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RRS CHALLENGER

CRUISE 66/90 LEG 1

20-31 MAY 1990

NORTH SEA SURVEY

CRUISE REPORT NO.8

1990

NATURAL ENVIRONMENT RESEARCH COUNCIL

PROUDMAN
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North Sea Survey

Principal Scientist

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ABSTRACT

This report describes the first leg of "RRS CHALLENGER" cruise 66/90, from 20 - 31 May, 1990; Hull to Hull. The cruise followed on from the North Sea Project survey cruises, with the intention of obtaining data in May for the third consecutive year. 10 moorings were deployed at 6 sites, 3 in the Dover Strait preparatory to leg 2, and 3 at 'survey' sites in the southern North Sea. Three day's of measurements and one day's sea time were lost at the end of the cruise when the ship's auto-pilot failed, so that 38 out of a planned 120 CTD sites were not visited. The missed CTD stations stretched from the Tyne to the Humber and out to the Dogger Bank, the rest of the survey track being covered.

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CHALLENGER/RRS-CRUISE (1990)	(66 - Leg 1)	*PRICE*

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CRUISE OBJECTIVES

1. To follow a set track around the southern North Sea (Figure. 1) making continuous measurements of :-

a) Sea surface temperature, conductivity and transmittance.

b) Air/sea fluxes.

c) Current profiles, with Challenger's acoustic doppler current profiler (ADCP).

2. At 120 sites along the track (Figure 2) :-

a) To record CTD profiles of temperature, conductivity and transmittance.

b) To obtain water samples with a rosette sampler for calibration of the CTD conductivity and temperature sensors and to determine suspended sediment loads.

3. To deploy moorings at (Figure 1) :-

a) Sites A, B and C in the Dover Strait - a recording transmissometer and a 1 Mhz sea-bed ADCP at each site.

b) Sites F and G - S4 current meters.

c) Site H - thermistor chain and a 250 kHz sea-bed ADCP.

The recovery of the moorings is scheduled for the end of leg 2.

4. To obtain cores and water samples from the six survey coring sites.

5. To call at Esbjerg to collect a sea-bed ADCP which had drifted ashore in Denmark.

NARRATIVE

Prior to sailing the ship ADCP electronics and sensor head were reinstalled, having been overhauled by the manufacturer. Despite all efforts by the technical staff the instrument could not be persuaded to operate. Since further attempts to make the ADCP operational would have seriously delayed the start of the cruise, its use was foregone for this leg and the cruise destination changed from Great Yarmouth to Hull again, to enable divers to check the head. In addition it was arranged for the UK agent for RD Instruments and a spare instrument from RVS to meet the ship when she docked.

RRS Challenger left Hull on time, at 07.00 GMT on 20 May 1990. After the pilot had left, the first CTD profile, DQ, was recorded at 11.20, Table 1. The track was then followed into the Wash and round East Anglia to be at mooring site F for first light the next day. The u-shaped current meter mooring was deployed from 05.12 to 05.42 on 21 May, followed by a similar mooring at G, 12.07-12.30, Table 2. In order to have plenty of daylight in the Dover Strait for the mooring deployments the next day CTD stations AF, AG and AH were missed, with the intention of visiting them later. CTD stations AI and AJ were completed but at AK the CTD failed, with data from the CTD not reaching the deck unit in an intelligible form. After checking the deck unit and the cable the fault appeared to be within the probe. Challenger hove to at AK whilst the fault was studied. From 19.54 to 21.48 the acoustic releases for the transmissometer moorings at A, B and C were successfully wire tested. At 23.00 a course was set for the mooring sites in the Dover Strait, the problem with the CTD not yet having been diagnosed and as a result CTD stations AK - AP were omitted.

Between 09.43 and 14.55 22 May six moorings were deployed at sites A, B and C - a transmissometer mooring and a sea-bed ADCP at each. By 10.00 the fault in the CTD had been rectified - a broken connection within the probe. The CTD was successfully tested at site B. After the deployments the survey track was rejoined at AQ and was followed along the Dutch coast, including AH, AG and AF. Several attempts were made to obtain cores with the Craib corer, without success since the sea bed was sandy. At AE a Day grab was used and some (sandy) sediment recovered. Also at AE the toroid and pellets of mooring G were sighted. The survey track was followed to mooring site H (BB), when sites DV, DU and DW were visited in order to return to H for 06.00 for the deployments. The thermistor chain mooring was duly deployed from 06.10-06.19 24 May and the sea-bed ADCP at 06.28. A sediment sample was obtained with the Day grab.

