias, Metridia, Anomalocera

3. OTHER SURVEY DATA

3.1 Shipborne ADCP data - Survey cruises

Shipborne ADCP data was collected on all survey cruises as shown in the table below. Profiles were taken at 10 minute intervals, with a 4m bin size.

Cruise	Start date/time	End date/time	Number of profiles
CH33	0701 05 Aug 1988	0713 16 Aug 1988	1568
CH35	1550 03 Sep 1988	0801 15 Sep 1988	1680
CH37	0025 02 Oct 1988	1346 13 Oct 1988	1525
CH39	1521 01 Nov 1988	0757 13 Nov 1988	1682
CH41	1745 01 Dec 1988	0955 13 Dec 1988	1627
CH43	1845 30 Dec 1988	0015 12 Jan 1989	1760
CH45	1441 28 Jan 1989	1826 09 Feb 1989	1756
CH47	1451 27 Feb 1989	2325 11 Mar 1989	1779
CH49	1705 29 Mar 1989	0507 10 Apr 1989	1655
CH51	1146 30 Apr 1989	0831 09 May 1989	1274
CH53	1527 26 May 1989	1045 06 Jun 1989	1544
CH55	1305 26 Jun 1989	0742 06 Jul 1989	1417
CH57	1329 24 Jul 1989	0345 06 Aug 1989	1814
CH59	1717 28 Aug 1989	1016 03 Sep 1989	1540
CH61	1431 21 Sep 1989	0515 03 Oct 1989	1607

3.2 Primary productivity

For primary productivity investigations, water bottle samples from a pre-dawn CTD cast were taken from six depths (usually 1, 3, 7, 15, 20 and 30m) instead of the more usual top, middle and bottom samples. Triplicate samples were then incubated at six simulated depths, the incubation period being usually 24 hours. The table below shows which survey cruises performed incubation experiments, and how many sets of experiments were carried out. In addition to those experiments noted below, on CH55 additional experiments were carried out. A ✓ indicates that an unspecified number of experiments was carried out. These were to assess the importance of picophytoplankton productivity. On most days during the cruise parallel on-deck incubations were conducted using oxygen flux and carbon-14 measurements. A second set of experiments compared oxygen productivity with carbon-14 uptake using a light gradient incubator.

Cruise	Number of experiments
CH33	11
CH39	10
CH43	10
CH47	13
CH49	9
CH51	11
CH53	✓
CH55	10
CH57	9
CH61	10

3.3 Phytoplankton

During the survey cruises a water sample was collected for microscopic analysis of phytoplankton numbers and species composition at every other CTD station. The area covered by the survey cruises was split into fifteen representative regions and one or two samples falling within each area analysed for each survey cruise because of the time taken for each analysis (see Figure 2).

3.4 Marine aerosols

The air-sea interaction parts of the North Sea survey comprised four experiments measuring organic particles, inorganic (trace metal) particles, large airborne particles and rainfall. The table below shows the measurements taken. A ✓ indicates an unspecified number of measurements.

Cruise	inorganic/organic high volume pairs	cascade impactor samples	Large aerosols	Rainfall
CH28	6	2	not fully operative	4 sites
CH33	14/13	3		2
CH35	✓		✓	✓
CH37	7	1 (100 hrs)		7
CH39	9			1 *
CH41	6		✓	✓
CH43	4 (12-14hrs)	1 (51 hrs)	8 (8-12 hrs)	3 **
	3	1	(47 hrs cascade)	
CH45	6 (20 hrs)	1 (72 hrs)		contaminated with sea water
CH47	7 (20 hrs)	1 (55 hrs)	50 hrs cascade	7
CH49	✓		✓	✓
CH53	7	1 (55 hrs)		6
CH55	6 (14 hrs)	1 (90 hrs)	12 (10 hrs)	4
			(80 hrs cascade)	
CH57	✓		✓	✓
CH59				various
CH61	7 (16 hrs)	2 (30 hrs)	14	1 (poor)
			(60 hrs cascade)	

* NO_x - 55 samples taken also
** NO_2 - ~6 samples taken also

3.5 Moored instruments

Six current meter stations were maintained over the fifteen month survey period. Instruments were recovered and redeployed on each of the survey cruises. Three of the moorings (B, E and F) were made up of Aanderaa and S4 current meters, while the other three (A, C and D) were bottom mounted ADCPs. In addition at four sites (A, B, C and D) moored thermistor chains were deployed during the stratification season. Recording fluorometers were also deployed at sites A and E between February and May 1989. The nominal positions of these six mooring sites are given below together with the mooring configuration. A more detailed inventory of moored instruments, including current meters, thermistor chains and fluorometers is given in Appendix 2 and Figure 2 shows the six mooring sites.

Site	Latitude	Longitude	Water Depth	Instruments
B	55° 30'N	005° 30'E	52m	S4 current meters at 15, 27 & 37m & Aanderaa current meter Thermistor chain
E	52° 41'N	002° 25'E	49m	2 S4 current meters at 20m & 35m & Aanderaa current meter Fluorometer
F	52° 37'N	003° 46'E	30m	S4 current meter at 12m & Aanderaa current meter at 7m
A	55° 30'N	000° 54'E	85m	Bottom mounted ADCP (bin size 7m) & Aanderaa current meter Thermistor chain (10 thermistors) Fluorometer
C	54° 20'N	000° 24'E	60m	Bottom mounted ADCP (bin size 7m) & Aanderaa current meter Thermistor chain (8 thermistors)
D	53° 30'N	003° 00'E	31m	Bottom mounted ADCP (bin size 5m) & Aanderaa current meter Thermistor chain (8 thermistors)

4. PROCESS STUDY CRUISES

For most process study cruises surface underway data, CTD casts and water bottle samples were taken, in the same way as on the survey cruises. Although all the sensors for the survey cruises were available, not all were calibrated for the process study cruises. Where details are available for these, they have been given in Section 2.

The major computer logged data sets can be described in this way; for the remainder of the data collected it is more straightforward to consider each topic studied. The process cruises fall into six main categories, although there is some overlap between the data collected and the processes studied. These categories are as follows:

Fronts	(Challenger 34, 36, 56 and 58)
Sand waves/Sandbanks	(Challenger 38, 40 and 42)
Plumes	(Challenger 42 and 46)
Resuspension	(Challenger 44, 52 and 60)
Air/sea exchange	(Challenger 48 and 62)
Productivity/blooms	(Challenger 50 and 54)

4.1 Fronts (nearshore, mixing, circulation)

These cruises studied the front extending from the region of Flamborough Head offshore between summer stratified water to the north and well mixed water to the south. The associated local circulation and distinctive dispersion are important to North Sea transports of all water-borne constituents. Surface underway, CTD casts and water bottle sample data were collected as detailed above. In addition, shipborne ADCP data were collected. Cruise CH56 deployed 14 current meters, including two seabed ADCPs and seven thermistor chain rigs. The ADCPs were recovered together with three thermistor chains by cruise CH56. The remainder were recovered by cruise CH58. Further details of this are given in the table of moored instruments (Appendix 2).

ARGOS drifting buoys were deployed and recovered on all four cruises as detailed below:

Cruise	Date deployed	Date recovered	No. of drifters
CH34	20 Aug 1988	21 Aug 1988	1
	20 Aug 1988	22 Aug 1988	2
	22 Aug 1988	26-27 Aug 1988	3
CH36	21 Sep 1988	26 Sep 1988	1 (recovered by gas rig)
	21 Sep 1988	27 Sep 1988	5
	21 Sep 1988	28 Sep 1988	1
CH56	10 Jul 1989	17 Jul 1989	3
	10 Jul 1989		2 (recovered by trawler)
	11 Jul 1989	18 Jul 1989	2
	11 Jul 1989	18 Jul 1989	3
CH58	09 Aug 1989	18 Aug 1989	5
	09 Aug 1989	19 Aug 1989	4

SeaSoar or UOR (undulating oceanographic recorder) surveys were undertaken on all fronts process study cruises. Deployment and recovery details are given below:

Cruise	deployed	recovered	comments
CH34	26 Aug 1988	26 Aug 1988	during aircraft overflight
CH36	17 Sep 1988	18 Sep 1988	2 legs
	21 Sep 1988	21 Sep 1988	25 mile section
	22 Sep 1988	25 Sep 1988	10 sections across front over a tidal cycle and coastal front section
	28 Sep 1988	28 Sep 1988	short section
CH56	11 Jul 1989	11 Jul 1989	towards Flamborough Head
	12 Jul 1989	12 Jul 1989	tidal cycle sections
	13 Jul 1989	13 Jul 1989	tidal cycle sections
	13 Jul 1989	14 Jul 1989	south of Outer Silver Pit
	14 Jul 1989	15 Jul 1989	cross frontal section over 2 tidal cycles
	15 Jul 1989	17 Jul 1989	to Flamborough Head, tidal cycle section
	18 Jul 1989	18 Jul 1989	Box pattern near moorings DA and DB
	19 Jul 1989	19 Jul 1989	towards mooring FC
	19 Jul 1989	21 Jul 1989	tidal cycles across frontal section
CH58	09 Aug 1989	11 Aug 1989	Outer Silver Pit front
	11 Aug 1989		10 mile section across front over tidal cycle NW flanks of Dogger Bank - towed south
	15 Aug 1989	16 Aug 1989	sections across front over a tidal cycle
	16 Aug 1989	17 Aug 1989	Flamborough Head to Dogger Bank Coastal survey close to Flamborough Head
	17 Aug 1989	18 Aug 1989	Outer Silver Pit front
	19 Aug 1989	20 Aug 1989	Silver Pit and southern flanks of Dogger Bank

Scanner images are available from aircraft flights on 26 Aug 1988 (CH34)

An OSCR (Ocean Surface Currents Radar) deployment was associated with CH34 to map surface currents.

Rhodamine dye releases:

Challenger 36 carried out two rhodamine dye releases on 22 and 25 September. The rhodamine was subsequently mapped using fluorometers. However some of the data recorded using the non-toxic water supply were corrupted when bad weather introduced bubbles into the system. Bad weather also meant that planned rhodamine dye releases from Challenger 58 were cancelled.

4.2 Sand waves & Sandbanks

The primary aims of this study were to measure the flow variations over and around sand waves and sandbanks, to measure total drag and to quantify the rate of sediment transfer under a variety of wave and tidal current conditions.

Surface underway data, CTD data and water bottle samples were taken as detailed in Section 2. Other measurements taken are described below.

Cores and grab samples:

Cruise	Comments
CH38	Bottom grab samples for sea bed grain roughness. 11 samples over 2 sand waves.
CH40	One tonne of fluorescent sand (blue) was released on the south side of Broken Bank & one tonne of fluorescent sand (yellow) to the north. 130 grab samples were subsequently taken to investigate sand movement and for grain size analysis.
CH42	Grab samples at Broken Bank (blue site & yellow site).
CH46	15 cores for benthic creatures and 21 grabs.

Shipborne ADCP measurements:

Cruise	No. of Profiles/ hours of measurement	Comments
CH38	300 profiles	2m depth bins, averaged over 2 minutes between pressure sensors
CH40	14 hours	ADCP profiles between pressure sensors
	32 hours	near STABLE deployment
CH46		ADCP between 2 current meter moorings

Bathymetry:

Cruise	Comments
CH38	sidescan sonar & echosounder survey, 80 miles mainly between pressure sensors
CH40	detailed sidescan sonar & echosounder survey both sand waves & sand banks site
CH46	brief side scan surveys

Moorings:

Cruise	Comments
CH38	2 pressure sensors deployed (42°42.5'N, 3°43.1'E; 52°37.1'N, 3°36.5'E)
CH40	2 pressure sensors recovered, deployed CH38, 27 days data. 8 current meter moorings deployed, 6 current meter moorings recovered, 2 lost, 3 bottom pressure recorders deployed, all near Broken & Well Bank
CH42	2 pressure recorders (deployed CH40) recovered, 1 lost
CH46	2 current meter moorings deployed, recovered after 3 days (6 meters), 3 pressure sensors deployed, recovered after 4 days
CH38	STABLE - failed deployment - no data
CH40	STABLE - 2 successful deployments, 3 days each, one in sandwave field near Dutch coast, the other in the Norfolk sandbank area. Instrument malfunction resulted in incomplete data.

Seabed photography was carried out during cruises CH40 and CH46. Four ARGOS drifting buoys were tracked during CH40, each was deployed for approximately 65 hours.

4.3 Plumes (Humber & Thames)

The purpose of these cruises was to characterise and model the processes controlling the transport of effluent species from large estuaries to the sea. Circuits of the plume area were made and a large suite of continuous measurements was made.

Measurements taken from the ship's automatically logged instruments include the following:

salinity
temperature
attenuance
total sediment (from transmissometer)
dissolved oxygen
chlorophyll (from calibrated fluorometer)
density anomaly
oxygen saturation
nitrate
nitrite
phosphate
silicate

In addition the following parameters were measured using the non-toxic supply:

chlorophyll (from spectrophotometry)
phaeopigment (from spectrophotometry)
total suspended matter (from actual determinations)
total mercury (unfiltered)
reactive dissolved mercury
total dissolved mercury
dissolved and particulate manganese
dissolved and particulate copper
dissolved and particulate lead
dissolved and particulate zinc
dissolved and particulate cadmium
dissolved and particulate cobolt
dissolved and particulate nickel
dissolved and particulate aluminium
dissolved chromium
dissolved and particulate iron
mass of sediment
sediment concentration
dissolved inorganic arsenic
dissolved monomethyl arsenic
dissolved dimethyl arsenic
cadmium (measured by MAFF)
lead (measured by MAFF)
copper (measured by MAFF)

Sediment cores were taken to measure the exchange of metals across the sea water interface. The number of cores and day grab samples are shown below.

Cruise	CH42	CH46	Comments
Box cores	9	15	also for benthic creatures
Day grab samples	47	21	

On cruise CH42 a sediment trap rig was deployed on 24 Dec 1988 and recovered 24 hours later.

The following on board experiments were conducted:

(1) Rates & equilibrium states of particle/water metal exchange using radiotracer techniques: water samples incubated under controlled temperature conditions following the addition of radiotracer dissolved metals.

(2) Undisturbed cores sub-sampled from box cores incubated in purpose built equipment, maintained at environmental temperature. Rates of transfer & nutrients and metals across sediment/water interface determined.

4.4 Resuspension

The objectives of the three resuspension cruises were to make time series observations of physical, sedimentological and biological properties of the sediment, suspended particle material and water at two sites in the North Sea, using a variety of moored instruments, CTD/water bottle casts, pumped sampling and sediment grabs and box cores. The two sites are: (1) northern site (N), 54° 35'N 4° 50'E, 45m depth, muddy sand, seasonally stratified water column, and (2) southern site (S), 52° 40'N, 3° 40'E, 27m depth, sand, permanently well-mixed water column. The cruises took place in January, May and September 1989.

Moored instruments were deployed and recovered at the Northern and Southern sites with a wide range of instruments on all three cruises. A brief summary of these is given below (Appendix 2 shows in detail the data collected):

Cruise	Site	No. of Moorings	Comments
CH44	N	8 moorings	Met. buoy, Waverider, STABLE, 4 current meter rigs (2 with transmissometer, 1 with tide gauge), 1 moored ADCP
CH44	S	1 mooring	1 current meter rig with transmissometer
CH52	N	3 moorings	1 current meter rig with transmissometers, thermistor chain, moored ADCP
CH52	S	8 moorings	Met. buoy, Waverider, STABLE, 4 current meter rigs (1 with transmissometers, 1 with tide gauge), 1 moored ADCP
CH60	N	9 moorings	Met. buoy, Waverider, STABLE, 4 current meter rigs (1 with transmissometers, 1 with tide gauge), 1 moored ADCP, thermistor chain (1 deployed & recovered 3 times)
CH60	S	2 moorings	1 current meter rig with transmissometers, moored ADCP

In addition sediment traps were deployed; details of these are as follows:

Cruise	Site	Type of trap	No. of samples
CH44	N	sequential	6
		large aperture	1
CH44	S	sequential	11
		large aperture	1
CH52	N	parflux	12
		large aperture	2
CH52	S	parflux	9
		large aperture	4
CH60	N	sequential	9
		parflux	9
CH60	S	sequential	9
		parflux	9

Shipborne ADCP measurements were taken as follows:

Cruise	Start date/time	End date/time	Number of profiles
CH44	1417 16 Jan 1989	2007 26 Jan 1989	1476
CH52	1348 11 May 1989	1603 23 May 1989	3371
CH60	1254 06 Sep 1989	1604 18 Sep 1989	1748

Photographs of sediment surface, grab and core samples were taken at regular station intervals within 1 nautical mile square grid (5x5 = 25 stations for photography and grab samples, 3x3 = 9 grid for box cores) surrounding each of the experimental sites as follows:

Cruise	Photography	Grab samples	Core samples
CH44	25x2 sites	25x2 sites	18 (9x2 sites)
CH52	14xS site 3xN site (abandoned due to high turbidity)	14x2 sites	18 (9x2 sites)
CH60	25	25 (S) + 12 (N)	10 (macrobenthos) 5 (chemical analysis)

Grab and core samples were taken for a variety of different measurements including:

geotechnical measurements (i.e. electrical resistivity, acoustic S-wave velocity)
grain size analysis
chemical measurements
faunal and microfaunal analysis
sediment porosity
water content/grain size
mucus content
chlorophyll a and phaeophytin content
sediment temperature
examination of macrobenthos (i.e. to assess species present and their abundance)
organic carbon content
pigment content
general observations/textural analysis (redox potential discontinuity (RPD) layer, feeding traces, rare microfauna, fecal layer, sediment structure, sediment size changes, surface topography, surface topography, presence and number of conspicuous animals, photographs used where possible)

Some sediment cores will also be used for investigating the effect of recent sediment resuspension on trace metal behaviour. Also the effects of early diagenesis will be studied on the cores from the Northern site.

Tidal cycle experiments:

Time series measurements were made over periods of 14 to 18 hours (i.e. a tidal cycle) of the water column properties. These were measured by the CTD system, water bottles, pumped water and particle settling velocity tubes. The table below shows the data collected in between CTD stations using the overside pump. Data were collected at three depths at each site, 40m, 20m and 5m at the northern site and 25m, 15m and 5m at the southern site.

Cruise	Site	No. of stations	No. of samples	Total suspended matter	Particulate organic carbon	Particulate organic nitrogen	Chlorophyll	Phaeopigment
CH44	N	16	47	47	46	46	15	6
	S	16	48	45	43	43	42	37
CH52	N	16	48	48	37	37	45	42
	S	44	133	127	72	72	100	58
CH60	N	26	78	65			60	59
	S	16	49	47			38	37

Samples were also collected for analysis of trace metals, including dissolved aluminium, and zooplankton for taxonomy and biomass.

4.5 Air-sea exchanges

The primary aims of these cruises were to measure the rate of gas exchange across the sea surface as a function of wind and sea conditions by the release of volatile tracers into the water column, to investigate the rates of dispersion and advection due to tidal and residual currents by means of the same tracer release and to investigate the biological sources of oxygen, methane, dimethyl sulphide and a suite of halocarbons in the coherent body of water marked by the tracers, with a view to obtaining budgets.

ARGOS drifting buoys were deployed and recovered on both cruises as detailed below:

Argos buoys	Cruise	Deployed	Recovered	Comments
	CH48	16 Mar 1989	18 Mar 1989	
1	CH48	18 Mar 1989	24 Mar 1989	
2	CH48	18 Mar 1989	23 Mar 1989	
3	CH48	18 Mar 1989	26 Mar 1989	
4	CH48	18 Mar 1989	24 Mar 1989	
5	CH62	08 Oct 1989	lost	
9	CH62	08 Oct 1989	18 Oct 1989	
6	CH62	08 Oct 1989	18 Oct 1989	15 Oct 1989 & redeployed
8	CH62	11 Oct 1989	18 Oct 1989	12 Oct 1989 & redeployed
Dahn buoy	CH48	16 Mar 1989	19 Mar 1989	
	CH62	08 Oct 1989	18 Oct 1989	attached to tank which had contained tracer

Tracer measurement of He_3/SF_6:

Tracer surveys: each ~24hours in duration, overside pump used for measurements, which were taken every 3 minutes (for SF_6).

