Continental Shelf Northern Unit
Internal Report No. 78/6

Shipboard Report on Leg 1 of Ferder Shallow Drilling Programme 1978; May 1 - 12 Cruise No. 78/5

by

D Evans

CONTENTS

Introduction

The purpose of the first leg of this year's 3-leg programme aboard the Norwegian MS Ferder was to drill selected priority sites and if necessary bad weather sites in which pre-Quaternary rocks would be encountered. In addition to the ship's equipment a Fugro designed re-entry system was employed, additional drilling equipment was provided by Christensen Diamond Products, and an NEC Gas penetration rate meter was fitted. A consultant (L Hill) was contracted to advise IGS on drilling matters.

In this report a summary log of operations (including a time analysis breakdown Table I) and a brief preliminary discussion of the geological results are presented. Appendix. I gives details of individual boreholes drilled, including a summary table (Table III). A graphic representation of cruise details is presented in Table II.

In total 3 sites were occupied (sites 62, 92 and 96 - see Fig. 1 for locations) and the geological objectives carried out. In addition site 97 was occupied and partly drilled. Location 97 (BH 78/4) will not be considered in this report.

Personnel

D Evans	IGS-CSNU	Chief Scientist
C E Deegan	IGS-CSNU	
K Rochow	IGS-CSNU	
M C Smith	IGS-CSNU	
L Hill	Len Hill (Drilling Consultant) Ltd.	
R Morris	Christensen (1-4 May, 7-10 May)	
K Reavell	Christensen (1-10 May)	

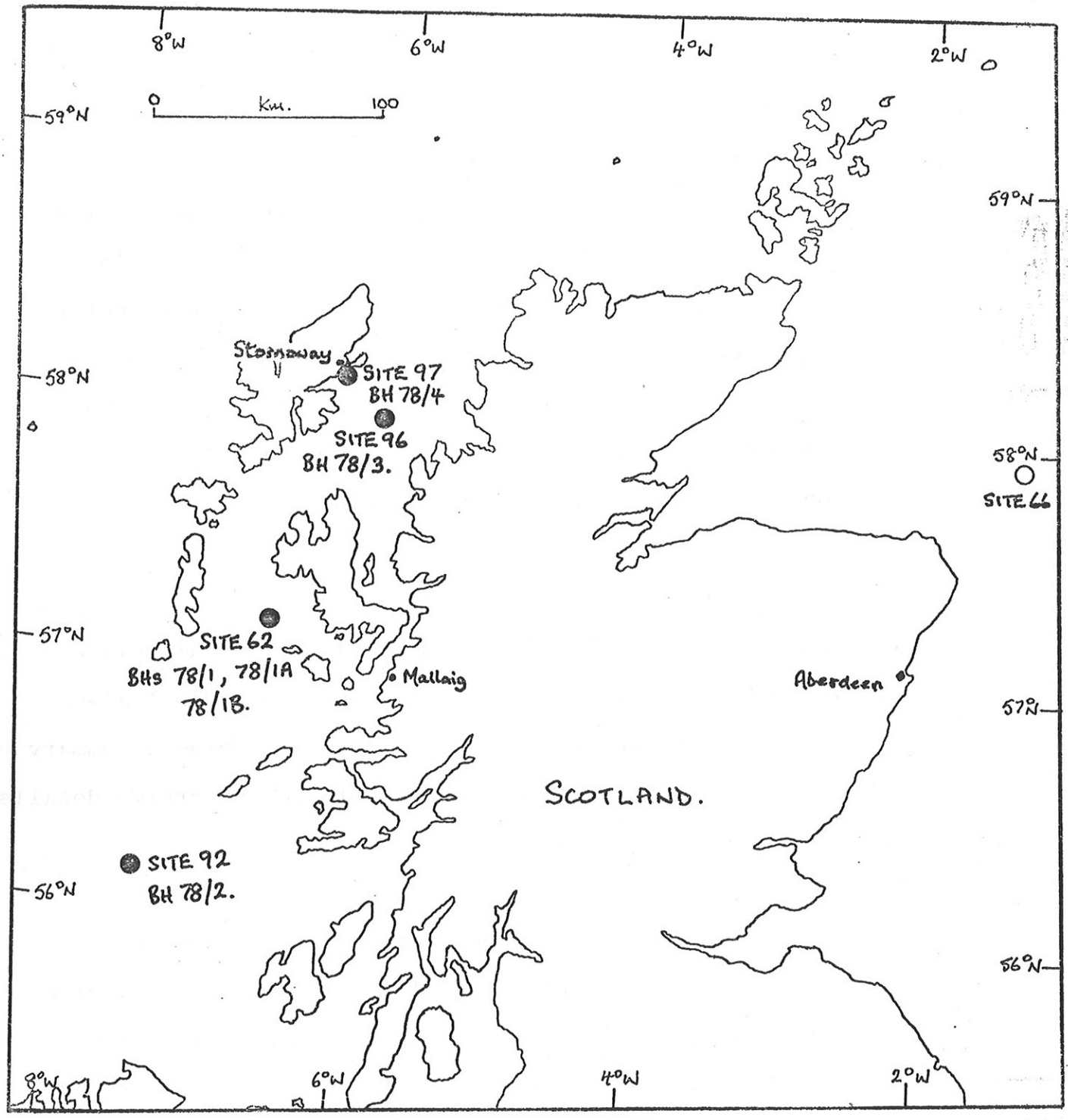


FIG. 1 LOCATION MAP

Summary Log (See Table I for time analysis breakdown)

Monday 1st May

0900	Leave Aberdeen, contract starts. Steam for site 66.
1415	Sea condition too rough for anchoring on site 66, steam for west coast site 62.
1520	Lifeboat drill and fire instructions.

Tuesday, 2nd May

0000	Steaming for site 62.
1650	Anchoring on site 62.
2015	Drilling operations begin BH 78/1.

Wednesday, 3rd May

0000	Drilling operations continue.
1015	Pull out string due to failure of Christensen overshot, on which modifications are attempted.

Thursday, 4th May

0000	Work on modification and testing continues, intermittent drilling.
1300	Begin new hole (BH 78/1A) with Ferder equipment only.
1400	MFV takes off Dick Morris (Christensen) to Mallaig. He will arrange further modification to overshot and/or barrels and delivery of last year's barrels.
2230	Pull out string due to fault in re-entry bit guide - badly bent.

