RRS CHALLENGER
Cruise 40
15 to 29 November 1988

SEDIMENT AND WATER MOVEMENT IN THE VICINITY OF A NORTH SEA SANDBANK[1]

A joint cruise of Southampton University, Department of Oceanography and the Proudman Oceanographic Laboratory (Bidston)

March 1991

[1] This report should be referenced as Collins M B, 1991, RRS Challenger Cruise 30, 15 to 29 November 1988. Sediment and Water Movement in the vicinity of a North Sea Sandbank. Southampton: Southampton University, Department of Oceanography. 28 pp.

Contents

Appendices

LIST OF FIGURES

LIST OF TABLES

1 Objectives and Methodology

The cruise was undertaken as part of the North Sea Community Research Programme and represented, primarily, collaborative research between the Department of Oceanography of the University of Southampton and the Proudman Oceanographic Laboratory (POL) (Appendix A). The research objectives of the programme, centred around the Norfolk sandbanks in the southern North Sea (Fig 1), may be summarised as follows:

(a) to establish the influence of the sandbank field on regional water flow patterns, which have important implications on the modelling of residual flow and dispersion in this area;

and

(b) in terms of process studies, to understand the mechanisms involved in the formation and maintenance of linear sandbanks, with particular reference to sand and water movement.

In addition to addressing the objectives outlined above, some time on the cruise was made available to Plymouth Polytechnic (Institute of Marine Studies); this was to enable data to be collected from a sandwave field near the Dutch coastline, following instrument failures during previous cruises.

For the main Norfolk Sandbanks investigation, information was collected on both water and sediment movement.

Water movement was monitored through the use of: near-bed and mid-depth self-recording current meters, rotor-type and ultrasonic; the release and recovery of Decca-Argos surface drifter buoys; the deployment of STABLE (Sediment Transport and Boundary Layer Equipment); and, for the detection of vertical water movement, the deployment of (POL)

bottom-mounted pressure sensors. Most of these instruments were deployed and recovered during the course of the cruise, although some current meters and pressure sensors were left for recovery during a subsequent cruise (see Table 1). Finally, information on the vertical structure of currents in the water column was collected, continuously throughout the cruise, through the use of a shipborne ADCP (Acoustic Doppler Current Profiler).

Sediment movement was examined through the use of: the continuous monitoring of surface water conditions, for suspended sediment (turbidity) determinations; the deployment of a CTD system, with transmissometer attached, to determine the tidal-cycle variability in the structure of turbidity and its relationship to characteristics of the water masses; side-scan sonar, for the identification of bedforms (megaripples and sandwaves) in the vicinity of the sandbanks; the release of coloured fluorescent sand at two locations during the initial part of the cruise, with subsequent sampling towards the end of the cruise and on succeeding cruises (*RRS Challenger* and through charter of a local fishing vessel); and the deployment of STABLE, equipped with OBS (Optical Back Scatter) systems and a camera to detect bedform mobility. Finally, sub-surface geological conditions around the sandbanks were determined through the use of a 3.5 KHz sub-bottom profiling system.

The sea bed was sampled using a **Shipik** grab, with a camera attached for the collection of sea bed samples. When sampling for fluorescent sand, the recovered grab samples were sub-sampled using a small core tube.

Instrumentation for the cruise was obtained predominantly from Research Vessel Services (RVS), Barry and POL. Due to a general shortage of self-recording current meters at the time of the cruise, use was made also of meters available from Southampton (Department of Oceanography).

The succeeding text now describes the following aspects of the study:

(i) a description of the cruise programme (Days 320 to 333);

(ii) a summary of the cruise activities (including Days 328 to 331, sandwave study in Dutch waters by Prof D Huntley).

and

(iii) comments on the use of STABLE (by J Humphery);

Finally, an overall assessment of the success of the cruise programme (in terms of meeting the scientific objectives and the functioning of instrumentation) is presented. Suggestions for any improvements are included.

The Appendices include Technical Specifications of the equipment used.

2 Programme: A Summary (Days 320-334)

Against a background of generally favourable weather conditions, data were collected to fulfil all the scientific objectives of the cruise programme. Some moorings still have to be recovered; likewise, the successful functioning of the STABLE system needs to be confirmed. Only a single day was lost to adverse weather conditions, towards the end of the cruise, when winds reached up to 40 knots.

Details of the scientific party are listed in Appendix A.

The main research area centred around Broken Bank, within the Norfolk Banks system. Bathymetry over the area is shown on Fig 1, with the cruise track over the sandbank region and the general surface characteristics shown as Fig 2(a) and (b).

Upon leaving Great Yarmouth, equipment to be deployed around the sandbanks was prepared; this included self-recording current meters, bottom-mounted pressure sensors and STABLE. During passage to the research area, the on-board continuously monitoring

equipment was set up and on-line sampling and measurements commenced (for details, see Appendix B).

Towards the beginning of the cruise, 2 tonnes of fluorescent sand were deposited successful at two sites: one to the north of the bank (yellow sand) and one to the south (blue) (see Fig 3).

Moorings incorporating RVS, Deacon Laboratory, (Wormley), POL (Bidston) and SUDO meters were then deployed around the sandbank (Fig 4). Meters were positioned mid-way along the flanks of the bank, on the basis of detailed echosounder surveys. 8 U-shaped current meter moorings were laid in 2 days, followed by 3 POL pressure sensor mooring (Table 1). Side-scan sonar and pinger surveys were then carried out, followed by a number of CTD dips at selected sites adjacent to the banks and within the troughs between them. At a 'nominal' single location, CTD dips over a tidal cycle were carried out (Fig 5, Table 2).

As part of the initial phase of the cruise, Decca-Argos buoys were switched on and their position checked on board ship, by reference to the station at Toulouse (via the ship's telex system). The buoys were deployed subsequently and, with intermittent checks being made on their positions, were recovered after a few days (Fig 6, Table 3). No problems were encountered with recovery, although one had to be recovered from a 'rig supply vessel' in the Leman Field.

Upon deployment of the self-recording current meters around Broken Bank, a detailed ADCP survey was carried out (throughout a tidal cycle) to compare with self-recording current meter observations.

STABLE (see Appendix C) was deployed on Day 324 (19 November), without difficulty; it was recovered on Day 327, when it appeared to have functioned (*ie* the tape had wound on) (see Table 1).

Between Days 328 and 331, the research was concentrated upon the sandwave field in Dutch coastal waters.

Returning to the Broken Bank area, 6 self-recording current meters were recovered in a single day (see Table 4, for details). 2 moorings containing current meters and 3 with pressure sensors were left for recovery during Cruise 42. Throughout the cruise, extensive use was made of the shipboard computer facilities - operating in an interactive mode and allowing experiments to be planned/modified.

Some 130 grab samples were collected at the site of fluorescent sand deposition (release), to investigate its initial pattern of movement (Fig 7). In association with this, stereo camera stations were completed.

At the end of the cruise, a transect was made to POL long-term Mooring D across the Indefatigable Bank. Several hours were spent in trying to locate and release the mooring, in adverse weather conditions. Up to 6 hours were spent at long-term Mooring E, again without success, before returning to port.

3 Scientific Activities

3.1 General

Following a presentation on the scientific objectives of the cruise programme to the officers and scientists, at 10.00 hours, the vessel sailed from Great Yarmouth at 12.30 hours on Day 320 (15 November, 1988): In transit, during the afternoon, the various sea-surface sensors

were brought 'on-line' and a successful fix obtained on one of the Decca-Argos drogues (No 1), whilst on the ship's deck. During the night, 1 tonne of blue (at 53° 14.03' N/02° 14.78' E) and 1 tonne of yellow (at 53° 19.74' N/02° 07.13' E) fluorescent sand were released, by inverting an airline cargo bag on the sea bed. Some concern was expressed at the time of the release, that contamination of the various coloured sands had taken place (by the supplyers). Overnight, the side-scan and 3.5 Hz pinger systems were set up and run.

All the daylight hours of Day 321 were spent in the deployment of bottom-mounted rigs in the Broken Bank region. Current meter rigs F, G and H were released without problems, but some difficulties were encountered with the batteries of the ultrasonic current meters. The programme was changed then to POL tidegauges and moorings and then moorings POL 03 and D were deployed. These activities finished at 18.40 hours. Geophysical surveys of Well Bank and Broken Bank were carried out overnight.

On the following day (322), the following moorings were deployed: POL 02, E, C, B, A and POL 01. Some time was spent in setting up the Decca-Argos buoys then, from 22.30 hours, the geophysical survey work was continued. Weather conditions worsened steadily throughout the night. Eventually, at 08.00 hours on Day 323, this led to the abandonment of the deployment of STABLE. The decision was taken then to carry out some 24 hours of ADCP continuous surveys across the Broken and Well Banks, adjacent to current metering moorings (C-H). These data would act as a means of calibration for the ADCP, against conventional instrumentation.

