

FORTROLIG

i h.t. Beskyttelsesinstruksen,
jfr. offentlighetslovens

§ nr.

UNIONOIL NORGE A/S

OLJE
JRA:ET
073348 01.NOV77
OFFENTLIG
UNNTALT GEF. §
SIGN.

BA 77 - 58 - 1

- 1 NOV 1977

**REGISTRERT
OLJEDIREKTORATET**

WELL COMPLETION REPORT

BLOCK 8/4

WELL 8/4-1

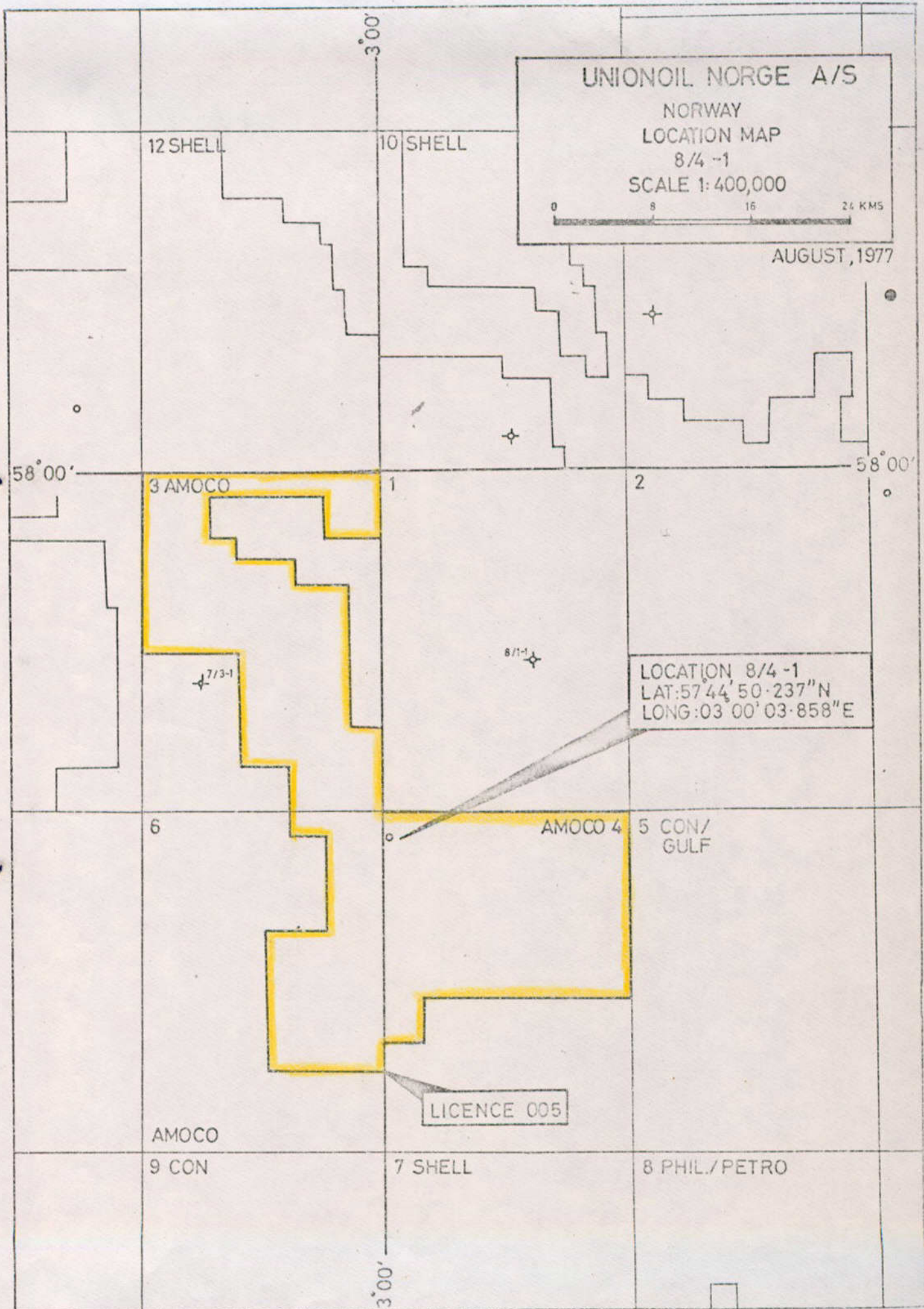


FIGURE -1

WELL COMPLETION REPORT

CONTENTS

SUMMARY 1

WELL HISTORY

General Data 2
Drilling Data 3
Logging and Testing 3
Supervision 4

GEOLOGY

Summary of Previous Work 5
Geological 5
Geophysical 5
Drilling Objectives 6
Structure and Stratigraphy 7
Hydrocarbon Shows 7

REFERENCES 8

ILLUSTRATIONS

- Figure 1 - Location Map, 1 : 400,000
Figure 2 - Mechanical Condition Diagram well 8/4-1

APPENDICES

- No. 1 - Pre-Site Survey
- No. 2 - Well Location (Final report)
- No. 3 - Drilling Record and Time versus Depth Curve
- No. 4 - Mud, Bit and Casing Record
- No. 5 - Deviation and Direction Report
- No. 6 - Ditch Sample Description
- No. 7 - Sidewall Core Description and Sidewall Core
Analysis Results
- No. 8 - List of Wireline Logs
- No. 9 - Wellsite Log Analysis
- X No.10 - Micropalaentological Report
- X No.11 - Aftersite Survey
- No.12 - Reports on Wellhead and Sea Floor
- X No.13 - Geochemical Analysis
- No.14 - Pressure Report

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§ nr.

