Marine Geology
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CRUISE REPORT

British Enterprise Four: Leg 2

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Introduction

This second leg of the charter had originally been planned as a routine sampling leg. Delays in the ship mobilisation however resulted in most of the leg being devoted to the completion of the mobilisation and operational trials. The planned operational area included continental shelf waters as well as the upper part of the continental slope with depths down to 1200m. The operational trials were therefore required to devise practical methods of working in deep water. These were achieved for vibrocoring in water depths down to 500m.

The sampling area is shown in Fig. 1 and the cruise log summary is given in Appendix I. Details of the sample stations are given in Appendix II.

Personnel

N G T Fannin	(Party Chief)
D Long	(Day Lab Geologist)
J McGuigan	(Day Laboratory)
B Lonie	(Day Technician)
J A Chesher	(Night Geologist)
R Hamblin	(Night Lab Geologist)
G Bradley	(Night Laboratory)
A Bell	(Night Technician)
C Graham	(Navigation)
J Pheasant	(Development Engineer)
D Cockcroft	(Student)

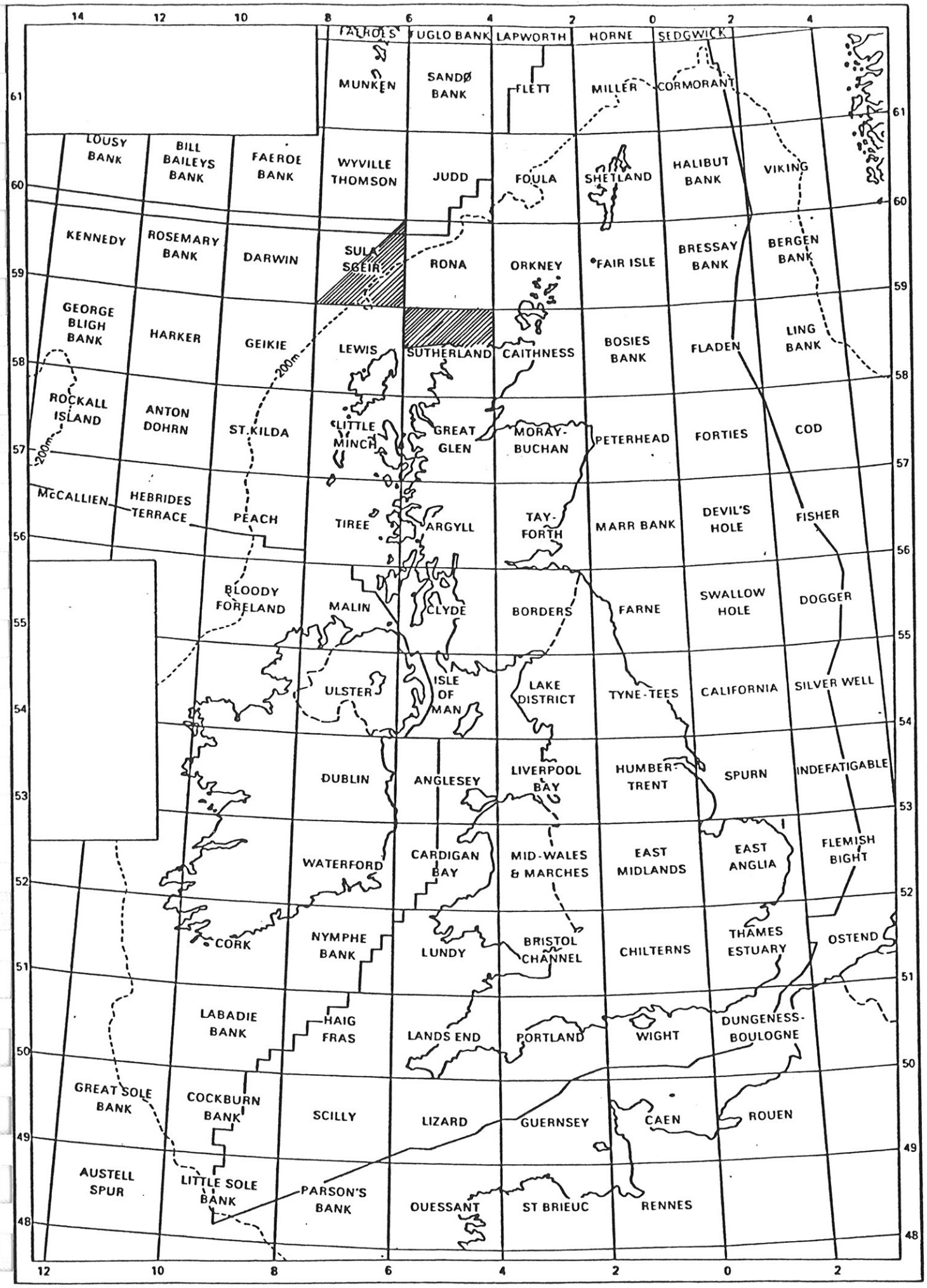
Area

Samples were collected in the northern part of the Sutherland Sheet and in the Sula Sgeir sheet (Fig. 1).

Geology

The suite of samples were collected over a wide range of geological terrains. Glacial diamictons were sampled on the shelf top and upper slope. In the mid slope area clear evidence of slumped sediments were

FIG. 1


FAIROES
FUGLO BANK
LAPWORTH
HORNE
