INSTITUTE OF GEOLOGICAL SCIENCES
CONTINENTAL SHELF DIVISION

MARINE GEOPHYSICS UNIT

Report No. 101

Cruise Report for Projects 79/14, West Shetland, and Project 79/15, Bosies Bank m.v. Sperus, July-September 1979

Edited by

E J Armstrong

Murchison House
West Mains Road
Edinburgh EH9 3LA.

October 1979

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INTRODUCTION

This report deals with the cruise by cruise operation of Projects 79/14 and 79/15, run during July, August and September 1979 as part of the IGS, Marine Geophysics Unit, Continental Shelf survey programme.

Project 79/14 was designed to provide regional geophysical coverage of the Foula sheet, of the IGS 1:250,000 map series, on a N-S, E-W grid of lines at approximately 15km by 9km spacing. A number of gravity lines were also to be run over the Orkney sheet to complete gravity coverage in that area. In addition, some regional geophysical lines were to be surveyed on the Halibut Bank sheet after a study of the FLAGS pipeline route with the Huntec deep tow boomer.

The aim of Project 79/15 was completion of regional geophysical coverage of the Bosies Bank sheet, on a grid of NS-EW lines at approximately 10km by 10km spacing.

The m.v. Sperus, chartered from Cosag Marine Services Ltd, was used for this work as for previous work in 1979, described in Marine Geophysics Unit Reports 99 and 100. The ship has a net weight of 921 tons, an overall length of 63m, an 11m beam and a draught of 4m.

Short reports were prepared on a leg by leg basis by the Senior Scientist, geophysicists, geologists, surveyors and technicians. These reports, together with the log sheets and summary charts, on which this report is based, are archived on open file at the Marine Geophysics Unit, IGS, Murchison House, West Mains Road, Edinburgh.

The authors of the reports for the two projects are listed below:

PROJECT 79/14

Leg 1

Senior Scientist	A Dobinson
Navigation	A S Mould
Geophysical	E J Armstrong and J R Walker
Geological	R Owen
Technical	P Walters

Leg 2

Senior Scientist	A Dobinson
Navigation	A S Mould
Geophysical	J R Walker
Geological	N Fannin
Technical	C Paulson

Leg 3

Senior Scientist	M C Tully
Navigation	M Glen
Geophysical	M C Tully and S D Spencer
Technical	C Paulson, A Ogilvie, H Miles

PROJECT 79/15

Leg 1

Senior Scientist	M C Tully
Navigation	M Glen
Geophysical	M C Tully and S D Spencer
Technical	C Paulson, A Ogilvie, H Miles

Leg 2

Senior Scientist	A Dobinson
Navigation	M Glen
Geophysical	A Skuce
Geological	D Evans
Technical	K Robertson

PROJECT 79/14

Legs 1, 2 and 3 of this project were run during legs 7, 8 and 9 of the main 1979 survey programme, leg 3 occupying just over half of leg 9.

Leg 1

Newcastle-Lerwick: 9-23 July 1979

After a ship maintenance period from 4-9 July during which the MX600 doppler sonar was replaced for the deeper tracking MX610, the ship sailed for the start of the FLAGS line. A drift test and calibration run were carried out en route and following a short sand bank study off Peterhead, 416km (over 93% of the total length) were surveyed along the pipeline with the Huntec deep tow boomer.

This data will be combined with other IGS and commercial data for special study and incorporation into the regional mapping programme.

Six regional geophysical lines were then run in the northern half of the Halibut Bank sheet before the ship moved to the main survey area west of the Shetland Islands. Overall, 1900km of data were collected in fairly good weather on this, leg despite losing 24 hours while disembarking a crew member in Lerwick. This completed 25% of the work on the Foula and Orkney sheets.

In order to improve positioning results the computer, latitude torquing constant of the satellite navigation (sat/nav) system was reduced after detection of gyrocompass errors. The MX610 doppler sonar tracked water bottom satisfactorily down to approximately 270m, below which Decca Navigator was incorporated into the dead reckoning calculation.

The RVS, S40 LaCoste and Romberg gravity meter was installed at the beginning of the leg and generally worked well though it was necessary to smooth the traces in seas greater than about force 5. A mean mistie of 0.6mGal was obtained from 10 crossovers.

The S75 gravity meter long axis gyro was changed after failure on Friday 13 July. Another platform failure occurred later whilst a tachometer in the autoreader was being checked. Both meters had

been previously tripped out twice en route to Peterhead but were reset quickly. A mean mistie of 0.5mGal was obtained from reduced S75 Bouguer anomalies and reasonable agreement with previous years' results was observed.

A consistent, mean offset of 1.19mGal between the two meters, S40<S75, during this leg, was probably due to a poor base tie for the S40 at Newcastle.

The magnetometer was run on lines 3-18 and gave a mean mistie from crossover data of 34γ. A broad band of high frequency, high amplitude magnetic features extends from 59°30'N, 3°30'W, to 60°40'N, 2°W and corresponds closely to the outcrop of presumed metamorphic basement.

The seismic equipment used consisted of 1 or 2¼kJ sparker, watergun or airgun, deep towed boomer and pinger. Due to cable and electronic problems the boomer was not run on all lines.

The watergun provided superior records to those of the airgun giving resolution comparable to the sparker in fair weather, down to 800ms of sediments. Up to 400ms penetration was achieved by the sparker while the boomer provided good resolution in the shallow section.