For the rest of 24 May and all of 25 and 26 May the zig-zag track was followed towards the Dutch coast and into the German Bight. Every few stations a Day grab sediment sample was obtained. Since the pilot at Esbjerg had been booked for 07.00 27 May and since CF was reached at 18.27 26 May CG, CH and an extra station - ET at 55 10N 7 00E - were recorded before docking at Esbjerg at 08.00 27 May. The ADCP was collected and, in addition, a waverider which the pilot had informed us was also there. The waverider had been deployed during Challenger 60, as part of the resupension experiment, but was absent when recovery was attempted. Challenger left Esbjerg at 10.30, resuming its westward course along the 55 30N line, with CI at 17.49. In the vicinity of CS, from 5 miles to the west to 5 miles to the east an unsuccessful attempt was made to contact a lost ADCP, which had been deployed on Challenger

39. The English coast was reached at 04.30 29 May. On the way south, towards the Tyne, the auto-pilot failed. After three unsuccessful attempts to repair it, Challenger anchored off the mouth of the Tyne, at 10.30, to await a service engineer. Spare parts were ordered from London but in the first instance the wrong part was sent. When the engineer returned, at 13.00 30 May, he was unable to effect a repair. The cruise was then terminated and Challenger steamed to Hull, docking at 08.00 31 May, one day early.

Only two of the five objectives were met in full, 2 - the mooring deployments - and 5 - the visit to Esbjerg. The remaining three objectives were all affected by the loss of three day's steaming at the end of the cruise, because of the failure of the auto-pilot. This was disappointing since Challenger had been making good time round the track, both because of the reasonable weather and because she was moving quicker through the water between stations as a result of having her hull cleaned during her recent refit. If the auto-pilot had not failed there was every expectation of completing the track fully. In the end 38, out of the planned 120, CTD stations were not visited. Objective 1c (the ship ADCP) was not met at all, since the instrument failed to work after re-installation. In fact the cruise was dogged by a series of equipment failures both on the scientific and the marine side. In addition to those mentioned immediately above, on the scientific side, the CTD failed, and 6 stations were lost whilst it was repaired; an electrical fault in the CTD wire necessitated its shortening by 60m; the laboratory salinometer and the MUFAX both needed servicing and cleaning before they worked properly; the CTD level A needed replacing; both the level B and the computer master clock needed restarting on numerous occasions. On the marine side following the rupture of a hydraulic pipe the crane collapsed in a potentially dangerous fashion; and a gyro compass failed.

INDIVIDUAL PROJECT REPORTS

CTD AND SURFACE MONITORING EQUIPMENT (D PHILLIPS)

CTD.

87 CTD profiles were completed, Table 1, and at each a salinity and a temperature check were performed. One problem only occurred, which caused the loss of six stations (AK,AL,AM,AN,AO,AP). The CTD was dismantled and after several hours a broken connection was found on the backplane wiring. Once this had been fixed the CTD worked until the end of the cruise. Also during the trip the wire was reterminated once (and the cable shortened by 60m), when a data dropout occurred at 50m on several profiles. The CTD salinities were on average 0.017 PSU lower than those determined with the Autosal. The CTD temperatures were approximately 0.010 degC high compared with digital reversing thermometers (s/n 253 & 255). On every cast the rosette was used without any problems. Again the GO-FLO bottles needed some cleaning to loosen the ball valves.

PES.

The PES was used at every station to track the CTD above the sea bed, but the signals produced and received were fairly poor. In addition the trace jumped erratically on the chart. The circuit boards were cleaned, resulting in a stronger signal and the trace not jumping.

Monitoring equipment.

The winch monitoring equipment had a slight hiccup at the start when it would not reset, but this cured itself and from then on performed well. A BBC micro was used in the plot to relay Decca position and Simrad depth to a monitor in the main laboratory. This proved invaluable during the station work.

Autosal.

At the beginning of the cruise the Autosal would not stabilise, making it impossible to standardise. This instability resulted in very poor salinity values for the first 25 samples (stations DQ to AF). After this an attempt was made to clean the circuit boards to try to prevent the fluctuations. This had a limited success but it was sufficient to make the Autosal operational.

Surface instruments.

There were four instruments recording surface water, two Sea-Tech 25cm transmissometers, one Chelsea Instruments fluorimeter and a Grundy 6620 thermosalinograph. Both the transmissometers and the fluorimeter performed well and were kept clean on a daily basis. The only problem with the thermosalinograph was that the watchkeepers had to change the range, and hence there were times when the instrument was not on the correct range, resulting in a full scale output. A close watch was not kept on the thermosalinograph due to other problems, but a rough indication is that the temperature was 0.04 degC high and the salinity 0.05 PSU low.

SUSPENDED SEDIMENTS (T MOFFAT)

Continuous surface profiles of optical transmission / attenuance were made along the survey track using two deck-mounted transmissometers linked into the ship's non-toxic water supply. Vertical profiles of optical transmission / attenuance were taken at each CTD station. Calibration water samples were taken at 3 depths (surface, middle and bottom) at 36 CTD stations, Table 1. 61 water samples, from 19 CTD stations, were analysed for particle size using a model 180XY Elzone Particle Analyser. 17 large volume water samples (165 litres of water), from 7 CTD stations, were "pressure" filtered for subsequent mineralogical analysis.