Appendices marked X will be provided under
separate cover.

SUMMARY

Well 8/4-1 was Unionoil Norge's first well to be drilled on Licence 005 as part of farmin agreement with Amoco Norway Oil Company, Norwegian Consortium A/S and Co., Amerada Petroleum Corporation and Texas Eastern Norwegian Inc.

License 005 covers an area of approximately 801 sq. km (310 sq. miles) and is situated on blocks 7/3, 7/6 and 8/4 in the southern part of the Norwegian North Sea.

The well 8/4-1 is located at 57°44'50.237" North Latitude and 03°00'03.858" East Longitude which is approximately 180 km south-west of Stavanger.

Well 8/4-1 was drilled primarily to test the Middle Jurassic sands, the secondary objective being the Upper Cretaceous chalk.

The well was spudded on June 21, 1977 and reached a total depth of 2631.46m on July 20, 1977. A suite of electrical logs was run to total depth with 27 sidewall cores being recovered from zones of interest.

The stratigraphic section penetrated comprised sediments of Pleistocene to Permian in age.

The well was plugged and abandoned as a dry hole on the 25th July 1977.

WELL HISTORY

GENERAL DATA

WELL NAME: 8/4-1

OPERATOR: UNIONOIL NORGE A/S
P.O. Box 377, LANGGATEN 64
4300 SANDNES, NORWAY

CONTRACT AREA: LICENCE 005, Situated on blocks 7/3,
7/6 and 8/4, southern Norwegian North Sea.

SURFACE LOCATION:
(SAT.NAV) LAT. 57°44'50.237"N
LONG. 03°00'03.858"E
(UTM) 6400720.498 N
500063.794 E

DISTANCE FROM SHORE: 180 km

WATER DEPTH: 63.40 m

WELL ELEVATION: KB 24.38 m above MSL

TOTAL DEPTH: 2631.46 m

SPUD DATE: 21st JUNE 1977

DATE DRILLING COMPLETED: 20th JULY 1977

DATE RIG RELEASED: 25th JULY 1977

STATUS: Plugged and abandoned

CASING DETAILS: 30" at 124.66 m
20" at 410.05 m
13-3/8" at 1378.14 m

PLUGS/RETAINERS: No. 1 2109.85 m - 2077.54 m (32.31m)
Cement plug in open 12-1/4" hole.

No. 2 1341.14 m, retainer in 13-3/8"
casing, approximately 73.66 m cement
below retainer and 14.37 m on top of it

No. 3 239.88 m - 97 m (142.88 m) Cement plug
in 13-3/8" casing.

ABANDONMENT:

Cut and retrieved 13-3/8" casing at 96.40 m, 7.60 m below the mudline. Cut and retrieved 20" and 30" casing at 95.38 m, 8.62 m below the mudline.

DRILL STEM TESTS:

Nil.

DRILLING DATA

DRILLING CONTRACTOR:

Rowan (Nor-102) Inc.

DRILLING RIG:

"Norjarl" Semisubmersible.

DERRICK:

Lee C. Moore, cantilever type. Hook load rating 1 million lbs.

DRAW WORKS:

National type 1625.

ROTARY:

National type C-375.

PUMPS:

2 National type 12P - 160 triplex.

DRILL PIPE:

3048.04 m 5" 19.50 lbs/ft GRADE "E"
1524.02 m 5" 19.50 lbs/ft GRADE "G"
36 joints drillco 5" Hevi-Wate, Heavy wall.

BOP EQUIPMENT:

18-3/4" Cameron type "U"
Double unit 10,000 psi. Two special hydrils
GL 18-3/4" 5,000 psi.

MUD:

Lime drispac and lignosulfonate.

LOGGING AND TESTING

Lagged ditch samples were collected at regular intervals from 159.41 m to T.D. 2631.46m. The break-down of the sampling intervals are as follows:

| DEPTH | SAMPLE INTERVAL | GEOLOGICAL BREAK |
|---------------------|-----------------|----------------------------|
| 159.41 to 1388.36m | 10 m | Approx. top Palaeocene |
| 1388.36 to 2125.00m | 5 m | Approx. base of chalk |
| 2125.00 to 2412.00m | 3 m | Approx. top Jurassic sands |
| 2412.00 to 2631.46m | 2 m | |

CONVENTIONAL CORES

Nil.

SIDEWALL CORES:

30 Sidewall cores were attempted

27 Sidewall cores were recovered

DRILL STEM TESTS:

Nil.

SUPERVISION

DRILLING:

W. Steiger.

C. Green.

C. Blackburn,

GEOLOGICAL:

J. Ellice-Flint.

J. Battrick.

A. Armitage.

ENGINEERING:

W. Willsmer.

R. Schmidt.

GEOLOGY

SUMMARY OF PREVIOUS WORK

GEOLOGICAL

Unionoil Norge's 8/4-1 is the second well to be drilled on Licence 005, the first well drilled was Amoco's 7/3-1 which was plugged and abandoned as a dry hole.