To the west and north of the Shetland Platform a thickening succession of presumed Mesozoic, Tertiary and Quaternary sediments with apparent dips towards the continental slope extend over the shelf edge, which runs SW-NE across the Foula sheet, giving the general appearance of a deltaic sequence.

To the south the Shetland Platform may be faulted against an outcropping block of metamorphic basement.

Approximately parallel to and south of the shelf edge the presumed SW extension of the West Shetland fault is seen.

Leg 2

Lerwick-Lerwick: 23 July-6 August

During this cruise over 2000km of regional geophysical data were collected on the Foula sheet, completing the proposed work in this area. No significant amount of time was lost due to equipment downtime or bad weather.

Navigational problems in deep water were tackled as on leg 1, with some further difficulties during the Decca night effect period, at which time the gaps in satellite coverage tended to be largest. This may necessitate the use of pure Decca data during the post processing stage. As before, the limitation of doppler sonar operation was approximately 225m.

Both gravity meters were run on all lines, the data giving misties of 1.60mGal for the S75 and 1.37mGal for the S40. The cross axis gyro of the S40 was replaced after failing on line 25, immediately after which the S75 platform toppled due to a faulty 400Hz supply. On 31 July a faulty servo amplifier caused the S75 gravity trace to read low.

After replacement of the S40 gyro the previously consistent discrepancy of about 1mGal between the meters, S75 $<$ S40, was reduced and its direction became inconsistent.

The mean, magnetic crossover error from the Barringer magnetometer, which was run on all lines, was 35.5γ. Anomalies of up to 2000γ were seen to correlate with a gravity high over the ?metamorphic complex noted before.

All lines were run with sparker and deep tow boomer systems. In depths less than 300m the transit sonar was used. The pinger was run on the majority of lines, though being hull mounted it was very susceptible to rough weather. The watergun or airgun was used on about half the lines until the compressor failed, after which a 3.75kJ sparker was used as a deep penetration source.

Iceberg plough marks were commonly seen on the seabed which appeared to be mainly composed of winnowed clays in many areas, with sand ribbons near the shelf edge. The Quaternary, probably composed mainly of tills and stiff glaciomarine clays and usually less than 50m thick, overlies a Tertiary sequence which extends over the shelf edge where it contains many unconformities.

The ?Tertiary oversteps lower sequences in which a small area of sedimentary rocks in the south is partly faulted against a basement complex. Farther north the Old Red Sandstone of western Foula Island forms an extensive platform, partly faulted against the basement complex to the west, with the Foula-Ve Skerries basement ridge partly exposed to the east.

Leg 3

Lerwick-Fraserburgh: 6-20 August

This leg was designed to complete Project 79/14 by finishing gravity coverage of the Orkney sheet and to start work on Project 79/15 in the Bosies Bank area. Work on Project 79/15 is described in later sections.

Altogether, 1335km of gravity, magnetic and pinger profiles were run in the complex Orkney area by 14 August. This completed the required gravity coverage. Heavy weather then forced the ship to seek shelter off the Shetland Islands for 24 hours.

During work on this cruise the Decca Navigator system was not used in the dead reckoning calculations as depths were almost everywhere within the range of the doppler sonar. Calibration constants of the sat/nav system were found to be in need of adjustment without the Decca input and were altered accordingly, though it was not possible to calculate good estimates before leaving the area.

Satellite coverage was good, though groups of large updates occurred which were uncorrelated with periods of bad weather or satellite gaps. Data accuracy however should be reasonable after post processing of the data.

The RVS, S40 gravity meter was removed at the start of this leg, leaving the S75 meter on board. A mean mistie of 0.78mGal was obtained from the reduced crossover data for this leg. Using crossovers with the previous two surveys on the sheet, a mean mistie of 0.82mGal was obtained from about 150 crossovers.

PROJECT 79/15

This project was run during the second half of leg 9 and all of leg 10 of the 1979 survey programme.

Leg 1

15-20 August 1979

Work commenced on this project on 15 August after completion of the Orkney area on Project 79/14. The aim of the cruise was to complement regional coverage of the western part of the Bosies Bank sheet, obtained in 1970, so as to complete the sheet. Ten hours were lost due to rough seas and in all 570km of high quality data were obtained.

Difficulty in calibration of the sat/nav system persisted in this area and further calibration was found to be necessary. Although satellites were only separated by up to 2½ maximum the calibration errors caused large updates which should be much reduced, as before, in the post processing sequence.

Near the end of line 4 steep topography apparently caused spuriously high, north velocities, which resulted in an apparent jump in position.

Despite the failure of a gyro, the 5 lines of gravity data were of good quality, giving low crossover errors and close agreement with 1978 data. This new data has allowed delineation of some higher frequency elements of the gravity field.

The magnetometer generally performed well with satisfactory crossover values.

Shortly after work began in this area the deep tow boomer failed and was out of operation for two days. The airgun was replaced by the watergun on 18 August giving an improvement in penetration and resolution.

The sparker results obtained were of good quality as were those from the deep tow boomer when it was redeployed.

Leg 2

Fraserburgh-Sunderland: 20 August-4 September

This, the final leg of the project and the 1979 field season, essentially achieved its objective of completing regional geophysical coverage of the Bosies Bank sheet, with a total of 1870km being surveyed. The weather was generally good though there were some periods of fog and 1½ days were lost during bad weather. Work finished on 3 September prior to transit to Sunderland.

Some bunching of navigational satellites occurred though the maximum time between passes was approximately 2½ hours.

New calibration constants were derived from the five lines of the last leg but large updates were still obtained especially for westerly headings. The inclinometers and doppler counts were monitored and indications were that a fault existed in the D/R processing but this could not be related to any individual unit.

