(c) RV EDWARD FORBES CRUISE 16/76

24 August - 17 September 1976

SIZEWELL - DUNWICH BANK FIELD STUDY

Cruise Report No 44

1976

Institute of Oceanographic Sciences
Crossway
Taunton
Somerset

CONTENTS

SCIENTIFIC PERSONNEL

IOS (Taunton)

Mrs B J Lees (Principal Scientist)	27 August - 14 September
J O Malcolm	31 August - 2 September
D N Langhorne	4 September - 6 September
P J Hardcastle	5 September
E J Moore	5 September
M A S Moore	5 September
T Upham	8 - 11 September
Dr A D Heathershaw	11 - 14 September

IOS (Barry)

W G J Miller	(27 August - 1 September (11 September - 17 September
P Taylor	27 August - 17 September

SHIP'S OFFICERS

P Tilbury (Master)
D Pye (1st Officer)
G Price (2nd Officer)
C Phillips (Chief Engineer)

OBJECTIVES

1. To lay ten Plessey self-recording current meter rigs, seven of conventional design and three designed for shallow water of a mean depth of 5 - 6m. Fig 1 shows their stations and all other locations mentioned in the text. To recover the moorings at the end of the cruise, leaving the long term mooring at Station 22 to be changed at the end of two months, ie the end of October, 1976. The sites have been chosen for three reasons. Firstly to provide data from areas where none or very little existed previously, secondly to monitor current speed and direction at the north and south boundaries of the study area. This information is primarily for input to the mathematical model, ProjectS32B. Thirdly, one station has been sited to assess