On Day 324, at 13.11 hours, STABLE was deployed in 30 m of water at 53° 14.45' N/02° 14.68' E, adjacent to the 'blue sand' site. Following a successful deployment, the 4 Decca-Argos buoys were released. A CTD test station was carried out, at 20.17 hours. Overnight, a thermosalinograph survey was undertaken - to obtain information on sea surface conditions

from areas which had previously not been monitored. This survey was completed at 09.10 hours on Day 325.

Throughout the day (325), a series of CTD casts were carried out in the vicinity of the sandbanks. Following a series of transects, a 13 hour (tidal cycle) CTD 'yo-yo' station was maintained. The ship was effectively maintained 'on station' during this period, by manoeuvring the vessel. Data recovery during this period was high and evidence of sediment resuspension obtained in the vicinity of the sandbanks. The final cast of the tidal cycle survey was commenced at 13.08 hours on Day 326.

On Day 326, general sea bed samples from the Broken Bank area were collected. Following the collection of (11) grab samples, using the Shipek system, the sampling was concentrated into the area of release of the yellow fluorescent sand (samples CH40/12 - CH 40/63). During this latter phase, the ship drifted over a grid of approximately 1820 km x 640 km. Position fixing was on the basis of radar ranging from 3 gas platforms, supplemented by Decca Main Chain readings (in this area, and during nighttime and winter, the Decca system was not expected to produce highly accurate or repeatable results). Short cores were sub-sampled from each of the Shipek grab samples collected, to examine the depth of reworking of the fluorescent sand.

A thermosalinograph survey was commenced at 00.00 hours, on Day 327; this was organised so as to arrive at the Leman Gas Field at first light (for the recovery of the Decca Argos buoys). One of the buoys was recovered by a rig supply vessel, then brought to *Challenger*. Buoys No 10 (08.43 hours), No 7 (12.01 hours) and No 6 (12.32 hours) were then recovered by the ship, following visual siting. The ship returned then to the STABLE deployment site and the rig recovered successfully. A series of sea bed photographs were collected, adjacent to the site. Following these observations, a grab survey of the 'blue fluorescent sand' area of release was undertaken; this was followed by a side-scan sonar

survey of the deployment site. The vessel progressed then to the Dutch sandwave field, where the PSO duties were undertaken by Prof D Huntley (see Section 3.2).

Return to the Norfolk Sandbanks research area commenced at 17.00 hours on Day 331. During the traverse leg, sea surface conditions were monitored continually and the side-scan and 3.5 KHz (pinger) systems were deployed. The towfish was brought in-board at 0427 hours, on Day 332. Throughout the first part of the day, the following current meter moorings were recovered: B, F, H, G, E and C. Moorings A and D and the pressure sensors were left for later recovery. Weather conditions during recovery were ideal - calm and cold. During the afternoon (Day 332), grab sampling at the blue sand site was carried out; this was continued until high tidal current activity prevented continuation of the sampling programme. The ship moved then to the yellow sand site, returning to the blue site to complete the sea bed sampling. Overnight, side-scan and pinger (3.5 KHz) surveys were carried out across a moribund sandbank system (Indefatigable Bank) farther offshore (towards the POL sites of long-term ADCP deployments). Any additional time available at the end of the cruise had been agreed to be made available to carry out acoustic searches, for POL deployments which had not been recovered during earlier (survey) cruises.

The searches were carried out, during Day 333, against a background of worsening weather conditions. The acoustic search at POL Site D (54° 29.87' N/02° 59.79' E) extended over 2½ to 3 hours, without any success. Gale force 8, going up to 9 (or more) conditions prevailed at this time. It was attempted to ride out the storm, then proceed to POL Site E. Under extreme weather conditions, 6 hours were spent in trying to locate the mooring - again without success.

The ship proceeded then to Great Yarmouth, arriving at 12.00 hours on day 334 (29 November, 1988).

3.2 Sandwave Study, Dutch Coastal Waters (Days 328-331: prepared from information provided by Professor D Huntley, Plymouth Polytechnic)

(i) Objectives:

To investigate flow and sediment movement over the sandwaves by:

(a) the deployment of STABLE;

(b) using the Acoustic Doppler Current Profiler (ADCP) to measure currents in the vicinity of STABLE, for at least two tidal cycles;

(c) measuring the average current profiler with the ADCP between two pressure sensors 10 km apart across the sand waves field, for at least one tidal cycle;

(d) taking bottom photographs at different locations over a sandwave, profiled to characterise the small scale topography;

(e) measuring vertical profiles with the CTD, particularly to look for evidence of sediment suspension with the transmissometer;

and

(f) continuing a detailed survey of the sand wave field using sidescan sonar and echo sounder.

(ii) Results

Most of the objectives were achieved but, at the time of the cruise, the data recovery from STABLE and the pressure sensors were still awaited.

The achievements of this part of the cruise may be summarised, as follows:

(a) STABLE was deployed for almost exactly three days;

(b) 32 hours of ADCP measurements were taken, while station-keeping near STABLE;

(c) about 14 hours of average ADCP profiles were measured, by steering between the pressure sensors (the pressure sensors (deployed on Cruise 38) were then recovered successfully);

(d) two clear sets of bottom stereo photographs (22 per set) were taken;

(e) the CTD was 'flown' as close to the bottom as possible (typically, 3 m above the sea bed) over sandwave profiles, at approximately hourly intervals and through a tidal cycle (evidence for resuspension was found, and bottle samples filtered to determine the nature of the particles resuspended);

(f) about 30 hours of sidescan and echo sounder surveying were completed, at both fine spacing (0.1 nm) and coarse spacing (1-2 nm).

Original plans to deploy two current meter strings near STABLE (after recovery from the Norfolk Sandbanks site) were not possible, due to time constraints and general cruise programming limitations.

4 Use of STABLE (based on information supplied by J Humphery)

STABLE (Sediment Transport And Boundary Layer Equipment) was deployed successfully twice during the cruise: over (i) the Norfolk Sandbanks and (ii) the sandwave field in Dutch coastal waters.

Four open (toroidal) electromagnetic current meters (ECMs) were mounted in two pairs at 30 cm and 70 cm above the anticipated sea-bed level, to provide three-dimensional turbulent current information. Two optical back-scatter (OBS) sensors were mounted at the same heights, to provide concurrent suspended sediment concentration data. A Digiquartz pressure sensor was included, to provide wave-induced pressure information. Nine data channels (6 EMCM, 2 OBS and one pressure) were recorded in bursts, at 4 Hz for 18 minutes every 3 hours onto a digital cassette data logger.

The logger recorded also spot readings at one minute intervals, from instruments measuring parameters which were likely to change only slowly during the course of the experiments. The pressure transducer mentioned above was interrogated in this way, to provide tidal depth information. To provide tidal current data, on Aanderaa rotor measured flow rate, with a vane measuring direction. A compass was used to orientate the rig, relative to North, and pitch and roll sensors mounted in the logger measured rig attitude (thus, corrections to horizontal and vertical EMCM data can be applied if necessary). A thermistor was fitted, to provide sea-temperature data. These 7 'mean' data channels were logged throughout the experiments (including throughout the 'bursts').

A camera was used to provide photographs, to quantify bedload sediment transport rates resulting from the tidal current flows. It was triggered from the logger: once at the beginning and once at the end of each burst period of measurement. A flashgun illuminated the picture area at an oblique angle. Shadow-bars, calibrated at 5 cm intervals along their length and separated vertically by 7.5 cm, cast shadows across the picture area. Thus, ripple progression, shape and wavelength could all be determined, together with bed slope. A small diver's compass was fitted to the upper shadow bar to provide orientation information in a corner of each photograph.

Careful measurements of the disposition of all instruments were made prior to the start of the experiments.

There is a need to re-examine the means of deployment and recovery of the system, in view of the potential damage which could be caused to sensitive instruments in the present design configuration. Regrettably, since the cruise, it has become apparent that the OBS (Optical BackScatter Sensors) did not function during the Norfolk Banks deployment. With the advances which could be made within the field of sediment dynamics research through the

use of high frequency monitoring system (such as STABLE or other tripods/tetrapods), it is evident that NERC should invest in more technical/financial support for such instrumentation.

5 COMMENTS

1 The cruise was undertaken with the full cooperation of the Captain, officers and crew and technical staff from RVS and POL. No criticisms whatsoever could be levelled at the individuals involved and the scientific programme was undertaken in a professional and congenial atmosphere.

2 In terms of general arrangements, some consideration might be given to the provision (on a 'routine' basis) of more accurate position fixing systems for NERC vessels. Over that particular research area, for example, Decca Main Chain is particularly poor in its resolution ($\pm$ 150 m) for some of the activities which have been undertaken.