Friday, 5th May

0000	Pulling string.
0115	Begin second new hole (BH 78/1B) without re-entry system. Ship fabricate new bit guide on board.
0800	Ship on full daily rate.

Saturday, 6th May

0000	Drilling BH 78/1B.

Sunday, 7th May

0000	Drilling BH 78/1B.
1230	Small boat brings out Dick Morris and Christensen gear. Inner barrel lost.

1710	End drilling, gamma log borehole.
1750	End logging, pull string.
2040	Pulling anchors.
2200	Steam for site 92.

Monday 8th May

0000	Steaming for site 92.
0635	Begin anchoring site 92, heavy swell up to 15ft.
0815	Drilling operations begin. New bit guide also bends, go in without re-entry system. BH 78/2. Work on modifying and strengthening original Fugro bit guide begins.

Tuesday 9th May

0000	Drilling continues BH 78/2.
1615	End drilling, logging begins.
1830	Logging completed, pull string.
2100	Pull anchors.
2230	Steam for site 14.

Wednesday 10th May

0000	Steaming for site 14.
1300	R Morris and K Reavell (Christensen) put off on small boat off Stornoway.
2015	Deteriorating weather and poor forecast. Steam for sheltered site 96.

Thursday, 11th May

0000	Steaming for site 96.
0630	Anchoring on site 96.
0740	Drilling operations begin on BH 78/3.

Friday, 12th May

0000	Drilling continues.
0125	Drilling ends.
0520	Pull anchors.
0615	Steaming to site 97.
0750	Begin anchoring on site 97.
0840	Drilling operations begin on BH 78/4.
1650	Leg 1 crew disembark by fishing boat, Leg 2 crew take-over.

TABLE I

Time Analysis

Activity	Mon 1	Tues 2	Wed 3	Thurs 4	Fri 5	Sat 6	Sun 7	Mon 8	Tues 9	Wed 10	Thurs 11	Fri 12
Steaming	15.0	16.8					2.0	6.6	1.5	24.0	6.5	1.6
Mooring and Raising		3.4					1.3	1.0	1.5		1.2	1.8
Drilling and Logging...		3.8	24.0	24.0	23.5	23.2	19.9	15.0	19.8		15.7	
Port Calls ...												
Standby and Downtime					0.5	0.8		0.8			0.6	
Waiting on weather												

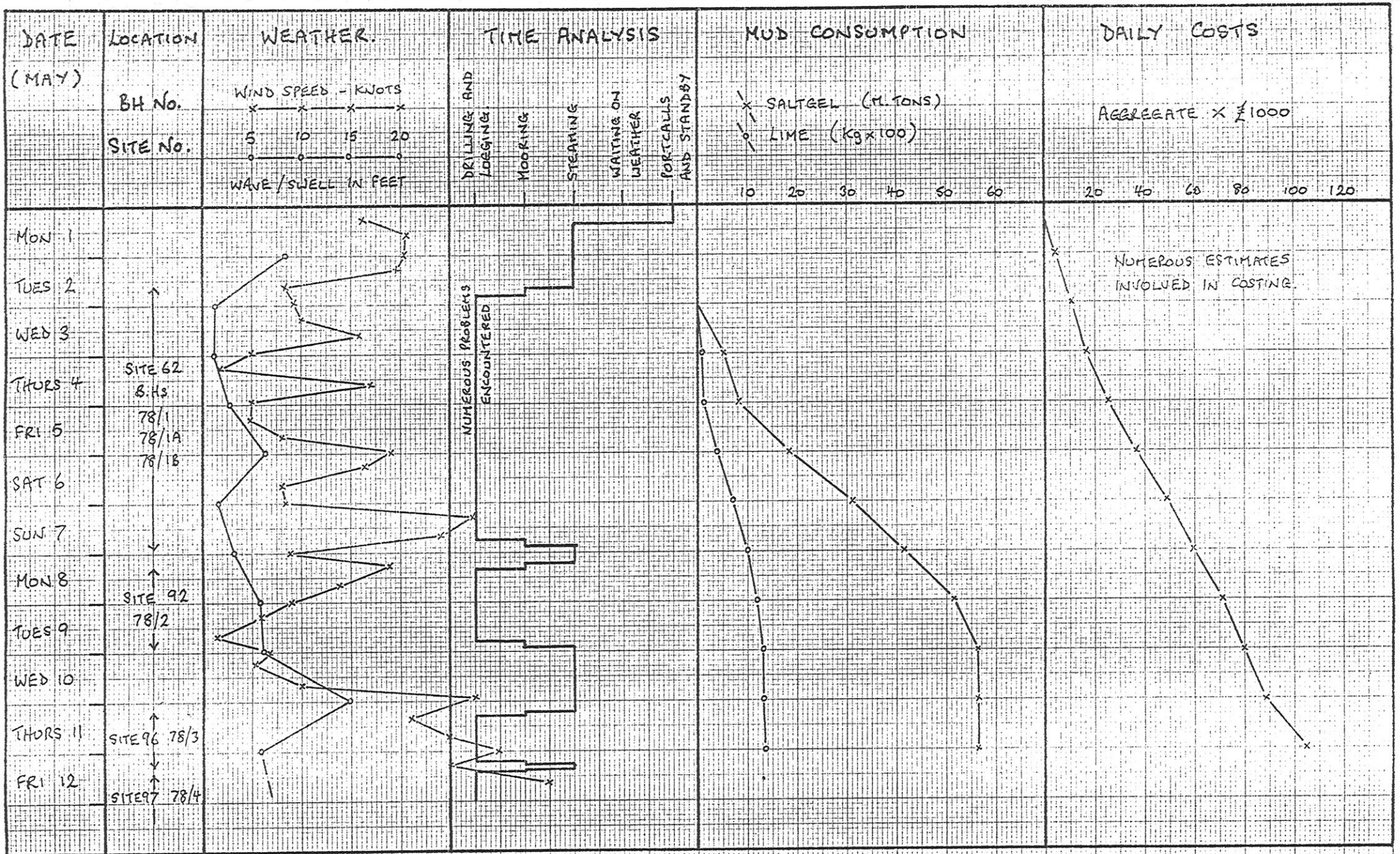


TABLE II CRUISE DETAILS, GRAPHIC.