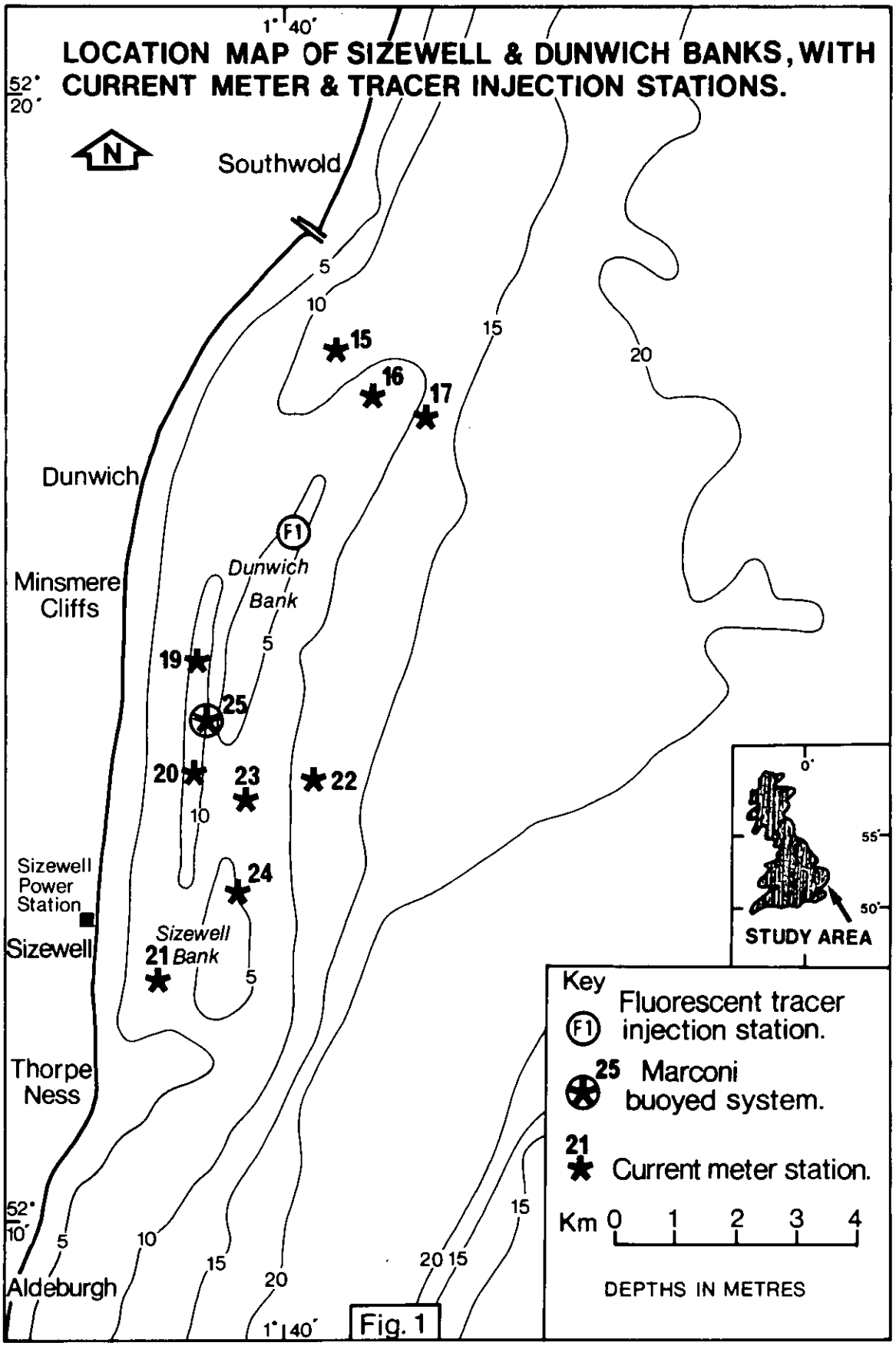

LOCATION MAP OF SIZEWELL & DUNWICH BANKS, WITH CURRENT METER & TRACER INJECTION STATIONS.
1° 40'
52° 20'
N
Southwold
Dunwich
Minsmere Cliffs
Dunwich Bank
Sizewell Power Station
Sizewell
Sizewell Bank
Thorpe Ness
Aldeburgh
52° 10'
1° 40'
F1
15
16
17
19
25
20
23
22
24
21
5
10
15
20
0°
55°
50°
STUDY AREA
Key
F1 Fluorescent tracer injection station.
25 Marconi buoyed system.
21 Current meter station.
Km 0 1 2 3 4
DEPTHS IN METRES

Fig. 1

the long term current conditions, initially over one year.

2. To lay the Marconi buoyed system at Station 25 in a mean depth of 12m water, the rig to include a string of six sensors, spaced at 1m intervals. The purpose of the deployment is to evaluate the system and measure velocity profiles through the water column.

3. To undertake pilot tracer experiments with fluorescent dyed sand in two colours, blue and red, using a Decca HiFix 6 position fixing system for location. To decide whether this method of position fixing is adequate for the Sizewell-Dunwich study requirements.

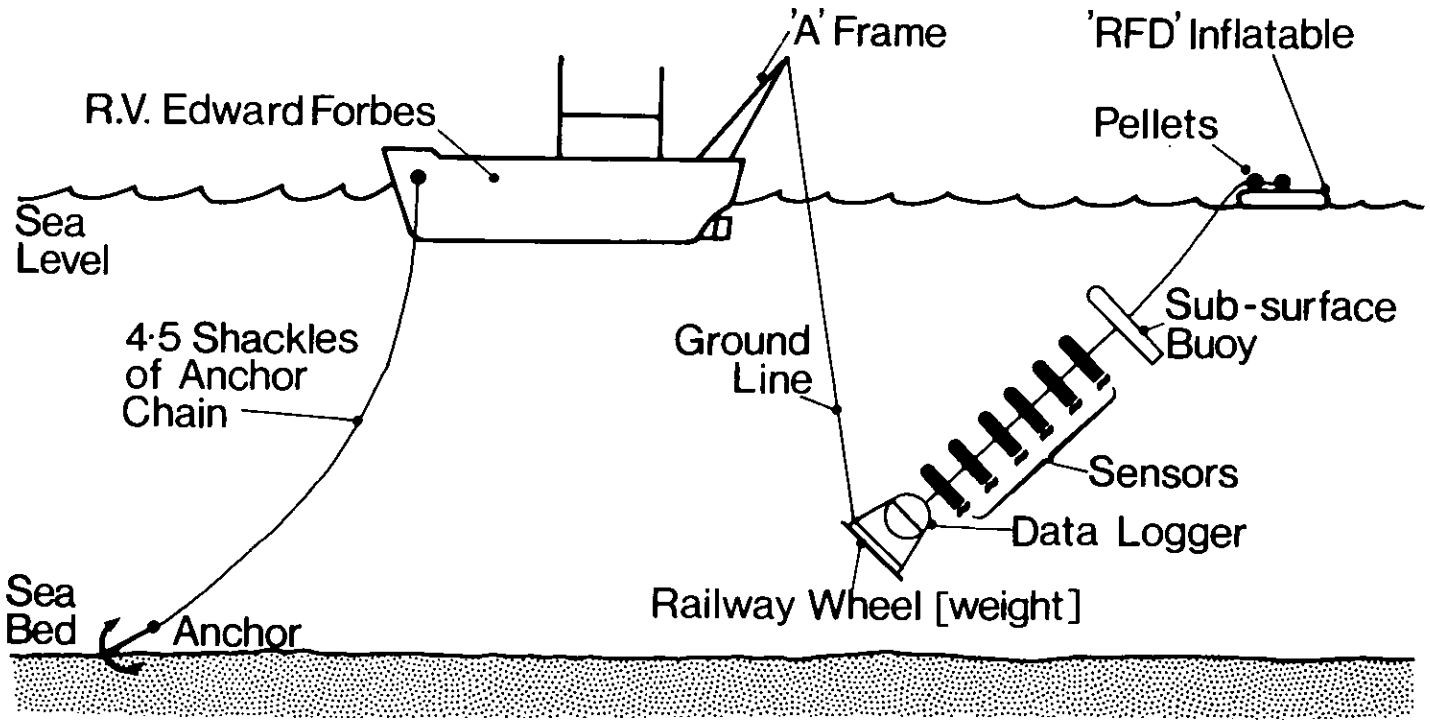
4. To conduct a box coring programme in the area of the banks and their environs. The fluorescent tracer sampler is designed to detect the whereabouts of the dyed sand on the seabed surface. In order to detect the tracer at depth it is intended to take box core samples in areas where the tracer is found. The box cores will also be analysed using X-ray and impregnation techniques to give information on sedimentation.