3 Specific shipboard instrumentation or monitoring problems are as follows:

(i) the on-line SIMRAD echosounder failure to produce consistent digital records, which has meant that analogue data has had to be digitised and inserted into the data sets - in addition, when complete failure of the scientific system occurs (as happened), there should be some way to tap into the bridge system;

(ii) the ship-board arrangement of the non-toxic supply needs to be examined carefully, in terms of interpretation of transmissometer output - on occasions, it was noted that the direction of wave approach (relative to the sub-surface intake location) caused 'peaks' in the readings (possibly due to the presence of air bubbles in the water, making it difficult to distinguish between bubbles or suspended particle concentrations);

(iii) a continuous readout of Decca position and analog SIMRAD readings should be available in the main laboratory, to remove the need for radio communication when accurately fixing bottom grabs, photographs etc.

6 Acknowledgements

It is a pleasure to acknowledge the willing and capable assistance of the ship's officers and crew in carrying out the work described in this Report. It should be noted that each member has been written to (by the PSO) and thanked individually for their assistance.

Warmest thanks are extended also to Dr P J Statham and other scientific personnel, for additional seabed sample collection during *RRS Challenger* cruises 88/42 and 88/43, respectively.

Finally, the author is grateful to Mrs C Tresise for typing the manuscript and Miss K Saull for producing the diagrams.