The S75 LaCoste and Romberg gravity meter worked well with a base drift of 1.1mGal over the leg and a mean mistie of 0.76mGal from 125 intersections of this year's data.

The magnetometer was towed throughout the survey and worked well with crossovers generally less than 40γ.

The deep tow boomer, 1kJ sparker, transit sonar and watergun were run on all the lines until maintenance on the watergun necessitated replacing it with a 40 cu.in. airgun. Both the airgun and watergun achieved up to 0.7sec penetration. Pinger results were generally inferior to the boomer

except in good weather and so was not used on all lines. Preliminary interpretation of the profiling records showed presumed Devonian rocks occurring as a ridge to the north of the Wick Fault with tentatively identified Permo-Trias farther north.

Lower and ?Upper Cretaceous rocks lie to the north and south of this ridge with older ?Mesozoic rocks being identified on the airgun/watergun records at depth. Well bedded Tertiary sediments are seen in the eastern half of the sheet, overlain by a complex Quaternary succession showing similarity to the central North Sea succession.

Figure 4 shows a geological sketch map of the Bosies Bank sheet.

EQUIPMENT PERFORMANCE SUMMARY

The four legs during which Projects 79/14 and 79/15 were run are designated legs 1-4, for convenience, in the description below.

Huntec Deep Tow Boomer

On leg 1 the tow cable, which was showing signs of rust was reterminated due to strands of the outer armouring failing. A certain amount of corrosion was also found on the fish towing bridle.

A number of laboratory, electronic console faults were rectified during legs 1 and 2 and sympathetic firing of the boomer by the sparker was reduced by resiting the earthing system.

On leg 3 the SCU power module was modified to Huntec specifications. After two 20A fuses blew in the PCU, checks on the fish ESU revealed a broken circuit board due to a design fault which had caused the 20A fuses to blow and a very high rate of autofiring.

The system worked well after repair on legs 3 and 4.

Osel Winch

This unit generally worked well apart from leg 3 when the winch appeared to be able to pay out only at either full or slow speed.

Sparker Systems

On leg 1 heavy duty AC relays were replaced in two power supplies and an arc corroded, trigger bank transducer bolt was replaced. On the last line of leg 2 a faulty Sigma relay and Square D contacts were replaced on the power regulator board of an EG & G 232 power unit.

On leg 4 the system operated well apart from a minor amount of erratic

firing at the start of the leg.

Watergun

The air/trigger hose was extended before the start of leg 1. This led to numerous problems due to the trigger line failing from water drag. The gun failed due to an air leak when redeployed after shortening the cable.

The trigger lead failed again on leg 2 after 18 hours operation when the air hose and trigger lead were reassuaged.

On legs 3 and 4 the gun worked well until it was taken out of operation due to a lack of spares for routine maintenance.

Airguns

These generally worked well on all four legs apart from minor solenoid trouble. The gun in use flooded on leg 2 when the compressor failed and the trigger cable was replaced at the start of this leg. On leg 4 both guns were rebuilt after solenoid trouble and one gun required starting at 1000 psi after which it worked satisfactorily at normal pressures.

SAT 7H Compressor

The water pump, drive belt was replaced on leg 1 after which the unit worked well until the fuseable safety plug blew due to excessive temperatures. This plug blew again on leg 2 after four days and the compressor was put out of action until the next leg.

On leg 4 the compressor overheated once again due to a warm, water pump, drive belt which was replaced. A minor leak on the third stage relief valve was repaired on this leg.

Edig 10

This unit digitised depths well except in waters over 400m deep on legs 1 and 2.

Edo 248 Pinger

The frequent bleeding of air from the transducer housing required to maintain performance of this instrument was due to incorrect mounting and could only be fixed in dry dock.

Decca Data Logger

The problem of continuous running of the tape decks caused by faulty control logic on the shift register memory board was rectified on leg 1 when problems were also found in attempting to supply +10 and -20v from independent supplies. After this, the unit worked well.

9400 Data Logger

Misdigitising of gravity digits reoccurred after work on the problem had apparently cured it on leg 1.

The system normally worked well except for cessation of cycling at sporadic intervals on leg 4, when the BOT and EOT amplifiers also required balancing.

Gravity Meters

S75: On leg 1 the long axis gyro failed and was replaced. On leg 2 the 400Hz rotary convertor failed due to a loose wire causing the platform to go down. Lost TC input to the gravity servo on this leg was due to a faulty Deihl transistor servo amplifier.

The cross axis gyro U47 failed on leg 3 and was replaced by V51.

On leg 4 the Texas Instruments recorder stopped twice without any obvious cause and was restarted after the motor cooled.

S40: This instrument worked well on leg 1 during which a relay in the spring tension circuit line was replaced in an unsuccessful attempt to improve trace stability.

On leg 2 after only four months operation it was necessary to replace the cross axis gyro. The meter was demobilised at the end of leg 2.

Generators

New, heavy duty batteries were installed at the start of the first leg during which, generator 1 kept cutting out after a few hours operation.

Hydrophones

These worked well. On leg 4 the gain of the laboratory amplifier for the new, 30m Geomecanique was increased to x10 from x1 to improve EPC response.

Satellite Navigation System

The only equipment problems were numerous write errors on one Pertec deck and the weak returns on the aft and port trackers of the doppler sonar.

EPC Recorders

On leg 2 mistriggering of the slave EPC was rectified. These recorders generally worked satisfactorily. On leg 3 No. 373 tacho/accelerate motor was found to be unserviceable due to a lack of spares. A paper drive problem and two inoperative fans occurred on one recorder on leg 4.