On CH48, five times after release, samples were collected for He_3/SF_6 ratios, 4-5 samples of SF_6 and 1 of He_3 at each of 3 depths (2, 10 & 25m). On CH62, seven times after release 4 samples collected for He_3/SF_6 ratios, at 3 depths.

Tracer release (CH48) from RV Corystes (18 Mar 1989)

Tracer release (CH62) from RRS Challenger (8 Oct 1989)

Cruise	Start date	End date	Comment
CH48	19 Mar 1989 1300	20 Mar 1989 2200	1st tracer survey
CH48	21 Mar 1989 1800	22 Mar 1989 1038	2nd tracer survey
CH48	24 Mar 1989 2222	26 Mar 1989 0602	3rd tracer survey
CH62	10 Oct 1989 0800	11 Oct 1989 0600	1st tracer survey
CH62	12 Oct 1989 1000	13 Oct 1989 0600	2nd tracer survey
CH62	14 Oct 1989 1100	15 Oct 1989 0830	3rd tracer survey
CH62	17 Oct 1989 0250	17 Oct 1989 2300	4th tracer survey

Coastal survey for methane (CH_4) and halocarbons:

Cruise	Start date	End date	Comment
CH48	20 Mar 1989 2345	21 Mar 1989 1100	1st coastal survey
CH48	22 Mar 1989 1115	23 Mar 1989 2219	2nd coastal survey

At all CTD stations water bottle samples were taken at 2, 10 and 25m. At 17 of the sites samples were collected for methane analysis. Oxidation of methane was investigated at five sites. Analyses for dimethyl sulphide (DMS) and its cellular precursor dimethyl sulphoniopropionate (DMSp) were carried out, together with analyses for a further 12 halocarbons including methyl iodide, bromoform, methylchlorform and tetrachloromethane.

Oxygen air/sea exchange and productivity:

Cruise	Dates	Comments
CH48	19-20 and 25-26 March	oxygen evasion rates were determined by comparing in situ changes in dissolved oxygen at three depths. Samples were also collected for the determination of chlorophyll, particulate organic carbon and cell count.
	16, 18, 19 March	Three oxygen and carbon-14 incubations were carried out in order to determine potential rates of primary productivity. Picoplankton production was also determined. Bacterial production rates were also determined at several stations.
CH62		Diurnal cycle productivity over many days. Discrete oxygen samples taken from three depths from 44 CTD casts. On deck oxygen and carbon-14 incubations for four 24-hour cycles. Chlorophyll and cell number determinations were also carried out.

Also during CH62 discrete and continuous measurements of pCO_2 were made. Continuous measurements were made half hourly, together with methane determinations, for three periods of 24 hours. In addition, pCO_2 and CH_4 measurements were made during the first 24 hour period of oxygen productivity measurement and during a 19 hour survey close to the Rhine outflow. These are detailed below.

Cruise	Start date/time	Comments
CH62	08 Oct 1989 0700	1st diel survey
	11 Oct 1989 0600	2nd diel survey
	13 Oct 1989 0600	3rd diel survey
	15 Oct 1989 0520	Rhine/Scheldt estuary

4.6 Primary productivity

This process study cruise aimed to measure primary productivity and relate it to physical conditions, light, nutrients and organic fluxes. Also, the horizontal and vertical distribution and behaviour of zooplankton was studied in relation to hydrographic conditions and primary production. CTD casts, surface underway and shipborne ADCP data were collected. In addition the following measurements were made.

Undulator Tows:

Ten undulator tows were completed with plankton samples taken on four of them. Parameters measured include light, temperature, chlorophyll and depth.

Three of the tows were timed to coincide with flights of the EISAC (European Imaging Spectroscopy Campaign) Aircraft, operated by the European Space Agency and the Joint Research Centre, Ispra.

Particle characterisation - particle size measurements were made with a Coulter counter from surface and profile samples.

Primary productivity and irradiance:

An in situ light meter and carbon-14 incubation rig was deployed on eight days to determine the productivity of different size fractions of phytoplankton and the light available. In situ light was measured on seven of the incubations. The fraction of light absorbed by phytoplankton pigments, detritus and water was determined on each deployment.

The photosynthetic parameters (P_{max} and alpha) of the three size fractions of phytoplankton were measured each day in an artificial light gradient; the incorporation of the carbon-14 label into the major biochemical constituents of phytoplankton was also determined.

Zooplankton:

11 hauls resulted in a total of 411 samples as the table below illustrates. Microzooplankton samples (<20 microns) were taken on nine hauls.

Triple Longhurst Hardy Plankton Recorder Haul Information

Haul No.	Date/Time	Bottom depth	Maximum sampler	Position	No. of samples 20 microns	53 microns	200 microns
NS/1	10 Jun 1989 1225	29	26	54°00'N 06°09'E	8*	12	11
NS/2	12 Jun 1989 1320	29	24	54°06'N 08°00'E	3*	10	7
NS/3	13 Jun 1989 0040	39	36	54°08'N 07°47'E	13	13	12
NS/4	13 Jun 1989 1706	16	14	53°52'N 07°54'E	15	14	6*
NS/5	15 Jun 1989 1127	35	33	54°27'N 06°51'E	13	12	12
NS/6	15 Jun 1989 2212	36	34	54°27'N 06°51'E	13	13	13
NS/7	16 Jun 1989 1123	39	36	54°47'N 06°03'E		14	15
NS/8	17 Jun 1989 1100	46	45	55°19'N 04°55'E	17	16	17
NS/9	20 Jun 1989 1017	44	42	54°10'N 03°49'E	13*	20	18
NS/10	20 Jun 1989 2136	44	40	54°10'N 03°49'E	18	21	20
NS/11	21 Jun 1989 1153	42	40	52°42'N 02°51'E		17	5*

* loss of some samples. Jamming due to excess clogging or jelly fish.

Half of the above were preserved for species analysis, the remainder were filtered and frozen for subsequent chlorophyll & Carbon-Hydrogen-Nitrogen (CHN) analysis. Additional plankton samples taken for chemical analysis to gauge pollution load and proportion of viable phytoplankton cells and detritus content.

Larval distribution:

Sprat larvae were collected and preserved for instological/instochemical treatment, gut contents analysis, CHN determinations, growth rate, DNA/RNA ratios, gut enzyme measurements. Larval feeding experiments were carried out using turbot larvae.

4.7 Blooms/Chemistry

The primary aims were to investigate gross and net primary production during bloom conditions and to examine the relationships between primary productivity and biogeochemical cycling of certain trace metals and biogenic trace gases. In addition to the underway, CTD and water bottle measurements described in Section 2, the following measurements were carried out.

Primary productivity: Nine on-deck incubations were carried out to measure primary productivity using a combination of the radiotracer carbon-14 technique and measurements of oxygen flux; ten experiments to investigate the effects of light intensity on phytoplankton; eight experiments using an in situ incubation rig to calibrate on deck incubator. Experiments were also carried out to investigate the productivity of pico, nano and micro-phytoplankton. In addition samples were taken for the determination of bacterial and phytoplankton abundance and bionics. Nine sets of measurements were made of bacterial productivity.

Measurements of nutrients were made from the non-toxic supply at 2.5 minute intervals on 22 runs; only the nitrate data are considered reliable.

Phosphorus and alkaline phosphatase activity:- 120 samples were taken for dissolved organic phosphorus and dissolved phosphate measurements. In addition 240 samples were taken for phosphorous analysis of suspended particulate matter. Alkaline phosphatase activity was measured on board. 26 samples from CTD casts were analyzed for dissolved organic carbon.

Trace gases: Surface water samples were analyzed using gas chromatography for trace gases. DMS and DMSp (including intra and extracellular DMSp) and 16 halocarbons were detected. Experiments were carried out to investigate effects of light intensity and nutrient concentration on DMS and DMSp, examination of distribution of DMSp according to size fraction and the rate of bacterial breakdown of extracelluar DMSp. Analysis was also undertaken for methane using gas-liquid chromatography. Measurements comprised 107 surface water samples and vertical profiles at 19 stations. Shipboard incubation experiments were carried out to measure rates of bacterial methane oxidation using methane labelled with carbon-14.

Trace metals: 29 samples were taken from water bottles, Kevlar line and pumped water for particulate analysis. Also 88 filtrates were analyzed for aluminium by spectrofluorimetry. Unfiltered samples were also analyzed. Forty-one samples were taken for arsenic species analysis at Polytechnic South West and 29 replicates for analysis at Liverpool University.

Radiochemical measurements of uptake of trace metals: At each drogue deployment a 20 litre water sample was taken and incubated for 4-5 days. Nutrients were measured at 8-12 hour intervals and samples taken for chlorophyll and cell numbers. Dark and sterilised controls were incubated in parallel. Separated particulate/dissolved phases were analyzed to determine the extent of metal uptake in photosynthesis. Parallel measurements of stable metal behaviour were also made.

Drogue deployments:

Site	Deployed	Recovered	Comments
North Site	04 Apr 1989 0736	07 Apr 1989 1355	78 hrs
South Site	11 Apr 1989 0540	14 Apr 1989 1601	82 hrs

Suspended particulate material: Free drifting sediment traps with in situ incubation rigs were deployed, usually for 24 hour periods. Three were deployed at the northern site (28m from surface) and four at southern site (17m from surface). Samples were taken for carbon and nitrogen content analysis and some were frozen for trace metal analysis. Samples of water were taken for gravimetric determinations of the suspended solids concentration at each CTD station occupied while traps deployed.

Four samples of rainwater were collected as part of the program to determine atmospheric inputs of constituents in wet deposition.

5. FOLLOW UP CRUISES

5.1 Blooms - Challenger 62A

The main aims were to measure concentrations and spatial distributions of major nutrients and their influence on the formation of phytoplankton blooms, to study the historical record of eutrophication using sediment cores, to investigate the distributions of chlorophyll and particulate organic carbon and nitrogen, to study primary and bacterial productivity and to investigate the influence of benthic macrofauna on the resuspension of particulate matter. In addition to those measurements detailed in Section 2, the following measurements were made to meet these aims.

1. Continuous sampling (1400 nmiles) of nitrate, nitrite, silicate, phosphate, ammonia.
2. 56 samples for particulate carbon and nitrogen analysis, chlorophyll, dissolved organic nitrogen and phosphorus.
3. 56 surface phytoplankton productivity experiments were carried out. 52 size fractionated nitrogen assimilation and 27 phosphorus up-take experiments were carried out. 45 bacterial production estimates were made. Depth related production was investigated using an in situ incubation rig on 27 Oct (deployed 0616, recovered 1646). Methane oxidation rates were measured at 4 stations.
4. Sediment cores for microfauna investigations as detailed below.

Station	Comment
A	5 cores - for measurements see below
C	severe weather prevented coring
D	Scheldt Estuary - two cores for assess species occurrence and abundance in order to evaluate suitability of this site for further bioturbation studies
E	unsuccessful due to bottom conditions (coarse flint and shelly gravel)

Measurements carried out on cores collected at station A:

determination of water content
organic content
grain size (mucus content once appropriate method available)
pigments for evaluating the presence of diatoms, faeces, surface organic content
sediment temperature at a depth of 10cm
Observations on RPD layer
sediment structure
dead faunal remains
surface topography
presence and numbers of conspicuous animals
Remainder sieved for abundance estimates of the larger and relatively lower density macrofauna

5.2 Plumes/Resuspension - Challenger 65 and 69

These cruises continued the work of Challenger 42 and 46. Four circuits were made of the Humber plume grid on both cruises. In addition a shortened transect was completed on CH65 and a transect of the Thames plume was made on CH69. The two resuspension sites were also visited on both cruises. In addition to the usual underway, CTD and water bottle measurements described in Section 2, the following data were collected.

Data Type	CH65	CH69	Comment
Underway nutrients	1200	600	measured in nautical miles plus 24 hours on station (CH69)
Grab samples	55	40	analysis of sediment micro-organic pollutant content
Cores	12	11	for incubations & chemical fluxes
Cores/grabs		10	enumeration of benthic population
Trace metals	95	44	including hourly values from non-toxic supply (CH65)
Phytoplankton	130		
Suspended sediments	130	90	for sediment load, suspended particles, trace metals, chlorophyll, particulate organic contaminants
Primary productivity	5	5	
Macrocosm experiments	8	✓	✓ indicates an unspecified number of experiments

Grab samples and cores were taken for organic contaminant analysis, sediment/water metal and nutrient experiments and incubation experiments. Water samples were taken from the non-toxic supply and water bottles for trace metal and suspended matter analysis. Measurements were made of volatile halocarbons.

Metal particle/water distribution coefficients were determined radiochemically. Similar on board experiments were carried out on Ouse river water and coastal sea water. Incubation experiments, using large volume sea water samples dosed with radiotracer metals to investigate metal uptake during phytoplankton growth, were carried out.

5.3 Survey cruises - Challenger 66A and 72A

These cruises carried out the usual survey measurements (i.e. surface underway, CTD and water bottle samples) as detailed in Section 2. Shipborne ADCP measurements were recorded on Challenger 72A, but the instrument failed on Challenger 66A, so no data were recorded. Other measurements not detailed earlier are given below:

Moorings:

Cruise	Deployment	Recovery	Comments
CH66A	4 sea floor ADCPS 2 current meter rigs 1 thermistor chain 3 transmissometers		
		Waverider	deployed by CH60
		Sea floor ADCP	deployed by a previous cruise
CH72A	5 sea floor ADCPs		including water level recorders
	2 current meter rigs		including 4 current meters, fluorometer and transmissometer
	2 current meter rigs		including 4 current meters and transmissometer
	2 current meter rigs Waverider, Met. Buoy		2 current meters each
		1 sea floor ADCP current meter & transmissometer	

Atmospheric constituents:

Data type	Cruise	No. of samples	Comments
Atmospheric Cl, NO_3, NH_4	CH66A	11	
	CH72A	21	
Atmospheric Cl, NO_3, NH_4	CH66A	4	extraction/filter samples from Denuder tube
	CH72A	6	extraction/filter samples from Denuder tube
Nitrogen dioxide, ozone, peroxyacetylinitrate (PAN)	CH66A		continuous Scintrex analysis
	CH72A		continuous Scintrex analysis
Particle size	CH66A	1	
Rainfall	CH66A	0	no rain
Trace organic compounds	CH72A		testing new equipment, few hours only

Sea water and sediment samples were taken from water bottles and day grabs to be analyzed for reduced organic sulphur (i.e H_2S, COS, CH_3SH, CS_2, DMS, DMSp) from 11 stations collected on Challenger 66A and 5 stations from Challenger 72A.

5.4 Flux of contaminants through the Dover Straits - Challenger 66B

This cruise formed part of a study to measure the flow of contaminants entering the North Sea over a complete year. Shore based HF Radar stations, deployed from May 1990 to May 1991, will measure sea surface currents over most of the Strait. A mooring in mid-channel, instrumented with a sea floor ADCP, transmissometer and current meter, will also be maintained for one year. During the cruise surface underway data, CTD data and water bottle samples were taken as detailed in Section 2. Shipborne ADCP measurements were also made. In addition the following measurements were collected.

Filtration of 800 bottle samples provided data for determination of sediment concentrations. Some 30 measurements of settling velocities were made and 170 determinations of particle size spectra.

A total of 132 samples was taken for analysis of dissolved trace metals (including 25 samples for dissolved aluminium) and a further 107 for particulate trace metal analysis. 107 samples were taken for dissolved phosphate analysis and 80 for dissolved silicon. 40 water and 20 sediment samples were taken for analysis of dissolved and particulate organics, including saturated hydrocarbons, polynuclear aromatic hydrocarbons (PAHs), chlorinated pesticides and polychlorinated biphenols (PCBs).

The following moorings (deployed CH66A) were recovered:

3 sea floor ADCPs with water level recorders
1 sea floor ADCP with current meter
3 transmissometer and current meter moorings
2 U-shaped moorings with 3 current meters each
1 thermistor chain

1 sea floor ADCP was deployed (measurement to continue until May 1991).

Further details of moorings are given in Appendix 2

5.5 Sand waves - Challenger 72B

Challenger 72B visited the southern sand wave site and carried out the following measurements. Two pressure sensor tide gauges were deployed; these were recovered during the following cruise (CH72C) and obtained 12 days data. In addition a waverider and a current meter rig were deployed and recovered after 24 hours. Ship's radar photography was carried out concurrently with the waverider deployment. Shipborne ADCP measurements were made throughout the cruise.

5.6 Rhine plume - Challenger 72C

This formed the second half of a pilot study of the region of the North Sea which is directly influenced by the Rhine discharge. The primary aim was to obtain time series data from a mooring array in the Rhine plume (deployed by CH72A) in order to investigate the variability of the water column stratification and its influence on primary productivity and sediment resuspension. In addition to the measurements detailed in Section 2, the following were collected:

Data type	Comment
Moorings	moorings deployed on CH72A and CH72B recovered
Shipborne ADCP	continuous data collection
Nutrients	nitrate, phosphate and silicate at up to 6 depths at 50 stations
Halocarbons	20 stations
Trace metals	20 stations
Rhodamine dye expt.	~100 samples taken in support of a survey carried out by RV Holland

6. BACKGROUND DATA

6.1 AVHRR

Advanced very high resolution images of the North Sea are available where clear conditions prevailed.

6.2 River discharge

Daily mean discharges (m3/s) from Norway, Germany (Elbe), the Netherlands (Rhine) and the UK. The Rhine data covers the period 1960-1990. The UK data covers mostly the 2 year period 1988-1989 and is adjusted to give total runoff at the coast. In addition, for the east coast of the UK, mean monthly flows between 1960 and 1990 are available.

6.3 Water quality

Fortnightly measurements from UK rivers from 1980-1989. Also some data for the Elbe and Rhine for 1988.

6.4 Meteorological data

UK Met. Office atmospheric model gridded (~75km) data, covering the European Shelf, at 3 hourly intervals including surface pressure and winds, rainfall, cloud cover, heat flux, air temperature and sea surface temperature.

6.5 Wave data

UK Met. Office wave model gridded (~25km) data, covering the shelf, at 3 hourly intervals. Significant wave height, period and direction; swell height, period and direction; wind sea height, period and direction.

6.6 Surge and tide data

POL storm surge model products of tide and surge elevations and depth mean currents at hourly intervals covering the shelf on a 35km grid.

6.7 Coastal sea level measurements

UK data available; other European data being sought.

6.8 Air mass trajectories

Air mass back trajectories for a 48 hour period every 12 hours for all survey cruises.

6.9 Monthly 3 dimensional distributions of temperature and salinity

A joint effort by POL and the Institut fur Meereskunde (IfM), Hamburg has produced a set of distributions describing the 3 dimensional variation in temperature and salinity through the seasonal cycle. The North Sea area has been covered by IfM, the rest of the northwest European shelf by POL. The final datasets, covering the shelf, contain approximately 35,000 values each and have a resolution 0.2 degrees latitude by 0.33 degrees longitude in the horizontal and up to 12 vertical levels.