GEOPHYSICAL

Unionoil's original farmin interpretation was completed using the following seismic data.

- I. Analog data: acquired by SSL in 1965 ((Dynamite; 600%; Cable 2 x 1200m (split-spread)) processed and partly reprocessed by SSL May 1965 - March 1966.

| | | |
|-------|----------|----------|
| LINES | ANO - AA | ANO - 12 |
| | AX | 13 |
| | AN * | 14 |
| | BD | 16 |
| | BE | |
| | S | |
| | V | |

(*)

(Transcribed and digitally reprocessed by GSI. July 1972).

- II. Digital:(a) Acquired by SSL in 1966 (Dynamite; 600%; cable: 2400m). Processed by SSL, September - November 1966. Partly reprocessed (line 66-18) by GSI, September 1972.

| | | |
|--------|------------|----|
| LINES: | ANO 66 -7C | 16 |
| | 9A | 18 |
| | 11 | 19 |
| | 14 | 20 |
| | 15 | 22 |

(b) Acquired and processed by GSI for Phillips, October-November 1966 (Dynamite; 600%; cable: 2400m).

LINES: PH 315, PH 5754.

III. Digital data reprocessed for Union's account: Approximately 257 kilometers of lines listed in paragraph II were reprocessed in May 1976 by S and A Geophysical in order to improve the interpretation in the critical areas on structure 8/4.

| | | | |
|-------|-------------|------|-------------------------|
| LINES | ANO 66 - 7C | Sp:s | 2920 - 3029 |
| | 66 - 9A | | 1744 - 1845 |
| | 66 - 11 | | 1846 - 1994 (migration) |
| | 66 - 14 | | 2004 - 2236 |
| | 66 - 15 | | 3718 - 3900 |
| | 66 - 16 | | 2306 - 2572 |
| | 66 - 18 | | 3135 - 3245 |
| | 66 - 20 | | 3324 - 3442 |
| | 66 - 22 | | 3443 - 3566 |

These lines form a more or less orthogonal grid with approximately 5 km spacing - the digital grid bisects the analog grid.

Unionoil deemed it necessary to acquire an extra 105.4 kilometers of seismic lines over the 8/4 structure to gain higher resolution and to tie in the Amoco seismic using Decca Pulse 8 (2 Networks) plus Satellite Navigation for position fixing. These lines were acquired by Geoco and processed by S and A Geophysical in December 1976.

DRILLING OBJECTIVES

The well 8/4-1 was drilled in order to test that series of seismic reflectors which have good continuity below 2.05 seconds at the 8/4-1 location. These seismic events were identified as sands of Middle Jurassic age which have proven oil accumulation at the Bream and Brisling fields to the northeast in Block 17/12.

A secondary objective was the Upper Cretaceous chalk which has oil production from the Ekofisk Complex 120km to the south.

Well 8/4-1 reached the stipulated T.D. of 25 metres into the Zechstein at a depth of 2631.46 metres.

STRUCTURE AND STRATIGRAPHY

Based on seismic interpretation the 8/4-1 structure was identified as a large faulted dome which exhibits four way dip. Seismic data indicates that the principle stages of growth were during Late Cretaceous and Early Tertiary time. The northern portion is intersected by a series of NW-SE faults possibly the result of Tertiary salt collapse, whereas the southern north-south extension does provide some indication of Early Cretaceous growth.

The areal closure of the 8/4 structure at the Middle Jurassic level is 51.8 sq. kilometers and it has a vertical closure of approximately 365.8 metres at this level.

The oldest rock type penetrated was Upper Permian in age, the youngest Recent.

The Upper Permian consists of halite with minor anhydrite and gypsum. These sediments were transgressed by nonmarine shales and sands of Triassic age which in turn were overlain by deltaic sands and clays of Jurassic age. Stabilization during Cretaceous time resulted in the deposition of shallow marine chalks and marls, which were overlain by deeper marine clays, silts and sands of Tertiary age.