Geological Results

1. BHs 78/1, 78/1A, 78/1B (Site 62)

The recovery was limited on this borehole, but was quite sufficient to show the geology at the site. The Quaternary was soft clay from 0-11.8m, overlying firm-v.stiff gritty pebbly clays down to the bottom 3m of the succession where larger pebbles and cobbles were encountered. It seems probable that the borehole passed through Binns et al's Formations 1 (till), 2 sub-divided into two lithologies (late glacial glacio-marine) and 3 (post-glacial glacio-marine).

The Quaternary was underlain by stiff-hard carbonaceous silty clays, which are almost certainly of Tertiary (?Oligocene - Smythe and Kenolty 1975) age. Palaeontological examination of these sediments should give an accurate age and confirm marine origin as deducted on board from the presence of forams and glauconite.

2. BH 78/2 (Site 92)

The Quaternary succession differed from BH 78/1B in that it was less gravelly and pebbly and was rather soft down to a depth of about 30m, below which it was firm-very firm. From the samples and seismic data it is suspected that the whole Quaternary succession fits into Binns' Formation II, other than the very base (c.1m) which is possibly till of Formation I.

The solid rock at this site proved to be hard clacareous, carbonaceous siltstones with thin limestone and coaly bands as well as softer horizons which smelt strongly of a "bituminous/H_2S mixture" (?). These siltstones are probably of Jurassic age (possible Liassic); again Palaeontological

dating should be possible. A fragment of an ammonite was found.

3. BH 78/3 (Site 96)

Solid rock was at outcrop on this site, with only a few cobbles strewn over the seafloor. Although only 3.7m were drilled at this site, the presence of arkosic sandstones of Torridonian aspect was clearly demonstrated.

4. BH 78/4 (Site 97)

This site was occupied only at the end of Leg 1 and will be dealt with by the report on Leg 2.

Conclusions and Recommendations

1. The efficiency of the leg was substantially affected by using untried and unproven equipment. The Fugro re-entry system needed modification on arrival at Aberdeen and the under strength bit guide was the cause of considerable delay. It is also clear that the Christensen gear was not a proven package.

2. Considerable difficulties were experienced with the Christensen gear, both in the delays in its assembly and in its early performance at sea. L Hill's report will contain the details of this problem.

3. On this type of drilling ship a two week leg is too short. It took a week to familiarise ourselves with the operations, by which time we were having to start planning for the crew change. If short legs are to be planned in future, some

continuity of personnel (preferably senior scientist or 2nd geologist) is strongly recommended.

4. This leg has confirmed the general suitability of the Ferder for our shallow drilling programme. The performance of the ship and its personnel was generally good, although rather a lot of minor breakdowns occured (see Captain's daily reports), including the main radio and radar as well as drilling equipment.

5. The use of the IGS container has proved an useful innovation.

6. Despite technical difficulties, the geological results of this leg can be considered successful. The 3rd and 4th priority holes were completed in addition to one purely bad weather site, and another partly drilled. The considerable steaming time involved during the leg was unavoidable due to the wide geographical range of the sites.

7. The NEC gas rate of penetration and weight of bit meters were of limited value, and are probably "too sophisticated" for this type of drilling. This comment must be qualified by the fact that we were unable to calibrate the meters properly.

8. It would be useful in future, if not essential, for the chief scientist on the first leg to be involved in negotiations leading up to the cruise. This problem related particularly to any unwritten agreements made, such as those with Christensen. It was understood by L Hill and IGS personnel

that IGS were totally responsible for the Chrsitensen gear, while the captain thought that there was a verbal commitment by Anton von der Lippe to be responsible for the gear.

9. Problems were experienced with radio communications on the west coast due to the ship's inability to work on the frequencies of west coast radio stations, and inability of the office to make a call through Røgaland radio.

10. Only 3 Telex weather messages were received during Leg 1, this being due to communication difficulties with Røgaland and breakdown of the main radio for four days.

APPENDIX I

Individual Borehole Details

BH 78/1, 78/1A, 78/1B

BH 78/2

BH 78/3

+ Table III - Borehole summaries

TABLE III

Borehole Summaries

Borehole No	78/1, 78/1A, 78/1B	78/2	78/3
Site No	62	92	96
Depth	c. 150m	c. 119m	c. 58m
Total time of site (dates) .	5 days 5.2hrs (2-7/5)	1 day 15.9hrs (8-9/5)	22.8hrs.
Time Mooring and raising ..	3.4 (+1.3)= 4.7hrs.	1.8 (+1.5)= 3.3hrs.	1.2 (+0.9)=2.1hrs.
Total depth	141.40m	71.75m	3.7m
Thickness Quaternary	122.44m	66m	Nil
Quaternary lithology	Stiff pebbly clay, soft at top	Soft-stiff gritty, pebbly clay	n/a
Thickness solid	18.96m	5.75m	3.7m
Solid lithology (age)	Carbonaceous clays (Tertiary ?go)	Calcareous siltstone (?Jurassic)	Arkosic sandstone (Torridonian)
Recovery Quaternary %	11.52+4.83+7.60=23.95m = 19.6%	19.08m= 28.9%	n/a
Recovery solid %	4.77m=25.1%	4.36m=75.8%	3.5m=95%
Total recovery %.....	28.72m = 20.3%	23.44m = 32.7%	3.5m = 95%
Mud { Saltgel	41.9m.tons	14.4m.tons	Nil
Mud { Lime	1020Kg	360Kg	120Kg
Mud cost	£6,428	£2,199	£13.2
Bit usage	Ship's bit only, except 78/1 -1xTC,c.50%	1xTC, c.25%	1xdiamond bit 10%, TC -15%

Borehole 78/1, 78/1A, 78/1B (Site 62)

For summary, see Table III

Comments

- Difficulties in anchoring, probably due to hard ground which surrounds the soft mud of the site.

- 78/1. Abandoned at 23.4m due to failure of Christensen overshot. Good recovery in stiffer clays below 13m but poor in soft clay above.

- 78/1A. Abandoned at 27.4m due to bending of Fugro re-entry system bit guide. Using ship's equipment only for open holing and getting push/hammer sample every 3m.