FIGURES

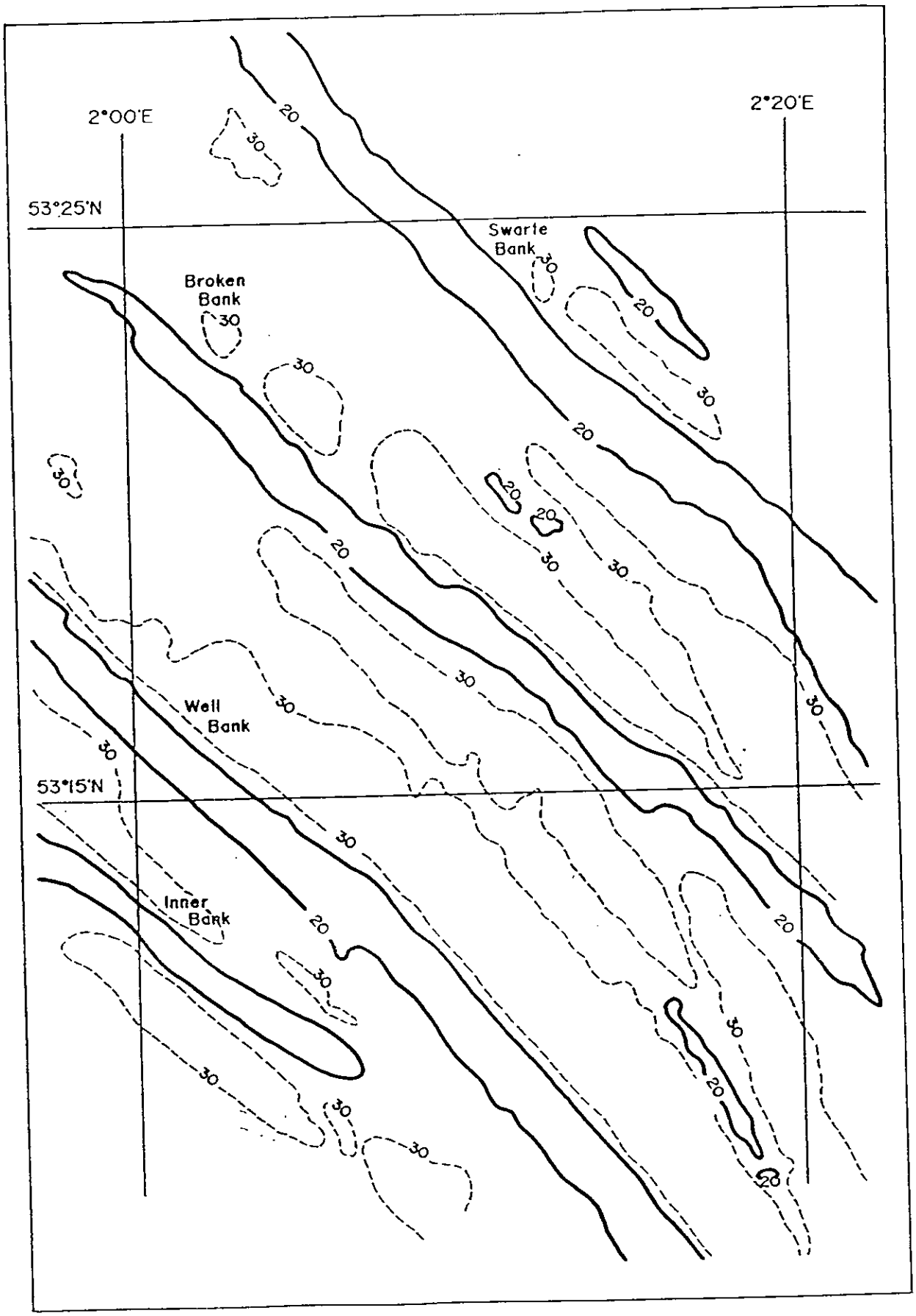


Fig 1 Bathymetry over Norfolk Sandbanks research area

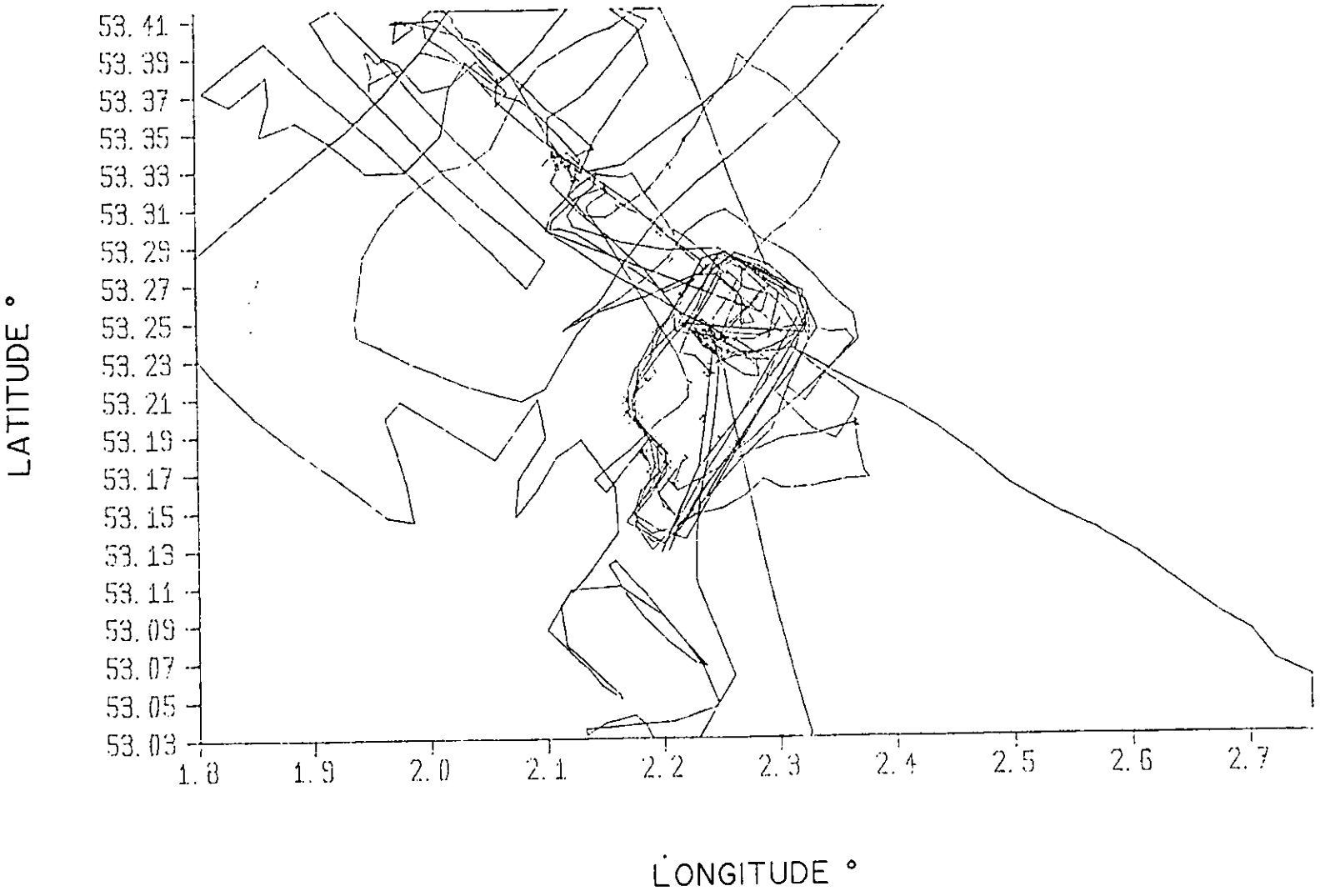
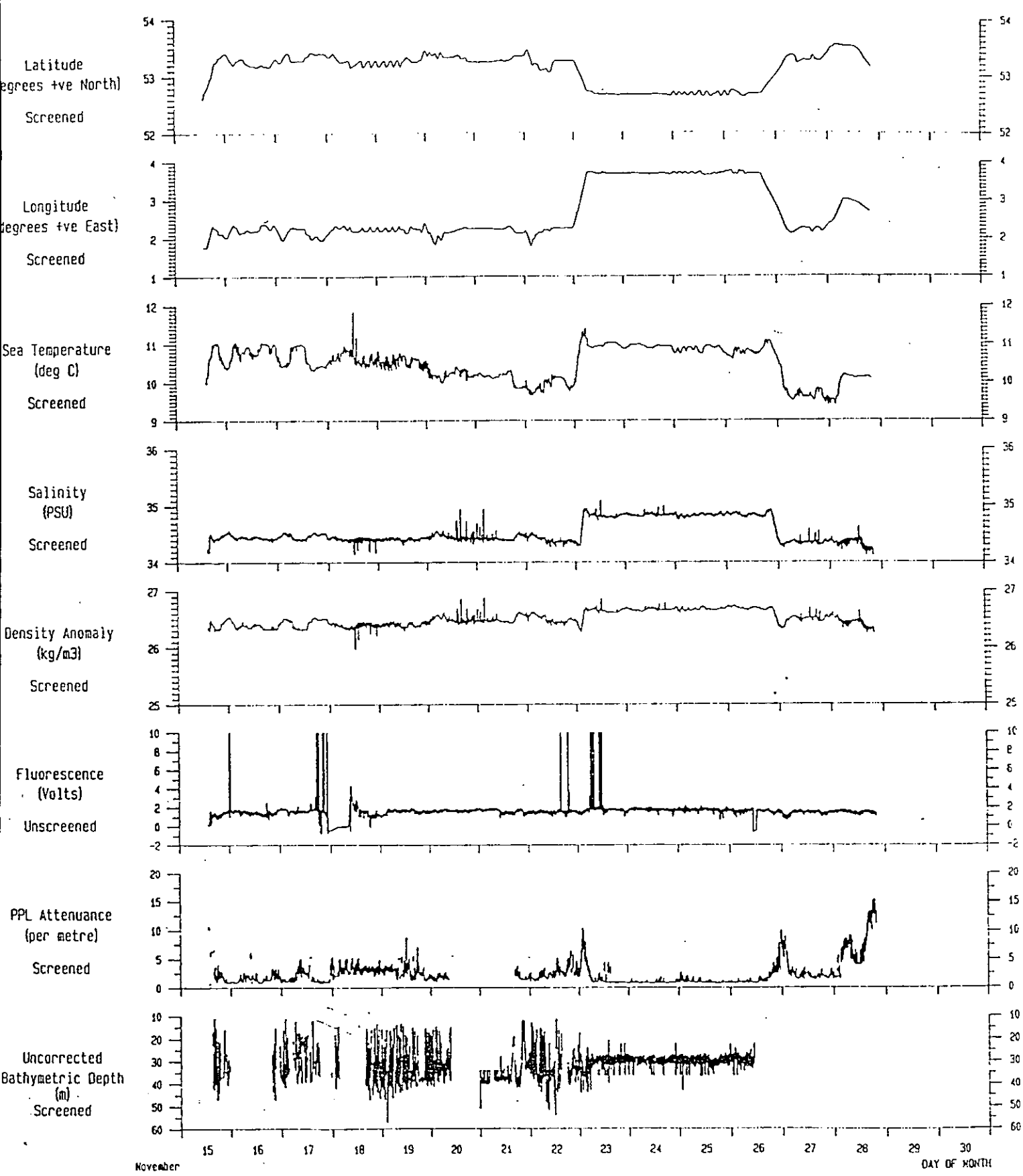


Fig 2 (a) Cruise tracks over the sandbank area, Challenger 40/88.



MIAS

SURFACE MEASUREMENTS FROM CRUISE CHALLENGER 40, 1988

PAGE 1 OF 1

Plotted on 30th January 1989 Flags Ignored - JIGR Flags Considered NULL - NBS Flags Indicated - UD RANGE Scaling

Fig 2 (b) Surface Measurements

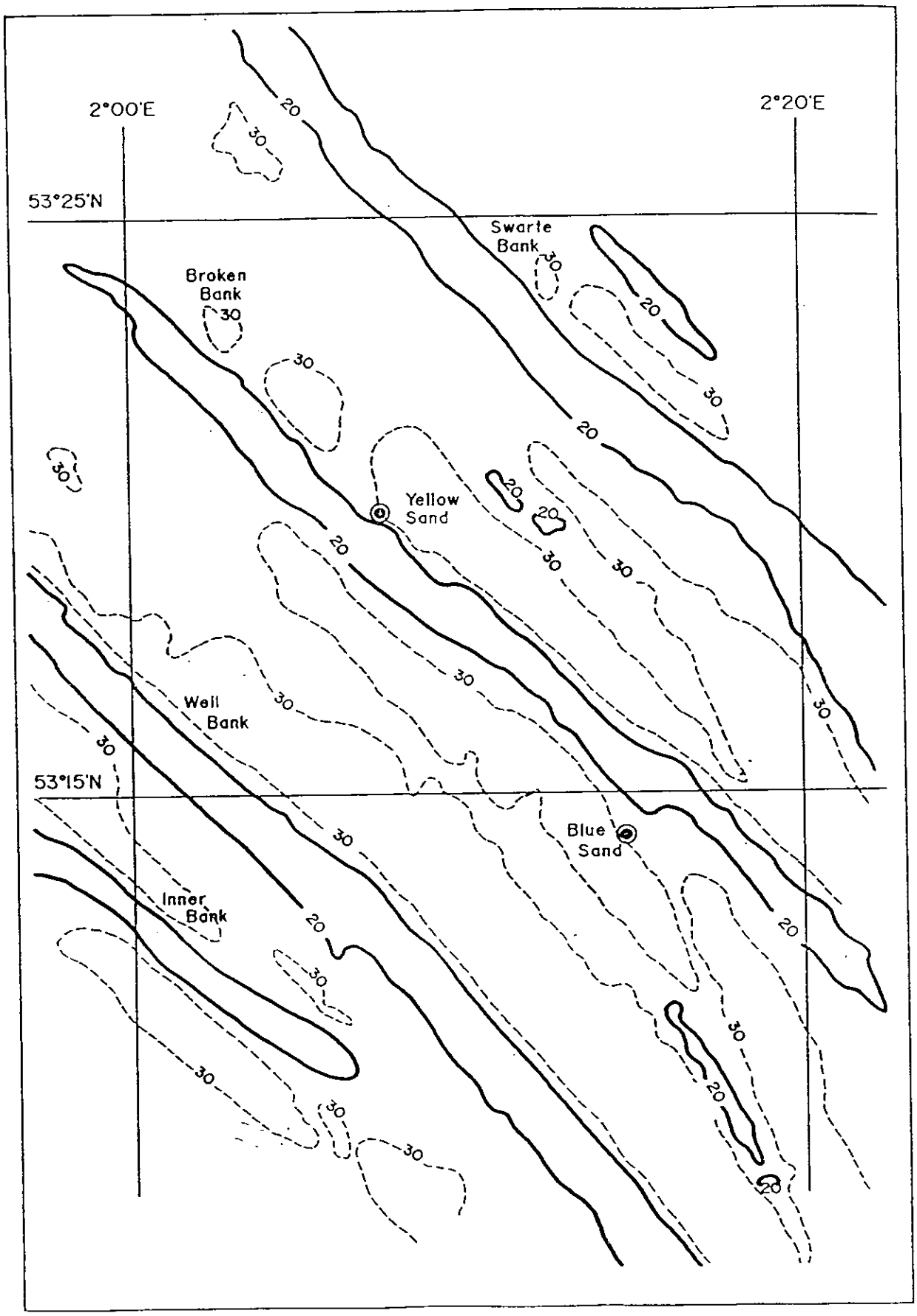


Fig 3 Fluorescent sand release sites.