SEDGWICK
MUNKEN
SANDØ BANK
FLETT
MILLER
CORMORANT
LOUSY BANK
BILL BAILEYS BANK
FAEROE BANK
WYVILLE THOMSON
JUDD
FOULA
SHETLAND
HALIBUT BANK
VIKING
KENNEDY
ROSEMARY BANK
DARWIN
SULA SGEIR
RONA
ORKNEY
FAIR ISLE
BRESSAY BANK
BERGEN BANK
GEORGE BLIGH BANK
HARKER
GEIKIE
LEWIS
SUTHERLAND
CAITHNESS
BOSIES BANK
FLADEN
LING BANK
ROCKALL ISLAND
ANTON DOHRN
ST.KILDA
LITTLE MINCH
GREAT GLEN
MORAY-BUCHAN
PETERHEAD
FORTIES
COD
McCALLIEN
HEBRIDES TERRACE
PEACH
TIREE
ARGYLL
TAY-FORTH
MARR BANK
DEVIL'S HOLE
FISHER
BLOODY FORELAND
MALIN
CLYDE
BORDERS
FARNE
SWALLOW HOLE
DOGGER
ULSTER
ISLE OF MAN
LAKE DISTRICT
TYNE-TEES
CALIFORNIA
SILVER WELL
DUBLIN
ANGLESEY
LIVERPOOL BAY
HUMBER-TRENT
SPURN
INDEFATIGABLE
WATERFORD
CARDIGAN BAY
MID-WALES & MARCHES
EAST MIDLANDS
EAST ANGLIA
FLEMISH BIGHT
CORK
NYMPHE BANK
LUNDY
BRISTOL CHANNEL
CHILTERNS
THAMES ESTUARY
OSTEND
LABADIE BANK
HAIG FRAS
LANDS END
PORTLAND
WIGHT
DUNGENESS-BOULOGNE
GREAT SOLE BANK
COCKBURN BANK
SCILLY
LIZARD
GUERNSEY
CAEN
ROUEN
AUSTELL SPUR
LITTLE SOLE BANK
PARSON'S BANK
OUESSANT
ST BRIEUC
RENNES
200m
200m

observed with clasts of stiff clays from the upper slope and shelf edge enclosed in a chaotic flow sediment, commonly pale grey in colour. The lower slope areas are composed of very soft, commonly bioturbated, clays and silty sands.

Seabed sediments are also very variable and coarse pebbly sands may occur at depths well in excess of 500m. The deepest water sediments are commonly clayey silts with a very high proportion of foraminifera.

Insufficient data are presently available to define the distribution of the main sedimentary facies.

