CRUISE REPORT

British Enterprise Four: Leg 2

15-29 August 1984

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Marine Research Programme C3
Marine Geology
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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)
В	Lonie	(Day Technician)
J	A Chesher	(Night Geologist)
R	Hamblin	(Night Lab Geologist)
G	Bradley	(Night Laboratory)
Α	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

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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.

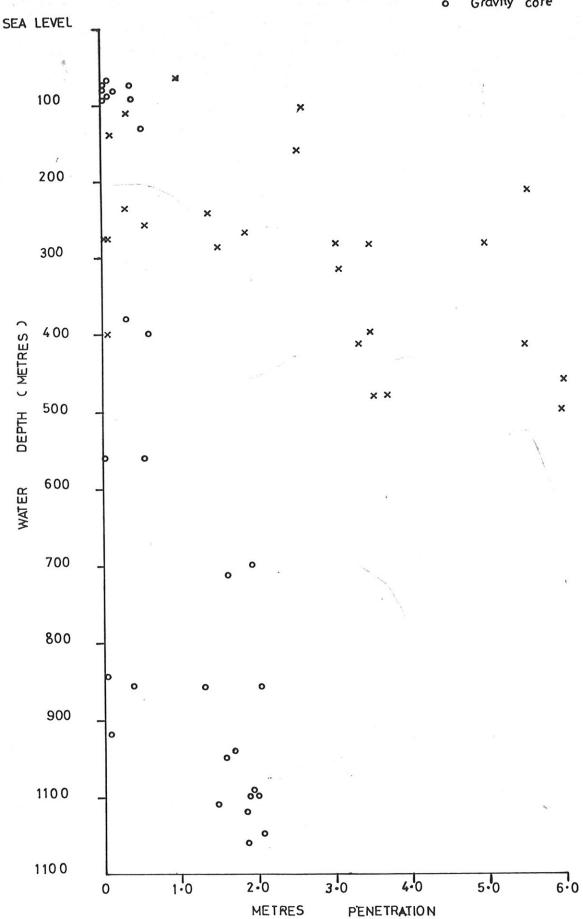
Sample recovery rates were also very variable. In general vibrocore recovery rates increased with depth with a significant increase in recovery below 275m water depth when recoveries ranged between three to six metres (Fig. 2). Poor penetration was achieved in the stiff pebbly clays of the upper slope 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.

PENETRATION WATER DEPTH

Vibrocore

Gravity core

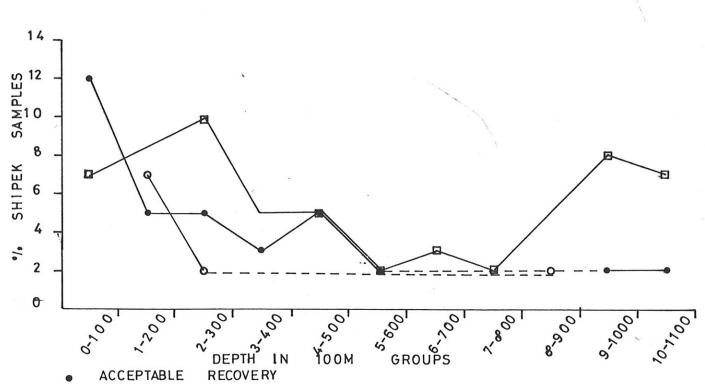


GRAB RECOVERY

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S SMALL RECOVERY

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.