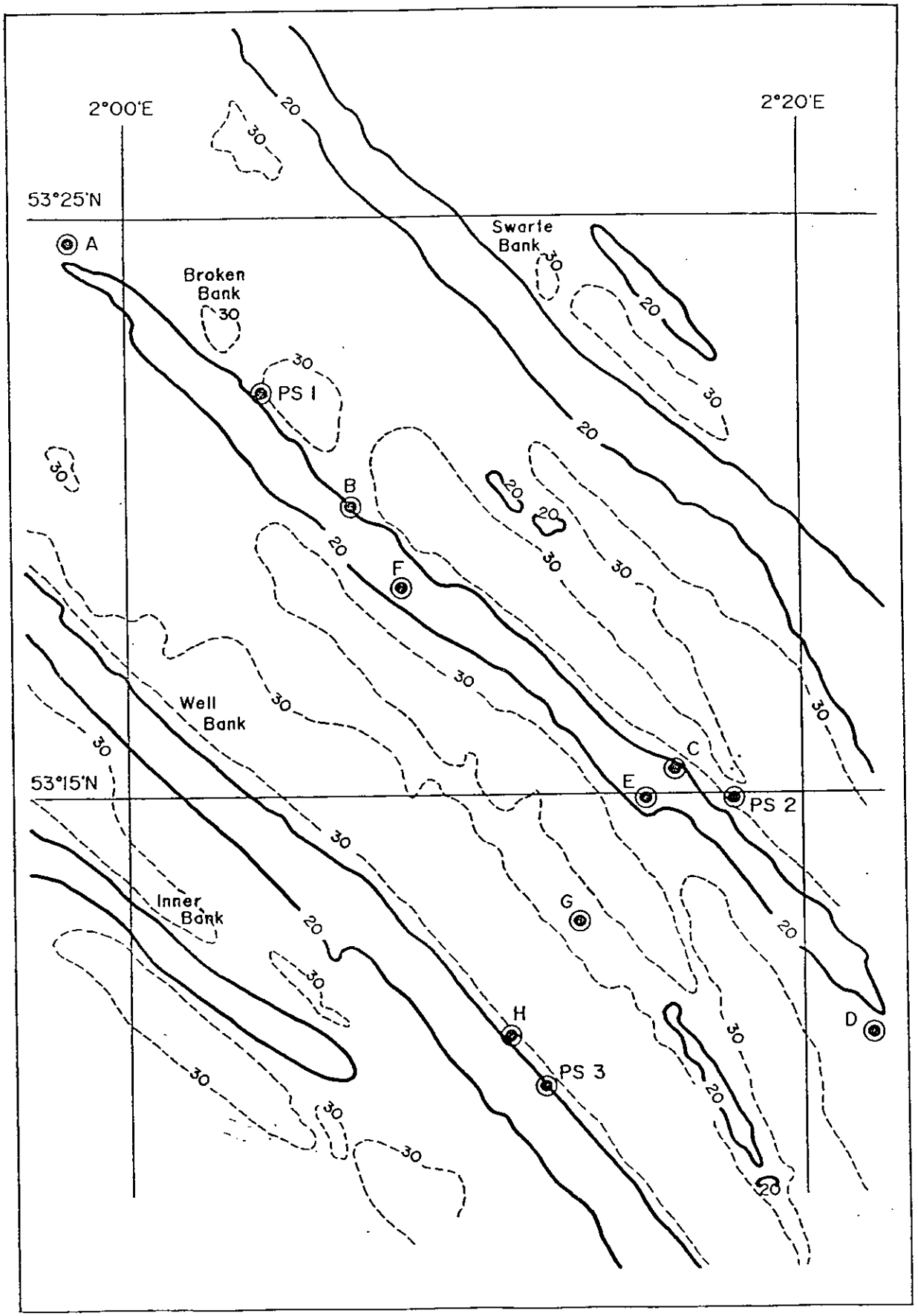


Fig 4 Sites of current meter (A to H) and pressure sensor deployments (PS1 to PS3).

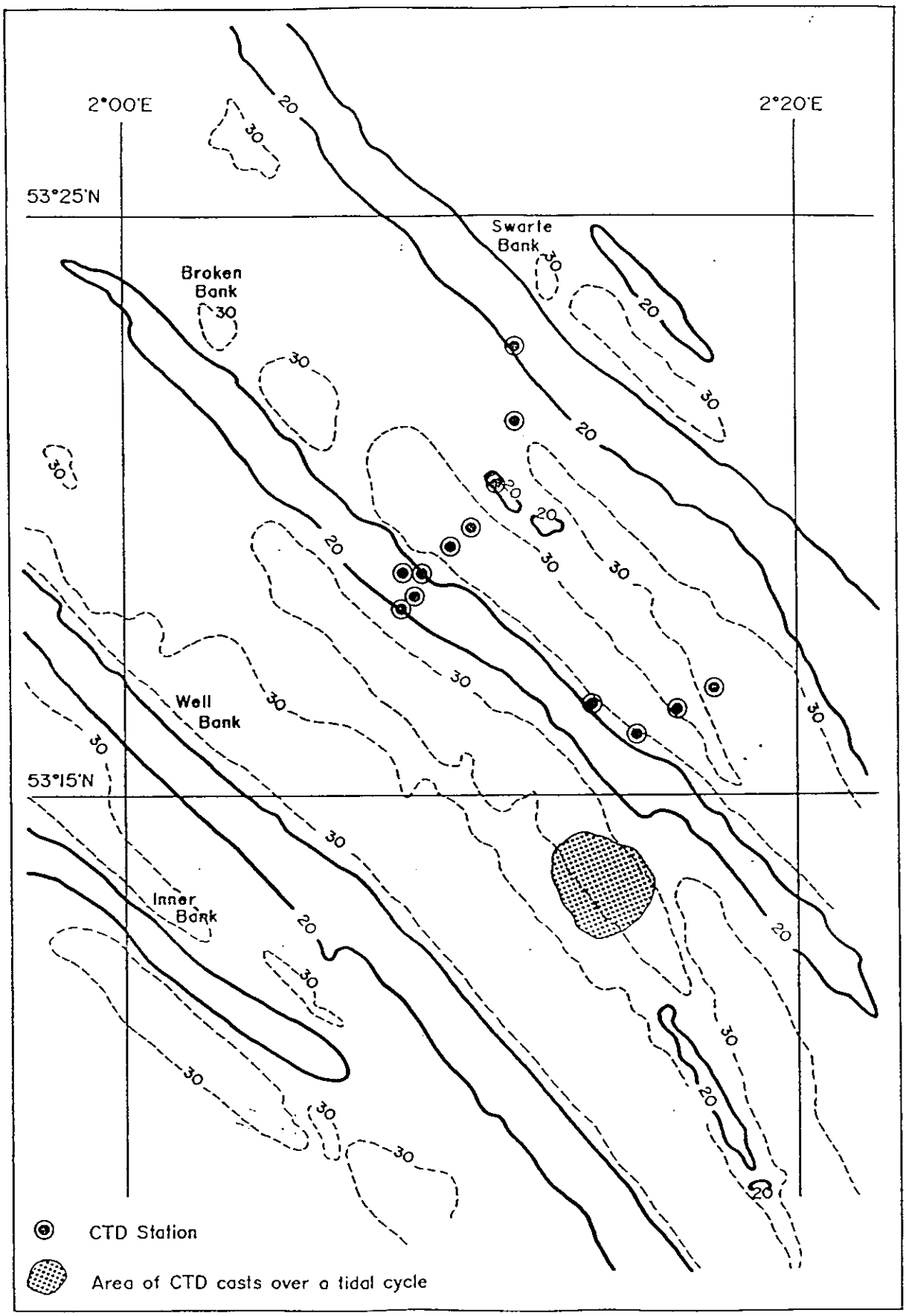


Fig 5 CTD stations.