- 78/1B. T.D. 141.4m. Open hole to 30m. Ship's equipment only. Sampling approximately every 5m (but every 2m in Tertiary) with moderate success. No re-entry system used. This sampling interval seems to be quite satisfactory in such a monotonous succession.

- These boreholes proved very expensive due to numerous shake down problems with untested equipment.

- The geological results are of considerable interest, the succession being very similar to that predicted.

- Weather conditions were ideal at this site, virtually no heave was encountered throughout the 5 days.

- The gamma logging was successfully and quickly completed by 2 men with an informative trace produced.

CONTINENTAL SHELF UNIT NORTH

Proposed Sealab Site 62

BH Nos 78/1, 78/1A 78/1B

Approximate Location 15km NW of Canna

Sea Area Hebrides

Area Geologist D. Evans

Map Area Little Minch

1:100,000 Sheet Number 57N 07W

Licence Block Number -

Operator -

Latitude 57°8.8'N

Longitude 6°45.2'W

Decca Main Chain	Decca Hi Fix	Other Navigational
Red	Patt I	Methods used on Seismic
Green	Patt II	Survey
Purple		

Conditions at Proposed Site

Water Depth = 146 m

Sediment Thickness = 125 m

Solid to be Drilled = 100 m

Total Length of Drill String Required = 371m

Bottom Conditions - mgS?

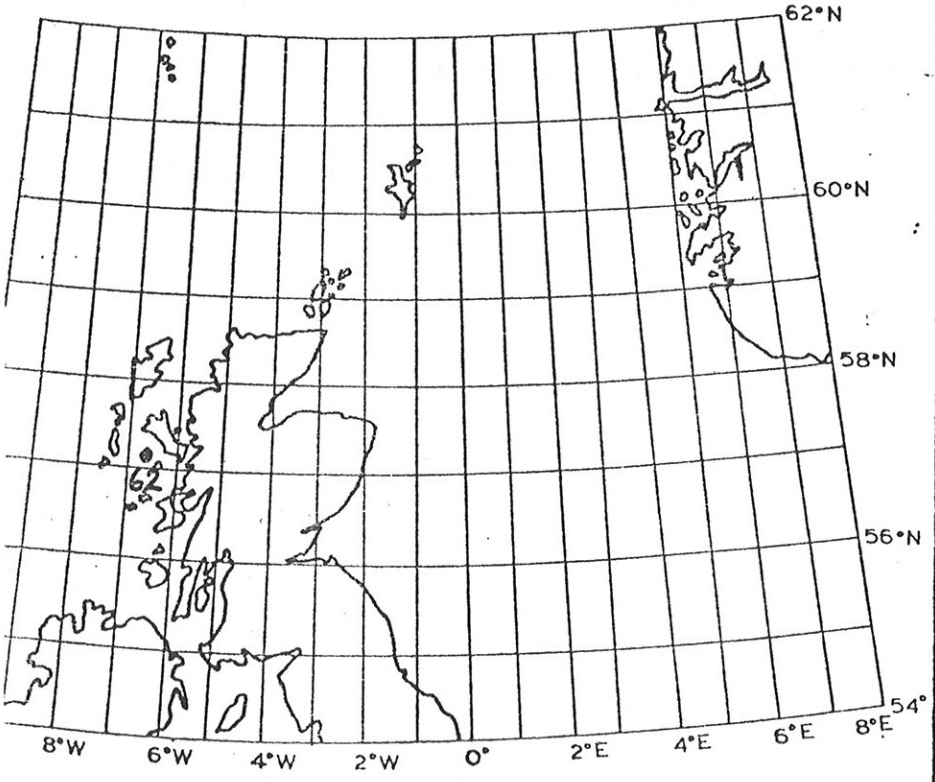
Predicted Age - Quaternary

Predicted Age - Tertiary

Site Located on Geophysical Line Number

Year/Cruise/Line/(Fix) 68/5/20/(71)

Location Map



General Notes

To prove Tertiary of Canna Basin (Smythe and Kenolty 1975).

Site Approved By

(D.G.)

Date 22.11.77 3.2.78

Site Drilled

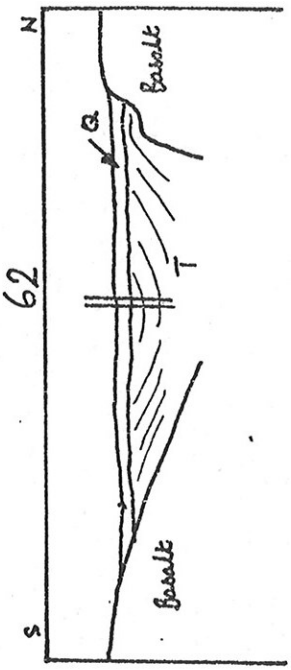
Date 2 - 7 May 1978

Site Geologists DE, CED, KR, HCS

Geological Background

Site Number 62

Geological Notes and Schematic Section



Predicted Succession
(Including Velocities Used)