HYDROCARBON SHOWS

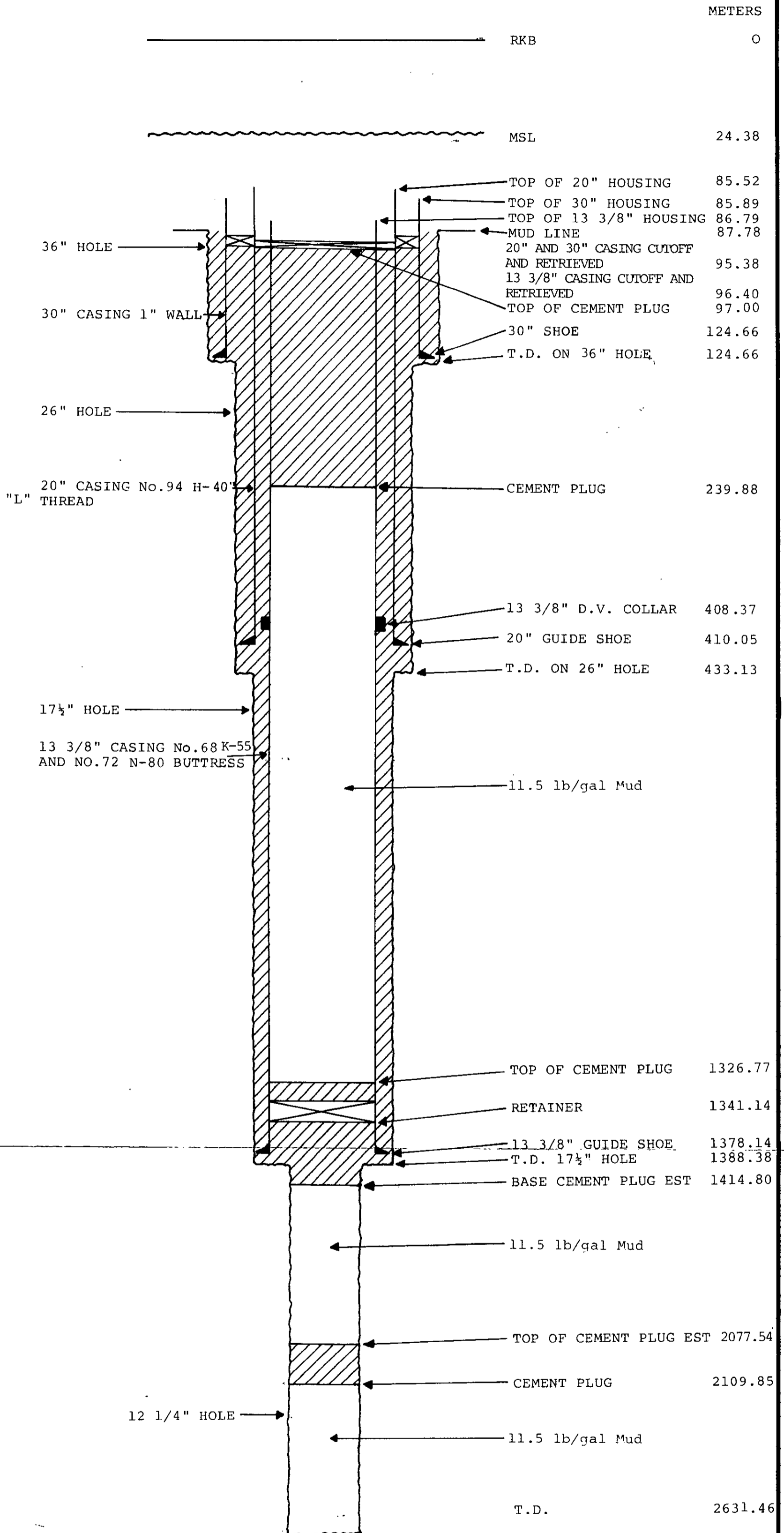
The hole was electrically logged from 85m to 2623m and no pay was present in the well to this depth. However, minor residual oil shows were seen in sidewall cores at 2417m and 2462m.

Total gas averaged 5 to 10 units throughout the course of drilling with no significant gas peaks. Shows of the heavier hydrocarbon gases C₂ to C₄ were present in the interval 2355m to 2466m.

REFERENCES

1. Lindsell, Gray, Metre, Wells, May 1976: Amoco Norway Farmout Proposal Licence 005,
London Report File
No. G.1.01 - 10j.

2. Lindsell, February 1977: Amoco Farmout Proposal Licence 005,
Seismic Check Survey
Interpretation and
Revised Location,
London Report File
No. G.1.01 - 11a.



DATUM LEVEL: RKB

UNIONOIL NORGE A/S
MECHANICAL CONDITION DIAGRAM
 8/4 -1
 J.F.

FIGURE 2

APPENDIX NO. 1

PRE - SITE SURVEY

SITE SURVEY
in
BLOCK 8/4, NORWEGIAN SECTOR
for
UNIONOIL NORGE A/S

Report No. 4974 March 1977

Prepared by
A/S GEOTEAM
GAMLE DRAMMENSVEI 48
1320 STABEKK
NORWAY



Report No. 4974

C O N T E N T S

| | Page |
|--|------|
| 1. INTRODUCTION | 3 |
| 2. HYDROGRAPHICAL AND GEOPHYSICAL SURVEY | 4 |
| 2.1 OBJECTIVES OF SURVEY | 4 |
| 2.2 SURVEY AREA | 4 |
| 2.3 SURVEY VESSEL AND INSTRUMENTATION | 4 |
| 2.4 SURVEY PROGRAMME AND EXECUTION | 5 |
| 2.5 DATA INTERPRETATION AND RESULTS | 6 |
| 2.5.1 Data Presentation | 6 |
| 2.5.2 Sea Floor Topography | 7 |
| 2.5.3 Evaluation of Sea Bed Conditions and Stratigraphy | 8 |
| 2.5.4 Navigation Accuracy | 9 |
| 2.6 CONCLUDING REMARKS | 10 |
| 3. APPENDICES: FIELD LOG | |
| 4. APPENDICES: HYDROGRAPHICAL AND GEOPHYSICAL SURVEY | |
| 4.1 DATA EXAMPLES | |
| 4.1.1 Echo-sounder, Profile No. 32 | |
| 4.1.2 Side Scan Sonar, Profile No. 13 | |
| 4.1.3 Side Scan Sonar, Profile No. 12 | |
| 4.1.4 Sparker, Profiles No. 13 and No. 32 | |
| 4.1.5 Sparker, Profile No. 31 | |
| 4.2 TRACK CHART | |
| 4.3 BATHYMETRIC CHART | |
| 4.4 INTERPRETATION CHART | |
| 5. APPENDICES: MARINE SURVEYING | |
| MS 1 VESSEL SPECIFICATIONS | |
| MS 2 NAVIGATION | |
| MS 3 DEPTH RECORDING | |
| MS 4 SIDE SCAN SONAR | |
| MS 5 GEOPHYSICAL PROFILING | |