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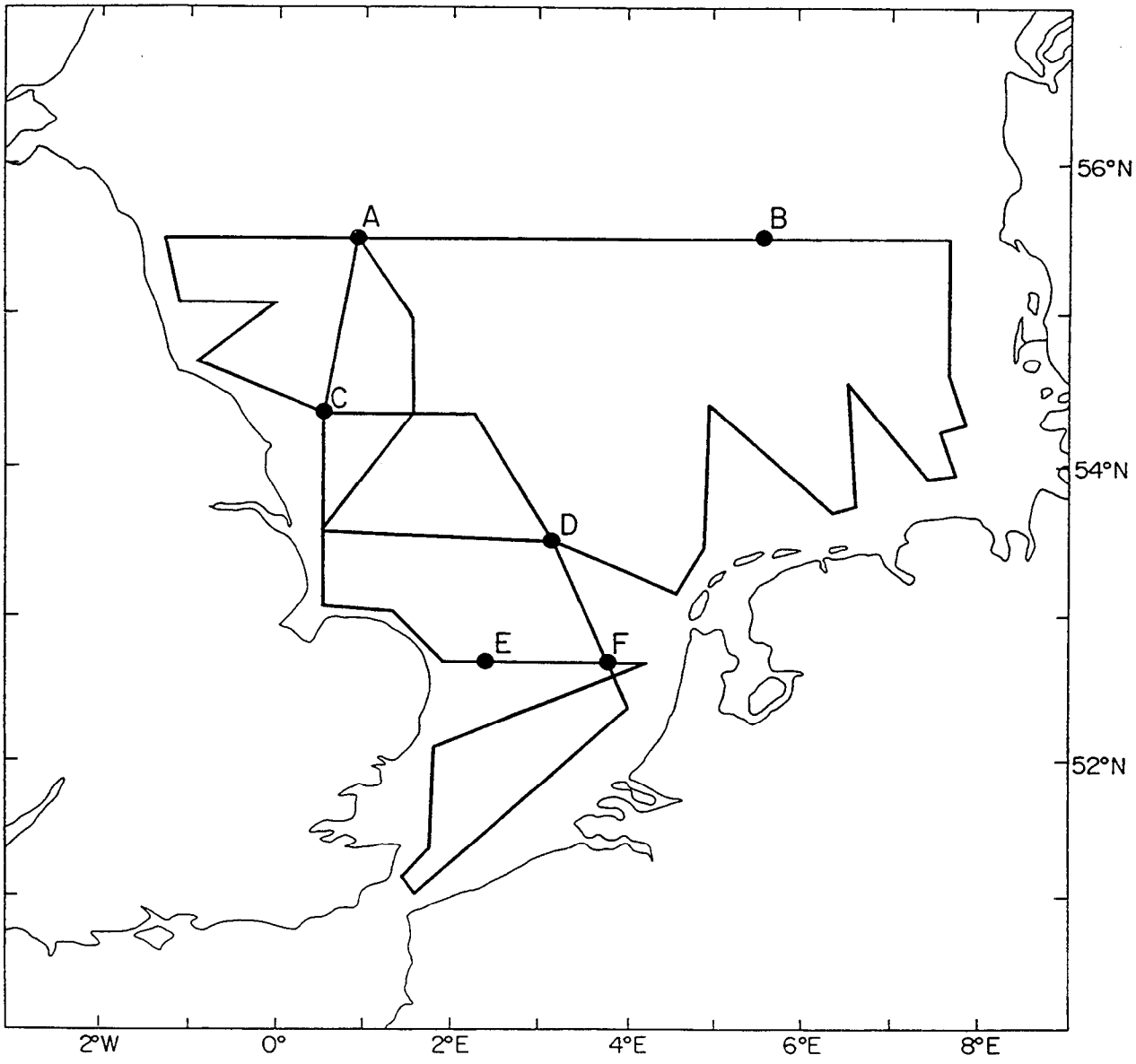
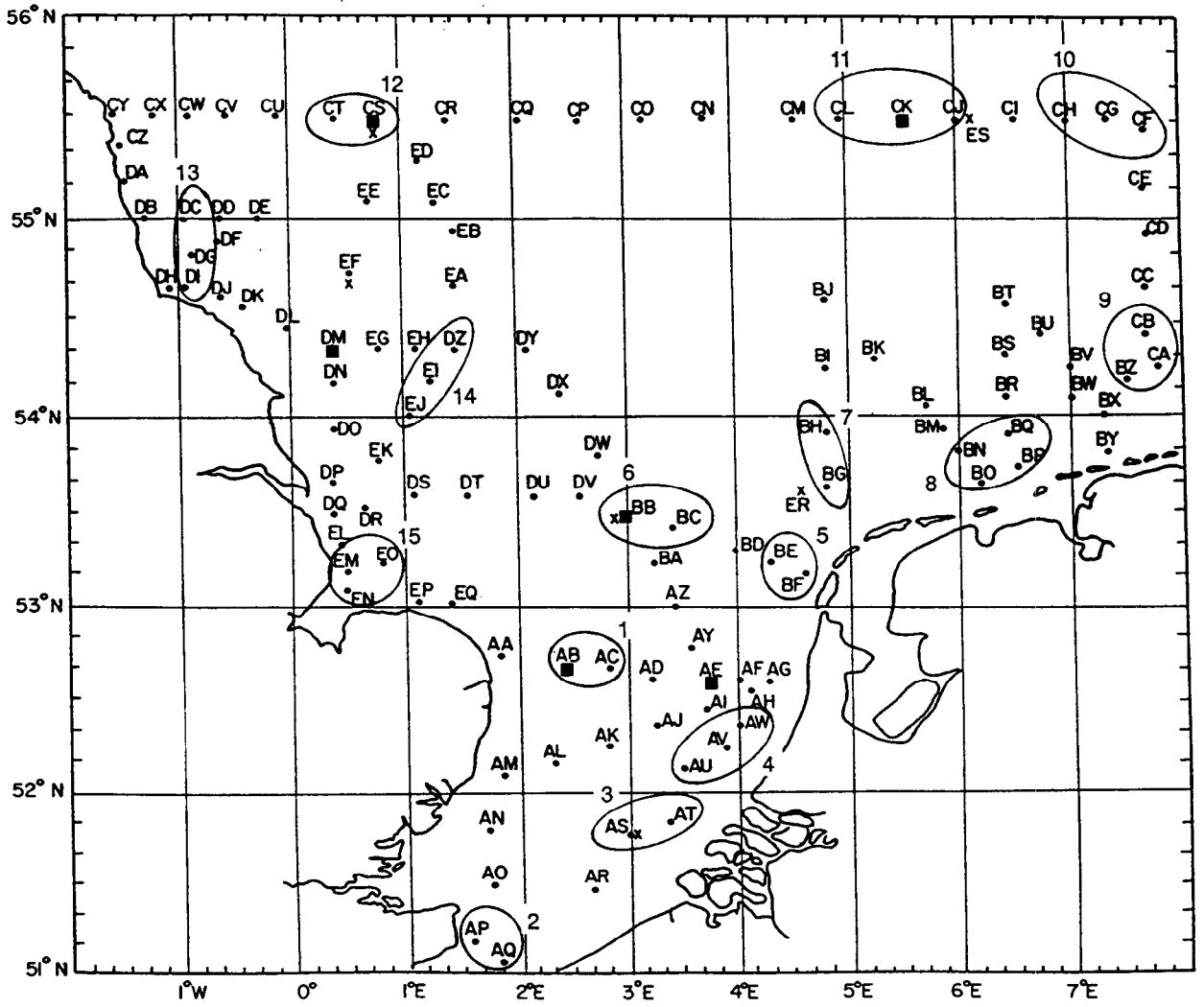


Figure 1. North Sea Survey cruise track.



● CTD

■ CTD & mooring

× core

Phytoplankton sampling areas

Mooring

A at CS

B at CK

C at DM

D at BB

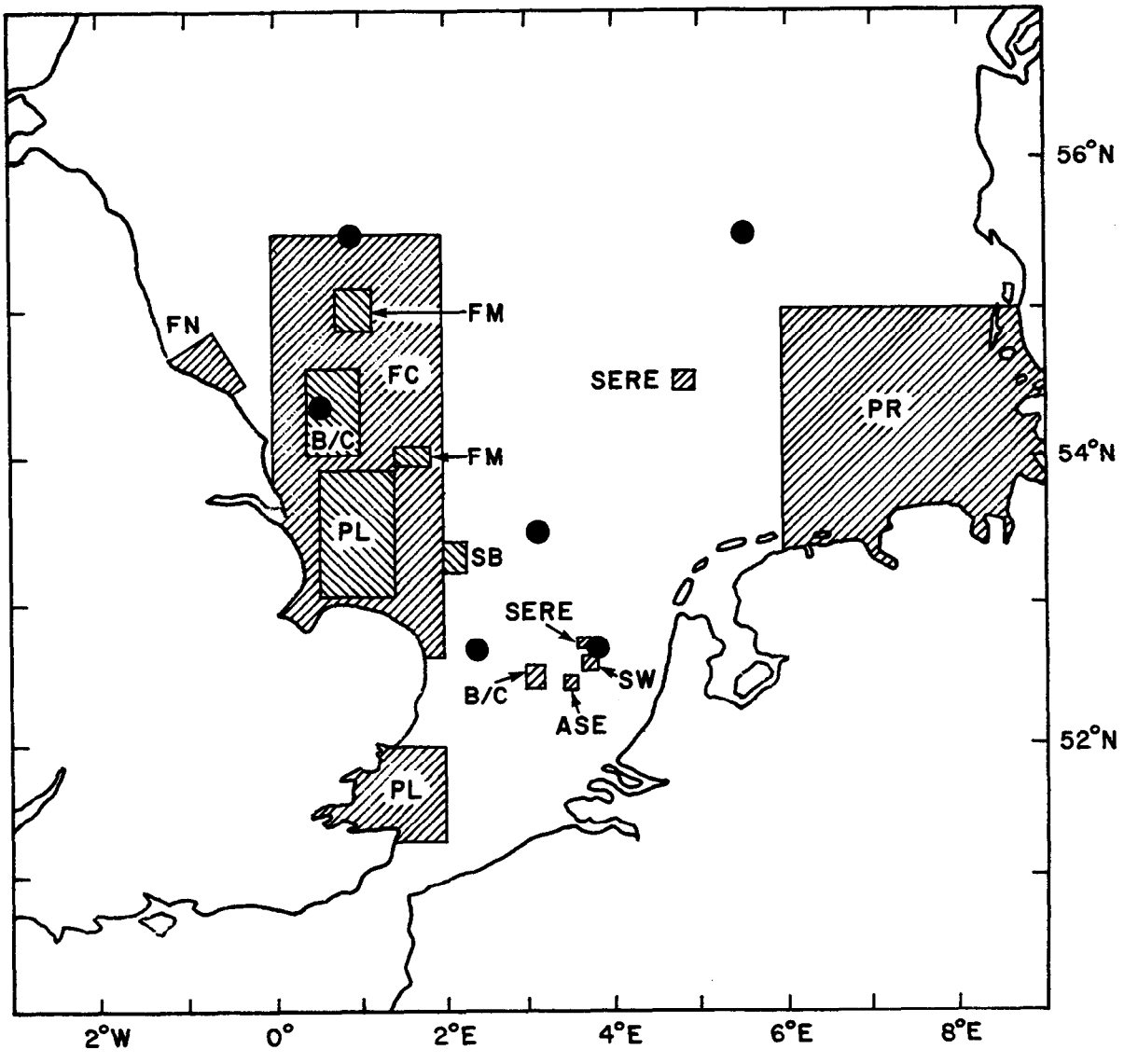
E at AB

F at AE

Figure 2. North Sea Survey station positions plus mooring sites, coring sites and key areas of phytoplankton study