Sample Recovery

A total of 62 stations were occupied of which 25 were vibrocore stations. Gravity core stations ranged in water depth from 60 - 1065 m and vibrocore stations from 67-500 m water depth. Details of the sample stations are given in Appendix II.

Sample recovery rates were also very variable. In general vibrocore recovery rates increased with depth with a significant increase in recovery below 275m water depth when recoveries ranged between three to six metres (Fig. 2). Poor penetration was achieved in the stiff pebbly clays of the upper slope and shelf. Gravity core recovery was also poor in the shallower water and was usually less than 0.5m. Recovery of between one and two metres were only achieved below 700m water depth while penetration was commonly up to three metres.

Shipek grab recoveries were also very variable and efficiency decreased noticeably below about 200 m water depth. Altogether only 36% of the samples were acceptable in terms of the amount of material recovered and at over half the stations (54%) the samples were unacceptably small (Fig. 3). Of the 20 stations occupied in water depths greater than 500m acceptable samples were obtained at only 15% with unacceptably small or no recoveries obtained at the remaining sites.

FIG. 2

WATER DEPTH v PENETRATION

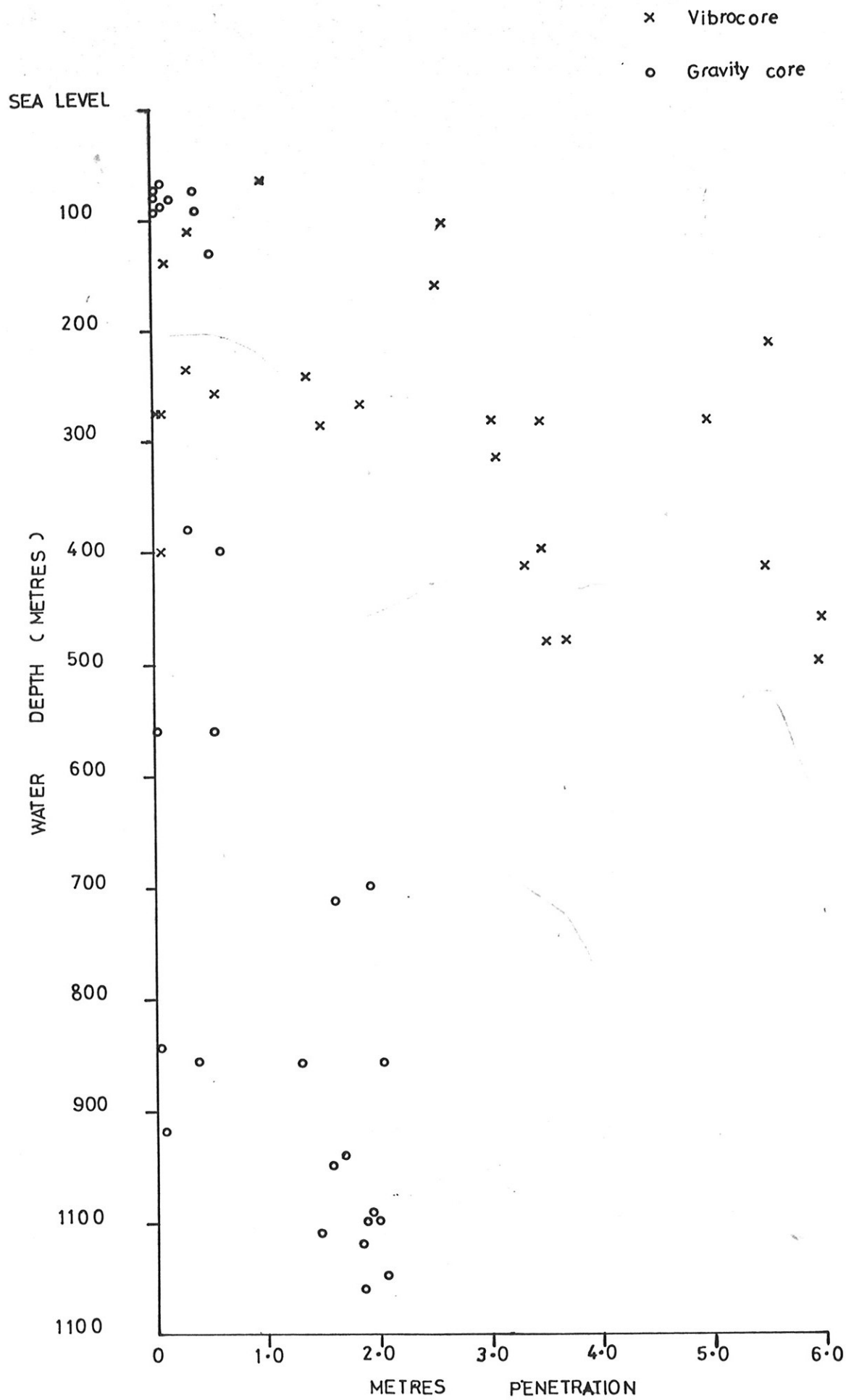


FIG. 3

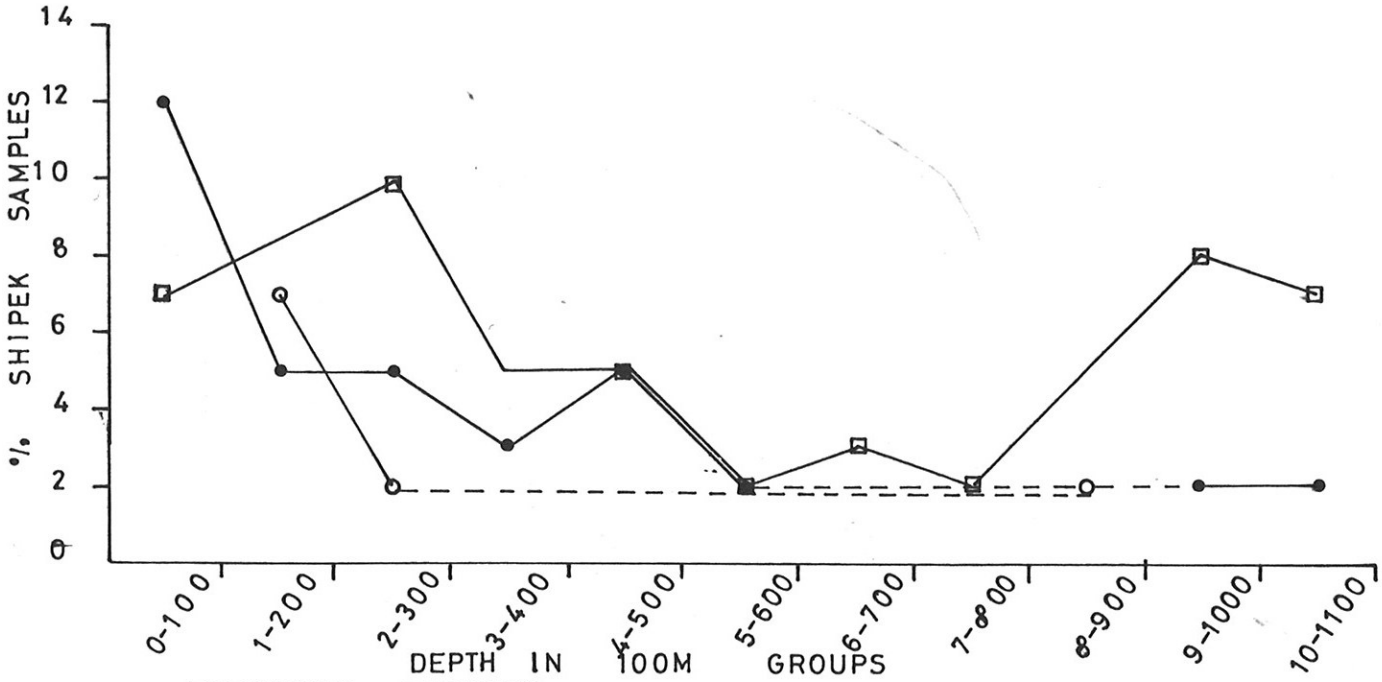
SHIPEK GRAB RECOVERY % VALUES

DEPTH IN 100M GROUPS