1. INTRODUCTION

As ordered by Saga Petroleum A/S & Co. and confirmed by A/S GEOTEAM in telex no. 65 dated February 14th 1977, A/S GEOTEAM performed a site survey in Block 8/4 Norwegian Sector, North Sea.

The field work was undertaken from the survey vessel M/V EMERALD in the period 14th to 17th of February 1977.

Client's representative on shore: Mr. S.E. Johansen,
Saga Petroleum A/S & Co.
Party Chief: Mr. K.M. Dukefoss,
A/S GEOTEAM

A preliminary survey report was given to Saga Petroleum A/S & Co. in our telex no. 77 dated February 18th 1977.

In a telex dated February 21st 1977, reference no. 77/180 sej/is, Saga Petroleum A/S & Co. stated that all further reporting concerning this survey should be made to Unionoil Company of Great Britain.

2. HYDROGRAPHICAL AND GEOPHYSICAL SURVEY

2.1 OBJECTIVES OF SURVEY

The objectives of this site survey were to determine the bathymetry of the area, to locate any obstructions that might be present and to obtain sparker registrations with special attention being paid to shallow gas.

2.2 SURVEY AREA

The area surveyed was a 3 x 3 kilometres square with sides aligned N-S and E-W and centered on the coordinates:

Latitude : $57^{\circ} 44' 49.79''$ N

Longitude: $03^{\circ} 00' 05.38''$ E

2.3 SURVEY VESSEL AND INSTRUMENTATION

The survey vessel was M/V EMERALD. The survey instrumentation was a Simrad EKS Echo-sounder, an EG & G Side Scan Sonar and an EG & G Sparker System with energy available up to 4500 Joules.

The navigation equipment was a Decca Pulse 8 Navigation System. A Magnavox Integrated Satellite Navigation System served as a back up.

For further specifications and descriptions of the equipment used, see Appendices on Marine Surveying, Chapter 5.

2.4 SURVEY PROGRAMME AND EXECUTION

The survey programme was to cover a square area of 3 x 3 kilometres with echo-sounder and side scan sonar profiles. The profiles should be aligned N-S and be spaced at 125 metres. The sparker programme should consist of at least two profiles through the given centre location.

The profiling was started using echo-sounder, side scan sonar and sparker on every other profile starting from east. The energy on the sparker system was set at 900 Joules and the sonar range at 200 metres when the survey started. Due to decreasing penetration the energy was set to 3900 Joules from profile 16 and westwards to profile 25.

The sparker system was then switched off and the sonar range set to 125 metres before the intermediate profiles were run.

On the two profiles crossing the centre location the sonar range was set at 125 metres and the energy on the sparker system was 3900 Joules.

Before the survey was completed two more profiles were added on both the eastern and the western side of the survey area. The sonar range was set at 200 metres. The energy on the sparker system was 900 Joules on the most easterly profiles and 3900 Joules on the most westerly profiles.

The layback of the sonar tow-fish relative to the Pulse 8 antenna was 180 metres throughout the survey.

The layback of the sparkarray was 50 metres and of the hydrophone 65 metres relative to the Pulse 8 antenna.

2.5 DATA INTERPRETATION AND RESULTS

2.5.1 Data Presentation

The results of this survey are presented as Data Examples, a Track Chart, Bathymetric Chart and Interpretation Chart.

As data examples in Appendices 4.1.1 to 4.1.5 are presented an echogram, two sonograms with sonar ranges of 125 and 200 metres and three sparker records obtained by using energy levels of 900 and 3900 Joules.

The Track Chart in Appendix 4.2 shows all profiles run during the survey. Profiles with sonar ranges of 125 and 200 metres are differentiated and profiles on which sparker data were obtained are marked. Positions are plotted for every minute.

The Bathymetric Chart, Appendix 4.3, is based on the corrected echo-soundings. Contours are drawn for every metre.

The Interpretation Chart in Appendix 4.4 is drawn on a copy of the Bathymetric Chart and shows the contours in milliseconds below sea level of the large buried channel seen on the sparker registrations.

All Charts are drawn to a scale of 1:10 000.

2.5.2 Sea Floor Topography

The sea floor in the area is even, nearly flat, with a water depth relative to mean sea level of 63.5 metres at the centre location.

The recorded depths are corrected for:

- a. Actual sound velocity in water, estimated to 1480 metres per second.
- b. Depth of transducer below sea surface.
- c. Tidal variations as taken from tide tables and charts, with Stavanger as standard port.