5. To conduct echosounding surveys across the Sizewell-Dunwich banks as time and conditions permit, again using HiFix 6 for position fixing.

EQUIPMENT AND METHODS

Current Meter Moorings

Of the ten planned moorings, nine were successfully deployed. One site, at Station 22 outside the banks, is to be continuously occupied for at least a year, the current meter being changed every two months. The first change took place in late October 1976. The other eight were recovered at the end of the cruise. The tenth mooring was one of three rigs modified for shallow water deployment (but not less than 5.5m depth) and was the first of this design to be laid. Because the basic U-shape of the mooring is retained, the subsurface buoy, A-frame and weight (in this instance c. 350 kgs lead) were necessarily as close together as possible. It was decided to attempt to lay this rig the reverse way from usual, ie meter end last. This was in order to avoid tangling between the meter and the ground line. During the final stages of deployment the ship's propeller and subsurface buoy accidentally came into contact, fortunately causing no damage to the former. However, the subsurface buoy was severed from the mooring and was picked up by inflatable boat. Three days later the rest of the mooring was recovered except for the lead weight. The meter was still attached to a rather distorted A-frame and appeared to have suffered little damage. It was still recording, although the



DEPLOYMENT OF MARCONI BUOYED CURRENT METER SYSTEM

Fig. 2

data would have been suspect because of a bent rotor.

After this accident the other two shallow water rigs were laid as normal. meter end first. The inflatable boat and pellet line were used to pull the subsurface buoy and meter line away from the ground line. The method proved to be successful.

Marconi Buoyed Current Meter System (Station 25)

D N Langhorne was responsible for the deployment of this system. There were important differences compared with the conventional method for laying U-shaped moorings. Before deployment began the vessel was anchored with four and a half shackles of chain out, and the engine declutched. She was allowed to stabilise, lying with the tide. With calm seas and this length of anchor chain the vessel was very unlikely to drag her mooring. The inflatable boat was launched and the pellet line from the subsurface buoy held by its crew. The subsurface buoy, the meter line with six sensors clamped at intervals of 1m, and the data logger were assembled and placed at the stern of the vessel. The subsurface float was lowered into the water by the A-frame and held clear of the stern by the crew of the inflatable. The ground line to the data logger was leading from the main winch. As the logger was lowered by paying out the ground line the subsurface buoy was towed as hard as possible away from the vessel by the inflatable boat in order to prevent the impellers from hitting the taut lowering wire. Once the logger reached the seabed the anchor chain was hauled in and the rope holding the subsurface buoy was released (see Fig 2). Effectively the ship moved towards the anchor along a line formed by the anchor chain and ground line. When the whole of the ground line had been paid out the remainder of the mooring was laid in the usual manner.

The system was due to remain moored at this station for approximately one month. It was recovered on 29 October 1976, although the meter wire had been severed, possibly by a trawler, resulting in the loss of the subsurface buoy and two sensors. The rotors of the remaining four sensors were missing. Preliminary examination of the tapes indicates that data have been recorded.