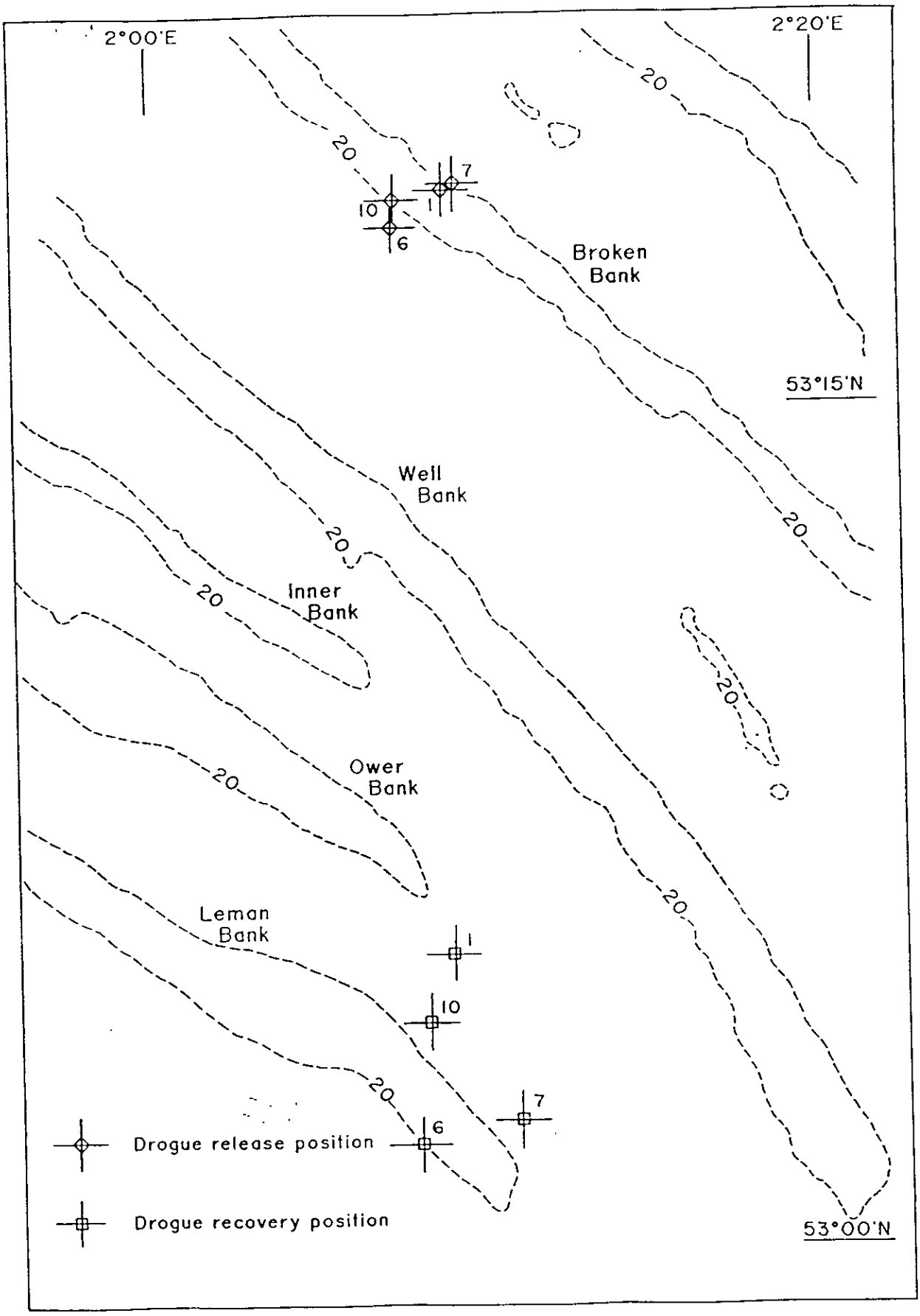


Fig 6 Decca-Argos Drogue, release and recovery positions.

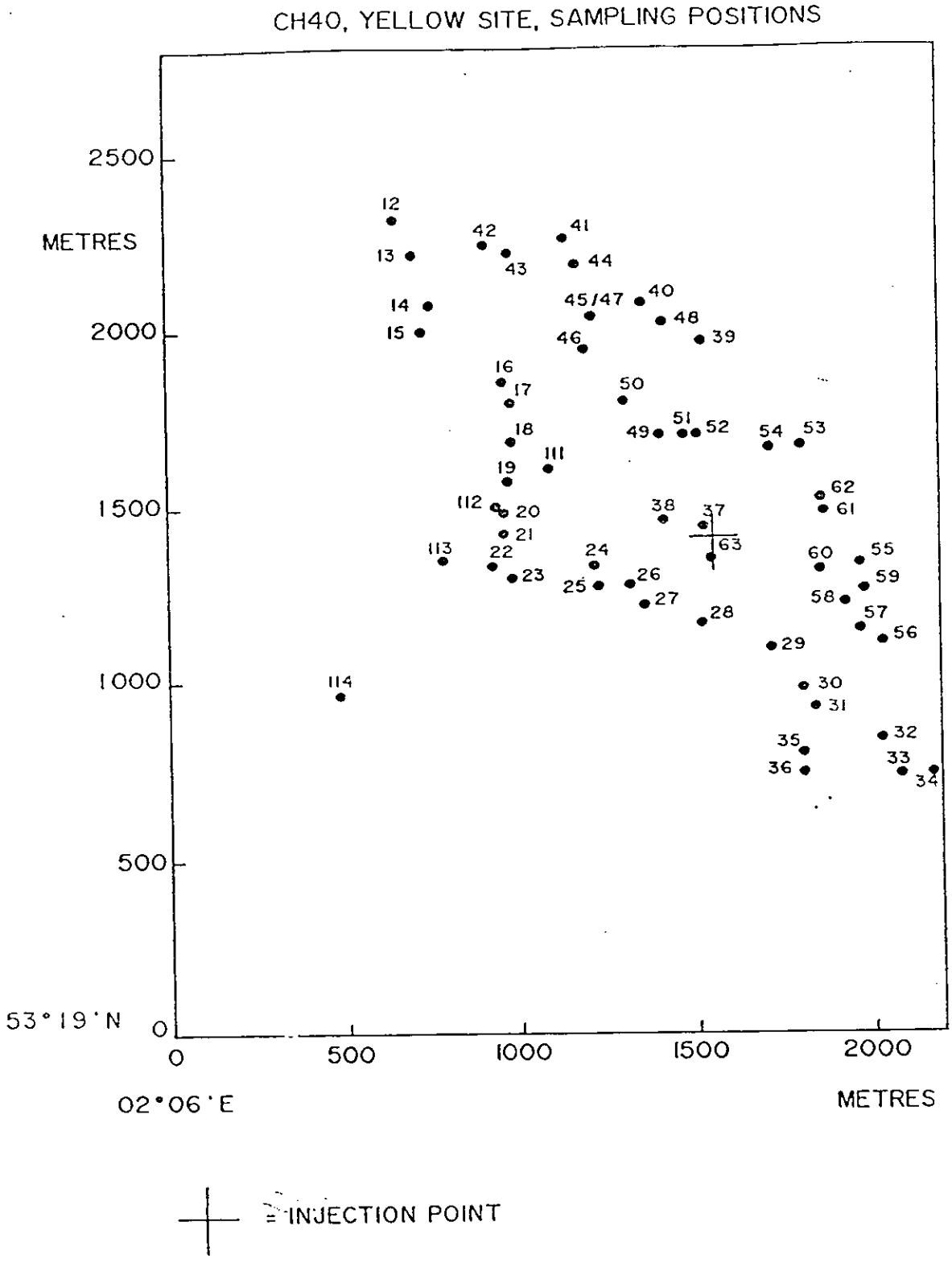


Fig 7 Grab sample locations in the vicinity of fluorescent sand release sites.