Not unexpectedly, living organic material in the sea water proved to be problematical, resulting in easily clogged up filters and blocked Elzone orifice tubes. With respect to the large volume filters, it is a distinct possibility that not enough inorganic material will be available for complete mineralogical analysis.

The optical transmission / attenuance observations seemed to show the now well established distribution pattern of suspended sediments for this time of year. Much of the survey area was characterized by low turbidity and low suspended sediment concentrations. Organic material made up a predominant proportion of the sediment, especially in those areas associated with the spring algal blooms, such as the coastal waters off the Dutch coast and in the German Bight. Higher turbidities and concentrations were associated with the coastal waters off East Anglia and in the Humber plume. By contrast, the lowest turbidities and concentrations were associated with the northernmost part of the survey area.

Variations with water depth were consistent with previous surveys. In the southern part, the water column was well mixed giving fairly uniform concentration profiles with depth. However, some stations in the German Bight showed near-bottom higher concentrations - resuspension events associated with the prevailing northerly swell. In the stratified, northernmost part of the survey area, variations with water depth, especially in the thermocline region, were associated with water column biological activity. At some stations there was evidence for living biological activity well below the thermocline. The clarity of the water allowing for the penetration of light to the sea bed (and the availability of near-bottom nutrients) presumably permitted this activity.

SHIP-MOUNTED ADCP (J HOWARTH, D PHILLIPS)

The ADCP did not work because of faulty re-installation of the sensor head - a plug was inserted the wrong way round. By the time this was realised it was too late to recall the diving team, without seriously delaying the start of the cruise.

MOORED ADCPS, CURRENT METERS AND THERMISTOR CHAIN (J HOWARTH, D FLATT)

Four sea-bed ADCPs, two 'U' shaped current meter moorings and a single strand thermistor chain mooring were successfully deployed, Table 2. Challenger's two auxilliary winches and deck arrangement are ideal for rig deployments, provided that, as for this cruise, no containers are carried.

MOORED TRANSMISSOMETERS (R WILTON)

Three pop-up moorings were deployed in the Dover Strait area, each consisting of a logging transmissometer designed by UCNW, which sampled every minute, at 5.5m above the sea bed, and an Aanderaa RCM4 current meter at 4m above the sea bed, Table 2. Due to the fault on the CTD, the transmissometers were calibrated against the surface monitoring Sea-Tech transmissometer, prior to the first deployment (A). This was achieved by suspending the transmissometers from the hydro wire at a depth of 3m and noting the readings from the Sea-Tech transmissometer over a period of approximately 20 minutes. During this period a 25l water sample was taken from the outflow of the Sea-Tech transmissometer and filtered.

AIR-SEA FLUXES (C OTTLEY, N NELSON)

Objectives.

1) To obtain samples of atmospheric chlorides, nitrates and ammonia using filter packs.
2) To test how effective the Denuder Tube method for obtaining these atmospheric constituents works at sea.
3) To measure continuously nitrogen dioxide using a Scintrex analyser.
4) To determine the atmospheric particle size distribution for nitrates and ammonium salts.
5) To collect rainwater at sea.

Results.

1) Filter packs.

The setting up and running of these devices was quite straight forward and by the end of the cruise 11 samples had been obtained. As with all sampling devices, information as regards to the time, ship's position, wind speed and direction and ambient temperature were recorded during the sampling periods. The facilities provided on board ensured that the changing of filters could be performed in 'clean' surroundings.

2) Denuder Tube.

The Denuder Tube method is a very sensitive and reliable method, however, even in ideal conditions on land it can be a very tricky method to perform effectively. The setting up of this method at sea was, therefore, expected to be quite difficult. Due to a combination of factors which included rough seas, tube breakage and badly designed tubes, only four samples were obtained. The experience at sea has afforded the opportunity to make some design changes which affect the extraction process.

3) Scintrex analyser.

With the aid of a sampling probe attached to a bamboo rod which extended over a metre and a half out on the starboard side of the ship, it was possible to analyse the ambient nitrogen dioxide levels away from possible contamination on board the ship. To work effectively a wind from the starboard was necessary, and was obtained on many occasions. On the other occasions when the wind was from the port side or when the ship performed manoeuvres which may have caused contamination (ie funnel smoke), either the analyser was switched off or the actions were noted in a log book. Apart from the stops made at Esbjerg and off North Shields the analyser performed continuously and, it was envisaged, effectively.

4) Particle size distribution.

The use of isokinetic sampling equipment is essential if correct particle size distributions are to be realised. This is particularly important as large particles may dominate the total fluxes to the water surface. Despite prolonged periods of moderately rough weather a good sample has been collected which should allow particles of between 20μm and 0.5μm to be quantitatively measured.