146m Water Depth

Quaternary (1800 m/s) soft-stiff clays, ?occasional sandy layers

100m

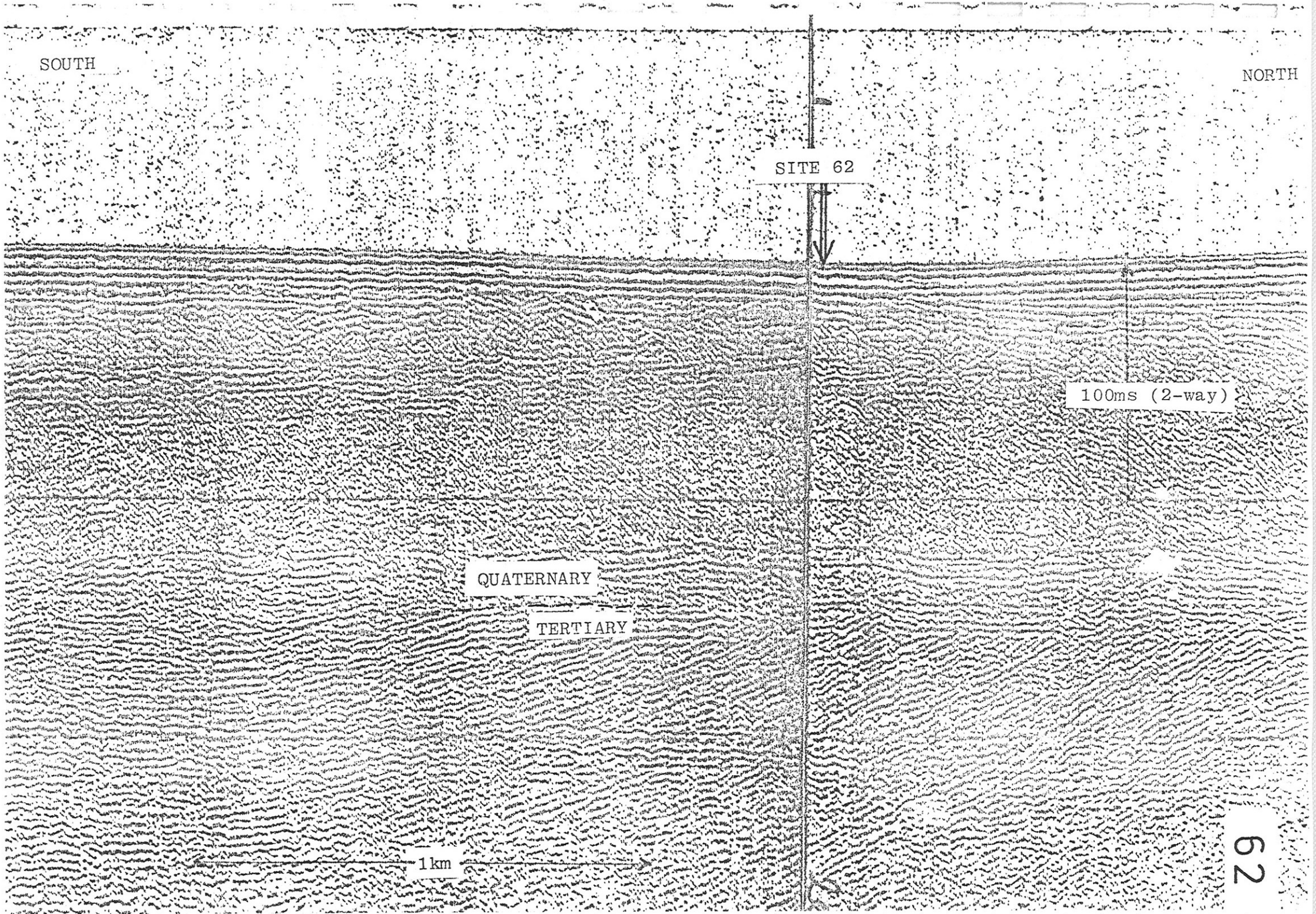
125m

Tertiary ?Oligocene

150m

Sands, clays and lignites

Sampling Required	Logging Required
Continuous	Gamma


SOUTH
NORTH
SITE 62
100ms (2-way)
QUATERNARY
TERTIARY
1km
62

Borehole 78/2 (Site 92)

For summary see Table III

Comments

- Due to failure of new ship-fabricated bit guide during initial string running, this borehole was drilled without a re-entry system.

- Virtually continuous coring was attempted using Christensen gear, which has no problems with overshot. Given that we attempted to core continuously, Quaternary recovery was poor, particularly low in the succession where the clays were quite firm, and good recovery could be reasonably expected. Recovery in solid was good, but the drilling rates were very slow, taking about 10 hours to drill the 6m.

- Sea conditions were not very good, particularly at the start of drilling due to a long swell. Wave heights of up to 15 feet were recorded on the ship's echosounder. This made depth estimations difficult, and necessitated gamma logging the hole through the top of the swivel and required considerable physical effort from 4 men.

- The geological results were informative and will prove valuable when solid samples are dated. Rockhead was encountered some 10m earlier than predicted, probably due to the low velocity of the thick soft clays which were expected to be stiffer.

CONTINENTAL SHELF UNIT NORTH

Proposed Sealab Site 92

BH No. 78/2

Approximate Location 77km W of Colonsay

Sea Area Hebrides

Area Geologist D Evans

Map Area Tiree SW

1:100,000 Sheet Number 56°N 8°W

Licence Block Number 134/28

Operator –

Latitude 56°7.65'N

Longitude 7°30.35'W

Decca Main Chain	Decca Hi Fix	Other Navigational
Red	Patt I	Methods used on Seismic
Green	Patt II	Survey
Purple		