RECOVERY	0-100	1-200	2-300	3-400	4-500	5-600	6-700	7-800	8-900	9-1000	10-1100	
N	—	7	2	—	—	—	—	—	2	—	—	11
S	7	—	10	5	5	2	3	2	5	8	7	54
A	12	5	5	3	5	2	—	—	—	2	2	36
	19	12	17	8	10	4	3	2	7	10	9	

N NO RECOVERY
S SMALL RECOVERY
A ACCEPTABLE RECOVERY

n = 59



● ACCEPTABLE RECOVERY
□ SMALL RECOVERY
○ NO RECOVERY

Sub samples

A total of 39 sub samples were collected for inorganic geochemical analysis from the shipek grab samples and 15 samples were collected at 1.00m depth in the cores for organic geochemistry. All samples were deep frozen at the time of collection.

Ship Operation

Considerable difficulties were encountered during the mobilisation phase and a good deal of this work was carried out during Leg II. Much of the ship operations were therefore still under development and trial throughout the leg.

Weather conditions during the cruise were very good and a complete assessment of the ships weather characteristics cannot be made. In general it seems likely however that sea state 5 will be the limiting weather condition in the area west of Orkney and Shetland for all types of work.

The dynamic positioning system, which encountered some problems during the cruise, did however work well and few difficulties were encountered during vibrocoring operations. Care must be taken to ensure that the main engines are not used during deployment and recovery of the vibrocorer. Turbulence caused by the ships prop can cause the vibrocore to spin in the water which may result in damage to the umbilical cable.

Vibrocore launch and recovery requires the simultaneous operation of three winches and the A frame. With practice a smooth handling system has been developed however and no problems were encountered in using the vibrocorer in a twenty four hour operation.

The seabed transponder for dynamic positioning was attached near the head of the vibrocorer and was used to guide it to the seabed. Once the vibrocorer was on the seabed the ship held station above it. Otherwise the ship occupies the stations using main Chain Decca and a track plotter.

Time taken to occupy stations ranged from a few minutes up to twenty minutes depending on weather conditions. Surprisingly strong tides were encountered in the area however and these caused some delays. The time on station (Fig. 4) also includes equipment deployment and, particularly in the case of the vibrocorer, delays due to technical and launch problems have weighted the figures. It is noticeable however that station times in water depths greater than two hundred metres are not significantly different between the gravity core and vibrocore sites. This is largely because the drift of the ship on gravity core stations (which was commonly in excess of 0.5 km) required that the site had to be occupied twice, once for the Shipek sample and once for the gravity core sample. This problem was less severe in the shallower vibrocore sites.