5) Rainfall

No prolonged periods of rain were encountered.

REDUCED ORGANIC SULPHUR IN SEAWATER AND CORES (T SHABBEER)

A gas chromatograph equipped with a flame photometric detector (GC-FPD) was installed and operated on board in order to determine reduced organic sulphur compounds. Seawater and sediment samples were obtained at stations AE, BB, ER, BJ, BO, BT, CB, CF, ES, CO and CS using GO-FLO water bottles and a Day grab, respectively. A Craib corer was also used to obtain intact sediment cores but without success.

Seawater samples were analysed immediately as well as some sediment samples. However, the majority of sediment cores were stored under nitrogen and removed for future analysis. The only sulphur compounds detected in both seawater and sediment samples were dimethylsulphide (DMS) and its precursor molecule dimethylsuplhoniopropionate (DMSP).

COMPUTER (K BATTEN)

The computer system aboard Challenger for this cruise consisted of the RVS 'ABC' system. Data were logged from various instruments: em log, gyro, Decca navigator, MX1107 satellite navigator, light meters, solar integrator, thermosalinograph, fluorescence and temperature, Simrad depth recorder and the CTD.

Multiple plots were produced of each CTD dip and contours were generated of various transects of CTD dips. Plots of the surface samples, light sensor readings and depth records, and cruise track were produced daily. At the end of the cruise surface contours were produced of temperature, salinity, fluorescence and transmittance.

Problems were encountered with the Level B during this cruise causing some loss of data. Where its failure was noticed quickly however, the loss was minimal. Also the CTD Level A caused concern over its failure to start logging on occasions. Boards were changed in the CTD level A, however a large amount of data drop-out was then noticed. Further board changes followed but due to the curtailment of this cruise, the Level A could not be tested in anger.

Table 1.
CTD Station list.

Stn. No.	Site	Start Position Lat.	Long.	Depth m	Start Time Yr	Day	Hr.Min	Work Code
3053	DQ	53 29.8N	0 24.0E	16	90	140	11.18	A,S,P
3054	EL	53 20.0N	0 30.1E	19	90	140	12.28	A,L
3055	EM	53 9.9N	0 31.3E	24	90	140	13.45	A,S
3056	EN	53 5.0N	0 29.9E	36	90	140	14.30	A,P
3057	EO	53 13.0N	0 47.2E	22	90	140	16.24	A,S,P
3058	EP	53 1.0N	1 3.9E	17	90	140	18.09	A,S,P
3059	EQ	53 1.2N	1 26.8E	27	90	140	19.50	A
3060	AA	52 44.2N	1 57.1E	37	90	140	23.17	A,S,P
3061	AB	52 40.6N	2 25.4E	51	90	141	05.52	A
3062	AC	52 40.0N	2 49.9E	44	90	141	07.42	A,S
3063	AD	52 38.0N	3 15.1E	34	90	141	09.37	A
3064	AE	52 37.1N	3 46.0E	31	90	141	11.50	A,S
3065	AI	52 28.0N	3 42.2E	27	90	141	13.54	A
3066	AJ	52 21.4N	3 15.8E	40	90	141	15.55	A
3067	RIGB	50 47.0N	1 14.5E	28	90	142	11.45	A
3068	AQ	51 3.2N	1 49.3E	28	90	142	17.23	A,S
3069	AR	51 28.1N	2 40.4E	34	90	142	22.45	A
3070	AS	51 45.3N	3 0.2E	35	90	143	01.03	A,S
3071	AT	51 50.1N	3 22.0E	30	90	143	02.53	A
3072	AU	52 8.0N	3 30.2E	27	90	143	05.21	A,S,P
3073	AV	52 12.8N	3 51.9E	23	90	143	07.12	A,L
3074	AW	52 20.9N	3 59.8E	24	90	143	08.35	A,S,P
3075	AH	52 34.4N	4 8.9E	25	90	143	10.23	A
3076	AG	52 37.1N	4 19.9E	21	90	143	11.36	A,S,P
3077	AF	52 37.3N	4 0.0E	27	90	143	13.06	A,L
3078	AE	52 37.1N	3 46.3E	29	90	143	14.46	C,S,P
3079	AY	52 46.9N	3 37.1E	32	90	143	16.05	A
3080	AZ	52 59.9N	3 26.3E	29	90	143	17.48	A,S,P
3081	BA	53 11.9N	3 16.1E	28	90	143	19.38	A
3082	BB	53 30.0N	2 59.7E	31	90	143	22.16	A,S
3083	DV	53 34.2N	2 34.7E	28	90	144	00.04	A,S
3084	DU	53 35.1N	2 9.8E	21	90	144	01.53	A,S
3085	DW	53 45.3N	2 44.5E	36	90	144	04.16	A,S,P
3086	BB	53 30.3N	3 0.1E	33	90	144	06.38	C
3087	BC	53 24.5N	3 27.0E	30	90	144	08.36	A,L
3088	BD	53 17.9N	3 59.9E	27	90	144	10.55	A,S,P
3089	BE	53 13.6N	4 19.7E	29	90	144	12.33	A
3090	BF	53 10.1N	4 37.0E	21	90	144	13.54	A,S,P,L
3091	BG	53 39.0N	4 50.2E	32	90	144	17.18	A
3092	ER	53 37.2N	4 35.8E	32	90	144	18.32	C
3093	BH	53 55.0N	4 50.1E	42	90	144	21.27	A,S