Conditions at Proposed Site

Water Depth = 117 m

Sediment Thickness = 76 m

Solid to be Drilled = 100 m

Bottom Conditions – sandy

Predicted Age – Quaternary

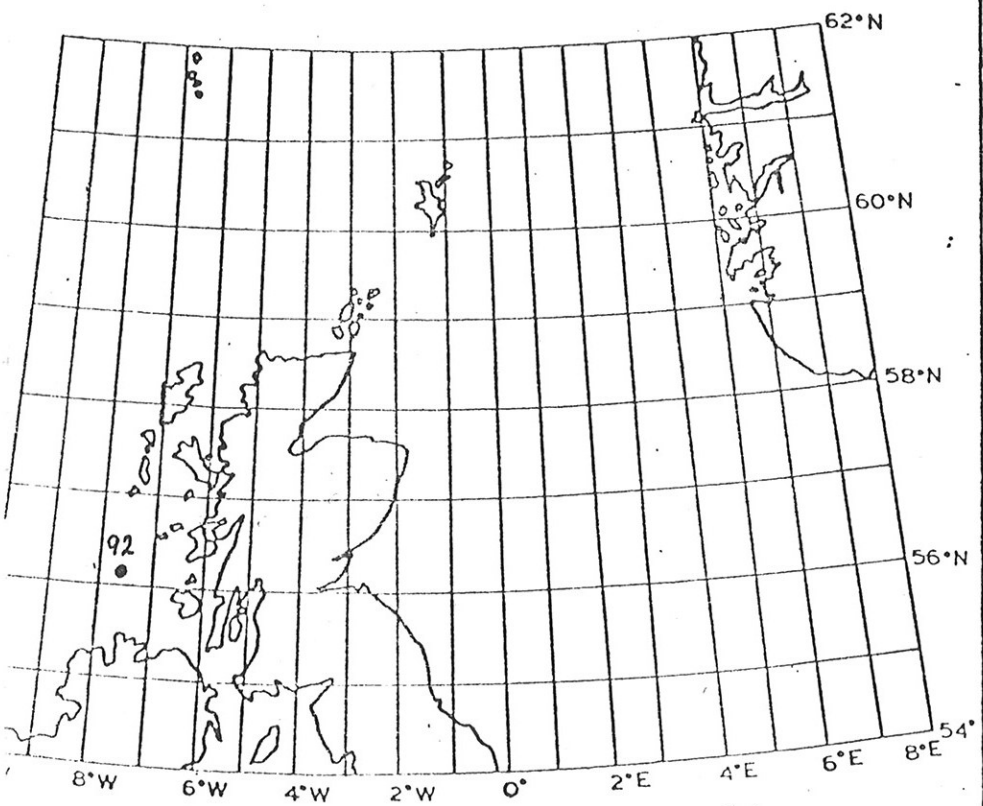
Predicted Age – Mesozoic

Total Length of Drill String Required = 293m

Site Located on Geophysical Line Number

Year/Cruise/Line/(Fix) 68/5/29/(13.5)

Location Map



General Notes

To sample part of Malin Basin, hitherto unsampled

Site Approved By

(D.G.)