Differences between actual and predicted tidal variations and inaccuracies in scaling off the echograms both introduce inaccuracies in the corrected water depths. Thus the absolute accuracy of the corrected water depths is estimated to be better than ± 1.0 metre.

2.5.3 Evaluation of Sea Bed Conditions and Stratigraphy

The sonograms of the area show an evenly reflecting sea floor with no special features observed. The sonograms presented in Appendices 4.1.2 and 4.1.3 are typical examples of the data obtained with sonar ranges of 125 and 200 metres. The darker patches on the sonograms are reflections from waves on the sea surface.

The sparker registrations reveal reflectors down to more than 800 milliseconds below sea surface. The section down to this reflector is divided into three zones, the lower zones being separated by a distinct erosion surface. See Appendices 4.1.4 and 4.1.5 for data examples.

The upper zone which extends down to approximately 200 milliseconds below sea surface, has numerous irregular reflectors and smaller buried channels. Thus rapidly varying sedimentary facies can be expected in this zone. A nearly horizontal reflector appears at a depth of approximately 20 milliseconds below sea bottom on most of the records. This upper layer (20 milliseconds) is expected to be sand.

The underlying zone extends down to a distinct erosion surface dipping southwards. See Appendices 4.1.4 and 4.1.5 for data examples. In this zone there are no marked reflectors except for a large buried channel with axis approximately E-W. The deepest part of this

channel also cuts into the underlying zone. See data examples and the Interpretation Chart in Appendix 4.3 for details.

At the centre location the buried channel extends, down to 275 milliseconds below sea level. The distinct erosion surface is at this location at 300 milliseconds below sea level.

The deepest of the three zones consists of parallel sub-horizontal reflectors. The deepest reflector seen on the sparker records appears on Profile 32 as a nearly horizontal reflector at 800 milliseconds below sea surface. On Profile 28 this reflector is seen to be dipping slightly southwards.

There is no indication of shallow gas being present on any of the sparker registrations.

2.5.4 Navigation Accuracy

In converting the Pulse 8 data from time differences to UTM co-ordinates static corrections have been applied to the time differences resulting in a correction of 26 metres in 56° (Fixed error) to all the plotted positions. The Pulse 8 stations used were: St. Fergus (1), Utsira (4) and Happisburgh (6).

The repeatability of the Pulse 8 is claimed to be better than ± 50 metres. Individually logged positions (20 second intervals) are seen to vary with several tens of metres from the plotted tracks which are based on data filtered over 2 minutes.



2.6 CONCLUDING REMARKS

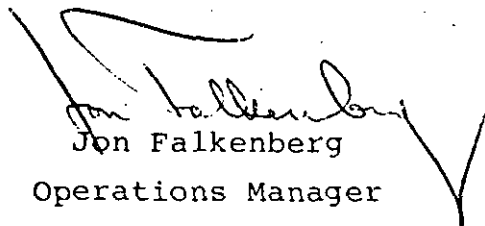
The side Scan sonograms do not reveal any obstruction that should restrict drill rig activity in the area.


There is no indication of shallow gas on the sparker registrations, which show penetration to more than 800 milliseconds.

The presence of the large E-W aligned buried channel through the area should be noted.

Stabekk, March 21st 1977.

for A/S G E O T E A M


Jon Falkenberg
Operations Manager


Kjell Martin Dukefoss
Project Engineer



APPENDICES:

FIELD LOG



FIELD LOG

All times GMT

February 14th 1977

- 2130 Mobilization finished and all equipment tested in port. Except for the Satellite Navigation System where the printer interface card was faulty, all equipment performed satisfactorily.
- 2135 M/V EMERALD left CCB. Set course for Stavanger where the faulty interface card would be replaced.
- 2315 Started testing equipment in Korsfjorden.

February 15th

- 0015 Finished testing equipment. All equipment operated satisfactorily. Full speed towards Stavanger.
- 0755 Arrived Stavanger.
- 1010 Satellite Navigation System repaired and operating. Left Stavanger.
- 2050 Reduced speed to set out equipment.
- 2254 Start of first profile with echo-sounder, side scan sonar and sparker (900 Joules).

February 16th

- 0530 Changed energy on sparker to 3900 Joules.
- 0950 Switched off sparker system. Continued profiling with echo-sounder and side scan sonar.
- 1800 Switched on sparker system, energy 900 Joules.
- 2000 Energy on sparker system switched to 3900 Joules.
- 2338 End of final profile.

February 17th

- 0000 All equipment on board. Set course for Bergen.
- 1530 M/V EMERALD at port in Bergen. End of field work.