Marconi Marine 10-way Talkback Unit

After call problems with the poop deck station on leg 3 the call line was replaced by spare wires between the laboratory and chartroom junction boxes and two wires were taken off the midships unit. The multiway cable between the lab and chartroom needed replacing.

On leg 4 the poop deck and aft deck lights worked well but would not actuate the buzzer.

Decca Navigator

A new Mk21 set was installed at the beginning of leg 1 and worked well, the only problem being a blown fuse on leg 3.

All other pieces of equipment worked satisfactorily.

TABLE 1

Personnel on Project 79/14

Leg 1		
9-23 July, Newcastle-Lerwick		
A Dobinson	Senior Scientist	IGS, MGU
A Mould		
E J Armstrong		
J R Walker		
J Bulat		
R Owens		IGS, CSNU
R Robinson		RVS, Barry
J Strangward		
P Walters		
B Bizzell		Gardline Surveys
D Reynolds		
Leg 2		
23 July-6 August, Lerwick-Lerwick		
A Dobinson	Senior Scientist	IGS, MGU
A Mould		
J R Walker		
K Hitchen		
J Gilmour		
N Fannin		IGS, CSNU
R Robinson		RVS, Barry
C Paulson		
B Bizzell		Gardline Surveys
D Reynolds		
Leg 3		
6-20 August, Lerwick-Fraserburgh		
M C Tully	Senior Scientist	IGS, MGU
R A Floyd		
M Glen		
E J Armstrong		
S Spencer		
R Holmes		IGS, CSNU
C Paulson		RVS, Barry
I Strangward		
H Miles		Gardline Surveys
B Bizzell		
A Ogilvie		Comap
L Livingstone		

Personnel on Project 79/15

Leg 1 - as for leg 3 Project 79/14.

Leg 2
20 August-4 September, Fraserburgh-Sunderland

A Dobinson	Senior Scientist	IGS, MGU
M Glen		
A G Skuce		
D Evans		IGS, CSNU
H Miles		Gardline Surveys
B Bizzell		
K Robertson		RVS, Barry
K Smith		
A Ogilvie		Comap
A Fleet		

LINE No.	LAST FIX	START DAY	START TIME GMT	END DAY	END TIME GMT	LINE LENGTH Km.	MAIN Nav AID	EQUIPMENT USED: Echo Sounder	Pinger	Sparker	A.G.* / W.G.	Side Scan	D.T. Boomer	Magnet-ometer	Data Logger	L&R S75 / L&R S40	9400 Logger
1	234	191	2300	193	1630	416	SATNAV + DOP. SON.	ATLAS DESO + EDIGIO	EDO 248			MS47	✓			✓✓	575
2	72	194	0110	194	1300	107	✓	✓	✓	1KJ	80cu in WATERGUN	✓			✓	✓✓	✓
3	63	194	2340	195	1000	103	✓	✓	✓	✓	40 cu in AIRGUN	✓	✓	✓	✓	✓✓	✓
4	72	195	1310	196	0100	108	✓	✓	✓	✓	10 cu in AIRGUN	✓	✓	✓	✓	✓✓	✓
5	50	196	0240	196	1050	81	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓
6	20	196	1230	196	1540	31	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓
7	35	196	1810	196	2350	53	✓	✓	✓	✓	80 cu in WATERGUN	✓	✓	✓	✓	✓✓	✓
8	30	197	1000	197	1450	38	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓
9	80	198	1320	199	0230	141	✓	✓	✓	✓	40cu in AG / WG			✓	✓	✓✓	✓
10	55	199	1110	199	2010	97	✓	✓	✓	✓	40 cu in AIRGUN			✓	✓	✓✓	✓
11	81	199	2200	200	1120	106	✓	✓						✓	✓	✓✓	✓
12	29	200	1310	200	1750	57	✓	✓						✓	✓	✓✓	✓
13	36	200	1950	201	0140	51	✓	✓						✓	✓	✓✓	540
14	28	201	0340	201	0810	58	✓	✓						✓	✓	✓✓	✓
15	103	201	1030	202	0330	164	✓	✓	✓	1/2¼KJ	80cu in WATERGUN			✓	✓	✓✓	✓
16	74	202	0650	202	1900	120	✓ + DECCA	✓	✓	2¼KJ	40 cu in AIRGUN			✓	✓	✓✓	✓
17	74	203	0230	203	1440	118	✓	✓		✓	WATER GUN 80cu in		✓	✓	✓	✓✓	✓
18	38	203	1700	203	2310	54	✓	✓		1KJ	40cu in AG PART ONLY		✓	✓	✓	✓✓	✓
19	17	207	0840	207	1120	28	✓	✓	✓	✓	80 cu in WATERGUN	✓	✓	✓	✓	✓✓	✓
20	11	207	1420	207	1600	19	✓	✓	✓	✓	40 cu in AIRGUN		✓	✓	✓	✓✓	✓
21	43	207	1710	208	0010	77	✓	✓	✓	✓	✓			✓	✓	✓✓	✓
22	59	208	0230	208	1210	107	✓	✓	✓	✓	✓	FROM FIX 43	✓	✓	✓	✓✓	✓
23	63	208	1510	209	0130	104	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓
24	61	209	0350	209	1350	106	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓
25	61	209	1700	210	0300	105	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓✓	✓