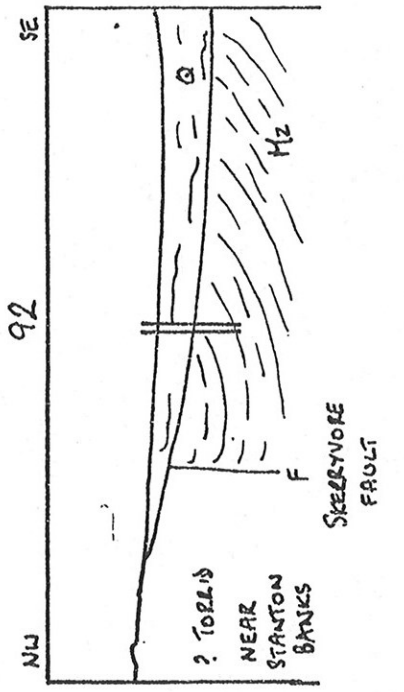
Date

Site Drilled

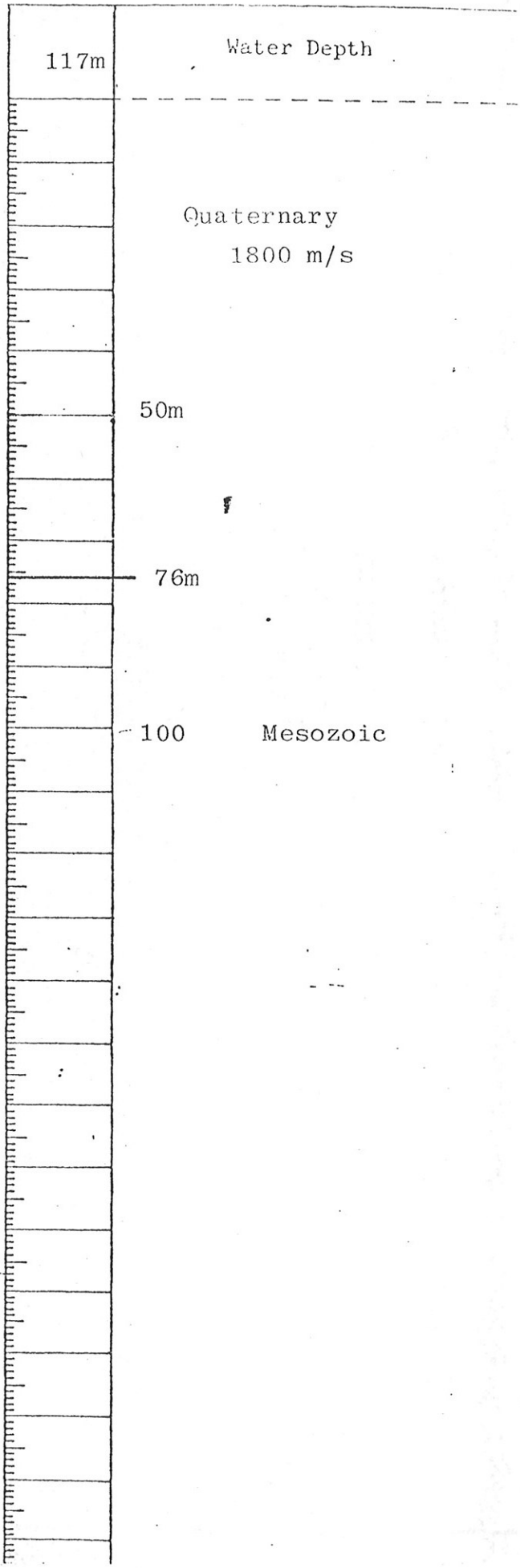
Date 8-9 May 1978

Site Geologists DE, CED, KR, MCS

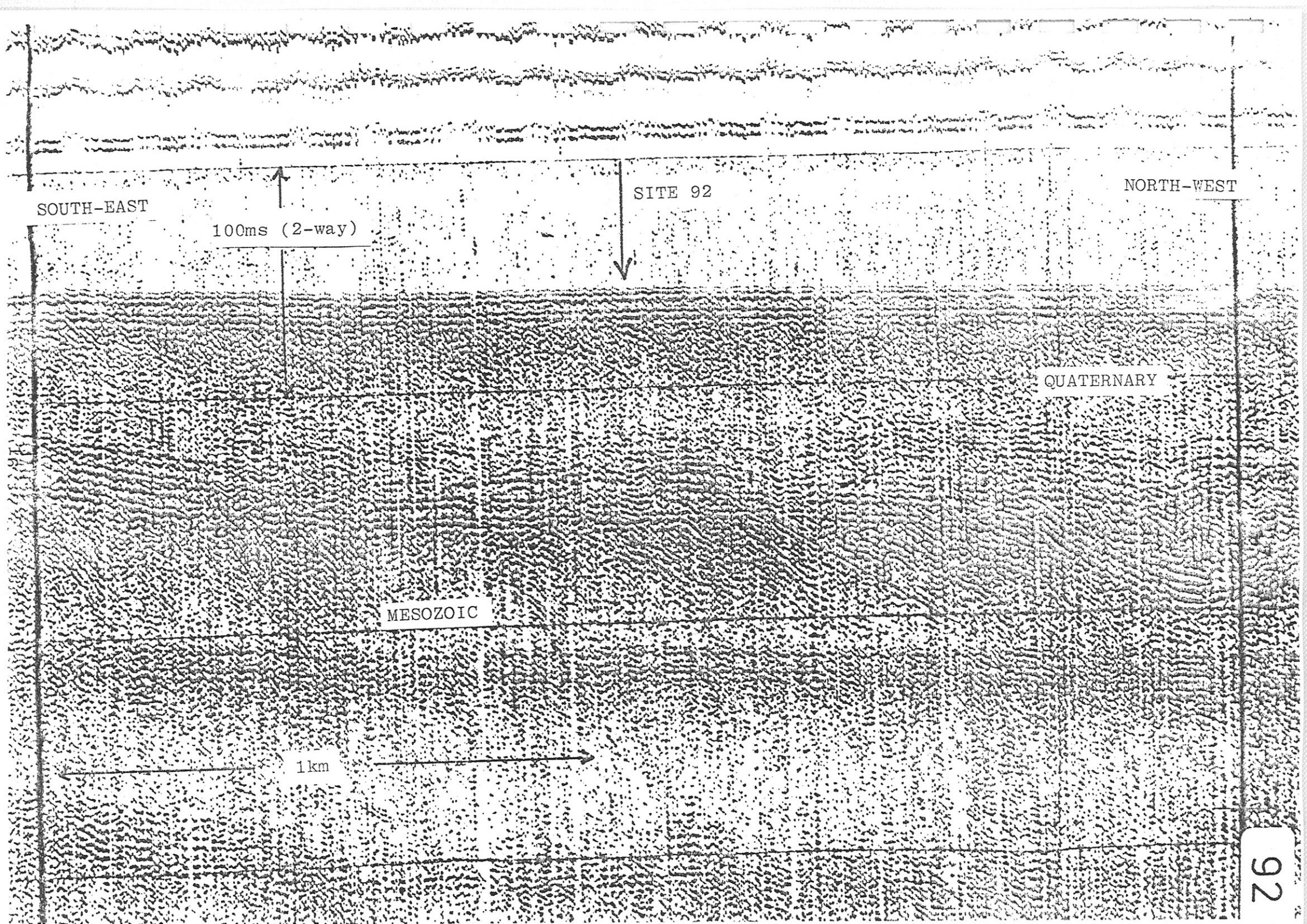
Geological Notes and Schematic Section



Predicted Succession
(Including Velocities Used)



Sampling Required	Logging Required
Continuous	Gamma if appropriate


SOUTH-EAST
100ms (2-way)
SITE 92
NORTH-WEST
QUATERNARY
MESOZOIC
1km
92

Borehole 78/3 (Site 96)

For summary see Table III

Comments

- The modified bit guide was used on this hole, the guide being wound up to the moonpool once the string was in the baseplate cone. No difficulties were experienced.

- Initially the T.C. bit was run, but as it was clear that rockhead was virtually at surface and no headway was being made, it was decided to pull out and run the diamond bit. When we ended the hole, the diamond bit showed c.10% wear, which was much less than feared due to the torque experienced and the slowness of drilling - 3.7m in about 14 hours.

- The core demonstrated satisfactorily that the rocktype at this location is Torridonian arkosic sandstone.

CONTINENTAL SHELF UNIT NORTH

Proposed Sealab Site 96 BH No 78/3

Approximate Location 20km NW of Rubh Reidh

Sea Area Minches

Area Geologist J A Chesher

Map Area Little Minch NE

1:100,000 Sheet Number 57°30'N 7°W

Licence Block Number -

Operator -

Latitude 57°59'N

Longitude 6°01'W

Decca Main Chain	Decca Hi Fix	Other Navigational
Red	Patt I	Methods used on Seismic
Green	Patt II	Survey
Purple		

Conditions at Proposed Site

Water Depth = 60 m

Sediment Thickness = 10 m

Solid to be Drilled = 50 m

Total Length of Drill String Required = 120m

Bottom Conditions - Sand and Boulders

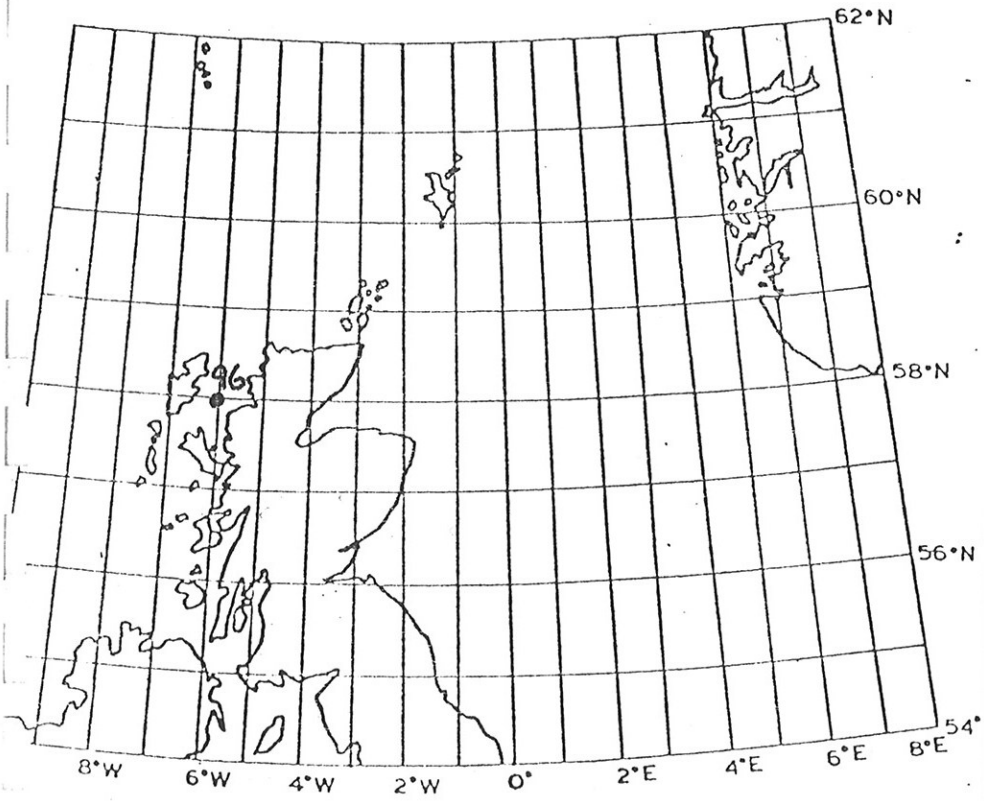
Predicted Age - Quaternary

Predicted Age - Torridonian, Lewisian or NRS

Site Located on Geophysical Line Number

Year/Cruise/Line/(Fix) 70/8/30/(2.5)