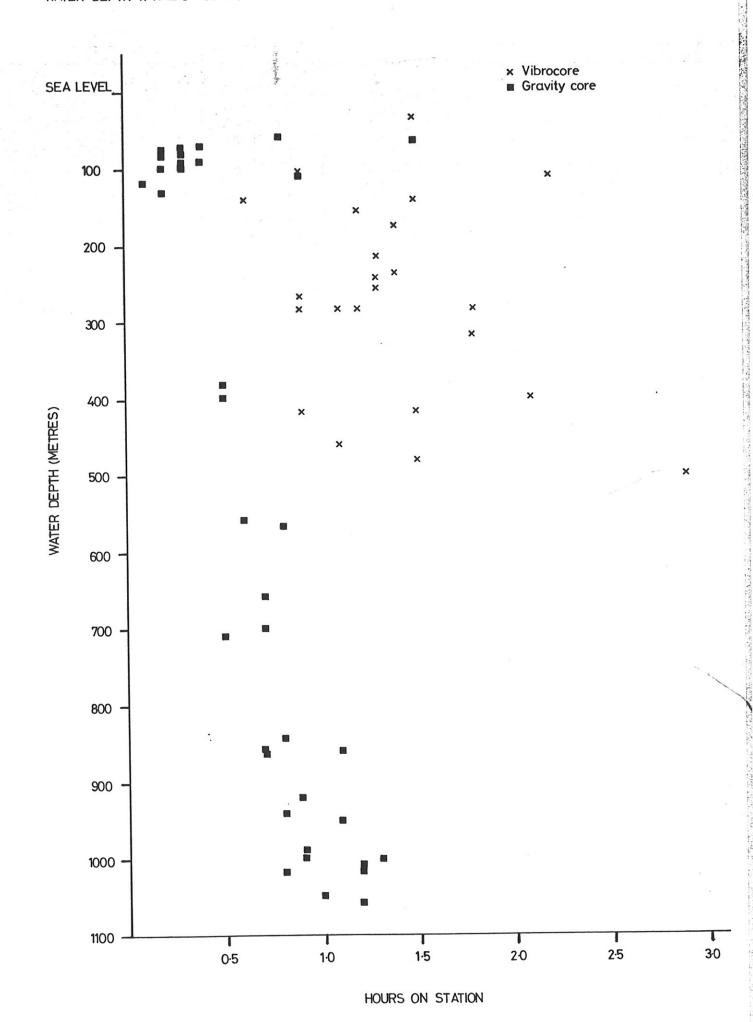
Otherwise the ship occupies the stations using main Chain Decca and a track plotter.

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.



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 15.30 - 24.00	Continue work on ships hydraulics Mobilisation
Sun 19/8	
01.00 05.00	Cast off — steam to Loch Eriboll 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 20.30 21.20	Continue mobilisation and deployment trials Raise anchor and steam towards sampling site Approaching site. Fault in DP. Operate DP in manual mode
23.00	Complete station holding trials.
Wed 22/8	
00.15 09.00 09.00 - 11.00 11.00 - 11.45 11.45 - 12.45 12.45 - 15.15 21.30	Begin gravity coring Complete gravity coring Check earth leak protection system on vibrocorer Launch Dory to assist test of DP system Vibrocoring On passage to Loch Eriboll Pick up GEC engineer and steam towards sampling area

Thur 23/8	
00.00 09.15	On passage to gravity coring site Gravity coring
09.15 - 21.30	Vibrocoring. DP system repaired and now working in automatic
21.30 - 22.15 22.15 - 24.00	Gravity coring Steaming to deep water to respool gravity core rope
Fri 24/8	
- 15.00 15.00 - 20.30 17.00 - 17.30 20.30 - 24.00	Respool 1500m of gravity core rope under tension. Complete gravity coring Gravity coring Ships safety meeting Gravity coring
Sat 25/8	
24.00 - 09.00 09.00 - 16.15 16.15 - 17.15 17.15 - 24.00	Complete gravity coring Vibrocoring Greasing umbilical wheel in A frame Vibrocoring
Sun 26/8	
00.00 - 20.00 20.00 - 20.30 20.30 - 24.00	Vibrocoring Replace retraction wire on vibrocore Vibrocoring
Mon 27/8	
00.30 11.00 - 12.00	Complete vibrocoring and begin gravity coring Gravity corer rope badly frayed at 500m. Rope cut and respliced
12.00 18.30	Gale warning - swly 8 imminent Abandon gravity coring in deteriorating weather and steam towards shelter
Tue 28/8	
05.00 10.30 22.00	Anchor in lee of Tolsta Head. Waiting on weather Calibrate vibrocorer penetrometer Raise anchor and steam to Kyle
Wed 2938	
00.00 - 07.50 07.50 - 24.00	On passage to Kyle 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 S Seabed	Sample 1m	Comments
140	GS, CS	60	А	I	0.8	<		Equipment failure on CS
141	gs, cs	ı	А	0.10	0.2	<		No depth given
142	GS, CS	75	А	0.20	0.2	<		
143	GS, CS	90	А	0.10	0.3	<		
	1							
			Ēz					
	,							