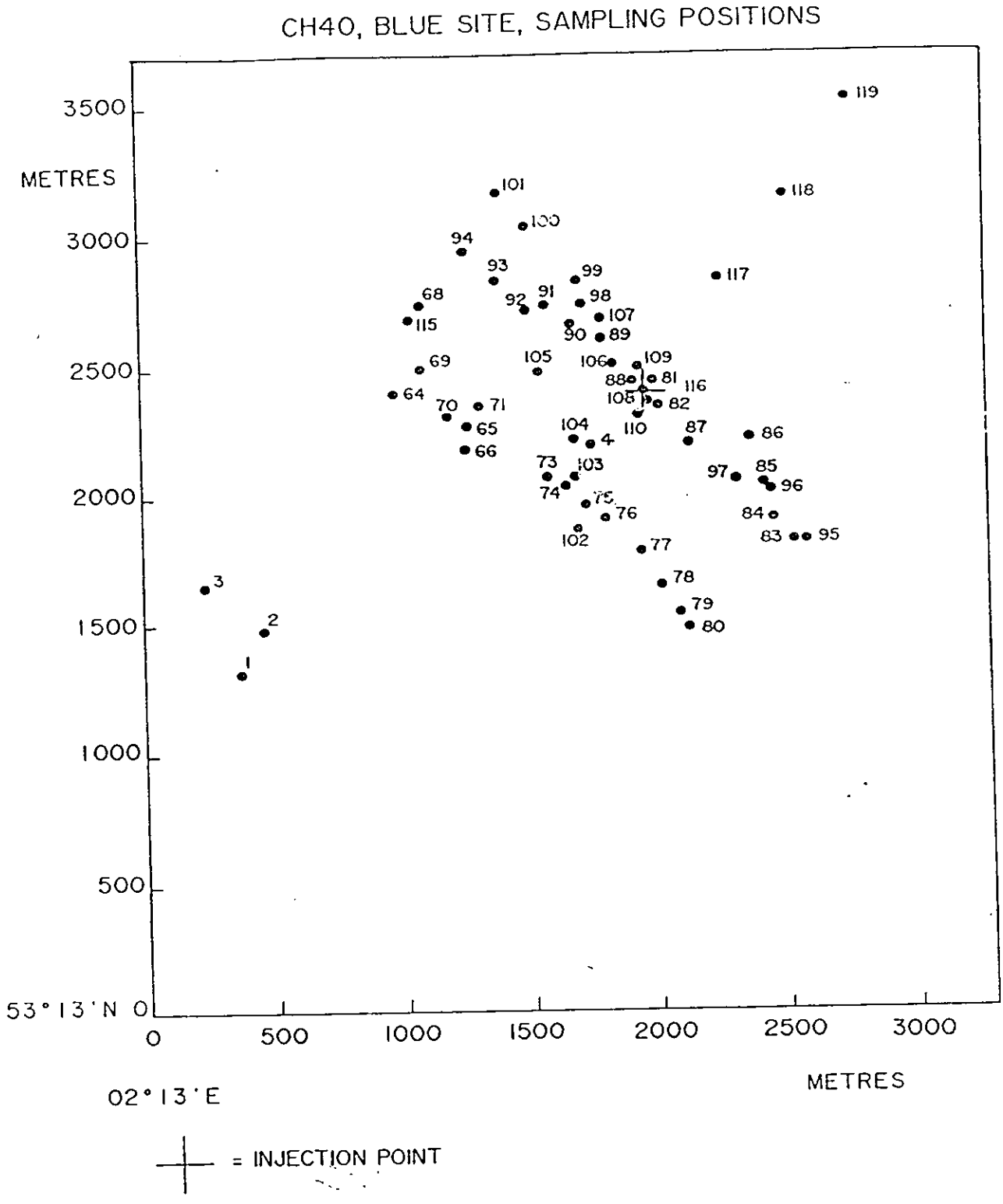


Fig 7 Grab sample locations in the vicinity of fluorescent sand release sites.

TABLES

Table 1: Details of Pressure Sensor and STABLE Deployments

(i) Pressure Sensors (POL)

Mooring	Position (Decca) Lat °N	Long °E	Water Depth (m)	Day / Time deployed*	Day / Time recovered	Instruments	Ref No	Height above bed (m)
PS (POL) 3	53 09.88	2 12.43	26	321 1620	* recovery accomplished during subse-	CM/TG	4	Vane 0.70 Rotor 0.53
PS (POL) 3	53 14.85	2 17.89	35	322 0818	sequent cruises	CM/TG	5	vane 0.70 rotor 0.53
PS (POL) 1	53 22.09	2 04.07	33	322 1922		Teleost TG	284	

(ii) STABLE

STABLE 1	53 14.45	2 14.68	30	324 1311	327 1622	vane		0.9
(Norfolk	53 14.70	2 14.38	29			EM&OBS		0.7
Sandbanks)						rotor		0.5
						EM&OBS		0.3
STABLE 2	52 39.42	3 40.04	29	328 1036	331 1144	vane		0.9
(Dutch	52 39 37	3 40.13	28			EM&OBS		0.7
Sandwaves)						rotor		0.5
						EM&OBS		0.3

Table 2: CTD-Station Locations

(1) Across Banks				
324/2017	930/1		test	
325/1033	931/1		53° 18.27N	02° 08.33E
325/1127	932/1		18.48	08.61
325/1201	933/1		18.93	08.27
325/1245	934/1		18.92	08.93
1351	935/1		19.41	09.76
1434	936/1		19.68	10.41
1510	937/1		20.226	11.077
1611	938/1		21.51	11.67
1656	939/1		22.80	11.75
1748	940/1		16.54	13.97
1837	941/1		16.08	15.30
1918	942/1		16.51	16.45
1951	943/1		16.89	17.58
(2) Tidal Cycle		Cast		
2104	944/1	1	13.42	14.00
2132	945/1	2	13.32	14.22
2208	946/1	3	12.03	14.27
2248	947/1	4	13.17	13.77
2333	948/1	5	12.86	14.37
326/0008	949/1	6	13.25	13.58
0032	950/1	7	14.04	13.69
0101	951/1	8	13.45	14.35

Table 3 Decca-Argos Drogue Deployments

Sail Depth = 4 m, below the water surface

Drogue 7

Released	day 324	15.16 GMT
Position	53° 18.9 N	02° 09.2 E
Recovered	day 327	12.01 GMT
Position	53° 02.3 N	02° 10.9 E

Deployment Time = 68.75 hours

Drogue 1

Released	day 324	15.22 GMT
Position	53° 18.8 N	02° 08.9 E
Recovered	day 327	06.10 GMT
Position	53° 05.3 N	02° 08.9 E

Deployment Time = 62.79 hours

Drogue 10

Released	day 324	15.35 GMT
Position	53° 18.6 N	02° 07.4 E
Recovered	day 327	08.43 GMT
Position	53° 04.1 N	02° 08.1 E

Deployment Time = 65.14 hours

Drogue 6

Released	day 324	15.40 GMT
Position	53° 18.1 N	02° 07.3 E
Recovered	day 327	12.32 GMT
Position	53° 01.9 N	02° 07.8 E

Deployment Time = 68.87 hours

All drogues functioned successfully
Decca logged every 100 secs

Table 4 Current Meter Deployments and Recoveries

Instrument Type	Instrument Identification No	Mooring (see Fig 4)	Latitude (°N)	Longitude (°E)	Height above Seabed (m)	Length of Deployment (hours)	Comments
RCM4	568	40-A	53 24.6	01 58.2	2		
DNC2	545				10		
RCM4S	7517	40-B	53 19.9	02 06.5	2	231.7	
RCM4S	7946				10		
UCM2	23				12		
RCM4S	6867	40-C	53 15.4	02 16.2	2	239.9	
RCM4S	3622				10		
UCM2	33				12		
RCM4	1139	40-D	53 10.7	02 22.2	24		Mooring
DNC2	548				16		lost
RCM4S	7947	40-E	53 14.9	02 15.3	21	242.2	Tape
RCM4S	7765				13		failed to
UCM2	24				11		advance
RCM4S	4738	40-F	53 18.6	02 08.1	17	263.6	
RCM4S	2109				9		
RCM4	3277	40-G	53 12.7	02 13.4	27	263.5	
UCM2	20				17		
RCM4	3559	40-H	53 10.7	02 11.2	29	259.4	
UCM2	22				19		

RCM4 = Aanderaa RCM4 - Savonius Rotor
RCM4S = Aanderaa RCM4S - Modified Rotor
UCM2 = Simrad Ultrasonic Current Meter, Model UCM2
DNC2 = NBA Self Recording Current Meter, Model DNL2

APPENDICES

Appendix A Scientific Party

Mr G Ballard	POL
Dr M B Collins	SUDO (Principal Scientist)
Mr E Cooper	RVS
Mr J Humphrey	POL
Prof D Huntley	IMS, PP
Dr J Huthnance	POL
Mr D Leighton	POL
Mr G Miller	RVS
Dr R Nicholls	IMS, PP
Dr J Taylor	SUDO
Mr D Tenre	RVS
Mr B Tomlinson	SUDO
Mr G Voulgaris	SUDO
Mr C Washington	RVS

Key: POL Proudman Oceangraphic Laboratory (Bidston)
SUDO Southampton University - Department of Oceanography
RVS Research Vessel Services (Barry)

Appendix B: Technical Specifications/Settings of Instruments used for Continuous Monitoring/Logging

(i) Hull-mounted ADCP (Acoustic Doppler Current Profiler)

Frequency:	150 KHz
Model:	RD-VM 0150
Ping Rate:	360 pings/2 min
No of Depth Cells:	20
Depth Cell Length:	2 m
Long-term accuracy:	$\pm$ 0.290 $\pm$ 0.5 cms^{-1}
Depth to bottom measurement accuracy:	$\pm$ 1 depth cell length
ME:	Diff > 150 cms^{-1}

(ii) Continuous Surface Monitoring

(a) Fluorometry

Chelsea Instruments, Aquatracka Mark II (Serial No 226)
Pulsed-light double beam system (visible and UV Wavelengths) with 2 microseconds long pulse
Log voltage output, 0-8 volts (2 volts/decade, up to 10,000 mm).
'Low' signal to noise ratio.

(b) Conductivity

TSG 103 Thermosalinography, Ocean Data Systems
Conductivity: resolution 0.01 mmhos/cm, accuracy $\pm$ 0.02
Salinity: 0.01% resolution, accuracy $\pm$ 0.03%.
(Instrument calibrated, by RVS, against laboratory salinity determinations).

(c) Temperature

Instrument, as conductivity
Resolution, on display 0.01° C
(Instrument calibrated, by RVS, against thermometers)

(d) Transmissometer

Sea Tech Inc, from WS Ocean Systems (Model no 103D, 25 cm beam length)

Modulating light-emitting diode (LED) and synchronos detector (hence, elimination of ambient light)

(iii) Data Logging

(a) Shipboard Computer Syustem

The following data are logged:

A Navigation - log em/gyro, for relative movement transit satellite navigator, Decca Main Chain.

B Surface Sampling - thermosalinography, transmissometer, fluorometer, total irradiance (2 channels) and irradiance (P and S).