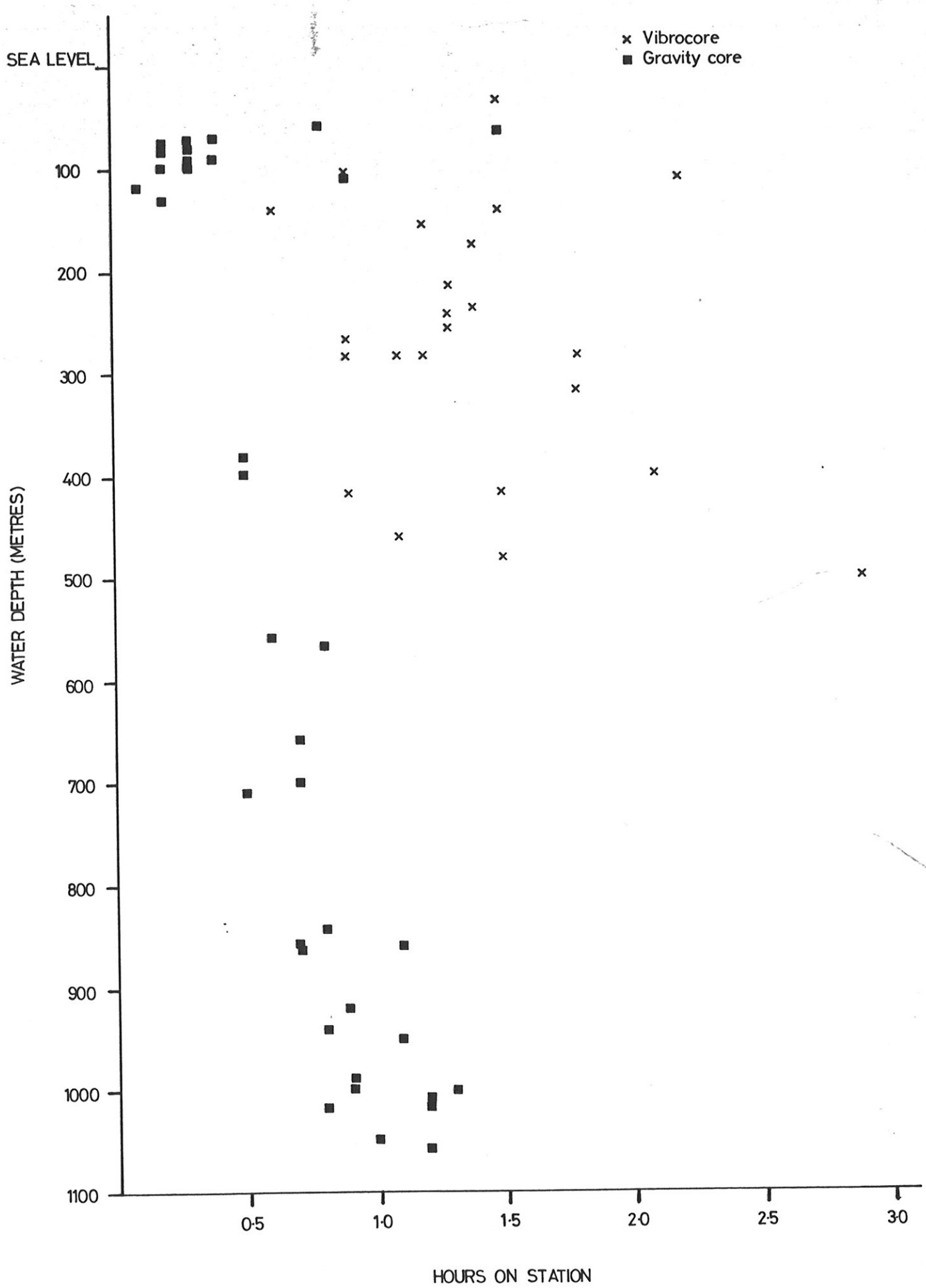
BGS Equipment

The vibrocorer worked well during the leg and operated successfully at depths down to 500m. This appears to be near the operational limit of the present configuration. Earth leakage trips were common below about 300m. These may be due to dampness in the plugs or more seriously ingress of water to the main splice. Some water ingress to the hydraulic box also occurred and towards the end of the leg some escape of emulsified oil was evident through the pressure compensation bag. During the cruise all possible snagging points were removed or covered to avoid damage to the umbilical.

The gravity corer (used in the three metre mode with four inch barrels) and shipek grab both operated moderately successfully. The limited recovery rates reflect the strength of the currents and tides which resulted, particularly in the case of the Shipek (Fig. 3), in the equipment being swept down current. In an attempt to improve recovery the ship was conned to maintain as near a vertical line of descent of the equipment as possible. This resulted in the eventual sampling position being off the planned site by up to several hundred metres at times.

WATER DEPTH V. TIME ON STATION

FIG 4



The new power/hoist umbilical proved particularly successful. The stiffness of the cable and the danger of damage to the power elements during severe bending places considerable limitations on its use however.

Further operational developments

Because of the early delays in the mobilisation a number of tasks remain. These include the development of operational procedures for the triggered gravity corer which has yet to be tested. The underwater camera also has to be built on to the grab assembly and an operating technique developed.