*AG.=Airgun W.G.=Watergun

LINE No.	LAST FIX	START DAY	START TIME GMT	END DAY	END TIME GMT	LINE LENGTH Km.	MAIN Nav AID	EQUIPMENT USED: Echo Sounder	Pinger	Sparker	A.G.* / W.G.	Side Scan	D.T. Boomer	Magnet-ometer	Data Logger	L&R S75 / L&R S40	9400 Logger
26	63	210	0540	210	1600	116	SATNAV + DOP. SON + DECCA	ATLAS DESO + EO1610	EOO 248	1KJ	40cm MAG TO FIX 48	MS 47	✓	✓	✓	✓ ✓	S40
27	66	210	1750	211	0440	115	✓	✓	✓	✓		✓	✓	✓	✓	✓ ✓	✓
28	71	211	0810	211	1950	119	✓	✓	✓	✓		✓	✓	✓	✓	✓ ✓	✓
29	77	210	2220	211	1100	120	✓	✓	✓	1KJ + 2.75KJ		✓	✓	✓	✓	✓ ✓	✓
30	75	212	1530	213	0350	121	✓	✓	TO FIX 47	✓		TO FIX 54	✓	✓	✓	✓ ✓	S75
31	63	213	0800	213	1820	118	✓	✓	FIX 46 - EOL	✓		FROM FIX 11	✓	✓	✓	✓ ✓	✓
32	55	213	2310	214	0810	106	✓	✓	✓	1KJ + 3.75KJ		✓	✓	✓	✓	✓ ✓	✓
33	71	214	1150	214	2330	115	✓	✓		✓		✓	✓	✓	✓	✓ ✓	✓
34	68	215	0250	215	1400	118	✓	✓		✓		✓	✓	✓	✓	✓ ✓	✓
35	15	215	1650	216	0240	109	✓	✓	✓	✓		✓		✓	✓	✓ ✓	✓
36	15	216	0510	216	0730	26	✓	✓	✓	✓		✓		✓	✓	✓ ✓	✓
37	55	216	0930	216	1830	104	✓	✓	✓	✓		✓		✓	✓	✓ ✓	✓
38	38	216	2150	217	0400	65	✓	✓	✓	✓		FROM FIX 28		✓	✓	✓ ✓	✓
39	30	217	0720	217	1210	42	✓	✓	✓	3.75 kJ		✓		✓	✓	✓ ✓	✓
40	21	217	1700	217	2010	47	✓	✓	✓					✓	✓	✓ ✓	✓
41	32	217	2120	218	0230	73	✓	✓	✓					✓	✓	✓ ✓	✓
42	48	221	0810	221	1600	112	SAT NAV + DOP. SON.	✓	✓					✓	✓	S75	✓
43	48	221	1740	222	0130	120	✓	✓	✓					✓	✓	✓	✓
44	37	222	0400	222	1000	91	✓	✓	✓					✓	✓	✓	✓
45	38	222	1240	222	1850	87	✓	✓	✓					✓	✓	✓	✓
46	30	222	2150	223	0240	88	✓	✓	✓					✓	✓	✓	✓
47	25	223	0400	223	0800	62	✓	✓	✓					✓	✓	✓	✓
48	24	223	0950	223	1340	64	✓	✓	✓					✓	✓	✓	✓
49	19	223	1500	223	1800	57	✓	✓	✓					✓	✓	✓	✓
50	17	223	1920	223	2150	43	✓	✓	✓					✓	✓	✓	✓

*AG.=Airgun W.G.=Watergun

LINE No.	LAST FIX	START DAY	START TIME GMT	END DAY	END TIME GMT	LINE LENGTH Km.	MAIN Nav AID	EQUIPMENT USED: Echo Sounder	Pinger	Sparker	A.G.* / W.G.	Side Scan	D.T. Boomer	Magnet-ometer	Data Logger	L&R S75 / L&R S40	9400 Logger
51	15	223	2244	224	0104	40	SAT. NAV. + DOP. SON.	ATLAS DESO + EDIG 10	EDO 248					✓	✓	S75	✓
52	48	224	0410	224	1200	121	✓	✓	✓ POOR					✓	✓	✓	✓
53	39	224	1640	224	1940	82	✓	✓	✓					✓	✓	✓	✓
54	48	224	2320	225	0710	123	✓	✓	✓					✓	✓	✓	✓
55	31	225	0920	225	1420	67	✓	✓	✓					✓	✓	✓	✓
56	26	225	1520	225	1930	64	✓	✓	✓					✓	✓	✓	✓
57	57	226	0050	226	1010	119	✓	✓	✓					✓	✓	✓	✓