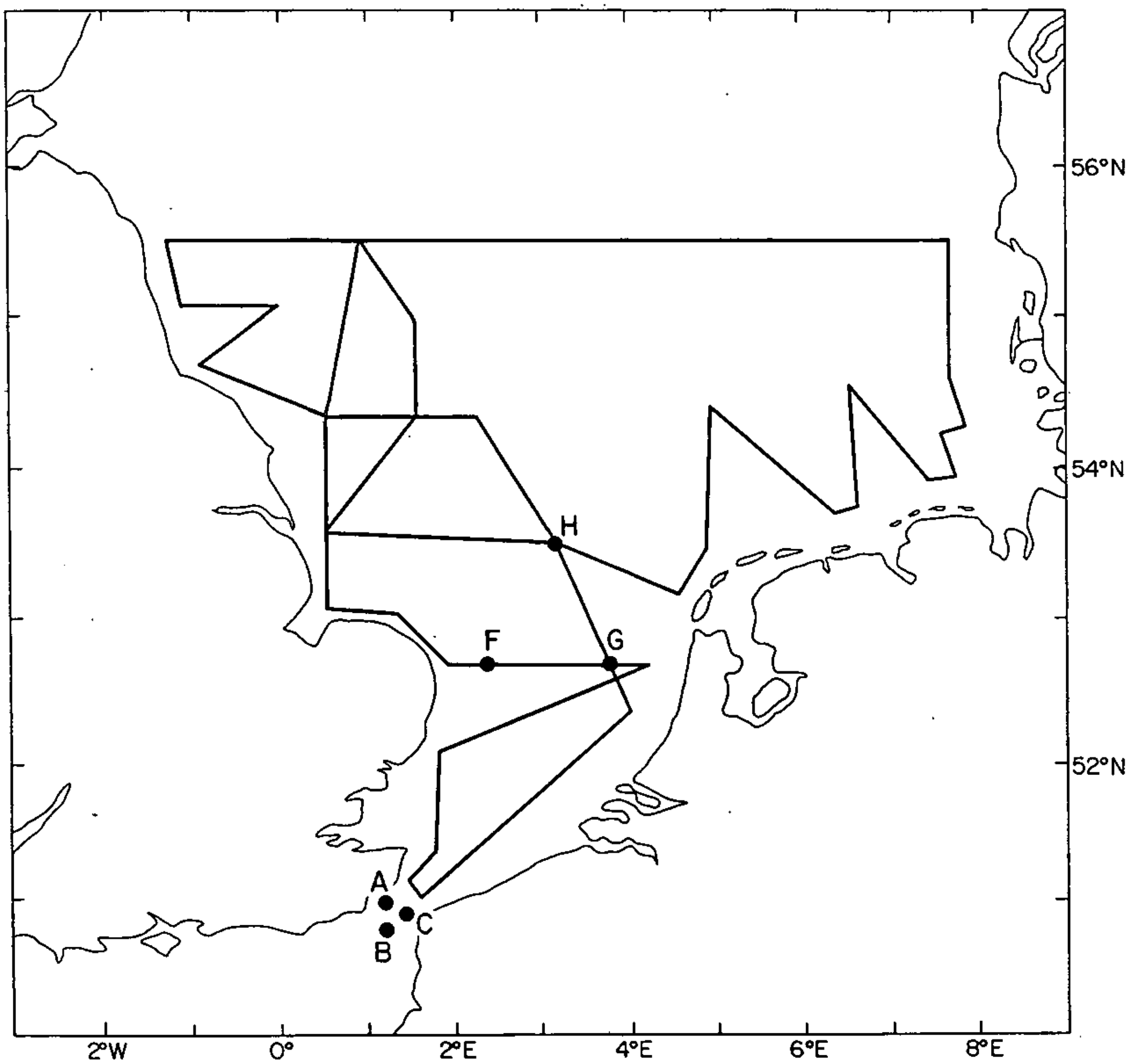
Stn. No.	Site	Start Position Lat.	Long.	Depth m	Start Time Yr	Day	Hr.Min	Work Code
3094	BI	54 14.8N	4 49.7E	46	90	145	00.14	A
3095	BJ	54 34.9N	4 49.7E	48	90	145	02.50	C,S,P
3096	BK	54 19.0N	5 14.9E	43	90	145	05.34	A
3097	BL	54 3.0N	5 40.2E	38	90	145	07.52	A,S,P
3098	BM	53 56.5N	5 50.4E	35	90	145	09.05	A,L
3099	BN	53 50.0N	6 0.1E	31	90	145	10.09	A
3100	BO	53 39.1N	6 9.9E	26	90	145	11.51	C
3101	BP	53 43.2N	6 29.5E	22	90	145	13.50	A,S
3102	BQ	53 55.0N	6 24.4E	26	90	145	15.29	A
3103	BR	54 6.0N	6 24.6E	33	90	145	17.09	A,S
3104	BS	54 19.9N	6 25.1E	38	90	145	19.01	A
3105	BT	54 35.0N	6 25.1E	40	90	145	21.13	C
3106	BU	54 24.9N	6 42.5E	38	90	145	23.05	A,S
3107	BV	54 15.1N	6 59.8E	38	90	146	00.43	A
3108	BW	54 6.0N	6 59.7E	35	90	146	02.05	A,S
3109	BX	54 0.6N	7 13.6E	31	90	146	03.23	A
3110	BY	53 49.5N	7 19.9E	24	90	146	05.02	A,S,P
3111	BZ	54 11.5N	7 28.1E	39	90	146	08.06	A
3112	CA	54 16.1N	7 45.1E	27	90	146	09.21	A
3113	CB	54 25.0N	7 40.1E	28	90	146	11.03	C,S
3114	CC	54 40.1N	7 39.8E	23	90	146	13.11	A
3115	CD	54 55.1N	7 39.8E	22	90	146	14.50	A,S