Location Map



General Notes

Investigation of Central ridge from Rudh Reidh to Kebock Head separating Little Minch basin from North Minch basin. Age of strata on ridge Torridonian, NRS or Lewisian.

Site Approved By D A Ardus (D.G.)

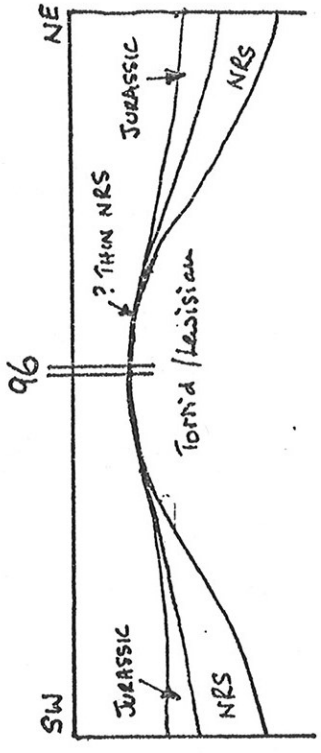
Date 3.2.78

Site Drilled

Date 11-12 May 1978

Site Geologists DE, CEb, KR, MCS

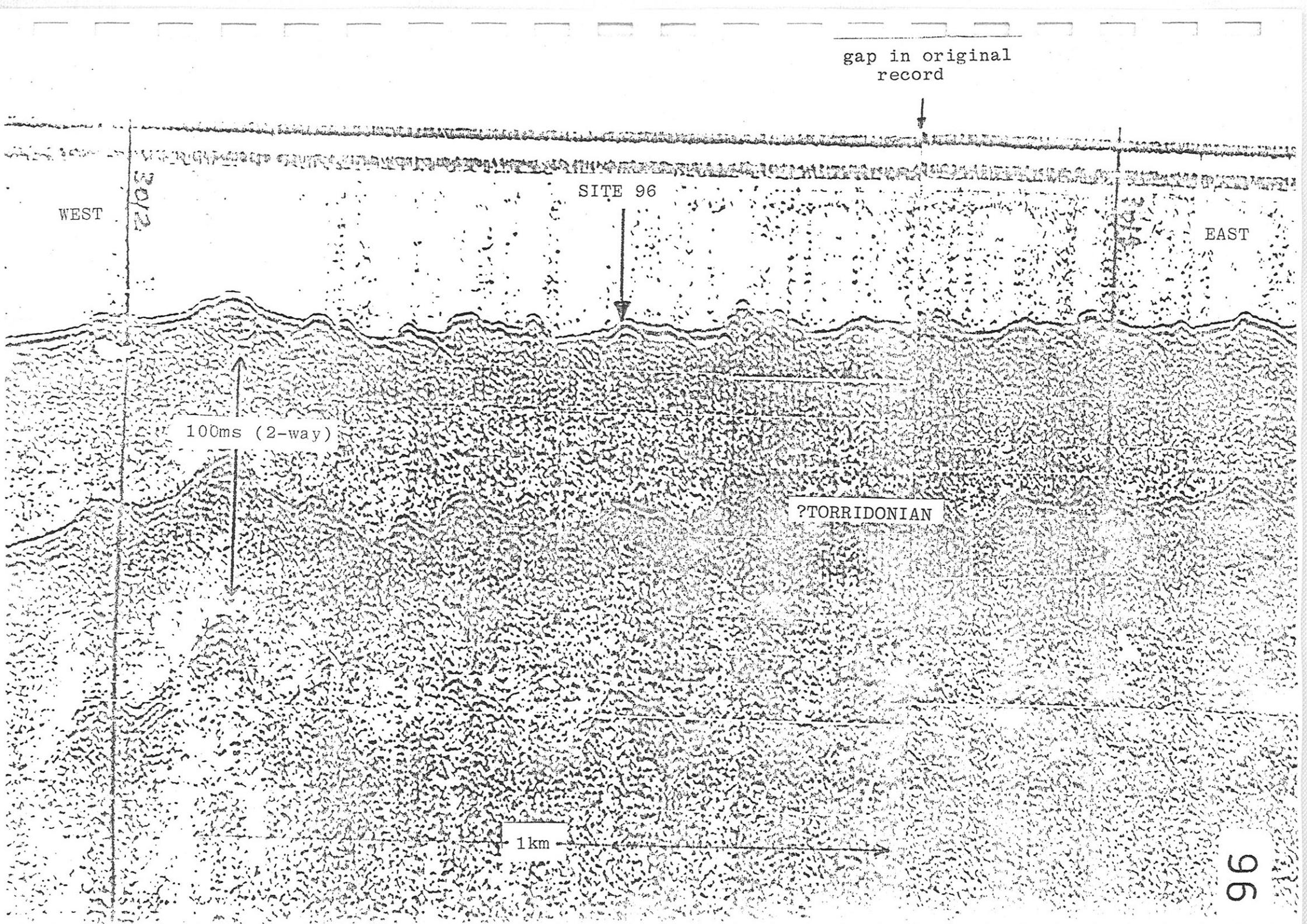
Geological Notes and Schematic Section



Predicted Succession
(Including Velocities Used)

60m	Water Depth
	Quaternary (Maximum)
	10m
	Lewisian/Torridonian/ NRS
	50m

Sampling Required	Logging Required
Continuous	


gap in original record
SITE 96
WEST
EAST
100ms (2-way)
?TORRIDONIAN
1km
96