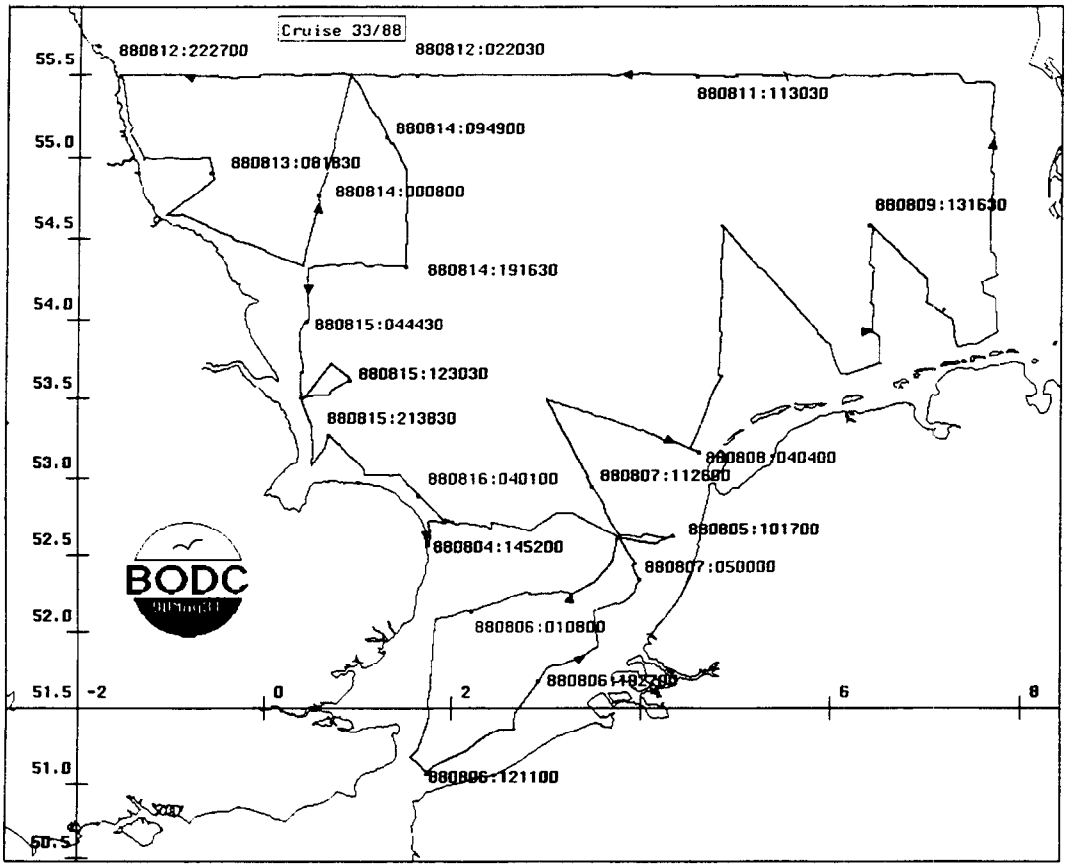
APPENDIX 1

Process cruise locations, cruise tracks for Shakedown and Survey cruises



Process cruise locations

FN	Fronts - nearshore	SERE	Sediment resuspension
FC	Fronts - circulation	PL	Plumes
FM	Fronts - mixing	ASE	Air-sea exchange
SW	Sandwaves	B/C	Blooms/chemistry
SB	Sandbanks	PR	Production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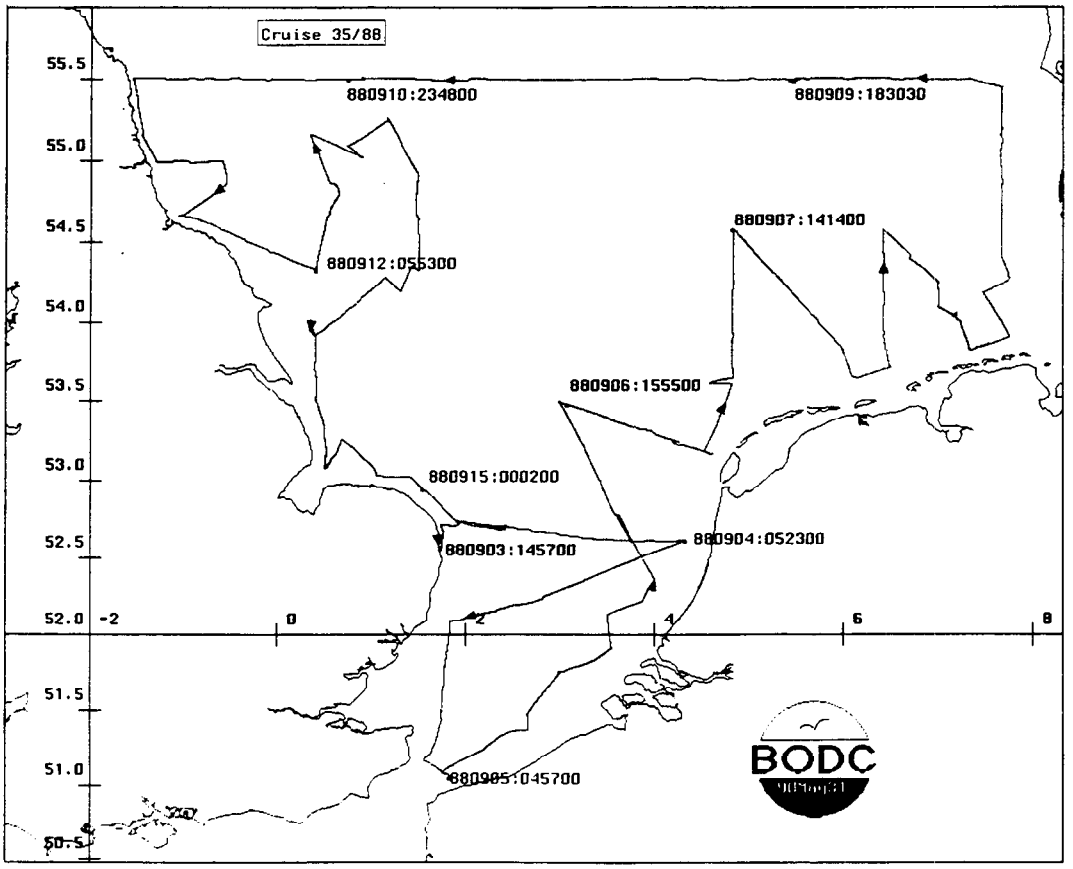
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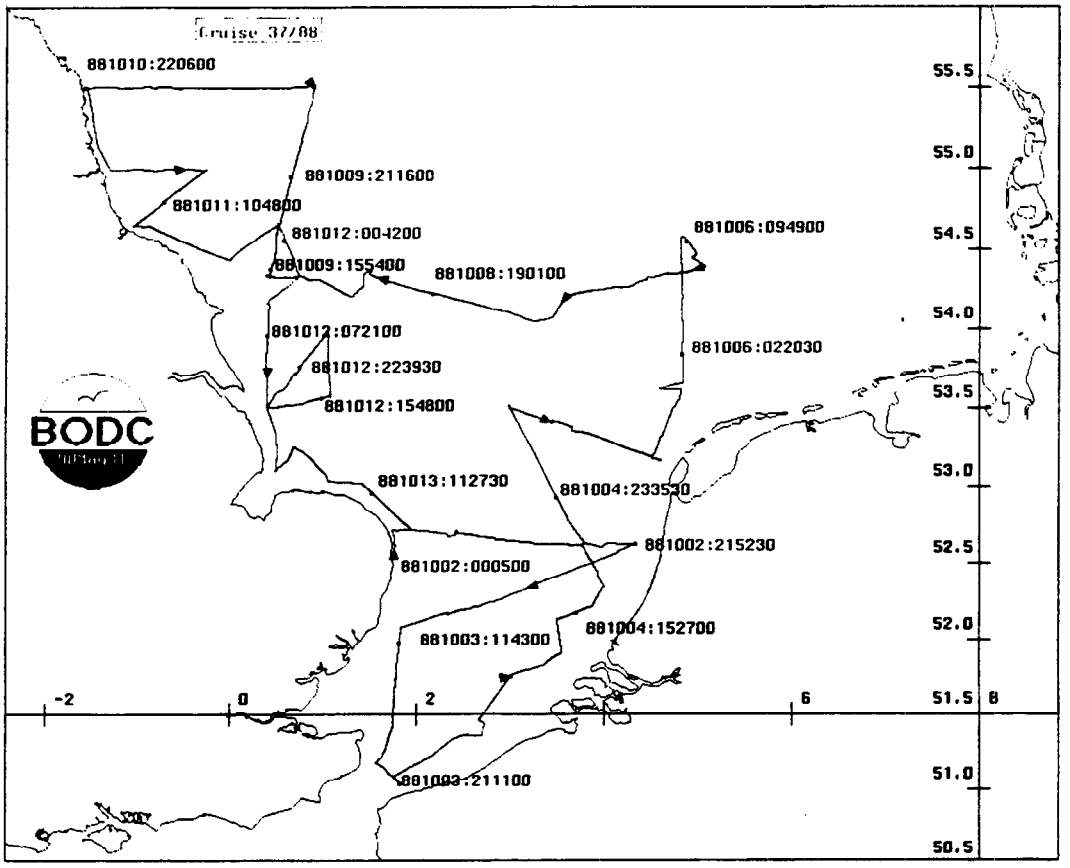
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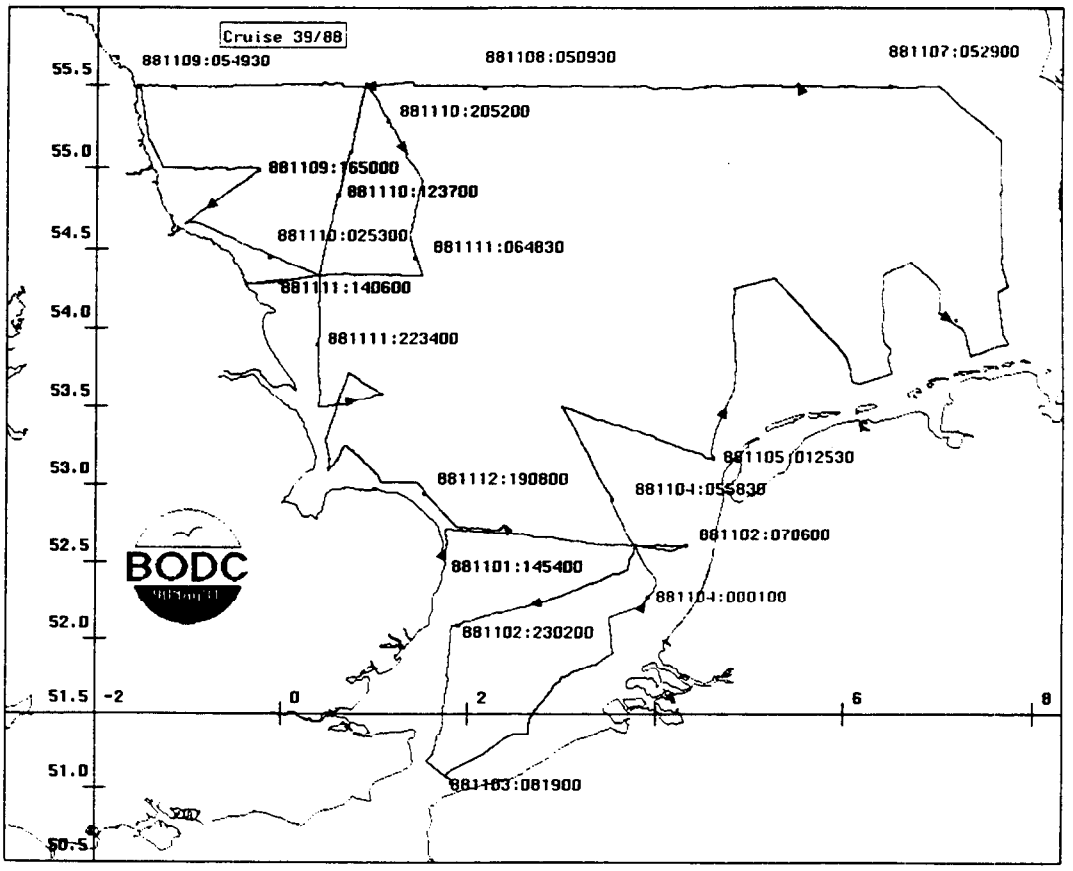
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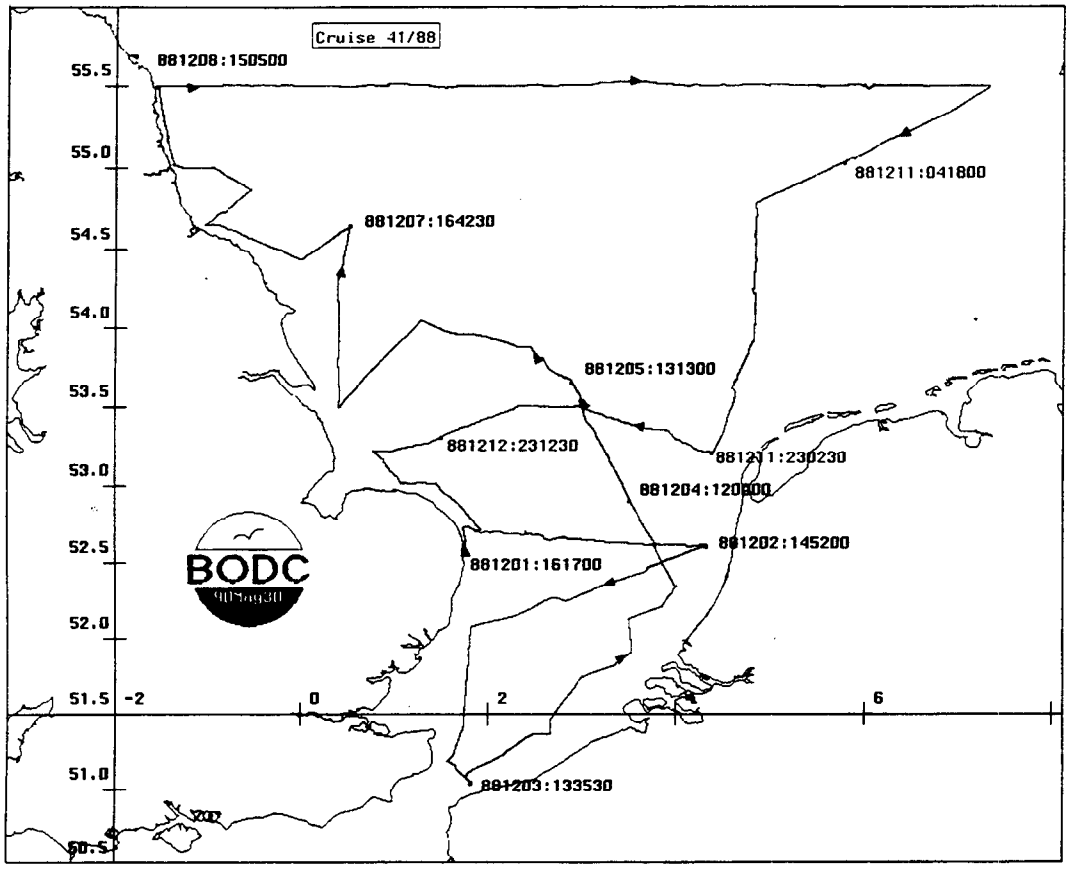
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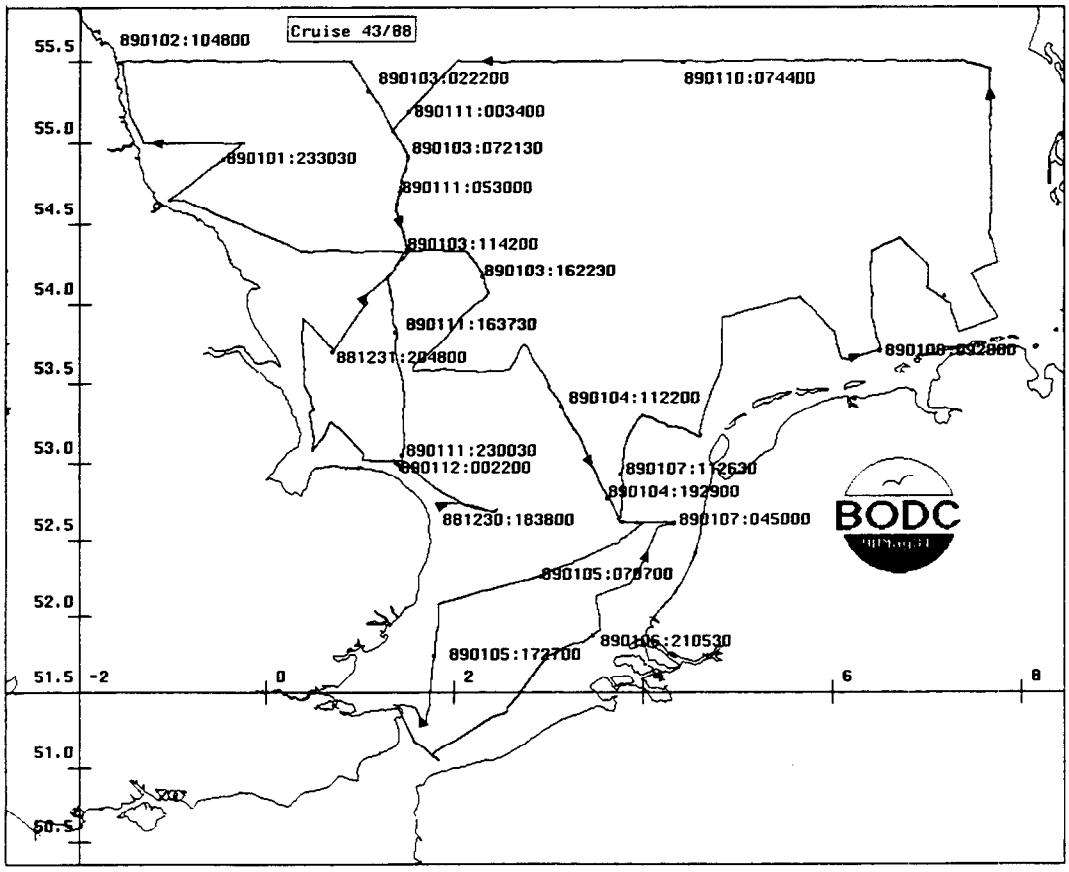
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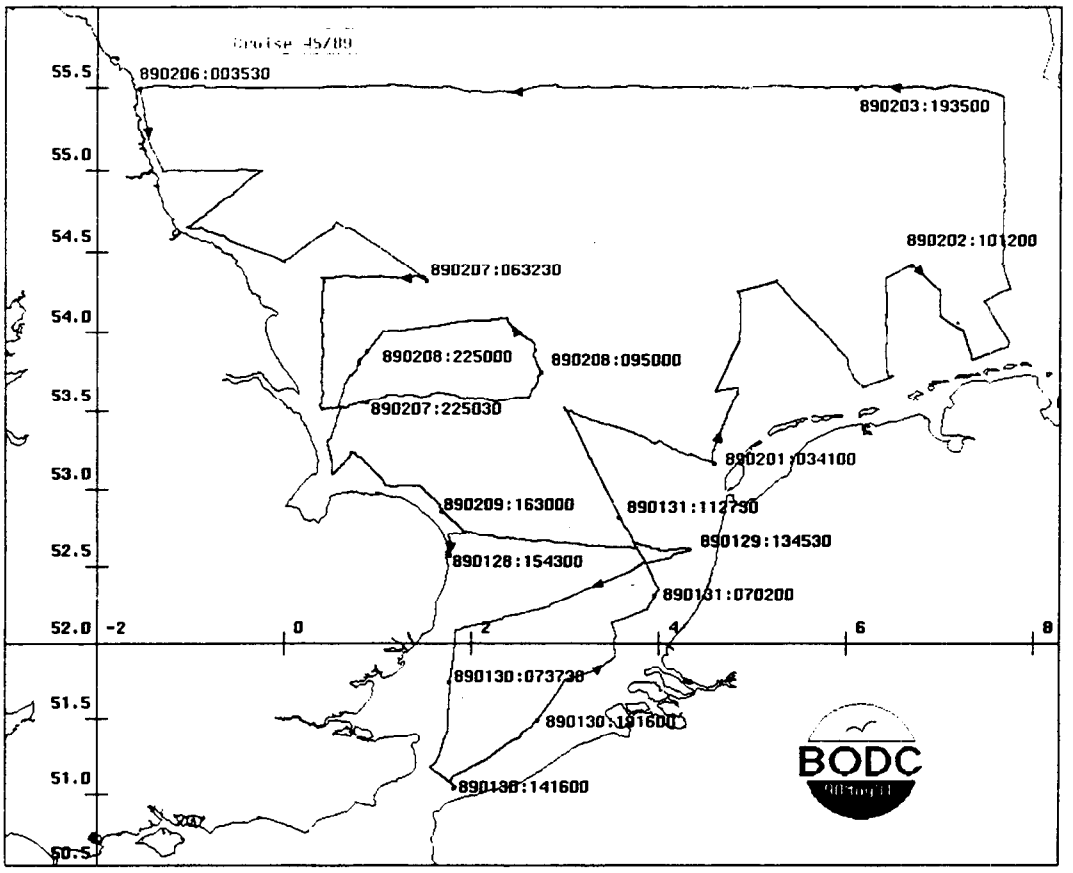
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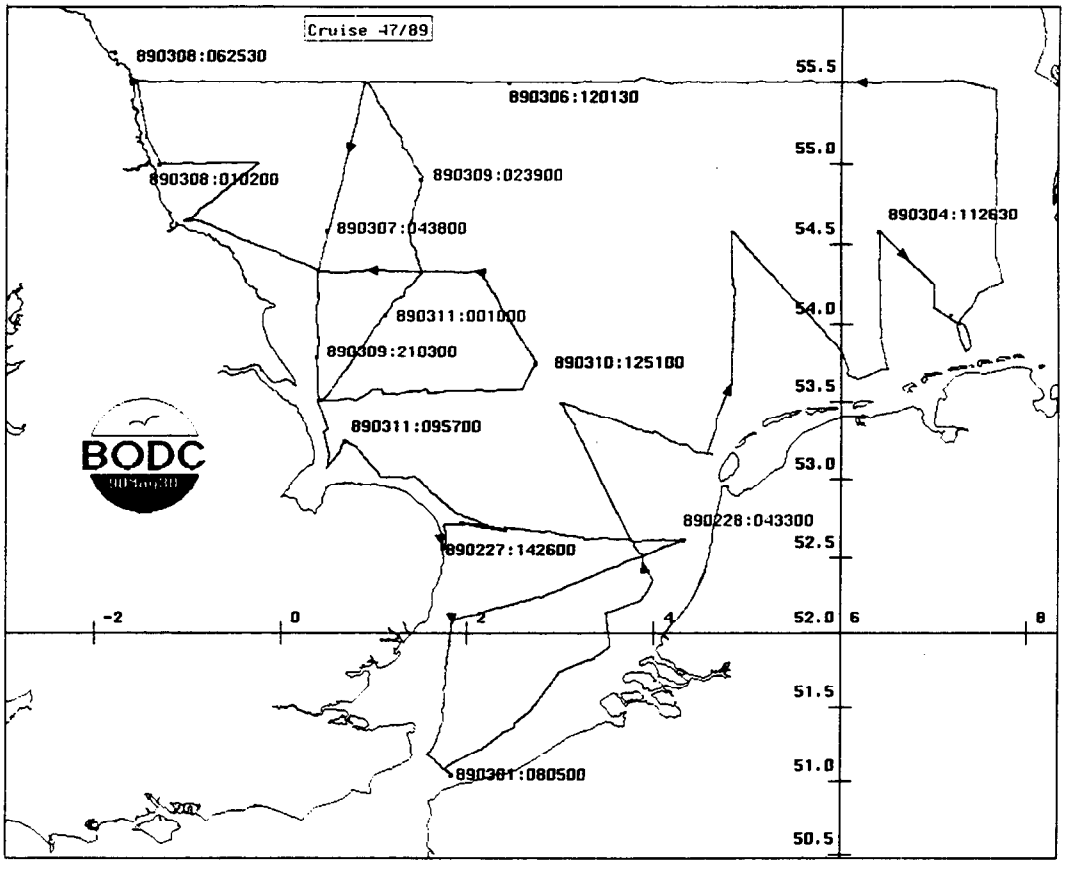
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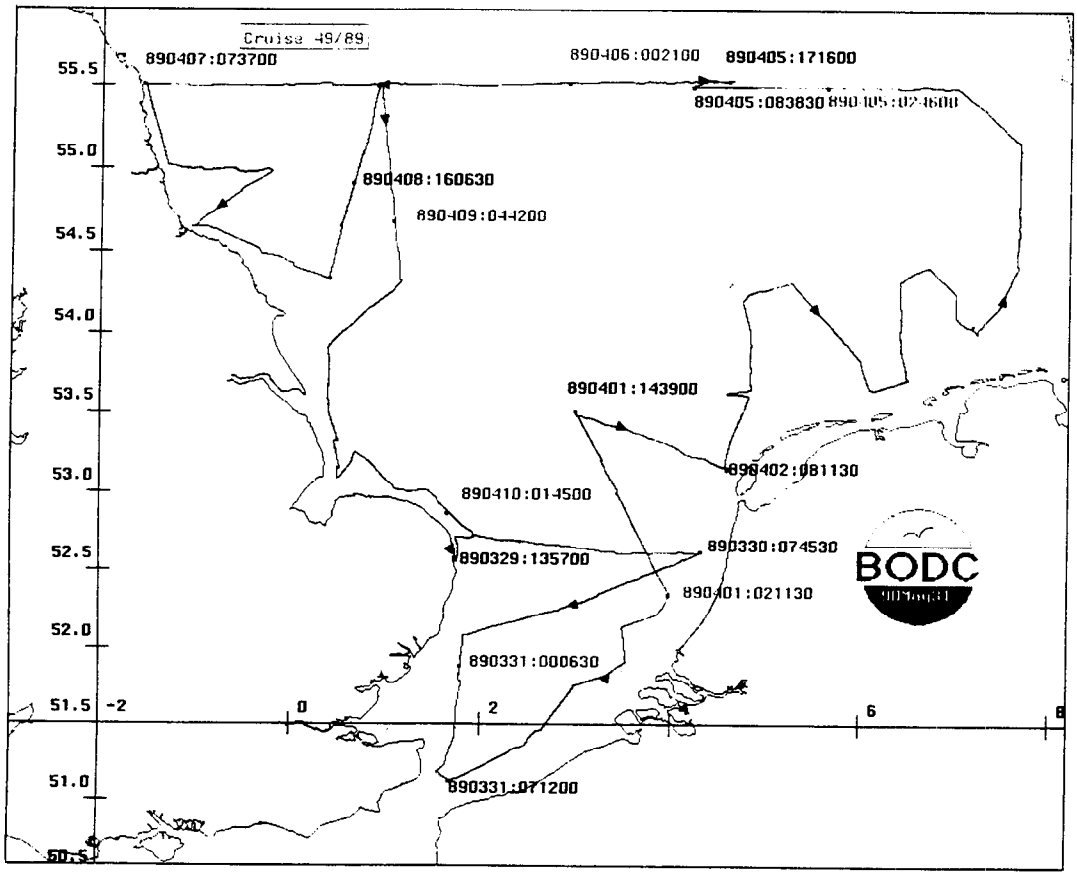
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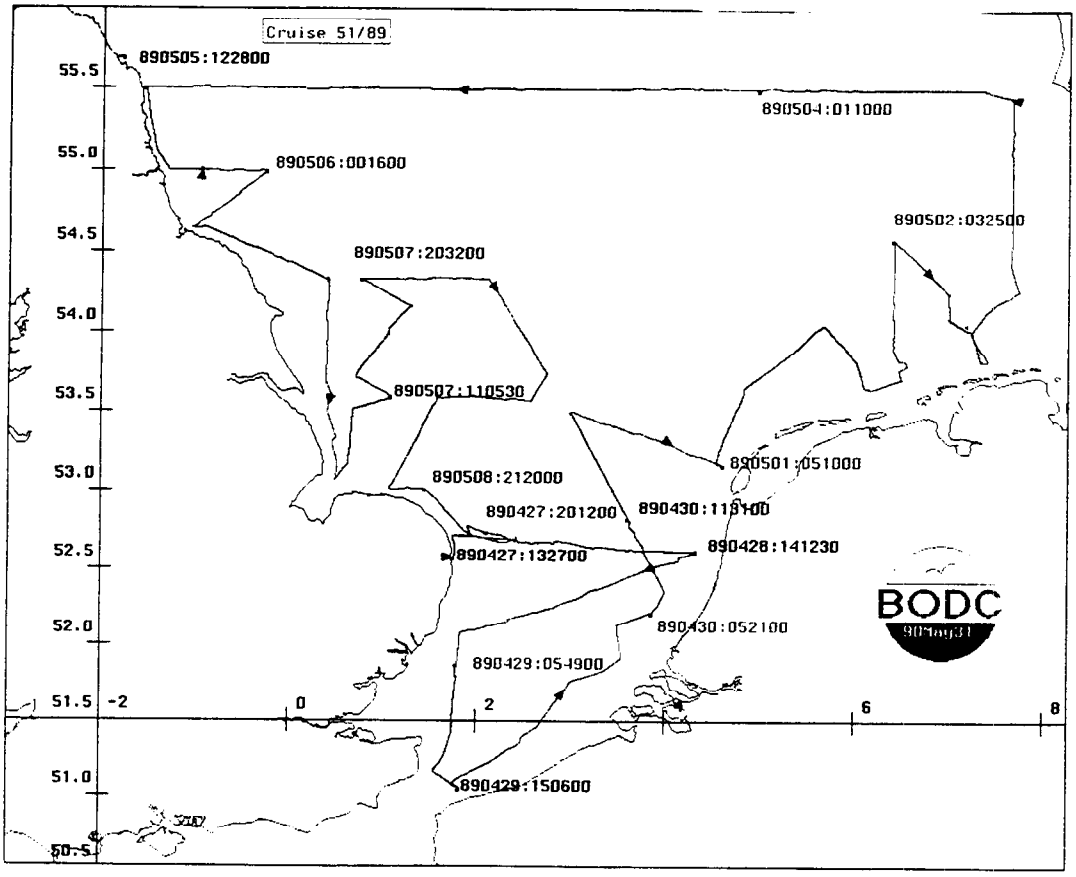
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890502:032500
890507:203200
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890508:212000