Fluorescent Tracer Experiment

Although IOS (Taunton) has used fluorescent dyed sand as a tracer in beach experiments (Blackley, Carr and Gleason, 1972, Internal Report), it is not commonly used by the Institute as an offshore technique. This work was

therefore undertaken as a pilot experiment on which to base designs for future tracer work. Useful sediment movement data obtained would be a bonus. The actual injection technique employed was a modified form of that described by de Vries (1971). The two colours of dyed sand used in the experiment matched as nearly as possible in grain size distribution sand found on the Dunwich Bank. Before the experiment began, a sample of sand from the Dunwich Bank was irradiated with ultra violet light to ensure there would be no background material fluorescing with the same two colours as the dyed sand. 120 kg of the blue dyed sand were wetted and frozen in 'tiles' some 10 cms thick. The 'tiles' were enclosed in a coarse meshed net and released at the injection site on the NW side of the Dunwich Bank (Fig 1), at high water slack on 3 September during neap tides. The freezing method enabled the material to reach the seabed and spread from there without losing any significant quantity to the water column. The sample stations were located at the intersections between lines every 0.5 red lane and 0.2 green lane on the Decca Main Chain chart. The HiFix 6 coordinates were noted for each sample station.

The sampler consisted of a 24 kg iron weight with a steel plate 25 x 12 cms screwed to its base. 'Formica' sample cards of the same size were coated with MS_4 silicon grease and fixed to the plate with elastic bands. Each greased card was irradiated with ultra violet light to ensure it was free of contamination before being lowered to the seabed. On recovery it was placed immediately in a transparent polythene bag which was then sealed. The sample could thus still be irradiated to detect fluorescent grains.

A second injection of 350 kg of the blue tracer was made at the same station at high water slack on 7 September. This quantity exceeded the capacity of the freezer and therefore the sand was placed at the stern and wetted whilst in the thick paper bags. Again a net was used to keep the sand together, and during the injection the ship's engine was declutched to minimise turbulence. It was expected that the bags would disintegrate soon after reaching the seabed. The sampling intensity was doubled at first, but later time constraints forced a return to the original sampling grid.

Lack of time because of bad weather meant that experiments with the red dyed sand had to be cancelled.

Sonar surveys.

The MS36 echosounder together with HiFix 6 positioning were used during runs normal to the shore across the Sizewell-Dunwich Banks. The first runs

were after the northerly gales of 27 and 28 August and part of 2 September had subsided. They were in two groups, firstly on the 2 and 3 September and secondly on 7 September. A second set of lines was followed on the 12 and 13 September after SW gales on the 11 September. Correction data for tidal height was provided by the pressure transducer located offshore from Dunwich, installed in April 1975. The recorder was modified for the duration of the cruise to sample continuously instead of at the normal three hourly intervals.

Box coring programme:

The weather conditions prevented any use of the box corer during the two periods set aside for the purpose.

RESULTS

All the data obtained during this cruise need some form of processing and analysis before the results are apparent. Therefore it is not possible to include them in a report at this stage. This includes data from the hydrographic surveys, the current meters and the tracer grain counts. However, continuous data were obtained from the eight recording meters deployed for the duration of the cruise, and it is hoped that these will prove satisfactory when validation is carried out. It is not yet known whether the long term current meter mooring or the Marconi sensors gave satisfactory data.

Some useful pointers have emerged from the pilot tracer experiment which will be borne in mind during the design of future experiments. After the first injection of fluorescent dyed sand very few grains were recovered, usually no more than twenty on one card. There could be several reasons for this. Firstly the quantity injected could be too small. Other workers have varied the size of injections from 6 lbs (Jolliffe 1963) to 2000 lbs (Stuiver and Purpura 1968). Therefore it seemed reasonable to make the second injection considerably larger than the first.

A second reason for the paucity of recovered grains could be that many were lying in the troughs of ripples and were therefore missed by the sampler (see under 'Equipment Performance'). Thirdly, the tracer could have been quickly buried. Without the box coring no evidence was obtained on this point. Fourthly, the sampling grid may have been too coarse for the amount of movement undergone by the tracer. This was difficult to assess on board ship, but counts made in the laboratory since the cruise seem to indicate that this may be so.

EQUIPMENT PERFORMANCE

IOS Barry (MSES) Equipment

The Kelvin Hughes MS36 echosounder operated satisfactorily.

Eight current meter moorings were successfully recovered and preliminary examination of the meters indicated that they functioned throughout their deployment.