3116	CE	55 10.0N	7 39.9E	22	90	146	16.30	A
3117	CF	55 27.0N	7 39.6E	25	90	146	18.28	C
3118	CG	55 29.9N	7 20.0E	28	90	146	20.06	A
3119	CH	55 30.0N	6 59.9E	29	90	146	21.40	A
3120	ET	55 9.8N	6 59.9E	37	90	146	23.50	A
3121	CI	55 30.0N	6 30.0E	43	90	147	17.50	A,S
3122	ES	55 30.0N	6 5.7E	50	90	147	19.30	C
3123	CJ	55 30.0N	5 60.0E	50	90	147	20.44	A
3124	CK	55 29.9N	5 30.3E	51	90	147	22.52	A
3125	CL	55 30.1N	4 58.8E	44	90	148	00.59	A
3126	CM	55 30.2N	4 30.5E	32	90	148	02.59	A
3127	CN	55 30.1N	3 45.0E	34	90	148	05.42	A,P
3128	CO	55 30.1N	3 9.9E	37	90	148	07.56	C
3129	CP	55 30.1N	2 35.0E	48	90	148	10.22	A,S
3130	CQ	55 30.4N	2 1.9E	65	90	148	13.08	A
3131	CR	55 30.0N	1 24.7E	74	90	148	15.24	A
3132	CS	55 29.9N	0 53.9E	85	90	148	17.49	C,S,P
3133	CT	55 30.0N	0 24.1E	75	90	148	20.35	A
3134	CU	55 30.0N	0 3.9W	74	90	148	22.32	A,S
3135	CV	55 30.0N	0 32.1W	63	90	149	00.29	A
3136	CW	55 29.7N	0 52.4W	94	90	149	01.52	A,S
3137	CX	55 30.1N	1 12.0W	88	90	149	03.13	A
3138	CY	55 29.9N	1 32.7W	35	90	149	04.43	A,S,P
3139	CZ	55 20.0N	1 27.5W	49	90	149	05.53	A
3140	DA	55 9.9N	1 27.0W	39	90	149	07.38	A,L