Future developments

This initial phase of deep water work has already provided valuable information for future deep water operations.

The shipek grab is clearly too light for operations in the present areas. It may however operate more successfully as the trigger weight to a triggered corer system should this in turn prove more successful than the present gravity coring system (Fig 2&3). Ultimately a larger grab or box corer may prove more successful.

The success of the vibrocorer in depths down to 500m is encouraging and initial geological evidence suggests that it might be advantageous to operate the system to about 700m. An articulating joint for the umbilical cable would also provide additional protection.

Looking further ahead, examination of the on station times in Figure 4 suggests that with a pressure uprated system use of the vibrocorer frame at all depths down to 1500m might be a practical solution. Coring could be carried out in a powered or unpowered mode and a bottom grab could be attached to the frame. The power/hoist umbilical could also provide the opportunity for further instrumentation of the system.

APPENDIX I

CRUISE SUMMARY

Wed 15/8	
00.00 - 24.00	Mobilisation - alongside Scrabster. Working on ships hydraulics.
Thur 16/8	
07.30	Cast off and anchor in Thurso Bay. Continue work in ships hydraulics.
21.30	Alongside Scrabster
Fri 17/8	
00.00 - 24.00	Continue work on ships hydraulics
Sat 18/8	
00.00 - 15.30	Continue work on ships hydraulics
15.30 - 24.00	Mobilisation
Sun 19/8	
01.00	Cast off - steam to Loch Eriboll
05.00	Anchor in Loch Eriboll Continue mobilisation and deployment trials
Mon 20/8	
00.00 - 24.00	Continue mobilisation and deployment trial
Tue 21/8	
00.00 - 20.30	Continue mobilisation and deployment trials
20.30	Raise anchor and steam towards sampling site
21.20	Approaching site. Fault in DP. Operate DP in manual mode
23.00	Complete station holding trials.
Wed 22/8	
00.15	Begin gravity coring
09.00	Complete gravity coring
09.00 - 11.00	Check earth leak protection system on vibrocorer
11.00 - 11.45	Launch Dory to assist test of DP system
11.45 - 12.45	Vibrocoring
12.45 - 15.15	On passage to Loch Eriboll
21.30	Pick up GEC engineer and steam towards sampling area

Thur 23/8

00.00 -	On passage to gravity coring site
- 09.15	Gravity coring
09.15 - 21.30	Vibrocoring. DP system repaired and now working in automatic
21.30 - 22.15	Gravity coring
22.15 - 24.00	Steaming to deep water to respool gravity core rope

Fri 24/8

	Respool 1500m of gravity core rope under tension.
- 15.00	Complete gravity coring
15.00 - 20.30	Gravity coring
17.00 - 17.30	Ships safety meeting
20.30 - 24.00	Gravity coring

Sat 25/8

24.00 - 09.00	Complete gravity coring
09.00 - 16.15	Vibrocoring
16.15 - 17.15	Greasing umbilical wheel in A frame
17.15 - 24.00	Vibrocoring

Sun 26/8

00.00 - 20.00	Vibrocoring
20.00 - 20.30	Replace retraction wire on vibrocore
20.30 - 24.00	Vibrocoring

Mon 27/8

00.30	Complete vibrocoring and begin gravity coring
11.00 - 12.00	Gravity corer rope badly frayed at 500m. Rope cut and respliced
12.00	Gale warning - swly 8 imminent
18.30	Abandon gravity coring in deteriorating weather and steam towards shelter

Tue 28/8

05.00	Anchor in lee of Tolsta Head. Waiting on weather
10.30	Calibrate vibrocorer penetrometer
22.00	Raise anchor and steam to Kyle

Wed 2938

00.00 - 07.50	On passage to Kyle
07.50 - 24.00	Alongside in Kyle

APPENDIX II

SHEET AREA 58-05

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
140	GS, CS	60	A	-	0.8	✓		Equipment failure on CS
141	GS, CS	-	A	0.10	0.2	✓		No depth given
142	GS, CS	75	A	0.20	0.2	✓		
143	GS, CS	90	A	0.10	0.3	✓		