-					223		222	221		220	1	219	218	217		Sample station no.	SHEET AREA 58-06
					GS, CS		GS, CS	GS, VE		VE		GS, CS	GS, CS	GS, CS		Equipment used	
					9		74	6/	3	102		88	96	80		Water depth(M)	
						v)	А	þ	Þ			A	w	A	>	Shipek Recovery(M)	
						0.20	0.38		1.07	2.65)	0.10	0.41	(0 10	Core Recovery(M)	
						0.3		D	1.5	C	0	0.4	0.3		0.3	Station (H)	3
						7		`	<			7	7		7	Seabed 1m	Geochem Sample
												_					le
																	Comments

HEET AREA 59-07

268	267	266	265	264	263	262	261	260	259	258	257	256	255	Sample station no.
gs, cs	GS, CS	gs, cs		GS, VE	GS, VE	GS,VE	GS, VE	VE	gs, cs	GS, CS	GS, CS	GS, CS	GS, CS	Equipment used
1020	1022	1000		400	214	154	146	110	100	120	128		70	Water depth(M)
ω	ω	w		A	А	N	N		ω	A	А	ω	w	Shipek Recovery(M)
	1.8	2.00		3.50	5.55	2.55	0.15	0.35			0.55	. 0.10	0.10	Core Recovery(M)
1.2	0.8	0.9	2.1	2.1	1.3	1.2	1.5	2.2	0.2	0.1	0.2	0.2	0.4	Time on Station (H)
<	×	<		<	<	×	X	×	×	<	<	7	×	Geochem Seabed
	×					×	×	×	X				×	Sample 1m
Fault on gravity core winch			Fault on gravity core winch			Shipek failed			No core	No core		No depth given		Comments

282	281	280	279	278	277	276	275	274	273	272	271	270	269	Sample station no.
GS, VE	GS, VE	GS, VE	GS, VE	cs, cs	GS, VE	GS, VE	cs, cs	GS, CS	Equipment					
500	415	480	420	380	660	1050	990	860	565	400	274	400	860	Water depth(M)
А	w	A	A	A	Ø	A	А	ຜຼຸ	ស	ß	S	ß	N	Shipek Recovery(M)
5.96	3.35	3.52	5.15	0.35	I	2.05	1.97	0.36	0.53	0.10	0.10	0.63	, 1.13	Core Recovery(M)
2.9	1.5	1.5	0.9	0.5	0.7	1.0	0.9	0.7	0.6	3.2	1.7	0.5	1.1	Time on Station (H)
<		7	<	<	×	×	7	7	×	×	×	×	7	Geochem Seabed
<	7	7	7		×	×			×	×	×	×		Sample 1m
													Shipek failed	Comments

SHEET AREA 59-07

SHEET AREA 59-07	0.7							
Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem S Seabed	Sample 1m	Comments
297	GS, CS	920	W	0.10	0.9		<	
298	cs, cs	940	ß	1.70	0.8	<	<	
299	cs, cs	565	А	I	0.7	<		
		z.						
			r					

SHEET AREA 59-08

SHEEL AREA SOFOO	100							
Sample station no.	Equipment used	Water depth(M)	Shipek Recovery(M)	Core Recovery(M)	Time on Station (H)	Geochem Seabed	Sample 1m	Comments
28	GS, CS	1000	ß	1.83	1.3	<		
29	GS, CS	715	တ	1.63	0.6	<		
30	GS, CS	840	യ	I	0.8			
31	GS, CS	950	ß	1.61	1.1	<	<	
32	1	1065	ഗ	1.85	1.2	<	7	
33	GS, CS	1010	αį	1.48	1.2	<	7	