Stations are numbered sequentially throughout the North Sea Project.
The nominal positions of the sites are displayed in Figure 2.
Work codes

A CTD and water bottles.
C CTD, water bottles and Day Grab.
L Large volume samples for mineralogical analysis.
P Particle size analysis.
S Suspended sediment calibration samples.

Table 2.
Mooring deployments.

Rig	Latitude N	Longitude E	Chain	Decca Red	Green	Purple	Water Depth (m)	Time Deployed	Instrument	Height above sea bed (m)
A	50 56.4	1 17.2	5B	D14.55	I32.37	-	36	0946 22/5/90	Transmiss # 6 RCM4 # 3308	5.5 4
	50 56.4	1 17.1	5B	D14.50	I32.50	-	36	1000 22/5/90	POLDOP # 4A WLR # 1038	Sea bed "
B	50 47.0	1 14.4	5B	D 8.32	I44.42	-	27	1227 22/5/90	Transmiss # 5 RCM4 # 5529	5.5 4
	50 47.1	1 14.4	5B	D 8.35	I44.40	-	27	1235 22/5/90	POLDOP # 9A WLR # 1042	Sea bed "
C	50 52.3	1 31.9	5B	E 0.60	I32.14	-	29	1444 22/5/90	Transmiss # 4 RCM4 # 5913	5.5 4
	50 52.5	1 32.0	5B	E 0.82	I31.86	-	29	1455 22/5/90	POLDOP # 10A WLR # 915	Sea-bed "
F	52 40.5	2 24.8	2E	H 9.51	F32.00	H60.82	53	0542 21/5/90	S4 # 1306 S4 # 1308 RCM7 # 9960	35 20 7
G	52 37.7	3 46.1	2E	I 9.45	D36.52	A60.98	30	1230 21/5/90	S4 # 1195 RCM7 # 9633	12 7
H	53 29.8	3 00.5	2E	J 8.98	D41.15	E68.68	32	0619 24/5/90	Logger # 7 Chain # 118	6-26m below surface
	53 29.9	3 00.4	2E	J 9.03	D41.13	E68.83	32	0628 24/5/90	POLDOP # 7 RCM7 # 9631	Sea-bed "



	N	E	Rigs
A	50° 56·1'	1° 16·8	ADCP, TR
B	50° 47·0'	1° 14·5'	ADCP, TR
C	50° 52·5'	1° 32·0'	ADCP, TR
F	52° 41'	2° 25'	CM
G	52° 37'	3° 46'	CM
H	53° 30'	3° 00'	ADCP, TC

ADCP - Acoustic doppler current profiler in sea bed frame
TR - Transmisometer
CM - S4 current meter
TC - Thermistor chain

Figure 1. Planned survey track.