IOS Taunton Equipment

It was found during the fluorescent tracer experiment that the greased cards, whilst successfully obtaining a seabed surface sample a grain or two thick where contact with the sand was made, were straddling the ripples on the banks. Thus any fluorescent grains in the troughs between were not detected. It may be possible to design a flexible sampler, or alternatively a much smaller one. The latter solution would mean greater difficulty in detecting a significant number of grains.

The performance of the Marconi equipment is currently being evaluated.

Decca HiFix 6 Equipment

After the early replacement of a faulty receiver the HiFix 6 equipment functioned satisfactorily. The set was locked in as the vessel passed through Lowestoft harbour entrance and checked at the same spot on the vessel's return. The only loss of lock was when the ship was away from Lowestoft overnight. The change was found to occur during the night with a maximum value of one lane and on one pattern only. According to Decca Survey Ltd the repeatability in this area is within 5m. It proved possible to return to the fluorescent tracer injection site, using HiFix 6.

SHIP PERFORMANCE

The performance of the RV Edward Forbes was satisfactory throughout. The only worktime lost was approximately half an hour when the brushes in the generator for the domestic supply were replaced.

CONCLUSIONS

The main disappointment was of course in the weather conditions. Of nineteen potential working days, seven were lost because of gales or near gales, and perhaps even more frustrating, a further day of good weather was lost because of faults in the Lowestoft harbour bridge lifting mechanism. 58% of the potential worktime remained.

Because of this, the scientific programme was considerably curtailed. The tracer experiment with the red dyed sand was cancelled, and no box coring at all took place. This, as mentioned earlier, also meant that there was no information as to the depth to which the fluorescent tracer became mixed.

One positive aspect of the bad weather is that with sonar surveys having been undertaken following gales from both the N and SW there should be an indication of how these gales have affected the shapes of the banks. Nine out of ten planned current meter moorings were successfully deployed and all eight short-term moorings recovered. The Marconi buoyed system was also laid successfully and the HiFix 6 method of position fixing proved satisfactory.

ACKNOWLEDGEMENTS

It is a pleasure to thank the Master, Officers and crew of the RV Edward Forbes who, in addition to their normal cheerful cooperation, showed resource in the face of various difficulties outside our control. We should like to thank particularly the staff at IOS Barry involved with current meter deployment. Our thanks go also to Captain Sellers, the Marine Superintendent at MAFF, Lowestoft, who was most helpful in allowing us the use of many facilities, and to Mr Mutimer of the British Transport Docks Board.

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APPENDIX 1

NARRATIVE

Friday 27 August	B J Lees, G W J Miller, P Taylor aboard. Remained in port due to gale force winds and rough seas.
Sunday 29 August	Wind force 3-4 N. Successfully deployed three Plessey self-recording current meter rigs at stations 15 (Decca Main Chain Red J 13.12 Green C 34.10); 16 (Red 12.12, Green 34.70); and 17 (R 12.04, G 35.13). Unsuccessful attempt to deploy shallow water rig at station 18. Problems due to new type of rig designed for shallow water. Subsurface buoy recovered, remainder of rig still on seabed, to be recovered later in cruise. NB: Similar rigs deployed successfully 1 September.
Monday 30 August	Wind force 2-3 NNE. Successfully deployed four current meter rigs at stations 19 (R 5.70, G 35.37); 20 (R 3.17, G 36.22); 21 (R 22.52, G 37.70) and 22 (R 4.12, G 37.10).
Tuesday 31 August	Wind force 4-5 NNE increasing. Conditions in study area proved too rough to work and vessel returned to Lowestoft. Visit from Mr P Martin, Fisheries Officer, MAFF. He reported the possibility of Dunwich fisherman having lost small trawl on rig at station 20. Assured him we would inspect rig as soon as weather permitted.
Wednesday 1 September	Wind force 2 W. Successfully deployed current meter rigs at stations 23 (R 3.31, G 36.80) and 24 (R 1.21, G 37.42). Remainder of rig at station 18 recovered. Rig at station 20 recovered, thoroughly inspected and relaid. No evidence of having snagged trawl. No apparent interruption in meter recording. WGJM put ashore at Southwold, JOM came aboard by inflatable boat. Anchored for night.
Thursday 2 September	Commenced by echosounding across Dunwich Bank, working from N to S. Weather deteriorating, sea roughening, wind gale force 8 N imminent. Vessel returned to Lowestoft. JOM returned to Taunton.