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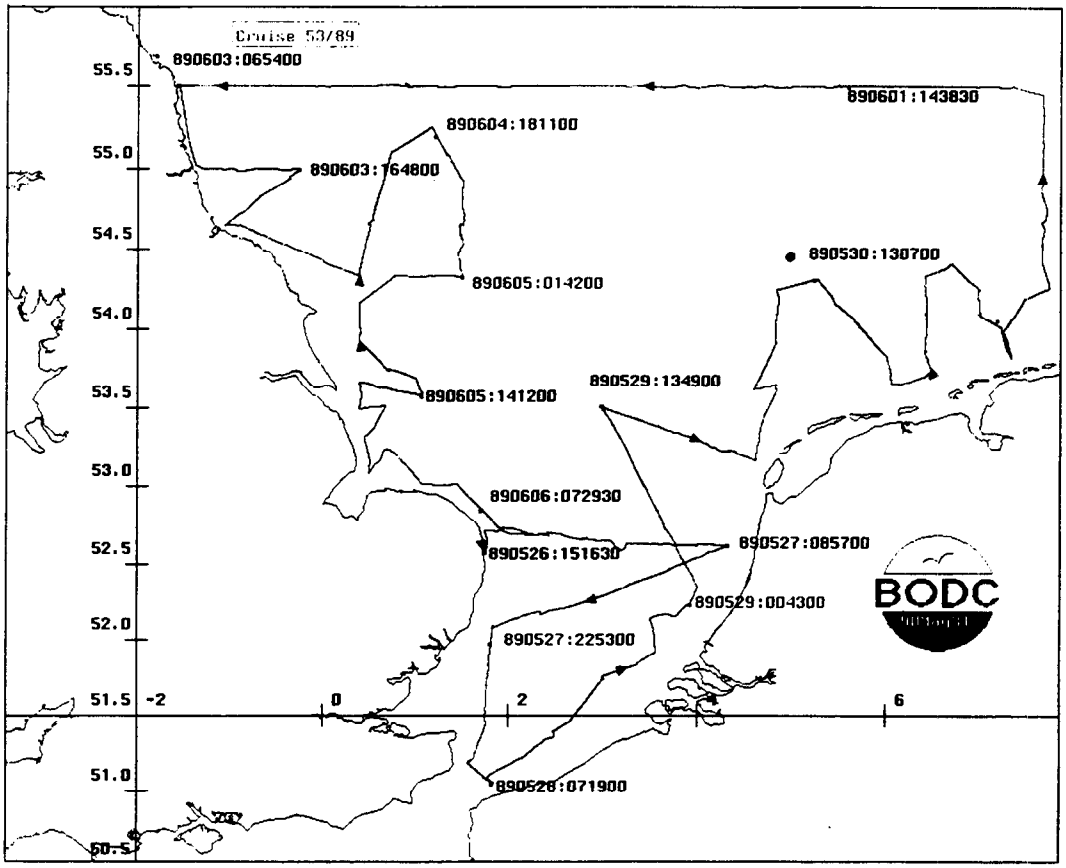
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890603:164800
890530:130700
890605:014200
890605:141200
890529:134900
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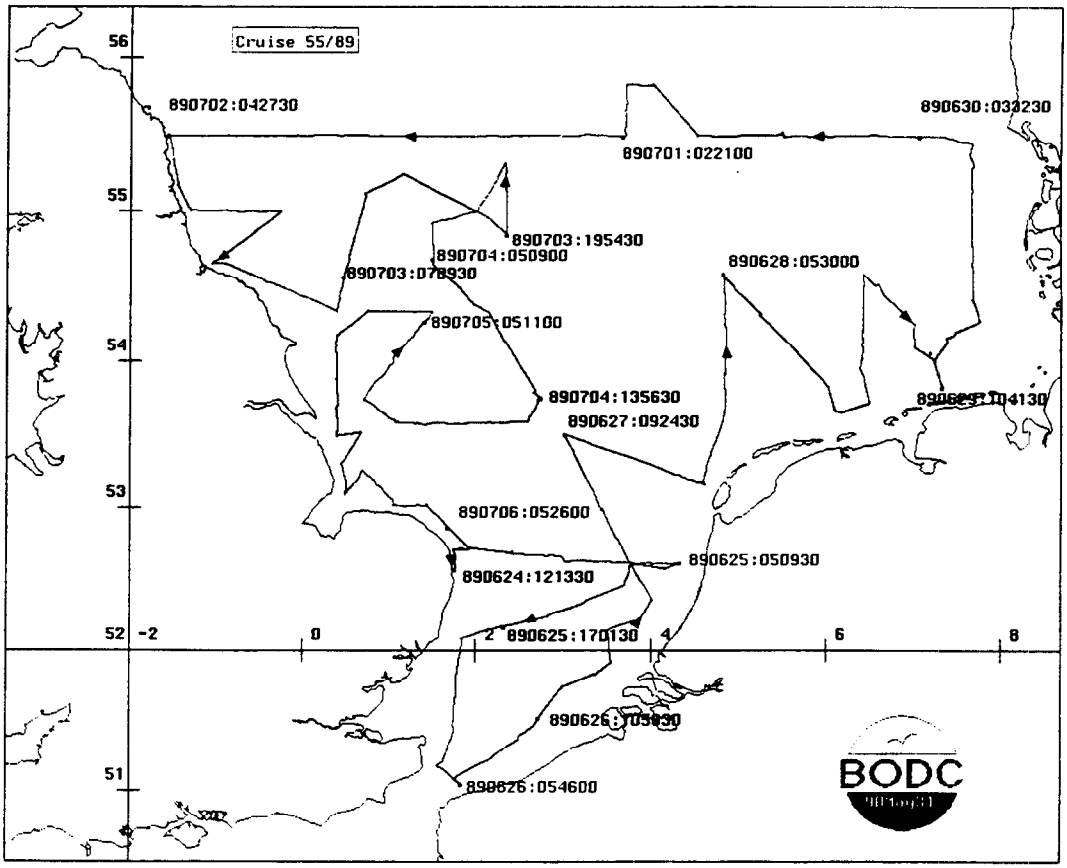
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890630:032230
890701:022100
890703:195430
890704:050900
890703:070930
890628:053000
890705:051100
890704:135630
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890706:052600
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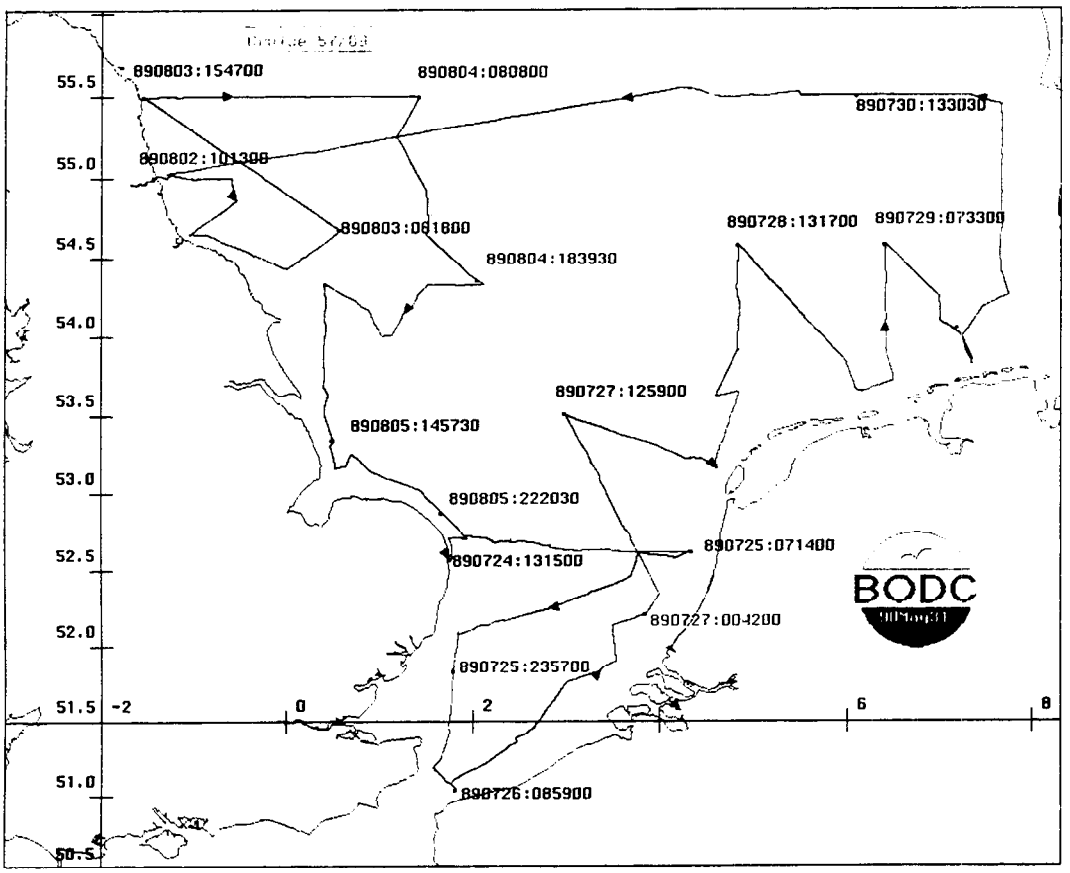
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890804:183930
890727:125900
890805:145730
890805:222030
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890727:004200
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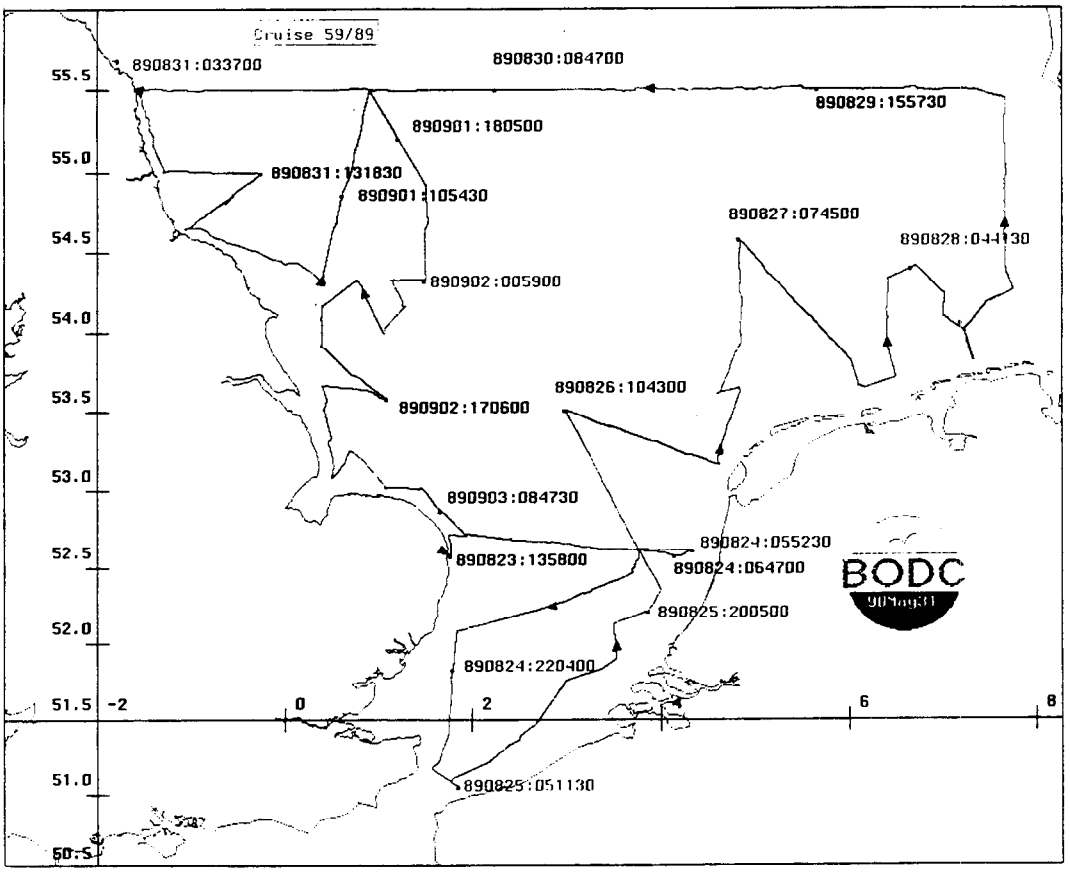
Cruise 59/89
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890901:180500
890831:131830
890901:105430
890827:074500
890828:044130
890902:005900
890826:104300
890902:170600
890903:084730
890824:055230
890823:135800
890824:064700
890825:200500
890824:220400
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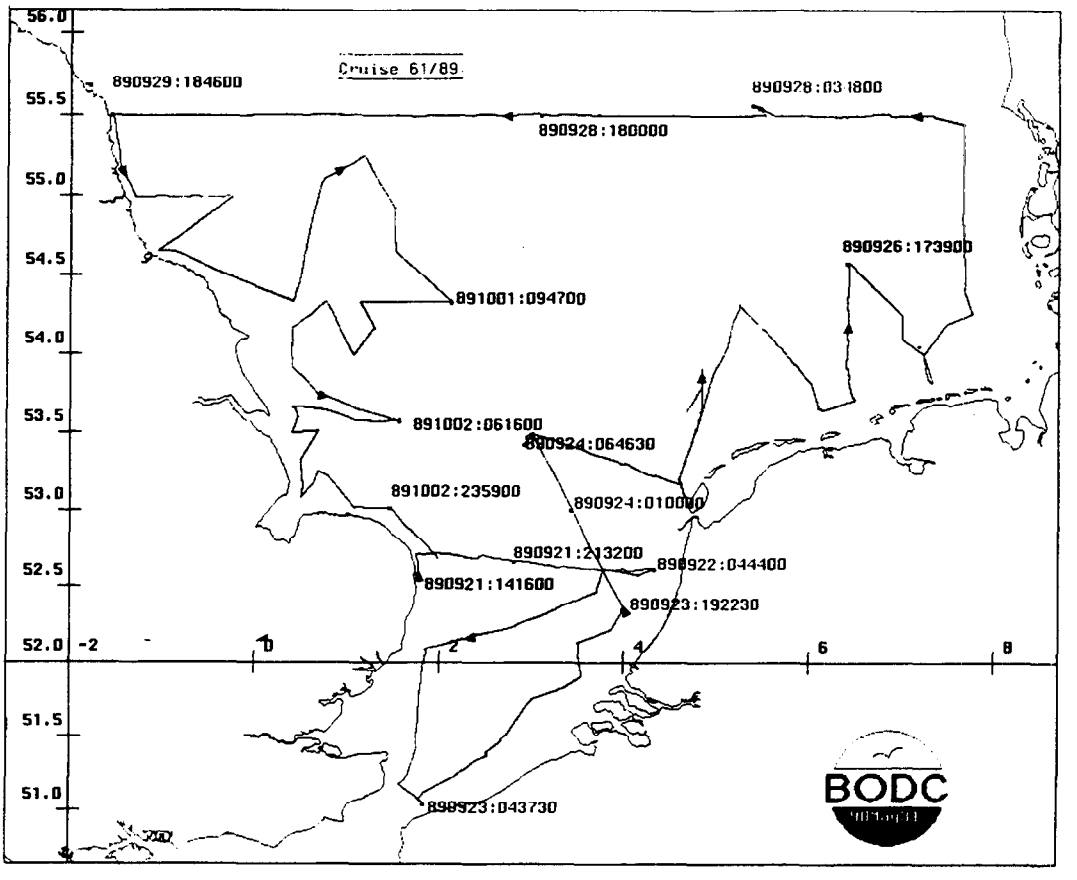
Cruise 61/89
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891002:235900
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APPENDIX 2