*A.G.=Airgun W.G.=Watergun

LINE No.	LAST FIX	START DAY	START TIME GMT	END DAY	END TIME GMT	LINE LENGTH Km.	MAIN Nav AID	EQUIPMENT USED: Echo Sounder	Pinger	Sparker	A.G.* / W.G.	Side Scan	D.T. Boomer	Magnet-ometer	Data Logger	L&R S75 / L&R S40	9400 Logger
1	76	227	1740	228	0610	115	SAT. NAV. + DOP. SON.	ATLAS DESO + EDIG 10	EOO 248	1KJ	40 cu in AIRGUN	MS 47		✓	✓	S75	
2	72	228	0910	228	2100	118	✓	✓	✓	✓	✓	✓		✓	✓	✓	
3	81	229	0035	229	1355	117	✓	✓	TO FIX 58	✓	✓	✓		✓	✓	✓	
4	81	230	1010	230	2330	118	✓	✓	✓	✓	✓	✓	PART	✓	✓	✓	
5	65	231	0620	231	1700	102	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
6	84	234	1200	235	0150	122	✓	✓	✓	✓	80 cu in WATERGUN	✓	✓	✓	✓	✓	
7	69	235	0430	235	1550	106	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
8	65	235	1830	236	0510	104	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
9	76	236	0740	236	2010	125	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
10	76	236	2300	237	1130	121	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
11	81	237	1510	238	0430	120	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
12	90	238	0610	238	2100	119	✓	✓		✓	✓	✓	✓	✓	✓	✓	
13	74	240	0840	240	2050	116	✓	✓		✓	✓	✓	✓	✓	✓	✓	
14	69	241	0030	241	1150	103	✓	✓		✓	✓	✓	✓	✓	✓	✓	
15	63	241	1530	242	0150	102	✓	✓		✓	AIRGUN ✓	✓	✓	✓	✓	✓	
16	68	242	0500	242	1610	101	✓	✓		✓	✓	✓	✓	✓	✓	✓	
17	40	242	1800	243	0030	64	✓	✓		✓	✓	✓	✓	✓	✓	✓	
18	81	243	0320	243	1640	117	✓	✓		✓	✓	✓	✓	✓	✓	✓	
19	74	243	2210	244	1020	115	✓	✓		✓	✓	✓	✓	✓	✓	✓	
20	32	244	1510	244	2020	52	✓	✓		✓	✓	✓	✓	✓	✓	✓	
21	35	244	2200	245	0340	51	✓	✓		✓	✓	✓	✓	✓	✓	✓	
22	78	245	0700	245	1950	121	✓	✓		✓	✓	✓	✓	✓	✓	✓	
23	68	246	0020	246	1130	115	✓	✓		✓	✓	✓	✓	✓	✓	✓	

*A.G.=Airgun W.G.=Watergun

TABLE 3

Coordinates of start and end of FLAGS line:-

Line 1 79/14

START	END
57° 45.444'N 1°31.046'W	60°58.575'N 1°39.615'E

GRAVITY BASE TIES TABLE 4

Date	Place and Berth	g at main base	g at berth corrected for tidal effects	Meter reading corrected for tidal effects	Drift
				575 540	575 540
190 9-7-79	NEWCASTLE QUAY NO.11 DOCK	981 494·89	981505·5	12299.4 9801.4	
					+1·8 +0.2
205 24-7-79	LERWICK	981948·3	981948·6	12748.3 10248.2	
					0.0 −0.2
206 25-7-79	LERWICK	981948·3	981948·6	12748·1 —	
					−0·6 −0.3
218 6-8-79	LERWICK HOLMGARTH TERMINAL	981948·3	981947·6	12746·5 10246.9	
					+0·5
220 8-8-79	LERWICK HOLMGARTH TERMINAL	981948·3	981947·6	12747·0 —	
					−0·2
232 20-8-79	FRASERBURGH	981746·2	981749·3	12546·7 —	
					+1·1
247 4-9-79	SUNDERLAND	981506·98	981501·3	12297·6 —	

TABLE 5

Equipment Carried

1. LaCoste and Romberg air-sea gravity meters S75 and S40 (Project 79/14 legs 1 and 2 only).

2. Monitor Labs 9400 data acquisition system.

3. Two Barringer magnetometers.

4. Edo Western 248 pinger with hull mounted transducers.

5. Atlas Deso 10 echo sounder with hull mounted transducer and digital readout unit (Edig 10).

6. Magnavox satellite navigation system, integrated with MX610 doppler sonar.

7. Decca Mk21 main chain receiver.

8. Decca data logger.

9. Reavell SAT 7H compressor.

10. EG & G trigger, power and capacitor units.

11. Huntec deep tow boomer and power supply.

12. Osel cable winch and power unit.

13. Sodera 80 cu.in. watergun.

14. Bolt 40, 20 and 10 cu.in. airguns.

15. Multi-element spark arrays (IGS).

16. EG & G 9 candle and 3 candle spark arrays.

17. Two 30m Geomecanique hydrophones.

18. 50m Geomecanique hydrophone.

19. EPC graphic recorders (4100 and 4600).

20. Analogue tape and control system (IGS).

21. Hiab 650 deck mounted crane.

22. Three Lewis 60kva 3 phase generators.

23. Stabilised no break power supply system.

24. 3kva generator.