APPENDIX NO. 2

WELL LOCATION (FINAL REPORT)

OFFSHORE RIG LOCATION SURVEY

WELL 8/4-1

NORWAY

PART 1: SATELITTE NAVIGATION REPORT

PART 2: DECCA PULSE 8 REPORT

GARDLINE SURVEYS
COTTON STREET

ABERDEEN AB2 1EA
UNITED KINGDOM

TELEPHONE (0224) 573421
TELEX 73535

SURVEY REPORT

for

UNION OIL NORSKE A/S

REFERENCE : NOR 8/4-1/507

DATED : 13/6/77 to 27/6/77

SATELLITE NAVIGATION REPORT

PART 1

PART 1

C O N T E N T S

| | |
|---------------|---|
| | SUMMARY |
| Section 1 | REQUIREMENTS |
| Section 2 | AERIAL LOCATION AND OFFSET |
| Section 3 | DATUM CONVERSION CORRECTIONS |
| Section 4 | TOTAL CORRECTIONS |
| Section 5 | PRESENTATIONS OF RESULTS |
| ENCLOSURES :- | DIARY OF EVENTS |
| APPENDIX A | CALCULATION OF FINAL DERRICK POSITION |
| APPENDIX B | DERIVATION OF AERIAL OFFSET FROM DERRICK POSITION |
| APPENDIX C | LOG OF SATELLITE 3D PASSES |

SUMMARY

After 30 '3D' Satellite fixes the derrick position of 'Norjarl' on location NOR 8/4-1 was found to be (International Spheroid, European Datum) :-

Latitude : 57° 44' 50.237" North

Longitude: 03° 00' 03.858" East

This position is estimated to be accurate to \pm 10 metres.

The final Satellite Navigation position was 28.1 metres on a bearing of 299° (T) from the intended location.

Total equipment days : 15

Total man days : 8

Section 1

REQUIREMENTS

The requirements were received from Mr W B Pace of Union Oil Co. of Great Britain and were to install a Dynamic Satellite Navigation system on board 'Norjarl' to navigate the rig to the intended location and to obtain a final geographical position once the rig was anchored on location.

Section 2

AERIAL LOCATION AND OFFSET

The Satellite Navigation positioning aerial was installed on the roof of the Pilot House with the remainder of equipment housed in the Pilot House.

The aerial position being 33.06 metres on a bearing of 3.57° to Starboard of the rig heading, which throughout the fix observations was 320° (T) as indicated by the rig's gyro compass.

This aerial offset resulted in the following corrections to be applied to convert aerial positions to derrick centre positions:

Latitude : -0.0143108 minutes

Longitude : +0.0198268 minutes

The height of the aerial above mean sea level was established by measurement to be 23.5 metres.

Section 3

DATUM CONVERSION CORRECTIONS

All positions obtained from Satellite Passes are on W.G.S. 72 spheroid, in order to convert these to International Spheroid, European Datum, it is necessary to apply the corrections which, for the location, are given below:-

Latitude : + 0.0402854 minutes

Longitude : + 0.0995785 minutes

Section 4

TOTAL CORRECTIONS

By combining the aerial offset correction with the Datum Conversion correction, it is possible to apply the corrections below to convert observed W.G.S. 72 aerial positions to International Spheroid, European Datum derrick positions :-

Latitude : +0.0259746 minutes

Longitude : +0.1194053 minutes

Section 5

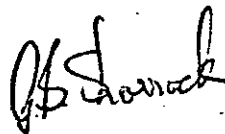
PRESENTATION OF RESULTS

The manner in which the Latitude, Longitude and Aerial height solutions converged to their final values is shown in figures 1;2; and 3 respectively.

Figure 4 shows a scatter plot depicting the movement of the 3D latitude/longitude solution throughout the course of the survey.



.....
M.P. Lillard
Manager, Gardline Surveys



.....
P.P. Engineer in Charge

ENCLOSURES

SUMMARY OF EVENTS

| <u>Date</u> | <u>Time</u> | <u>Event</u> |
|-------------|-------------|---|
| 13.6.77 | 0450 | Equipment delivered to shippers. |
| 14.6.77 | 0830 | Depart Dyce. |
| | 1000 | Arrive Sumburgh. |
| | 1810 | Depart Sumburgh. |
| | 1930 | Arrive 'Norjarl'. |
| | 2230 | Equipment set up and tested. |
| 15.6.77 | | Standing by. |
| 16.6.77 | | Standing by. |
| 17.6.77 | 0930 | Started anchor handling. |
| 18.6.77 | 0030 | Tow started. |
| 19.6.77 | 0300 | Approaching location. |
| | 0445 | Anchor handling started. |
| | 1730 | Finished anchor handling. |
| | 2200 | Anchors tensioned. |
| | | 3D fix started. |
| 20.6.77 | | 3D fix running. |
| 21.6.77 | 0400 | 3D fix finished |
| | 1130 | Personnel off 'Norjarl'. |
| | 1545 | Personnel arrive Dyce. |
| 25.6.77 | | Equipment arrived Stavanger. |
| 27.6.77 | | Equipment given to Agents. |
| | 1545 | Equipment arrived Aberdeen and demobilised. |

APPENDIX A

CALCULATION OF FINAL DERRICK POSITION

The final aerial position obtained after 30 3D
Satellite fixes was W.G.S. 72 Datum :-

Latitude : 57° 44.81140' North
Longitude : 02° 59.94489' East

Datum shifts to convert W.G.S. 72 positions to
International Spheroid, European Datum were
obtained from the computing section at Gardline
and are for location :-

Latitude : +0.0402854 minutes
Longitude : +0.0995785 minutes

Offset corrections to be applied to obtain derrick
positions are :-

Latitude : -0.0143108 minutes
Longitude : +0.0198268 minutes

The final derrick position is therefore (International
Spheroid, European Datum) :-

Latitude : 57° 44' 50.237" North
Longitude : 03° 00' 03.858" East

This position is 28 metres on a bearing of 299° True
from the intended location.