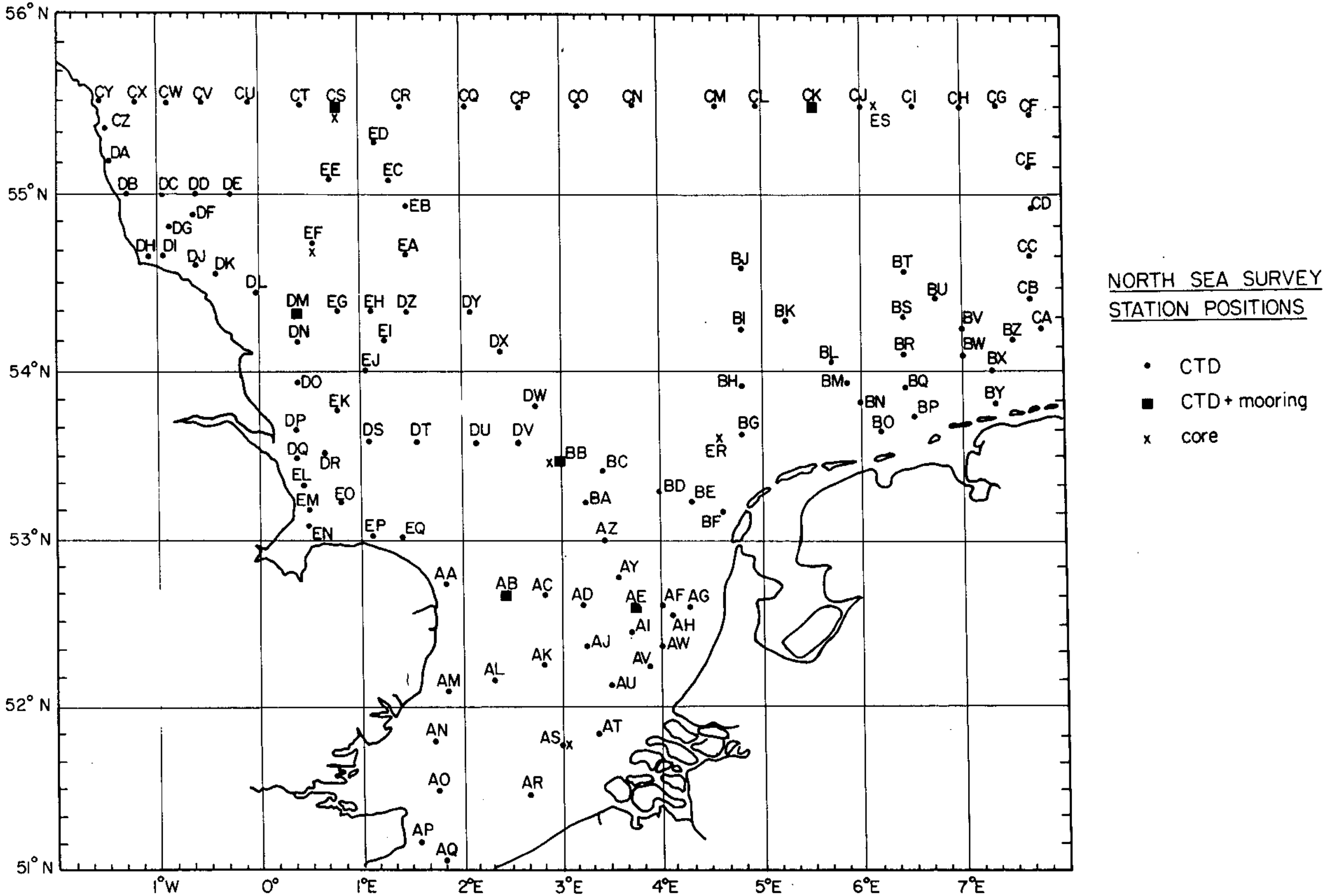


Figure 2. Nominal CTD positions.

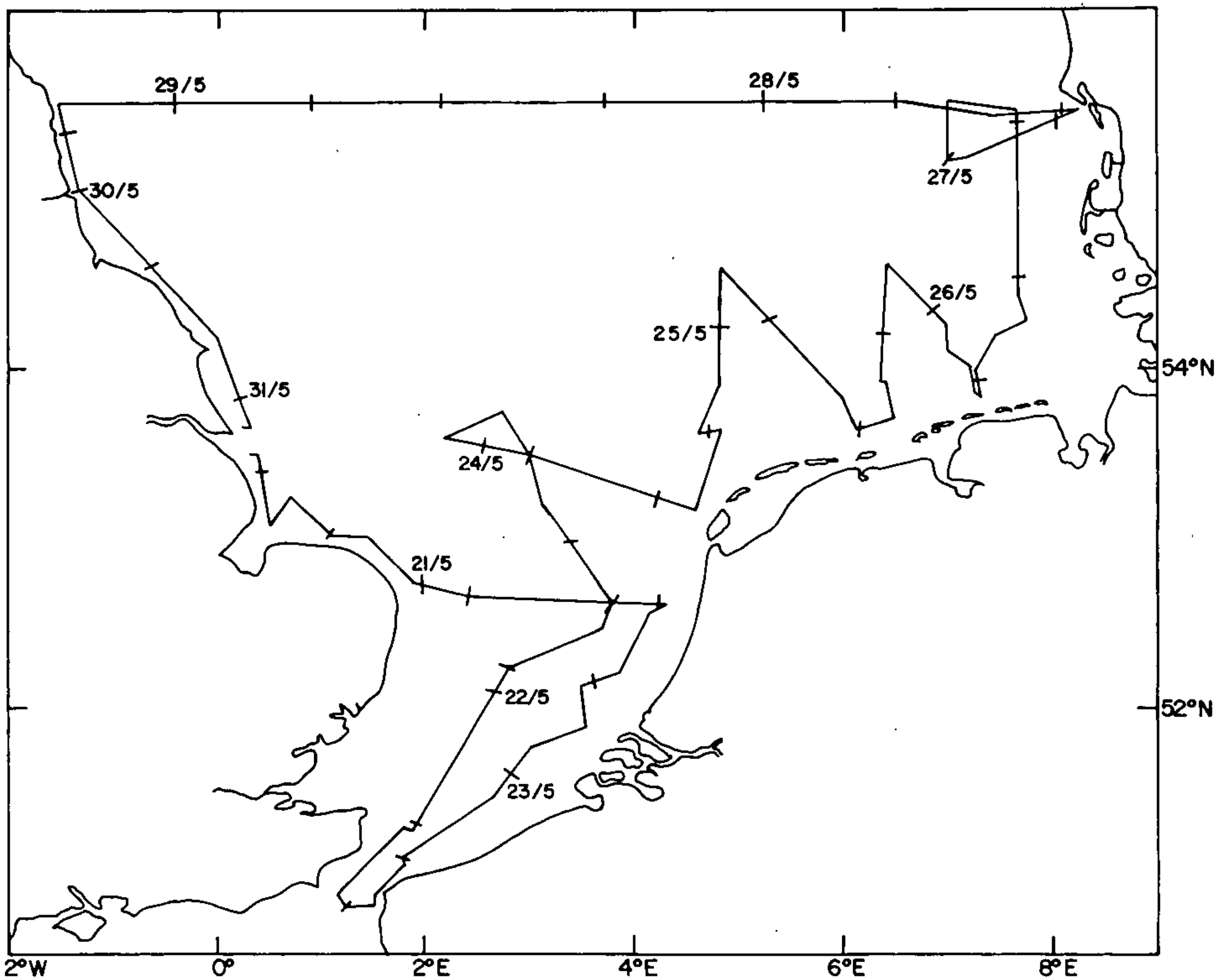


Figure 3. Cruise track. R.R.S. Challenger's position is marked every 6 hours.