C Depth Recorder (SIMRAD).

D CTD

Logging via Level Computer A, B and C Hierarchy System
A = interfaces
B = logger
C = pass to Level C (Sun 3/50 Workstations)

ADCP data also archived
Software: UNIRAS contouring package (surface/3D)
Vertical dips
Track plots etc

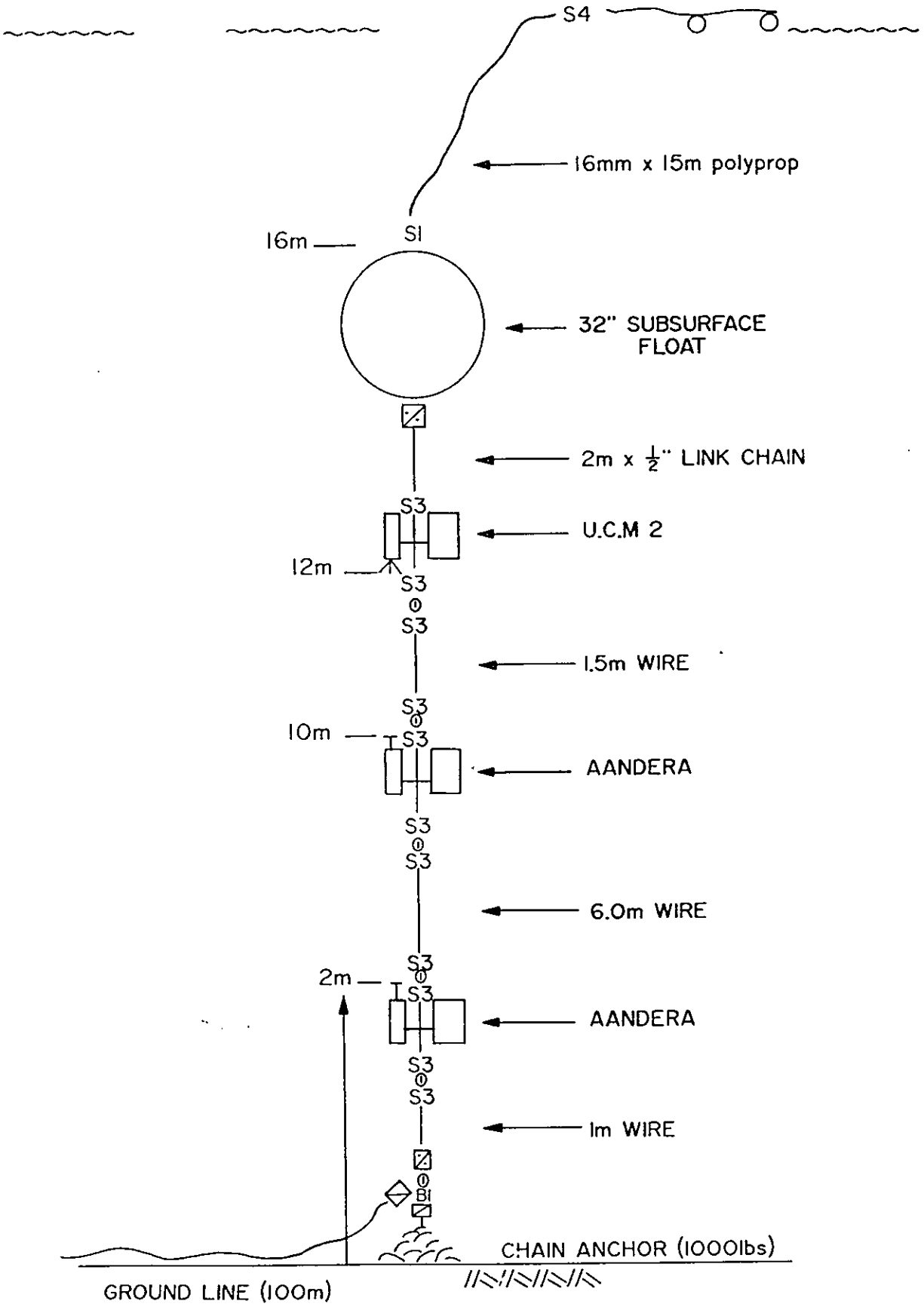
(b) Logging Rates
Satellite, every 1½-2 hours
Decca, each minute
EM log/gyro, 1 seconds
All transferred to the final navigation file, every 5 secs.
Depth, every 5 seconds
Transmissometer/fluorometer, every 30 seconds (instantaneous value)
Thermosalinography, every 30 seconds
2 light sensors (port, starboard), every 30 seconds
2 total irradiance meters (port/starboard), every 10 minutes
Sampling frequency 8Hz, for handling by level
CTD, every second} computing (see above) - eighth of a second.
Logging f, the average, at 1/sec.

Appendix C MOORING DETAILS

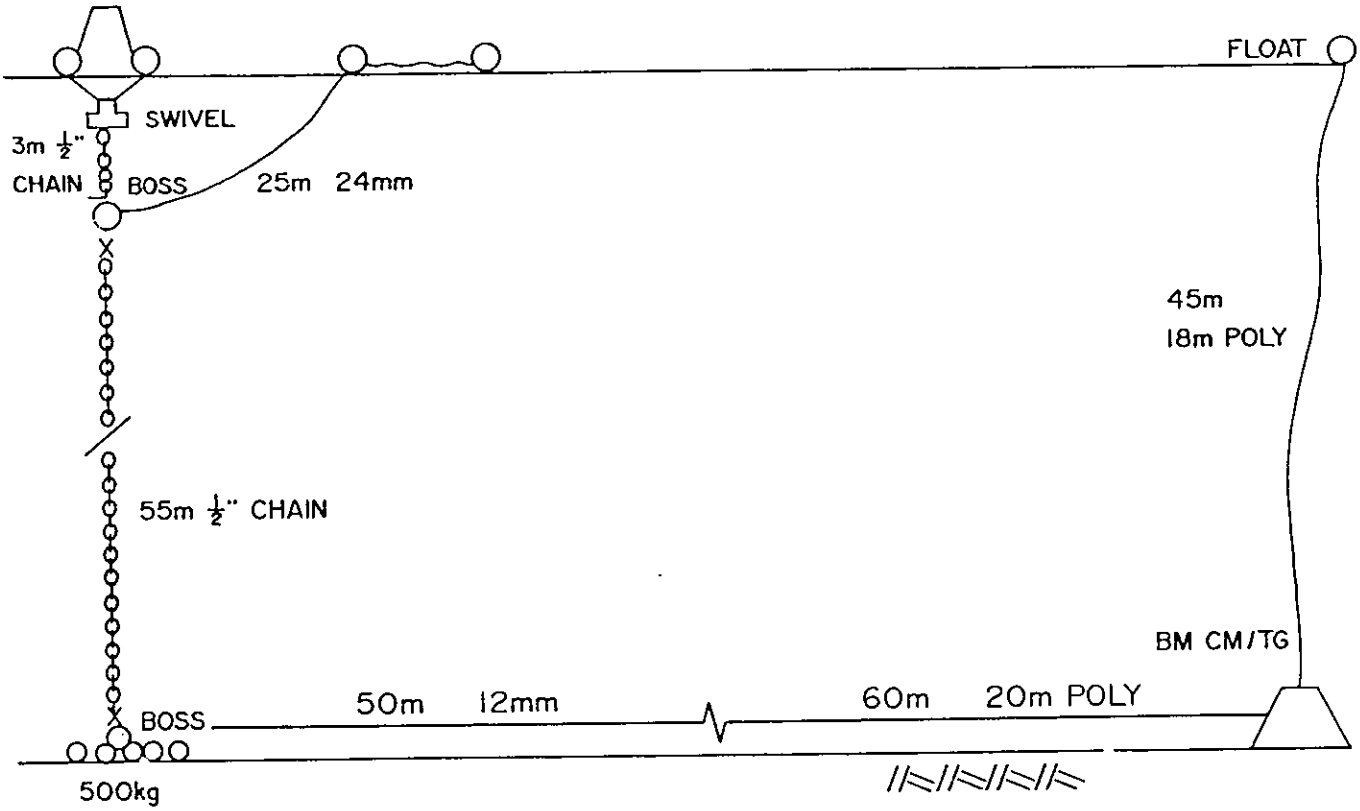
SPAR BALLAST CRUISE 40

Mooring B	600 lbs - 27 lbs	572 lbs
" C	600 lbs - 20 lbs	580 lbs
" E	600 lbs - 22 lbs	578 lbs
" F	Torroid (no ballast)	
" G	Balmoral 277 lbs - 23lbs	254 lbs
" H	Balmoral 277 lbs - 33 lbs	244 lbs

MOORING B
WATER DEPTH 27m



MOORINGS POL 02 & 03
WATER DEPTH 30m



MOORINGS A & D
WATER DEPTH 20m