Moored Instrument Inventory

INSTRUMENT CODE	DESCRIPTION
ADCP	MOORED ACOUSTIC DOPPLER CURRENT PROFILER
CMD	CURRENT METER
FLUOR	MOORED FLUOROMETER
MET	METEOROLOGICAL BUOY
PRES	BOTTOM PRESSURE RECORDER
STABLE	STABLE
SEDT	SEDIMENT TRAP
THCH	THERMISTOR CHAIN
T/S	TEMPERATURE AND SALINITY RECORDER
TRANS	MOORED TRANSMISSOMETER
WAVE	WAVERIDER BUOY

PARAMETER	DESCRIPTION
B	OPTICAL BACKSCATTER
C	CONDUCTIVITY
F	FLUORESCENCE
M	METEOROLOGICAL PARAMETERS
P	PRESSURE
S	SALINITY
T	TEMPERATURE
U	UNDERWATER PHOTOGRAPHY
V	CURRENT VELOCITY (ie.SPEED AND DIRECTION)
W	WAVE PARAMETERS
X	TRANSMITTANCE

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH28	52 30.0N	02 25.0E	50		29-APR-88	13	T	7895	PNSP/NSHAKEDOWN/R1	THCH	E	AB
CH28	52 30.0N	02 25.0E	31		29-APR-88		NO DATA	7898	PNSP/NSHAKEDOWN/R3	CMD	E	AB
CH28	52 30.0N	02 25.0E	31		29-APR-88		NO DATA	7897	PNSP/NSHAKEDOWN/R3	CMD	E	AB
CH28	52 30.0N	02 25.0E	31		29-APR-88	13	VT	7899	PNSP/NSHAKEDOWN/R3	CMD	E	AB
CH28	52 30.0N	02 25.0E	31	50	29-APR-88	13	V	7896	PNSP/NSHAKEDOWN/R2	ADCP	E	AB
CH33	52 42.9N	02 25.3E	49	35	04-AUG-88	41	V	7845	PNSP/SE/MT,M1115	CMD	E	AB
CH33	52 42.9N	02 25.3E	49	20	04-AUG-88	41	V	7846	PNSP/SE/MM,M1116	CMD	E	AB
CH33	52 42.9N	02 25.3E	49	7	04-AUG-88	41	VCPT	7847	PNSP/SE/MB,M9353	CMD	E	AB
CH33	52 36.7N	03 45.2E	30	12	05-AUG-88	31	V	7848	PNSP/SF/MT,M1117	CMD	F	AE
CH33	52 36.7N	03 45.2E	30	7	05-AUG-88	31	VCPT	7849	PNSP/SF/MB,M9348	CMD	F	AE
CH33	53 29.7N	02 59.9E	31	1	07-AUG-88	29	T	7844	PNSP/SD,M1608,H-26	THCH	D	BB
CH33	53 30.0N	03 00.0E	31		07-AUG-88	29	V	7842	PNSP/SD,MPD03	ADCP	D	BB
CH33	53 30.0N	03 00.0E	31	1	07-AUG-88	29	CT	7843	PNSP/SD/MA,M6443	CMD	D	BB
CH33	55 30.0N	05 30.7E	52	37	11-AUG-88	29	V	7834	PNSP/SB/MT,M1112	CMD	B	CK
CH33	55 30.0N	05 30.7E	52	27	11-AUG-88	29	V	7835	PNSP/SB/MMT,M1113	CMD	B	CK
CH33	55 30.0N	05 30.7E	52	15	11-AUG-88	29	V	7836	PNSP/SB/MMB,M1114	CMD	B	CK
CH33	55 30.0N	05 30.7E	52	7	11-AUG-88	29	VCPT	7837	PNSP/SB/MB,M9347	CMD	B	CK
CH33	55 30.4N	05 31.3E	52	7	11-AUG-88	29	T	7838	PNSP/SB,M1610,H-47	THCH	B	CK
CH33	55 30.0N	00 54.0E	85		12-AUG-88	29	V	7831	PNSP/SA,MPD02	ADCP	A	CS
CH33	55 30.0N	00 54.0E	85	1	12-AUG-88	29	CPT	7832	PNSP/SA/MA,M7570	CMD	A	CS
CH33	55 30.4N	00 53.9E	85	25	12-AUG-88	29	T	7833	PNSP/SA,M1612,H-75	THCH	A	CS
CH33	54 19.9N	00 24.0E	60	15	13-AUG-88	29	T	7841	PNSP/SC,M1609,H-55	THCH	C	DM
CH33	54 19.9N	00 24.2E	59		13-AUG-88	29	V	7839	PNSP/SC,MPD01	ADCP	C	DM
CH33	54 19.9N	00 24.2E	59	1	13-AUG-88	29	CT	7840	PNSP/SC/MA,M4387	CMD	C	DM
CH35	52 36.5N	03 45.2E	30	12	06-SEP-88	26	V	7685	PNSP/SF/MT,M1121	CMD	F	AE
CH35	52 36.5N	03 45.2E	30	7	06-SEP-88	26	VCPT	7686	PNSP/SF/MB,M9348	CMD	F	AE
CH35	53 30.0N	02 59.7E	31		06-SEP-88	28	V	7676	PNSP/SD,MPD05	ADCP	D	BB
CH35	53 30.0N	02 59.7E	31	1	06-SEP-88	28	CPT	7948	PNSP/SD/MA,M1509	CMD	D	BB
CH35	53 30.0N	02 59.9E	31	3	06-SEP-88	28	T	7678	PNSP/SD,M1608,H-28	THCH	D	BB
CH35	55 30.2N	05 30.5E	52	5	09-SEP-88	58	T	7693	PNSP/SB,M10L+1610C	THCH	B	CK
CH35	55 29.9N	00 54.1E	85		10-SEP-88	29	V	7669	PNSP/SA,MPD04	ADCP	A	CS
CH35	55 29.9N	00 54.1E	85	1	10-SEP-88	29	CT	7947	PNSP/SA/MA,M6443	CMD	A	CS
CH35	55 29.9N	05 30.4E	52	37	10-SEP-88	58	V	7689	PNSP/SB/MT,M1120	CMD	B	CK
CH35	55 29.9N	05 30.4E	52	27	10-SEP-88	58	V	7690	PNSP/SB/MMT,M1119	CMD	B	CK
CH35	55 29.9N	05 30.4E	52	15	10-SEP-88	58	V	7691	PNSP/SB/MMB,M1118	CMD	B	CK
CH35	55 29.9N	05 30.4E	52	7	10-SEP-88	58	VCPT	7692	PNSP/SB/MB,M9069	CMD	B	CK
CH35	55 30.5N	00 53.6E	85	30	10-SEP-88	29	T	7671	PNSP/SA,M1612,H-80	THCH	A	CS
CH35	54 20.1N	00 23.9E	60	18	12-SEP-88	26	T	7675	PNSP/SC,M1611,H-58	THCH	C	DM
CH35	52 42.6N	02 25.7E	49	35	15-SEP-88	17	V	7679	PNSP/SE/MT,M1117	CMD	E	AB
CH35	52 42.6N	02 25.7E	49	20	15-SEP-88	17	V	7680	PNSP/SE/MM,M1114	CMD	E	AB
CH35	52 42.6N	02 25.7E	49	7	15-SEP-88	17	VCPT	7681	PNSP/SE/MB,M9347	CMD	E	AB
CH36	54 20.6N	00 23.7E	59		18-SEP-88	20	V	7673	PNSP/SC,MPD01	ADCP	C	DM
CH36	54 20.6N	00 23.7E	59	1	18-SEP-88	20	CPT	7949	PNSP/SC/MA,M7570	CMD	C	DM
CH37	52 42.6N	02 25.7E	49	35	02-OCT-88		VT	7682	PNSP/SE/MT,M1116	CMD	E	AB
CH37	52 42.6N	02 25.7E	49	20	02-OCT-88		VT	7683	PNSP/SE/MM,M1115	CMD	E	AB
CH37	52 42.6N	02 25.7E	49	7	02-OCT-88		VCPT	7684	PNSP/SE/MB,M9353	CMD	E	AB
CH37	52 36.9N	03 46.1E	30	12	04-OCT-88	28	V	7687	PNSP/SF/MT,M1121	CMD	F	AE
CH37	52 36.9N	03 46.1E	30	7	04-OCT-88	28	VCPT	7688	PNSP/SF/MB,M9348	CMD	F	AE
CH37	53 29.9N	02 59.8E	31		05-OCT-88		V	7677	PNSP/SD,MPD6	ADCP	D	BB
CH37	53 29.9N	02 59.8E	31	1	05-OCT-88		V	8101	PNSP/SD/MA,M4387	CMD	D	BB
CH37	54 20.0N	00 24.2E	61		09-OCT-88	30	V	7674	PNSP/SC,MPD05	ADCP	C	DM
CH37	54 20.0N	00 24.2E	61	1	09-OCT-88	30	CPT	7951	PNSP/SC/MA,M1509	CMD	C	DM
CH37	55 30.3N	00 54.3E	80		10-OCT-88	29	V	7670	PNSP/SA,MPD03	ADCP	A	CS
CH37	55 30.3N	00 54.3E	80	1	10-OCT-88	29	CPT	7950	PNSP/SA/MA,M7570	CMD	A	CS
CH37	55 30.8N	00 54.3E	85	30	10-OCT-88	29	T	7672	PNSP/SA,M1612,H-80	THCH	A	CS
CH38	52 37.1N	03 38.5E			29-OCT-88	27	P		PNSP/POL,SOUTH	PRES		
CH38	52 42.5N	03 43.1E			29-OCT-88	27	P	8386	PNSP/POL,NORTH	PRES		
CH39	52 37.0N	03 45.9E	30	12	02-NOV-88	29	V	7955	PNSP/SF/MT,M1117	CMD	F	AE
CH39	52 37.0N	03 45.9E	30	7	02-NOV-88	29	VCPT	7956	PNSP/SF/MB,M9347	CMD	F	AE
CH39	53 29.8N	02 59.9E	31		04-NOV-88	37	V	8102	PNSP/SD,MPD04	ADCP	D	BB
CH39	53 29.8N	02 59.9E	31	1	04-NOV-88	37	CT	7954	PNSP/SD/MA,M6443	CMD	D	BB
CH39	55 30.2N	05 30.3E	52	37	07-NOV-88		V	8085	PNSP/SB/MT,M1120	CMD	B	CK

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH39	55 30.2N	05 30.3E	52	27	07-NOV-88		V	8086	PNSP/SB/MMT,M1114	CMD	B	CK
CH39	55 30.2N	05 30.3E	52	15	07-NOV-88		V	8087	PNSP/SB/MMB,M1121	CMD	B	CK
CH39	55 30.2N	05 30.3E		7	07-NOV-88		V	8088	PNSP/SB/MB,M9348	CMD	B	CK
CH39	55 33.7N	00 54.7E	85		08-NOV-88	32	T	7952	PNSP/SA,M08L+1612C	THCH	A	CS
CH39	54 20.0N	00 24.6E	60		09-NOV-88	28	V	8089	PNSP/SC,MPD03	ADCP	C	DM
CH39	54 20.0N	00 24.6E	60	1	09-NOV-88	28	CPT	7953	PNSP/SC/MA,M7570	CMD	C	DM
CH39	55 29.9N	00 54.5E	85		10-NOV-88		V	8076	PNSP/SA,MPD05	ADCP	A	CS
CH39	55 29.9N	00 54.5E	85	1	10-NOV-88		V	8075	PNSP/SA/MA,M1509	CMD	A	CS
CH40	53 09.9N	02 12.4E	26	.5	16-NOV-88		P		PNSP/POL/TG04	PRES	P3	
CH40	53 09.9N	02 12.4E	26	.5	16-NOV-88	30	V		PNSP/POL/CM	CMD	P3	
CH40	53 10.7N	02 11.2E		29	16-NOV-88	11	V		PNSP/RCM4#3559	CMD	*H	
CH40	53 10.7N	02 11.2E		19	16-NOV-88	11	V		PNSP/UCM2#22	CMD	*H	
CH40	53 10.7N	02 22.2E	20	24	16-NOV-88		NO DATA		PNSP/RCM4/LOST	CMD	*D	
CH40	53 10.7N	02 22.2E	20	16	16-NOV-88		NO DATA		PNSP/DNL2/LOST	CMD	*D	
CH40	53 13.0N	02 13.4E		27	16-NOV-88	11	V		PNSP/RCM4#3277	CMD	*G	
CH40	53 13.0N	02 13.4E		17	16-NOV-88	11	V		PNSP/UCM2#20	CMD	*G	
CH40	53 14.9N	02 17.9E	35	.5	17-NOV-88		P		PNSP/POL/TG05	PRES	P2	
CH40	53 14.9N	02 17.9E	35	.5	17-NOV-88	29	V		PNSP/POL/CM	CMD	P2	
CH40	53 14.9N	02 15.3E		21	17-NOV-88	10	V		PNSP/RCM4S#7947	CMD	*E	
CH40	53 14.9N	02 15.3E		13	17-NOV-88	10	V		PNSP/RCM4S#7765	CMD	*E	
CH40	53 14.9N	02 15.3E		11	17-NOV-88	10	V		PNSP/UCM2#24	CMD	*E	
CH40	53 15.4N	02 16.2E	20	12	17-NOV-88	10	V		PNSP/UCM2#33	CMD	*C	
CH40	53 15.4N	02 16.2E	20	10	17-NOV-88	10	V		PNSP/RCM4S#3622	CMD	*C	
CH40	53 15.4N	02 16.2E	20	2	17-NOV-88	10	V		PNSP/RCM4S#6867	CMD	*C	
CH40	53 18.6N	02 08.1E	20	17	17-NOV-88	11	V		PNSP/RCM4S#4738	CMD	*F	
CH40	53 18.6N	02 08.1E	20	9	17-NOV-88	11	V		PNSP/RCM4S#2109	CMD	*F	
CH40	53 19.9N	02 06.5E	27	12	17-NOV-88	10	V		PNSP/UCM2#23	CMD	*B	
CH40	53 19.9N	02 06.5E	27	10	17-NOV-88	10	V		PNSP/RCM4S#7946	CMD	*B	
CH40	53 19.9N	02 06.5E	27	2	17-NOV-88	10	V		PNSP/RCM4S#7517	CMD	*B	
CH40	53 22.1N	02 04.1E	33		17-NOV-88		P		PNSP/POL/TG#284	PRES	P1	
CH40	53 24.6N	01 58.2E	20	10	17-NOV-88		V		PNSP/DNL2#545	CMD	*A	
CH40	53 24.6N	01 58.2E	20	2	17-NOV-88		V		PNSP/RCM4#568	CMD	*A	
CH40	53 14.4N	02 14.7E	30	.5	19-NOV-88	3	VBTC		PNSP/POL/#1	STABLE		
CH40	52 39.4N	03 40.1E	28	.5	23-NOV-88	3	VBTC		PNSP/POL/#2	STABLE		
CH41	52 41.2N	02 25.7E	49	35	01-DEC-88	28	V	7959	PNSP/SE/MT,M1119	CMD	E	AB
CH41	52 41.2N	02 25.7E	49	20	01-DEC-88	28	V	7960	PNSP/SE/MM,M1118	CMD	E	AB
CH41	52 41.2N	02 25.7E	49	7	01-DEC-88	28	VCPT	7961	PNSP/SE/MB,M9069	CMD	E	AB
CH41	54 20.0N	00 25.0E	59		07-DEC-88	24	V	8090	PNSP/SC,MPD04	ADCP	C	DM
CH41	54 20.0N	00 25.0E	59	1	07-DEC-88	24	CPT	7957	PNSP/SC/MA,M7570	CMD	C	DM
CH41	53 29.8N	03 00.0E	31		12-DEC-88	43	V	8103	PNSP/SD,MPD01	ADCP	D	BB
CH41	53 29.8N	03 00.0E	31	1	12-DEC-88	43	CT	7958	PNSP/SD/MA,M6443	CMD	D	BB
CH42	53 36.0N	00 12.0E			24-DEC-88	1			PNSP	SEDT		
CH43	54 20.0N	00 25.3E	59		01-JAN-89	37	V	8091	PNSP/SC,MPD02	ADCP	C	DM
CH43	55 29.7N	00 54.5E	85		03-JAN-89	34	V	8077	PNSP/SA,MPD07	ADCP	A	CS
CH43	55 29.7N	00 54.5E	85	1	03-JAN-89	34	CPT	7962	PNSP/SA/MA,M7570	CMD	A	CS
CH43	52 37.1N	03 45.5E	30	12	07-JAN-89	22	V	7963	PNSP/SF/MT,M1117	CMD	F	AE
CH43	52 37.1N	03 45.5E	30	7	07-JAN-89	10	VCPT	7964	PNSP/SF/MB,M9347	CMD	F	AE
CH44	54 34.6N	04 51.5E	45		16-JAN-89	7	V		PNSP	CMD		BJ
CH44	54 34.6N	04 51.5E	45		16-JAN-89	7	P		PNSP	PRES		BJ
CH44	54 35.5N	04 51.8E	45	5	16-JAN-89		X		PNSP/NO DATA	TRANS		BJ
CH44	54 35.5N	04 51.8E	45	.5	16-JAN-89		V	8030	PNSP,R319/MT,M3277	CMD		BJ
CH44	54 35.5N	04 51.8E	45	.5	16-JAN-89		V	8031	PNSP,R319/MB,M3559	CMD		BJ
CH44	54 35.5N	04 51.8E	45	30	16-JAN-89	6	X		PNSP	TRANS		BJ
CH44	54 35.5N	04 51.8E	45	10	16-JAN-89	6	X		PNSP	TRANS		BJ
CH44	54 35.9N	04 51.5E	45		16-JAN-89		W		PNSP	WAVE		BJ
CH44	54 36.0N	04 51.9E	45		16-JAN-89	7	M	8388	PNSP	MET		BJ
CH44	54 34.5N	04 48.1E	45		17-JAN-89	6			PNSP	SEDT		BJ
CH44	54 34.5N	04 48.1E	45		17-JAN-89		NO DATA		PNSP/FAILED	CMD		BJ
CH44	54 34.8N	04 50.0E	45		17-JAN-89	7			PNSP	SEDT		BJ
CH44	54 34.9N	04 51.3E	45		17-JAN-89	5	V	8035	PNSP,R321/MB,M1195	CMD		BJ
CH44	54 34.9N	04 51.3E	45		17-JAN-89	5	V		PNSP,R321	CMD		BJ
CH44	54 35.4N	04 48.1E	45	37	17-JAN-89	5	V	8032	PNSP,R320/MT,M0716	CMD		BJ

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH44	54 35.4N	04 48.1E	45	31	17-JAN-89	5	V	8033	PNSP,R320/MM,M0714	CMD		BJ
CH44	54 35.4N	04 48.1E	45	21	17-JAN-89	5	V	8034	PNSP,R320/MB,M6979	CMD		BJ
CH44	54 35.5N	04 48.2E	45		17-JAN-89	5	VBX		PNSP	STABLE		BJ
CH44	54 35.9N	04 48.3E	45		18-JAN-89		V	8036	PNSP,R326,M0003	ADCP		BJ
CH44	52 39.0N	03 40.0E	30		19-JAN-89	1			PNSP	SEDT		AE
CH44	52 39.0N	03 40.0E	30		19-JAN-89				PNSP/TRAWLED	TRANS		AE
CH44	52 39.0N	03 40.0E	30		19-JAN-89	7			PNSP	SEDT		AE
CH44	52 39.0N	03 40.0E	30		19-JAN-89		V		PNSP/TRAWLED	CMD		AE
CH45	52 40.8N	02 25.4E	49	35	28-JAN-89	41	V	7966	PNSP/SE/MT,M1119	CMD	E	AB
CH45	52 40.8N	02 25.4E	31	20	28-JAN-89	41	V	7967	PNSP/SE/MM,M1118	CMD	E	AB
CH45	52 40.8N	02 25.4E	31	7	28-JAN-89	41	VCPT	7968	PNSP/SE/MB,M9069	CMD	E	AB
CH45	53 29.8N	03 00.0E	31		31-JAN-89	32	V	8104	PNSP/SD,MPD01	ADCP	D	BB
CH45	53 29.8N	03 00.0E	31	1	31-JAN-89	32	CT	7965	PNSP/SD/MA,M6443	CMD	D	BB
CH45	54 20.0N	00 25.3E	59		07-FEB-89	27	V	8092	PNSP/SC,MPD03	ADCP	C	DM
CH46	51 40.2N	01 26.6E			14-FEB-89				PNSP/LOST	SEDT		
CH46	52 39.3N	03 40.2E			21-FEB-89	3	VB		PNSP	STABLE	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	4	P		PNSP/POL	PRES	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	3	V		PNSP/RVS	CMD	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	4	P		PNSP/POL	PRES	F	AE
CH46	52 39.3N	03 40.2E			21-FEB-89	4	P		PNSP/POL	PRES	F	AE
CH47	53 29.6N	03 00.1E	31		04-MAR-89	27	V	7969	PNSP/SD,M0002	ADCP	D	BB
CH47	55 29.6N	00 53.7E	85		06-MAR-89		F		PNSP/SA	FLUOR	A	CS
CH47	55 29.6N	00 53.7E	85		06-MAR-89	30	V	8078	PNSP/SA,MPD04	ADCP	A	CS
CH47	54 19.8N	00 23.9E	59		09-MAR-89	29	V	8093	PNSP/SC,MPD03	ADCP	C	DM
CH47	52 41.0N	02 25.4E	49	7	11-MAR-89	30	F		PNSP/SE	FLUOR	E	AB
CH47	52 41.0N	02 25.4E	49	7	11-MAR-89	17	VCPT	7970	PNSP/SE/MB,M9347	CMD	E	AB
CH49	52 41.2N	02 24.9E	49		29-MAR-89	40	F		PNSP/SE	FLUOR	E	AB
CH49	52 41.2N	02 24.9E	49	7	29-MAR-89	40	VT	7974	PNSP/SE/MB,M9579	CMD	E	AB
CH49	52 41.2N	02 24.9E	49	7	29-MAR-89	40	V		PNSP/SE	CMD	E	AB
CH49	53 29.3N	03 00.0E	31		01-APR-89	28	V	8105	PNSP/SD,MPD01	ADCP	D	BB
CH49	53 29.3N	03 00.0E	31	1	01-APR-89	28	CT	8106	PNSP/SD/MA,M6443	CMD	D	BB
CH49	53 30.0N	02 59.6E	31		01-APR-89	29	T	8107	PNSP/SD,M09L+1608C	THCH	D	BB
CH49	55 30.0N	00 54.3E	85		06-APR-89	28	T	7972	PNSP/SA,M08L+1612C	THCH	A	CS
CH49	55 30.0N	00 54.3E	85		06-APR-89	28	F		PNSP/SA	FLUOR	A	CS
CH49	54 19.8N	00 24.0E	60		08-APR-89	28	V	8094	PNSP/SC,MPD04	ADCP	C	DM
CH49	54 19.8N	00 24.0E	60	1	08-APR-89	28	CT	7973	PNSP/SC/MA,M9632	CMD	C	DM
CH49	54 20.3N	00 24.2E	60		08-APR-89	28	T	8095	PNSP/SC,M10L+1610C	THCH	C	DM
CH49	55 30.0N	00 55.1E	85		08-APR-89	25	V	8079	PNSP/SA,MPD03	ADCP	A	CS
CH49	55 30.0N	00 55.1E	85	1	08-APR-89	25	CT	7971	PNSP/SA/MA,M9631	CMD	A	CS
CH51	52 37.0N	03 36.0E	30	12	28-APR-89		NO DATA	8114	PNSP/SF/MT,M1263	CMD	F	AE
CH51	52 37.0N	03 36.0E	30	7	28-APR-89	28	VCPT	7989	PNSP/SF/MB,M9347	CMD	F	AE
CH51	53 29.3N	02 59.3E	31		30-APR-89	28	V	8108	PNSP/SD,MPD02	ADCP	D	BB
CH51	53 29.3N	02 59.3E	31	1	30-APR-89	28	CT	7984	PNSP/SD/MA,M9633	CMD	D	BB
CH51	53 29.9N	02 59.6E	31		30-APR-89	28	T	7985	PNSP/SD,M07L+1608C	THCH	D	BB
CH51	55 29.9N	05 30.0E	52		03-MAY-89	28	T	7981	PNSP/SB,M09L+1609C	THCH	B	CK
CH51	55 30.2N	05 28.0E	52	37	03-MAY-89	28	V	7977	PNSP/SB/MT,M1265	CMD	B	CK
CH51	55 30.2N	05 28.0E	52	27	03-MAY-89	28	V	7978	PNSP/SB/MMT,M1261	CMD	B	CK
CH51	55 30.2N	05 28.0E	52	15	03-MAY-89	28	V	7979	PNSP/SB/MMB,M1264	CMD	B	CK
CH51	55 30.2N	05 28.0E	52	7	03-MAY-89	28	VCPT	7980	PNSP/SB/MB,M9069	CMD	B	CK
CH51	55 29.9N	00 54.6E	85		04-MAY-89	28	T	7976	PNSP/SA,M11L+1612C	THCH	A	CS
CH51	55 30.0N	00 54.1E	85		04-MAY-89	31	F		PNSP/SA	FLUOR	A	CS
CH51	55 30.0N	00 55.2E	85		04-MAY-89	28	V	8080	PNSP/SA,MPD01	ADCP	A	CS
CH51	55 30.0N	00 55.2E	85	1	04-MAY-89	28	CT	7975	PNSP/SA/MA,M6443	CMD	A	CS
CH51	54 19.7N	00 24.3E	60		05-MAY-89	29	T	7983	PNSP/SC,M08L+1610C	THCH	C	DM
CH51	54 19.9N	00 24.2E	60		06-MAY-89	28	V	8096	PNSP/SC,MPD03	ADCP	C	DM
CH51	54 19.9N	00 24.2E	60	1	06-MAY-89	28	CT	7982	PNSP/SC/MA,M9632	CMD	C	DM
CH51	52 41.2N	02 25.1E	49		09-MAY-89		F		PNSP/SE	FLUOR	E	AB