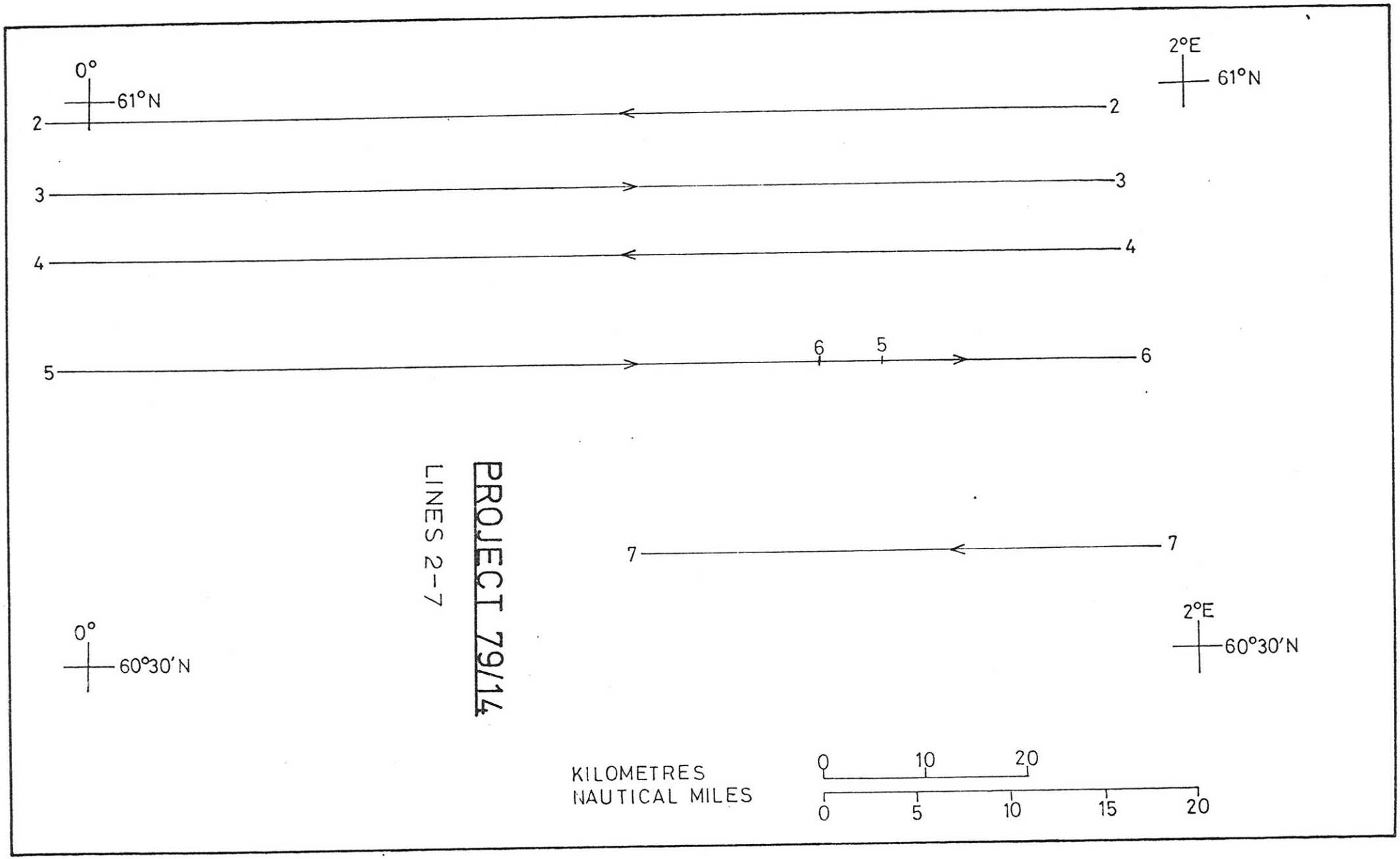
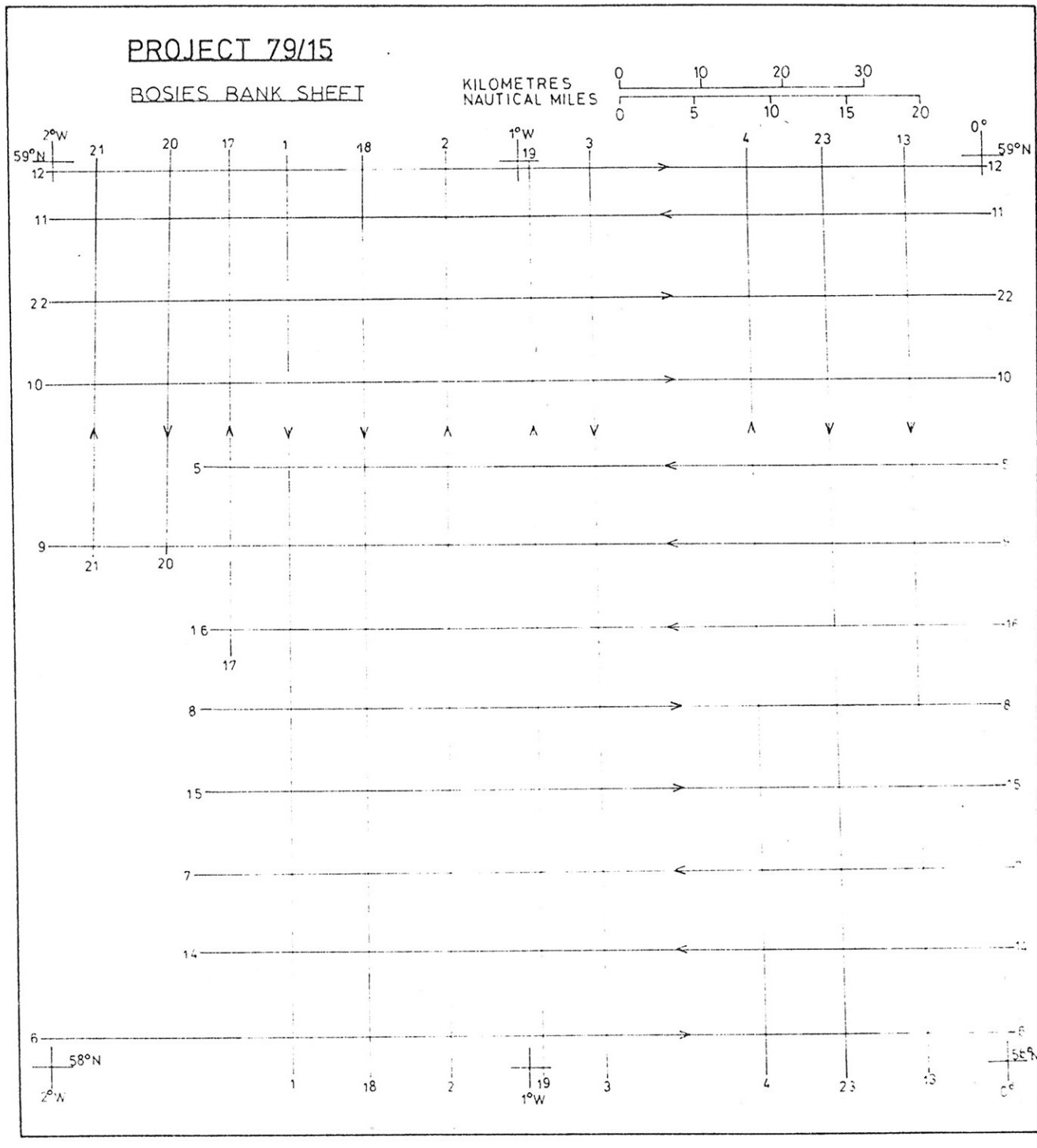