Friday 3 September	Wind force 5-6 locally 8 NW. Delayed sailing until 1430 hours. Echosounding across Dunwich Bank continued until high water slack. 120 kgs wetted and frozen blue fluorescent tracer sand injected on NW of Dunwich Bank (Station F1, see Fig 1). HiFix 6 Pattern 1, 2148.00, Pattern 2, 610.00. Sampled with greased cards on grid constructed at 0.5 Red Decca Main Chain lane and 0.2 Green Decca Main Chain lane intervals, positioning each sampling station with HiFix 6. Sampling continued until no more tracer showed on cards when irradiated with UV light. Anchored 0200 hours Saturday.
Saturday 4 September	0800 to 1720 hours sampled for fluorescent tracer. 1930 Berthed at Lowestoft. HLK, DNL came aboard.
Sunday 5 September	Wind force 3-4 NE. PJH, EJM, MASM joined vessel for day. Marconi buoyed system (with U-shaped rig) successfully deployed inside Sizewell-Dunwich Banks. DNL responsible. See 'Equipment and Methods' for details of method. 1630 berthed at at Lowestoft. PJH, EJM, MASM departed.
Monday 6 September	DNL departed. Vessel unable to leave port all day because harbour bridge jammed. Finally repaired early hours of Tuesday morning.
Tuesday 7 September	0900 to 1100 hours. Conducted echosounding survey until high water slack. 1115 hours injected c. 350 kg wetted blue fluorescent tracer at site F1 as before. Engine declutched to minimise turbulence. Sampling as before on similar grid pattern. 2400 hours anchored.
Wednesday 8 September	Sampling for fluorescent tracer sand continued.

Thursday 9 September)
Friday 10 September) Gale force winds, mainly SW, prevented work.
Saturday 11 September)

Sunday 12 September	Current meter rigs from stations 15, 17, 16, 19, 20 and 21 safely recovered. Echosounding carried out over Sizewell Bank. Anchored overnight.
Monday 13 September	Echosounding continued over Dunwich Bank. Returned to Lowestoft and offloaded current meter gear. HiFix 6 equipment removed by Decca engineers.
Tuesday 14 September	Current meter rigs safely recovered from Stations 23 and 24. Toroidal buoy at Station 22 (long-term mooring) righted. 1245 hours sailed for Barry.

CRUISE REPORTS

CRUISE No. and/or DATE	REPORT No.
R.R.S. "CHALLENGER"	
August - September 1974	IOS CR 22
R.V. "EDWARD FORBES"	
October 1974	IOS CR 15*
January - February 1975	IOS CR 19
April 1975	IOS CR 23
May 1975	IOS CR 32
May - June 1975	IOS CR 28
July 1975	IOS CR 31
July - August 1975	IOS CR 36
August - September 1975	IOS CR 41
R.R.S. "JOHN MURRAY"	
April - May 1972	NIO CR 51
September 1973	IOS CR 7
March - April 1974	IOS CR 9
October-November & December 1974	IOS CR 21
April - May 1975	IOS CR 25
April 1975	IOS CR 39
October - November 1975	IOS CR 40
August - October 1975	IOS CR 42
N.C. "MARCEL BAYARD"	
February - April 1971	NIO CR 44
M.V. "RESEARCHER"	
August - September 1972	NIO CR 60
R.V. "SARSIA"	
May - June 1975	IOS CR 30
August - September 1975	IOS CR 38
R.R.S. "SHACKLETON"	
August - September 1973	IOS CR 3
January - February 1975	IOS CR 18
March - May 1975	IOS CR 24
February - March 1975	IOS CR 29
July - August 1975	IOS CR 37
June - July 1976	IOS CR 45
M.V. "SURVEYOR"	
February - April 1971	NIO CR 38
June 1971	NIO CR 39*
August 1971	NIO CR 42*

*not distributed

CRUISE REPORTS

CRUISE No. and/or DATE	REPORT No.

D.E. "VICKERS VOYAGER" AND "PISCES III"

June - July 1973	IOS CR 1

R.R.S. "DISCOVERY"

1 (International)
2 (Indian Ocean)
3 (Expedition)

Published and distributed by the Royal Society

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4 February - March 1965	4
37 November - December 1970	37
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55 September - October 1973	5
56 October - November 1973	4
57 November - December 1973	6
58 December 1973	4
59 February 1974	14
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73 July - August 1975	34
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74 Leg 1 & 3 }	35
75 October - November 1975	43

[1]NIO CR National Institute of Oceanography, Cruise Report
[2]IOS CR Institute of Oceanographic Sciences, Cruise Report