SHEET AREA 58-06

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
217	GS, CS	80	A	0.12	0.3	✓		
218	GS, CS	96	S	0.41	0.3	✓		
219	GS, CS	88	A	0.10	0.4	✓		
220	VE	102		2.65	0.9			
221	GS, VE	67	A	1.07	1.5	✓		
222	GS, CS	74	A	0.38	0.3	✓		
223	GS, CS	80	S	0.20	0.3	✓		

HEET AREA 59-07

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
255	GS, CS	70	S	0.10	0.4	X	X	
256	GS, CS		S	0.10	0.2	✓		No depth given
257	GS, CS	128	A	0.55	0.2	✓		
258	GS, CS	120	A		0.1	✓		No core
259	GS, CS	100	S		0.2	X	X	No core
260	VE	110		0.35	2.2	X	X	
261	GS, VE	146	N	0.15	1.5	X	X	
262	GS,VE	154	N	2.55	1.2	X	X	Shipek failed
263	GS, VE	214	A	5.55	1.3	✓		
264	GS, VE	400	A	3.50	2.1	✓		
265					2.1			Fault on gravity core winch
266	GS, CS	1000	S	2.00	0.9	✓		
267	GS, CS	1022	S	1.8	0.8	X	X	
268	GS, CS	1020	S		1.2	✓		Fault on gravity core winch

SHEET AREA 59-07

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
269	GS, CS	860	N	1.13	1.1	✓		Shipek failed
270	GS, CS	400	S	0.63	0.5	X	X	
271	GS, VE	274	S	0.10	1.7	X	X	
272	GS, VE	400	S	0.10	3.2	X	X	
273	GS, CS	565	S	0.53	0.6	X	X	
274	GS, CS	860	S	0.36	0.7	✓		
275	GS, CS	990	A	1.97	0.9	✓		
276	GS, CS	1050	A	2.05	1.0	X	X	
277	GS, CS	660	S	-	0.7	X	X	
278	GS, CS	380	A	0.35	0.5	✓		
279	GS, VE	420	A	5.15	0.9	✓	✓	
280	GS, VE	480	A	3.52	1.5	✓	✓	
281	GS, VE	415	S	3.35	1.5		✓	
282	GS, VE	500	A	5.96	2.9	✓	✓	

SHEET AREA 59-07

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
283	GS, VE	480	S	3.71	4.3		✓	
284	GS, VE	314	S	3.43	1.8	✓	✓	
285	GS, VE	242	S	1.41	1.3		✓	
286	GS, VE	233	S	0.33	1.4	X	X	
287	GS, VE	270	S	1.88	0.9	✓	✓	
288	GS, VE	282	N	3.05	0.9	X	X	
289	GS, VE	460	S	6.01	1.1	X	X	
290	GS, VE	175	A	0.10	1.4	✓		
291	GS, VE	260	A	0.63	1.3	✓		
292	GS, VE	280	A	3.10	1.8	✓	✓	
293	GS, VE	282	S	4.95	1.2			
294	GS, VE	282	S	1.54	1.1	✓		
295	GS, CS	700	S	1.90	0.7	✓		
296	GS, CS	860	S	2.07	0.7	✓	✓	

SHEET AREA 59-07

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	Geochem Sample 1m	Comments
297	GS, CS	920	S	0.10	0.9		✓	
298	GS, CS	940	S	1.70	0.8	✓	✓	
299	GS, CS	565	A	-	0.7	✓		

SHEET AREA 59-08

Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Sample Seabed	1m	Comments
28	GS, CS	1000	S	1.83	1.3	✓		
29	GS, CS	715	S	1.63	0.6	✓		
30	GS, CS	840	S	-	0.8			
31	GS, CS	950	S	1.61	1.1	✓	✓	
32	GS, CS	1065	S	1.85	1.2	✓	✓	
33	GS, CS	1010	S	1.48	1.2	✓	✓	