0°
61°N
2°E
61°N
2
2
3
3
4
4
5
6
5
6
7
7
0°
60°30'N
2°E
60°30'N
PROJECT 79/14
LINES 2-7
KILOMETRES
NAUTICAL MILES
0
10
20
0
5
10
15
20

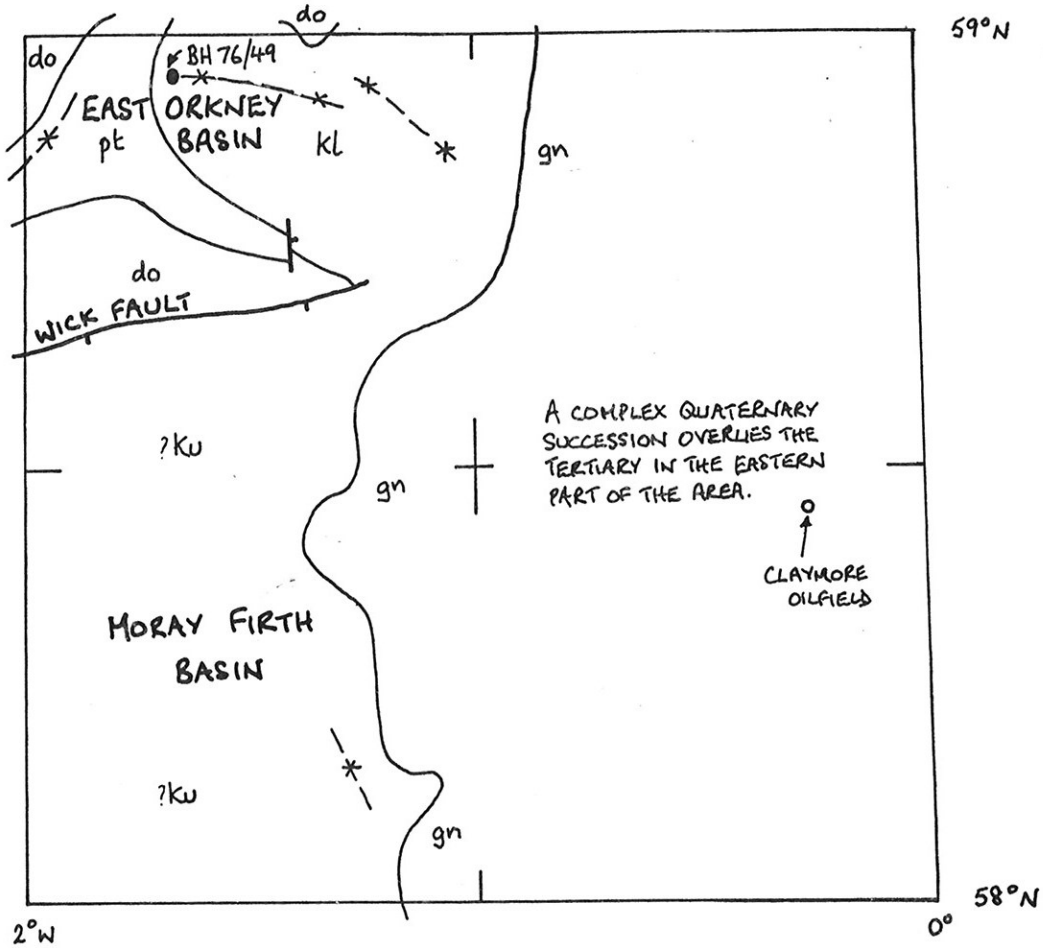
FIGURE 1

FIGURE 3


PROJECT 79/15
BOSIES BANK SHEET
KILOMETRES
NAUTICAL MILES
0 10 20 30
0 5 10 15 20
2°W
59°N
1°W
0°
59°N
58°N
2°W
1°W
21 20 17 1 18 2 19 3 4 23 13
12 11 22 10 5 9 16 8 15 7 14 6

GEOLOGICAL SKETCH MAP
BOSIES BANK SHEET

FIGURE 4



SCALE 1:1 000 000

gn	TERTIARY
Ku	UPPER CRETACEOUS
Kl	LOWER CRETACEOUS
pt	PERMO-TRIASSIC
do	DEVONIAN (OLD RED SANDSTONE)
/	GEOLOGICAL BOUNDARY
↓	FAULT, DOWNTHROW INDICATED
-*	SYNCLINE

SHIPBOARD INTERPRETATION - CRUISE MG/79/15