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH51	52 41.2N	02 24.9E	49	35	09-MAY-89		V	7986	PNSP/SE/MT,M1262	CMD	E	AB
CH51	52 41.2N	02 24.9E	49	20	09-MAY-89		V	7987	PNSP/SE/MM,M1117	CMD	E	AB
CH51	52 41.2N	02 24.9E	49	7	09-MAY-89		VT	7988	PNSP/SE/MB,M9414	CMD	E	AB
CH52	52 39.2N	03 40.4E	30	19	12-MAY-89	10	X		PNSP/TR852/R351	TRANS		AE
CH52	52 39.2N	03 40.4E	30	17	12-MAY-89	9	V	8037	PNSP,R351/MT,M0714	CMD		AE
CH52	52 39.2N	03 40.4E	30	13	12-MAY-89	9	V	8212	PNSP,R351,MVALEPRT	CMD		AE
CH52	52 39.2N	03 40.4E	30	11	12-MAY-89	9	V	8038	PNSP,R351/MU,M0715	CMD		AE
CH52	52 39.2N	03 40.4E	30	9	12-MAY-89	9	VT	8039	PNSP,R351/ML,M9652	CMD		AE
CH52	52 39.2N	03 40.4E	30	6	12-MAY-89	9	VT	8040	PNSP,R351/MB,M9680	CMD		AE
CH52	52 39.2N	03 40.4E	30	2	12-MAY-89	10	X		PNSP/TR853/R351	TRANS		AE
CH52	52 39.3N	03 40.1E	30		12-MAY-89	10	VBX		PNSP	STABLE		AE
CH52	52 39.4N	03 40.5E	30		12-MAY-89	9	W		PNSP	WAVE		AE
CH52	52 39.4N	03 40.5E	30	30	12-MAY-89	9	M	8211	PNSP,RPOL-MET	MET		AE
CH52	52 39.9N	03 40.1E	30	25	12-MAY-89	8	V	8213	PNSP,RETA,M195	CMD		AE
CH52	52 39.9N	03 40.1E	30	20	12-MAY-89		V	8214	PNSP,RETA,M258	CMD		AE
CH52	52 39.4N	03 40.0E	30	1	13-MAY-89		V	8216	PNSP,RADCP,MPD4	ADCP		AE
CH52	52 39.5N	03 39.9E	30	1	13-MAY-89	8	P		PNSP/RCM-TGM1750	PRES		AE
CH52	52 39.5N	03 39.9E	30	1	13-MAY-89	8	VP	8215	PNSP,RCM-TGM1750	CMD		AE
CH52	54 34.9N	04 49.9E	48	7	14-MAY-89	6	T	8219	PNSP,RT,M1146-1685	THCH		BJ
CH52	54 34.9N	04 51.1E	48	1	14-MAY-89		V	8220	PNSP,RADCP,MPD9	ADCP		BJ
CH52	54 34.9N	04 50.4E	45	21	14-MAY-89		VT	8041	PNSP,R352/MT,M9634	CMD		BJ
CH52	54 34.9N	04 50.4E	45	21	14-MAY-89	6	X		PNSP/TR834	TRANS		BJ
CH52	54 34.9N	04 50.4E	45	11	14-MAY-89		VT	8042	PNSP,R352/MM,M9650	CMD		BJ
CH52	54 34.9N	04 50.4E	45	9	14-MAY-89	6	X		PNSP/TR487	TRANS		BJ
CH52	54 34.9N	04 50.4E	45	6	14-MAY-89		VT	8043	PNSP,R352/MB,M9643	CMD		BJ
CH52	54 34.9N	04 50.4E	45	4	14-MAY-89	6	X		PNSP/TR561	TRANS		BJ
CH52	52 39.1N	03 39.8E	30	28	16-MAY-89	5	V	8217	PNSP,RSMBA,MT,M957	CMD		AE
CH52	52 39.1N	03 39.8E	30	26	16-MAY-89	5	V	8218	PNSP,RSMBA,MB,M858	CMD		AE
CH53	52 36.9N	03 46.1E	30	12	29-MAY-89	27	V	8000	PNSP/SF/MT,M1119	CMD	F	AE
CH53	52 36.9N	03 46.1E	30	7	29-MAY-89	27	VCPT	8001	PNSP/SF/MB,M9347	CMD	F	AE
CH53	53 30.0N	03 00.3E	31		29-MAY-89	29	V	8109	PNSP/SD,MPD04	ADCP	D	BB
CH53	53 30.1N	03 00.6E	31		29-MAY-89	28	T	7997	PNSP/SD,M10L+1611C	THCH	D	BB
CH53	55 29.9N	05 30.5E	52	37	01-JUN-89	28	V	7991	PNSP/SB/MT,M1118	CMD	B	CK
CH53	55 29.9N	05 30.5E	52	27	01-JUN-89	28	V	7992	PNSP/SB/MMT,M1112	CMD	B	CK
CH53	55 29.9N	05 30.5E	52	15	01-JUN-89	28	V	7993	PNSP/SB/MMB,M1113	CMD	B	CK
CH53	55 29.9N	05 30.5E	52	7	01-JUN-89		V	7994	PNSP/SB/MB,M9069	CMD	B	CK
CH53	55 30.4N	05 29.8E	52		01-JUN-89	28	T	7995	PNSP/SB,M07L+1609C	THCH	B	CK
CH53	55 30.0N	00 53.9E	85		02-JUN-89	28	V	8081	PNSP/SA,MPD02	ADCP	A	CS
CH53	55 30.0N	00 54.1E	85		02-JUN-89	28	T	7990	PNSP/SA,M09L+1612C	THCH	A	CS
CH53	54 20.3N	00 23.8E	60		04-JUN-89	28	T	7996	PNSP/SC,M11L+1610C	THCH	C	DM
CH53	54 20.4N	00 23.6E	59		04-JUN-89	28	V	8098	PNSP/SC,MPD01	ADCP	C	DM
CH53	54 20.4N	00 23.6E	59	1	04-JUN-89	28	CT	8097	PNSP/SC/MA,M6443	CMD	C	DM
CH53	52 41.1N	02 25.2E	49	35	06-JUN-89	18	V	7998	PNSP/SE/MT,M1264	CMD	E	AB
CH53	52 41.1N	02 25.2E	49	20	06-JUN-89	18	V	7999	PNSP/SE/MM,M1265	CMD	E	AB
CH55	52 41.0N	02 24.6E	49	35	24-JUN-89	30	V	8113	PNSP/SE/MM,M1263	CMD	E	AB
CH55	52 41.0N	02 24.6E	49	20	24-JUN-89	30	V	8011	PNSP/SE/MM,M1261	CMD	E	AB
CH55	52 41.0N	02 24.6E	49	7	24-JUN-89	30	VPT	8012	PNSP/SE/MB,M9378	CMD	E	AB
CH55	52 36.9N	03 46.0E	30	12	25-JUN-89		NO DATA	8013	PNSP/SF/MT,M1265	CMD	F	AE
CH55	52 36.9N	03 46.0E	30	7	25-JUN-89	30	VPT	8014	PNSP/SF/MB,M9352	CMD	F	AE
CH55	53 29.9N	03 00.5E	31		27-JUN-89	30	T	8010	PNSP/SD,M08L+0118C	THCH	D	BB
CH55	53 30.2N	03 00.3E	31		27-JUN-89	30	V	8110	PNSP/SD,MPD03	ADCP	D	BB
CH55	53 30.2N	03 00.3E	31	1	27-JUN-89	30	CT	8009	PNSP/SD/MA,M9632	CMD	D	BB
CH55	55 30.1N	05 30.3E	52	37	30-JUN-89	30	V	8003	PNSP/SB/MT,M1264	CMD	B	CK
CH55	55 30.1N	05 30.3E	52	27	30-JUN-89	30	V	8004	PNSP/SB/MMT,M1119	CMD	B	CK
CH55	55 30.1N	05 30.3E	52	15	30-JUN-89	30	V	8005	PNSP/SB/MMB,M1113	CMD	B	CK
CH55	55 30.1N	05 30.3E	52	7	30-JUN-89	30	VPT	8006	PNSP/SB/MB,M9419	CMD	B	CK
CH55	55 30.0N	00 54.3E	85		01-JUL-89	33	V	8082	PNSP/SA,MPD04	ADCP	A	CS
CH55	55 30.0N	00 54.3E	85		01-JUL-89		T	8083	PNSP/SA,M07L+1612C	THCH	A	CS
CH55	55 30.0N	00 54.3E	85	1	01-JUL-89	33	CT	8002	PNSP/SA/MA,M9631	CMD	A	CS
CH55	54 20.2N	00 23.8E	60		03-JUL-89	33	T	8008	PNSP/SC,M09L+1611C	THCH	C	DM
CH55	54 20.4N	00 23.7E	59		03-JUL-89	32	V	8099	PNSP/SC,MPD02	ADCP	C	DM
CH55	54 20.4N	00 23.7E	59	1	03-JUL-89	32	CT	8007	PNSP/SC/MA,M9633	CMD	C	DM

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH56	53 59.9N	00 09.4E	45	30	09-JUL-89	39	V		PNSP/RCM#9643	CMD	FA	
CH56	53 59.9N	00 09.4E	45	20	09-JUL-89	39	V		PNSP/RCM#9650	CMD	FA	
CH56	53 59.9N	00 09.4E	45	10	09-JUL-89	39	V		PNSP/RCM#9652	CMD	FA	
CH56	54 03.5N	00 17.4E	56	39	09-JUL-89	39	V		PNSP/S4#1258	CMD	FB	
CH56	54 03.5N	00 17.4E	56	24	09-JUL-89	39	V		PNSP/RCM#3277	CMD	FB	
CH56	54 03.5N	00 17.4E	56	10	09-JUL-89	39	V		PNSP/RCM#9780	CMD	FB	
CH56	54 03.9N	00 16.6E	54	16	09-JUL-89	10	T		PNSP/#1648	THCH	FB	
CH56	54 08.2N	00 24.5E	56	18	09-JUL-89	39	T		PNSP/#1685	THCH	FC	CS
CH56	54 08.7N	00 24.2E	57	1	09-JUL-89		NO DATA		PNSP/PDP#7/FAIL	ADCP	FC	CS
CH56	54 54.0N	01 11.7E	46	31	11-JUL-89	36	V		PNSP/S4#1195	CMD	DA	
CH56	54 54.0N	01 11.7E	46	20	11-JUL-89	36	V		PNSP/RCM#9634	CMD	DA	
CH56	54 54.0N	01 11.7E	46	9.5	11-JUL-89	36	V		PNSP/RCM#7570	CMD	DA	
CH56	54 54.1N	01 10.6E	47	8	11-JUL-89	7	T	8414	PNSP/#1702	THCH	DA	
CH56	54 54.9N	01 04.4E	56	41	11-JUL-89	36	V		PNSP/S4#1196	CMD	DB	
CH56	54 54.9N	01 04.4E	56	25	11-JUL-89	36	V		PNSP/RCM#3559	CMD	DB	
CH56	54 54.9N	01 04.4E	56	10	11-JUL-89	36	V		PNSP/RCM#568	CMD	DB	
CH56	54 55.2N	01 04.1E	57	1	11-JUL-89	7	V		PNSP/PDP#9	ADCP	DB	
CH56	54 55.2N	01 04.8E	56	18	11-JUL-89	7	T		PNSP/#1701	THCH	DB	
CH56	54 54.2N	01 10.9E	47		18-JUL-89		NO DATA		PNSP/1702/LOST	THCH	DA	
CH56	54 55.1N	01 04.1E	56		18-JUL-89	29	T		PNSP/#1701	THCH	DB	
CH56	54 03.7N	00 16.7E	54		19-JUL-89	29	T		PNSP/#1648	THCH	FB	
CH57	52 41.1N	02 24.8E	49		24-JUL-89	29	V	8026	PNSP/SE/MM,M1118	CMD	E	AB
CH57	52 41.1N	02 24.8E	49	35	24-JUL-89	29	V	8025	PNSP/SE/MT,M1112	CMD	E	AB
CH57	52 41.1N	02 24.8E	49	7	24-JUL-89	29	VT	8027	PNSP/SE/MB,M9579	CMD	E	AB
CH57	52 37.0N	03 46.0E	30	12	27-JUL-89	28	V	8028	PNSP/SF/MT,M1261	CMD	F	AE
CH57	52 37.0N	03 46.0E	30	7	27-JUL-89	28	VPT	8029	PNSP/SF/MB,M9352	CMD	F	AE
CH57	53 29.6N	03 00.3E	31		27-JUL-89	29	T	8024	PNSP/SD,M11L+0118C	THCH	D	BB
CH57	53 29.8N	03 00.7E	31		27-JUL-89	29	V	8112	PNSP/SD,MPD09	ADCP	D	BB
CH57	53 29.8N	03 00.7E	31	1	27-JUL-89	29	CT	8111	PNSP/SD/MA,M6443	CMD	D	BB
CH57	55 30.2N	05 30.4E	52	37	30-JUL-89	29	V	8017	PNSP/SB/MT,M1264	CMD	B	CK
CH57	55 30.2N	05 30.4E	52	27	30-JUL-89	29	V	8018	PNSP/SB/MMT,M1119	CMD	B	CK
CH57	55 30.2N	05 30.4E	52	15	30-JUL-89	29	V	8019	PNSP/SB/MMB,M1113	CMD	B	CK
CH57	55 30.2N	05 30.4E	52	7	30-JUL-89	29	VCPT	8020	PNSP/SB/MB,M9069	CMD	B	CK
CH57	55 31.3N	05 29.6E	52		30-JUL-89	29	T	8021	PNSP/SB,M08L+1682C	THCH	B	CK
CH57	55 30.1N	00 54.3E	85		04-AUG-89	12	V	8084	PNSP/SA,MPD03	ADCP	A	CS
CH57	55 30.1N	00 54.3E	85	1	04-AUG-89	12	CT	8015	PNSP/SA/MA,M9632	CMD	A	CS
CH57	55 30.1N	00 54.7E	85		04-AUG-89	26	T	8016	PNSP/SA,M10L+1683C	THCH	A	CS
CH57	54 20.2N	00 23.9E	60		05-AUG-89	27	T	8023	PNSP/SC,M07L+1612C	THCH	C	DM
CH57	54 20.4N	00 23.8E	60		05-AUG-89	26	V	8100	PNSP/SC,MPD04	ADCP	C	DM
CH57	54 20.4N	00 23.8E	60	1	05-AUG-89	26	CT	8022	PNSP/SC/MA,M9631	CMD	C	DM
CH59	52 41.0N	02 24.7E	49	35	23-AUG-89	29	V	8129	PNSP/SE/MT,M1263	CMD	E	AB
CH59	52 41.0N	02 24.7E	49	20	23-AUG-89	29	V	8130	PNSP/SE/MM,M1112	CMD	E	AB
CH59	52 41.0N	02 24.7E	49	7	23-AUG-89	29	VPT	8131	PNSP/SE/MB,M9378	CMD	E	AB
CH59	52 36.9N	03 46.1E	30	12	25-AUG-89	28	V	8132	PNSP/SF/MT,M1261	CMD	F	AE
CH59	52 36.9N	03 46.1E	30	7	25-AUG-89	28	VPT	8133	PNSP/SF/MB,M9419	CMD	F	AE
CH59	53 29.7N	03 00.6E	31		26-AUG-89	28	V	8126	PNSP/SD/MDP03	ADCP	D	BB
CH59	53 29.7N	03 00.6E	31		26-AUG-89		T	8128	PNSP/SD/M09C+0561L	THCH	D	BB
CH59	53 29.7N	03 00.6E	31	1	26-AUG-89	28	CT	8127	PNSP/SD/MA,M9632	CMD	D	BB
CH59	55 30.0N	05 30.6E	52	37	29-AUG-89	29	V	8118	PNSP/SB/MT,M1264	CMD	B	CK
CH59	55 30.0N	05 30.6E	52	27	29-AUG-89	29	V	8119	PNSP/SB/MMT,M1113	CMD	B	CK
CH59	55 30.0N	05 30.6E	52	15	29-AUG-89	29	V	8120	PNSP/SB/MMB,M1118	CMD	B	CK
CH59	55 30.0N	05 30.6E	52	7	29-AUG-89	29	VCPT	8121	PNSP/SB/MB,M9347	CMD	B	CK
CH59	55 31.4N	05 29.7E	52		29-AUG-89	29	T	8122	PNSP/SB/M11C+1682L	THCH	B	CK
CH59	55 30.1N	00 54.8E	85		30-AUG-89	29	V	8115	PNSP/SA,MDP09	ADCP	A	CS
CH59	55 30.1N	00 54.8E	85	1	30-AUG-89	29	CT	8116	PNSP/SA/MA,M6443	CMD	A	CS
CH59	55 30.1N	00 55.2E	85		30-AUG-89	29	T	8117	PNSP/SA/M08C+1683L	THCH	A	CS
CH59	54 20.2N	00 24.0E	59		01-SEP-89	29	T	8123	PNSP/SC/M10C+1612L	THCH	C	DM
CH59	54 20.4N	00 23.9E	59		01-SEP-89	29	V	8124	PNSP/SC/MDP02	ADCP	C	DM
CH59	54 20.4N	00 23.9E	59	1	01-SEP-89	29	CT	8125	PNSP/SC/MA,M9633	CMD	C	DM
CH60	54 34.7N	04 49.2E	45		07-SEP-89	10	X		PNSP/RN1	TRANS		BJ
CH60	54 34.7N	04 49.2E	45	3	07-SEP-89		NO DATA		PNSP/RN1	TRANS		BJ
CH60	54 34.7N	04 49.2E	45		07-SEP-89	10	V		PNSP/RN1	CMD		BJ

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH60	54 35.1N	04 49.3E	45		07-SEP-89	1			PNSP/RN11-1	SEDT		BJ
CH60	54 35.1N	04 49.3E	45		07-SEP-89	1	V		PNSP/RN11-1	CMD		BJ
CH60	54 35.2N	04 48.6E	45		07-SEP-89	9	T		PNSP/RN9	THCH		BJ
CH60	54 35.4N	04 50.7E	45		07-SEP-89	10			PNSP/RN5	STABLE		BJ
CH60	54 35.4N	04 50.0E	45		07-SEP-89	10			PNSP/RN10	SEDT		BJ
CH60	54 46.7N	04 49.2E	45		07-SEP-89	10	M		PNSP/RN6	MET		BJ
CH60	54 34.6N	04 48.6E	45		08-SEP-89		W		PNSP/RN7	WAVE		BJ
CH60	54 34.6N	04 50.2E	45		08-SEP-89	6	V		PNSP/RN3/ETA	CMD		BJ
CH60	54 34.6N	04 50.2E	45	40	08-SEP-89	6	V		PNSP/RN3/ETA	CMD		BJ
CH60	54 34.6N	04 50.2E	45	35	08-SEP-89	6	V		PNSP/RN3/ETA	CMD		BJ
CH60	54 34.9N	04 50.2E	45	43	08-SEP-89	8	V		PNSP/RN2	CMD		BJ
CH60	54 34.9N	04 50.2E	45	41	08-SEP-89	8	V		PNSP/RN2	CMD		BJ
CH60	54 34.9N	04 50.2E	45		08-SEP-89	8	V		PNSP/RN2	CMD		BJ
CH60	54 35.2N	04 50.7E	45		08-SEP-89	8	V		PNSP/RN8	ADCP		BJ
CH60	54 35.7N	04 50.9E	45		08-SEP-89	8	P		PNSP/RN4	PRES		BJ
CH60	54 35.7N	04 50.9E	45		08-SEP-89	8	V		PNSP/RN4	CMD		BJ
CH60	52 40.2N	03 39.2E	45		10-SEP-89	5	V		PNSP/RS4	ADCP		AE
CH60	52 40.2N	03 39.3E	45		10-SEP-89	1			PNSP/RS3	SEDT		AE
CH60	52 40.2N	03 39.3E	45		10-SEP-89	1	V		PNSP/RS1	CMD		AE
CH60	52 40.2N	03 40.8E	45		10-SEP-89	5	X		PNSP/RS1	TRANS		AE
CH60	52 40.6N	03 40.4E	45		10-SEP-89	5			PNSP/RS2	SEDT		AE
CH60	54 35.1N	04 49.4E	45		12-SEP-89	1			PNSP/RN11-2	SEDT		BJ
CH60	54 35.1N	04 49.4E	45		12-SEP-89	1	V		PNSP/RN11-2	CMD		BJ
CH60	54 35.0N	04 48.3E	45		13-SEP-89	1			PNSP/RN11-3	SEDT		BJ
CH60	54 35.0N	04 48.3E	45		13-SEP-89	1	V		PNSP/RN11-3	CMD		BJ
CH62	52 29.0N	03 41.0E			07-OCT-89	10	W		PNSP	WAVE		AE
CH62	52 29.0N	03 46.0E			07-OCT-89	10	M		PNSP	MET		AE
CH62	52 32.4N	03 15.0E			08-OCT-89	10			PNSP/DAHN			AD
CH62	52 26.0N	03 48.0E	30		09-OCT-89	8	V	8150	PNSP/R421/MT,M1307	CMD		AI
CH62	52 26.0N	03 48.0E	30		09-OCT-89	8	V	8151	PNSP/R421/MB,M1261	CMD		AI
CH66A	52 37.7N	03 46.1E	30	12	21-MAY-90	26	V	8334	PNSP/S4-1195/SG	CMD	F	AE
CH66A	52 37.7N	03 46.1E		7	21-MAY-90	26	V	8335	PNSP/RCM#9633	CMD	F	AE
CH66A	52 40.5N	02 24.8E	53	35	21-MAY-90		NO DATA	8331	PNSP/S1306/LOST/SF	CMD	E	AB
CH66A	52 40.5N	02 24.8E	53	20	21-MAY-90		NO DATA	8332	PNSP/S1308/LOST/SF	CMD	E	AB
CH66A	52 40.5N	02 24.8E	53	7	21-MAY-90		NO DATA	8333	PNSP/9960/LOST/SF	CMD	E	AB
CH66A	50 47.0N	01 14.4E	27	6	22-MAY-90	23	X		PNSP/TR05/SB	TRANS		
CH66A	50 47.0N	01 14.4E	27	5	22-MAY-90	23	V	8327	PNSP/RCM5529/SB	CMD		
CH66A	50 47.1N	01 14.4E	27		22-MAY-90	23	V	8325	PNSP/PDP09A/SB	ADCP		
CH66A	50 47.1N	01 14.4E	27		22-MAY-90	23	P	8326	PNSP/WLR1042/SB	PRES		
CH66A	50 52.3N	01 31.9E	29		22-MAY-90	23	X		PNSP/TR04/SC	TRANS		
CH66A	50 52.3N	01 31.9E	29	5	22-MAY-90	23	V	8330	PNSP/RCM5913/SC	CMD		
CH66A	50 52.5N	01 32.0E	29		22-MAY-90	23	V	8328	PNSP/PDP10A/SC	ADCP		
CH66A	50 52.5N	01 32.0E	29		22-MAY-90	23	P	8329	PNSP/WLR915/SC	PRES		
CH66A	50 56.4N	01 17.1E	36		22-MAY-90	24	V	8322	PNSP/PDP04A/SA	ADCP		
CH66A	50 56.4N	01 17.1E	36		22-MAY-90	24	P	8323	PNSP/WLR1038/SA	PRES		
CH66A	50 56.4N	01 17.2E	36	6	22-MAY-90	24	X		PNSP/TR06/SA	TRANS		
CH66A	50 56.4N	01 17.2E	36	5	22-MAY-90	24	V	8324	PNSP/RCM3308/SA	CMD		
CH66A	53 29.8N	03 00.5E	32	6	24-MAY-90	23	T	8338	PNSP/118/SH,H-26	THCH	D	BB
CH66A	53 29.9N	03 00.4E	32		24-MAY-90	23	V	8336	PNSP/PDP07/SH	ADCP	D	BB
CH66A	53 29.9N	03 00.4E	32		24-MAY-90	23	V	8337	PNSP/RCM9631/SH	CMD	D	BB
CH66B	50 55.9N	01 16.5E	30		15-JUN-90	33	V		PNSP/PDP10A/SA	ADCP		
CH66B	50 55.9N	01 16.5E	30		15-JUN-90	33	P		PNSP/WLR1042/SA	PRES		
ALK	50 55.9N	01 16.5E	33		18-JUL-90	34	V	8341	PNSP/PDP04A/SA	ADCP		
ALK	50 55.9N	01 16.5E	33		18-JUL-90	34	P		PNSP/WLR1038/SA	PRES		
ALK	50 56.6N	01 15.5E	32	4	21-AUG-90	23	V	8344	PNSP/RCM5229/SA	CMD		
ALK	50 56.6N	01 15.5E	32	6	21-AUG-90	23	X		PNSP/TR06/SA	TRANS		
ALK	50 56.6N	01 15.6E	33		21-AUG-90	23	V	8342	PNSP/PDP10A/SA	ADCP		
ALK	50 56.6N	01 15.6E	33		21-AUG-90	23	P	8343	PNSP/WLR1038/SA	PRES		
CH72A	52 10.1N	04 15.2E	18	17	22-SEP-90	24	X		PNSP/#02/SD	TRANS		
CH72A	52 10.1N	04 15.2E	18	17	22-SEP-90	24	TS		PNSP/#6941/SD	T/S		
CH72A	52 10.1N	04 15.2E	18	17	22-SEP-90	24	V		PNSP/05451263/SD	CMD		
CH72A	52 10.1N	04 15.2E	18	9	22-SEP-90	24	V		PNSP/RCM#9650/SD	CMD		

CRUISE	LATITUDE dd mm.mh	LONGITUDE dd mm.mh	WATER DEPTH	METER HEIGHT	START DATE	SERIES DURATION	PARAMETERS	BODC SEQ.NO	ORIGINATOR'S REFERENCE	INSTRUMENT CODE	MOORING SITE	CLOSEST CTD SITE
CH72A	52 10.1N	04 15.2E	18	6	22-SEP-90	24	V		PNSP/RCM#9632/SD	CMD		
CH72A	52 10.1N	04 15.2E	18	3	22-SEP-90	24	V		PNSP/RCM#7063/SD	CMD		
CH72A	52 16.2N	04 13.4E	21	20	22-SEP-90	24	TS		PNSP/#6275	T/S		DM
CH72A	52 16.2N	04 13.4E	21	20	22-SEP-90	24	V		PNSP/S4#05111117	CMD		DM
CH72A	52 16.2N	04 13.4E	21	20	22-SEP-90	24	X		PNSP/TR01	TRANS		DM
CH72A	52 16.2N	04 13.4E	21	20	22-SEP-90	24	F		PNSP/#109	FLUOR		DM
CH72A	52 16.2N	04 13.4E	21	11	22-SEP-90	24	V		PNSP/RCM#6749	CMD		DM
CH72A	52 16.2N	04 13.4E	21	7	22-SEP-90	24	V		PNSP/RCM#5913	CMD		DM
CH72A	52 16.2N	04 13.4E	21	3	22-SEP-90	24	V		PNSP/RCM#9643	CMD		DM
CH72A	52 16.6N	04 13.6E	21	.5	22-SEP-90	24	V		PNSP/PDP#4A	ADCP		DM
CH72A	52 16.6N	04 13.6E	21	.5	22-SEP-90	24	P		PNSP/WLR#915	PRES		DM
CH72A	52 37.0N	03 46.0E	32	12	22-SEP-90	24	V		PNSP/S4#1196	CMD		
CH72A	52 37.0N	03 46.0E	32	7	22-SEP-90	24	V		PNSP/RCM#9631	CMD		
CH72A	52 08.9N	04 05.5E	21	.5	23-SEP-90	23	V	8351	PNSP/PDP#6A	ADCP		CS
CH72A	52 08.9N	04 05.5E	21	.5	23-SEP-90	23	P	8352	PNSP/WLR#444	PRES		CS
CH72A	52 08.9N	04 05.9E	21	20	23-SEP-90	23	X		PNSP/#03	TRANS		CS
CH72A	52 08.9N	04 05.9E	21	20	23-SEP-90	23	V		PNSP/S4#05451262	CMD		CS
CH72A	52 08.9N	04 05.9E	21	20	23-SEP-90	23	TS		PNSP/#8240	T/S		CS
CH72A	52 08.9N	04 05.9E	21	20	23-SEP-90	23	F		PNSP/SA113	FLUOR		CS
CH72A	52 08.9N	04 05.9E	21	12	23-SEP-90	23	V		PNSP/RCM#3257	CMD		CS
CH72A	52 08.9N	04 05.9E	21	8	23-SEP-90	23	V		PNSP/RCM#3261	CMD		CS
CH72A	52 08.9N	04 05.9E	21	4	23-SEP-90	23	V		PNSP/RCM#9652	CMD		CS
CH72A	52 12.3N	04 09.0E	22	22	23-SEP-90	23	W		PNSP/#67749-7	WAVE		AB
CH72A	52 12.5N	04 09.6E	21	16	23-SEP-90	23	V		PNSP/S4#05451306	CMD		AB
CH72A	52 12.5N	04 09.6E	21	10	23-SEP-90	23	V		PNSP/S4-05451308	CMD		AB
CH72A	52 12.5N	04 09.0E	22	22	23-SEP-90	23	M		PNSP/	MET		AB
CH72A	52 14.9N	04 03.7E	21	.5	23-SEP-90	23	V		PNSP/PDP#2A	ADCP		CK
CH72A	52 14.9N	04 03.7E	21	.5	23-SEP-90	23	P		PNSP/WLR#500	PRES		CK
CH72A	52 14.9N	04 03.9E	21	20	23-SEP-90	23	X		PNSP/#04	TRANS		CK
CH72A	52 14.9N	04 03.9E	21	20	23-SEP-90	23	TS		PNSP/#5228	T/S		CK
CH72A	52 14.9N	04 03.9E	21	20	23-SEP-90	23	V		PNSP/S4#05451264	CMD		CK
CH72A	52 14.9N	04 03.9E	21	11	23-SEP-90	23	V		PNSP/RCM#9680	CMD		CK
CH72A	52 14.9N	04 03.9E	21	7	23-SEP-90	23	V		PNSP/RCM#9634	CMD		CK
CH72A	52 14.9N	04 03.9E	21	3	23-SEP-90	23	V		PNSP/RCM#3308	CMD		CK
CH72A	50 56.5N	01 15.9E	32		24-SEP-90	24	V		PNSP/PDP#10A/SA	ADCP		
CH72A	50 56.5N	01 15.9E	32		24-SEP-90	24	P		PNSP/WLR#1038/SA	PRES		
CH72A	53 30.0N	03 00.2E	31	.5	26-SEP-90	22	V		PNSP/PDP#7	ADCP		
CH72A	53 30.0N	03 00.2E	31	.5	26-SEP-90	22	V		PNSP/RCM#9959	CMD		
ALK	50 56.5N	01 17.7E	33		18-OCT-90	33	V		PNSP/PDP#4A/SA	ADCP		
ALK	50 56.5N	01 17.7E	33		18-OCT-90	33	P		PNSP/WLR#915/SA	PRES		
ALK	50 56.6N	01 16.1E	33	6	18-OCT-90	34	X		PNSP/SA	TRANS		
ALK	50 56.6N	01 16.1E	33	4	18-OCT-90	34	V		PNSP/RCM#5229/SA	CMD		
ALK	50 56.6N	01 16.4E	33		20-NOV-90		V	8379	PNSP/PDP#10A/SA	ADCP		
ALK	50 56.6N	01 16.4E	33		20-NOV-90		P	8380	PNSP/WLR#1038/SA	PRES		
ALK	50 56.6N	01 16.4E	33	6	21-NOV-90		X		PNSP/SA	TRANS		
ALK	50 56.6N	01 16.4E	33	4	21-NOV-90		V		PNSP/RCM#7570/SA	CMD		

NB. Meter height and water depth measured in Metres.

APPENDIX 3

North Sea Cruise timetable for RRS Challenger, April 1988 - October 1989

Cruise No.	Dates	Principal Scientist	Cruise Interest
28/1988	29 Apr - 15 May	M.J. Howarth, POL	Shakedown
33/1988	04 Aug - 16 Aug	M.J. Howarth, POL	Survey
34/1988	18 Aug - 01 Sep	J.H. Simpson, UNCW	Fronts - nearshore
35/1988	03 Sep - 15 Sep	J. Watson, DML	Survey
36/1988	16 Sep - 30 Sep	A.E. Hill, UCNW	Fronts - mixing
37/1988	02 Oct - 14 Oct	J.M. Huthnance, POL	Survey
38/1988	24 Oct - 31 Oct	D.A. Huntley, PSW	Sand waves
39/1988	01 Nov - 13 Nov	D.J. Hydes, IOSDL	Survey
40/1988	15 Nov - 29 Nov	M. Collins, SUDO	Sandbanks
41/1988	01 Dec - 13 Dec	J. Watson, DML	Survey
42/1988	15 Dec - 29 Dec	A. Morris, PML	Plumes/Sandbanks
43/1989	30 Dec - 12 Jan	D.J. Hydes, IOSDL	Survey
44/1989	13 Jan - 27 Jan	A. Morris, PML	Resuspension
45/1989	28 Jan - 10 Feb	J. Watson, DML	Survey
46/1989	12 Feb - 26 Feb	A. Morris/D.A.Huntley	Plumes/Sand waves
47/1989	27 Feb - 12 Mar	P.S. Liss, UEA	Survey
48/1989	13 Mar - 27 Mar	A.J. Watson, PML	Air/sea exchanges
49/1989	29 Mar - 10 Apr	P. Tett, UCNW	Survey
50/1989	12 Apr - 25 Apr	J.D. Burton, SUDO	Blooms/chemistry
51/1989	27 Apr - 09 May	A. Morris, PML	Survey
52/1989	11 May - 24 May	C.R. Griffiths, DML	Resuspension
53/1989	26 May - 07 Jun	J. Watson, DML	Survey
54/1989	09 Jun - 22 Jun	I.R. Joint, PML	Production
55/1989	24 Jun - 07 Jul	J.H. Simpson, UCNW	Survey
56/1989	08 Jul - 22 Jul	I.D. James, POL	Fronts - circulation
57/1989	24 Jul - 06 Aug	P. Tett, UCNW	Survey
58/1989	07 Aug - 21 Aug	A.E. Hill, UCNW	Fronts - mixing
59/1989	23 Aug - 04 Sep	J. Watson, DML	Survey
60/1989	06 Sep - 19 Sep	M.R. Preston, L'pool	Resuspension
61/1989	21 Sep - 03 Oct	I.R. Joint, PML	Survey
62/1989	05 Oct - 19 Oct	A.J. Watson, PML	Air/sea exchanges

Additional cruises with a North Sea interest since October 1989

Cruise No.	Dates	Principal Scientist	Cruise Interest
62A/1989	23 Oct - 03 Nov	N. Owens, PML	Blooms
64/1990	03 Apr - 03 May	N. Owens, PML	Blooms
65/1990	06 May - 17 May	A. Morris, PML	Humber Plume
66A/1990	20 May - 31 May	M.J. Howarth, POL	Survey
66B/1990	03 Jun - 18 Jun	D. Prandle, POL	Contaminants through Dover Strait
69/1990	26 Jul - 07 Aug	A. Morris, PML	Resuspension/Plumes
72A/1990	20 Sep - 02 Oct	J.M. Huthnance, POL	Survey
72B/1990	04 Oct - 06 Oct	D.A. Huntley, PSW	Sand waves/STABLE
72C/1990	06 Oct - 19 Oct	J.H. Simpson, UNCW	Rhine plume

APPENDIX 4

The host laboratory with the greatest involvement, including coordination and management, is the

Proudman Oceanographic Laboratory

Director	Dr. B.S. McCartney
Scientific Coordinator	Dr. J.M. Huthnance
Survey Coordinator	Mr. M.J. Howarth
Modelling Coordinator	Dr. D. Prandle
Project Manager	Mr. M.W.L. Blackley

PARTICIPANTS IN THE NORTH SEA PROJECT

Survey

Density/Dynamics	M.J. Howarth (POL)
Suspended sediments	K.R. Dyer (PSW)
Phytoplankton	I.R. Joint (PML)
Nutrients	D. Hydes (IOSDL)
Trace metals	D. Burton/P. Statham (SU)
Trace metals (particulates)	G. Millward (PSW)
Air/Sea fluxes - trace metals	R. Chester (LU)
- organics	M. Preston (LU)
- in rain	T. Jickells (UEA)
- large aerosols	R. Harrison (EU, Chemistry Dept.)
Benthic fluxes - cores	D. Nedwell (EU, Biology Dept.)
- radionuclides	D. Assinder (UCNW)
Oxygen	D. Purdie (SU)
Biogenic trace gases	P. Liss (UEA)
Zooplankton	M. Baars (NIOZ)
Decca/Argos buoys	E. Roberts/J. Last (UCNW, Elect. Eng.)
Methylated metals in estuaries	G. Millward (PSW)

Process studies

Fronts - mixing	P. Linden/E. Hill (Cambridge/UCNW)
- nearshore	J. Simpson/J. Matthews/D. Prandle (UCNW/ UCNW/POL)
- circulation	J. Howarth/I. James (POL)
Sandwaves	M. Collins/J. Huthnance (SU/POL)
Plumes	A. Morris (PML)
Resuspension/sediment characteristics	A. Morris/C. Jago (PML/UCNW)
Air/Sea exchange	A. Watson (PML)
Production	I. Joint (PML)
Bloom/Chemistry	D. Burton (SU)
Phytoplankton time series	P. Tett (UCNW)
Cohesive Sediments	R. Dickson/C. Vincent/N. McCave (MAFF/UEA/ Cambridge)
Modelling Coordination	D. Prandle (POL)
Data handling/storage	BODC (POL)

BODC	British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside. L43 7RA
Cambridge	DAMTP University of Cambridge, Silver Street, Cambridge, CB3 9EW
EU	University of Essex, Wivenhoe Park, Colchester. CO4 3SQ
IOSDL	Institute of Oceanographic Sciences Deacon Laboratory, Brook Road, Wormley, Godalming, Surrey. GU8 5UB
LU	Department of Earth Sciences, Oceanography Laboratories, University of Liverpool, P.O. Box 147, Liverpool. L69 3BX
MAFF	Ministry of Agriculture, Fisheries and Food, Lowestoft, Suffolk. NR33 0HT
NIOZ	Netherlands Institute for Sea Research, Postbox 59, Den Burg, Texel, Netherlands.
PML	Plymouth Marine Laboratory, Prospect Place, The Hoe, Plymouth. PL1 3DH
POL	Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside. L43 7RA

PSW	Polytechnic South West, Institute of Marine Studies, Drake Circus, Plymouth. PL4 8AA
SU	Southampton University, Department of Oceanography, The University, Southampton. SO9 5NH
UCNW	School of Ocean Sciences, University College of North Wales, Menai Bridge, Gwynedd. LL59 5EY
	School of Electronic Engineering Sciences, University of Wales, Bangor, Gwynedd. LL57 1HT
UEA	School of Environmental Sciences, University of East Anglia, Norwich. NR4 7TJ