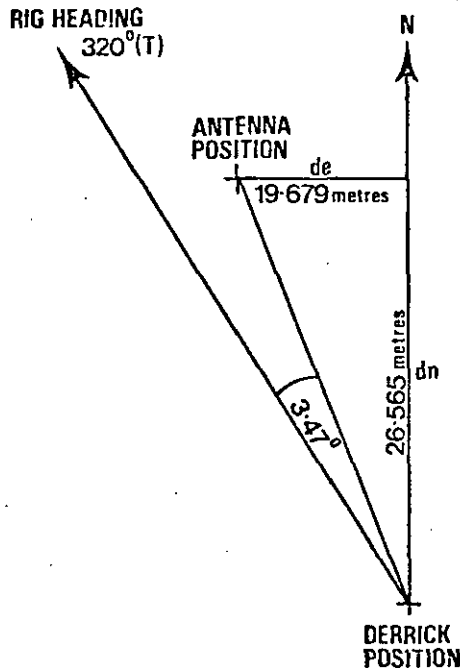
APPENDIX B

DERIVATION OF AERIAL OFFSET FROM DERRICK POSITION

Rig heading, obtained from Pilot House Gyrocompass was 320° T.

1 minute of latitude = 1856.299 metres

1 minute of longitude = 992.534 metres



The offset of the derrick position from the aerial position was determined from rig plans and deck measurements. From this information and the heading of the rig, the offset distance and bearing of the aerial from the derrick was found to be 33.06 metres on a bearing of 323.47° T.

From the range and bearing offset information the latitude and longitude corrections were calculated to be :-

(dn) Latitude correction = - 26.565 metres

= - 0.0143108 minutes

(de) Longitude correction = + 19.679 metres

= +0.0198268 minutes

APPENDIX C

LOG OF SATELLITE 3D PASSES

| <u>PASS NO.</u> | <u>TIME</u> | <u>LATITUDE</u> | <u>LONGITUDE</u> | <u>ANT. HT.</u> |
|-----------------|-------------|-----------------|------------------|-----------------|
| 1 | 2238 | 57°44.88189'N | 02°00.96296'E | 202.7 |
| 2 | 2304 | .78851 | 03°00.00060 | 45.32 |
| 3 | 2326 | .79812 | 02°59.95854 | 61.40 |
| 4 | 0020 | .79904 | 59.95067 | 64.67 |
| 5 | 0052 | .79995 | .94687 | 71.32 |
| 6 | 0112 | .80407 | .94458 | 72.11 |
| 7 | 0206 | .81369 | .94217 | 66.87 |
| 8 | 0236 | .81140 | .94601 | 65.11 |
| 9 | 0258 | .81048 | .94581 | 65.10 |
| 10 | 0352 | .81048 | .94715 | 64.56 |
| 11 | 0938 | .81048 | .94518 | 64.02 |
| 12 | 1022 | .81048 | .94701 | 64.22 |
| 13 | 1126 | .80957 | .94761 | 62.92 |
| 14 | 1150 | .80957 | .95007 | 63.66 |
| 15 | 1210 | .80865 | .95067 | 64.13 |
| 16 | 1312 | .80865 | .95267 | 63.36 |
| 17 | 1336 | .81048 | .95371 | 61.95 |
| 18 | 1356 | .81048 | .95362 | 61.95 |
| 19 | 1524 | .81048 | .95314 | 62.08 |
| 20 | 1554 | .81048 | .95087 | 62.77 |
| 21 | 1812 | .81048 | .94893 | 62.22 |
| 22 | 1958 | .81231 | .94830 | 61.05 |
| 23 | 2236 | .81231 | .94838 | 61.09 |
| 24 | 2402 | .81140 | .94895 | 61.17 |
| 25 | 0022 | .81140 | .94899 | 61.22 |

APPENDIX C

LOG OF SATELLITE 3D PASSES (continued)

| <u>PASS NO.</u> | <u>TIME</u> | <u>LATITUDE</u> | <u>LONGITUDE</u> | <u>ANT. HT.</u> |
|-----------------|-------------|-----------------|------------------|-----------------|
| 26 | 0058 | 57°44.81231'N | 02°59.94842'E | 61.04 |
| 27 | 0126 | .81231 | .94667 | 61.58 |
| 28 | 0146 | .81140 | .94527 | 63.14 |
| 29 | 0208 | .81140 | .94538 | 63.09 |
| 30 | 0248 | .81140 | .94489 | 63.93 |

SAT NAV PAC

FACILITIES AVAILABLE:-

1. ESSENTIAL PRE-JOB INFORMATION
2. POST-JOB CALCULATIONS
3. STATISTICS
4. CONVERGENCY GRAPHS. *

H.P. PLOTTER DRIVER (BROWN CASSETTE) MUST BE RUN BEFORE THE START OF THE SEQUENCE IF THIS FACILITY IS REQUIRED

INPUT FACILITY REQUIRED

GRAPH PLOTTER

NUMBER OF PASSES = 30

INTENDED LOCATION ON WGS72

LATITUDE = 57 44 48.5869 = 57 44.809781'
 LONGITUDE = 2 59 58.6183 E = 2 59.976972' E

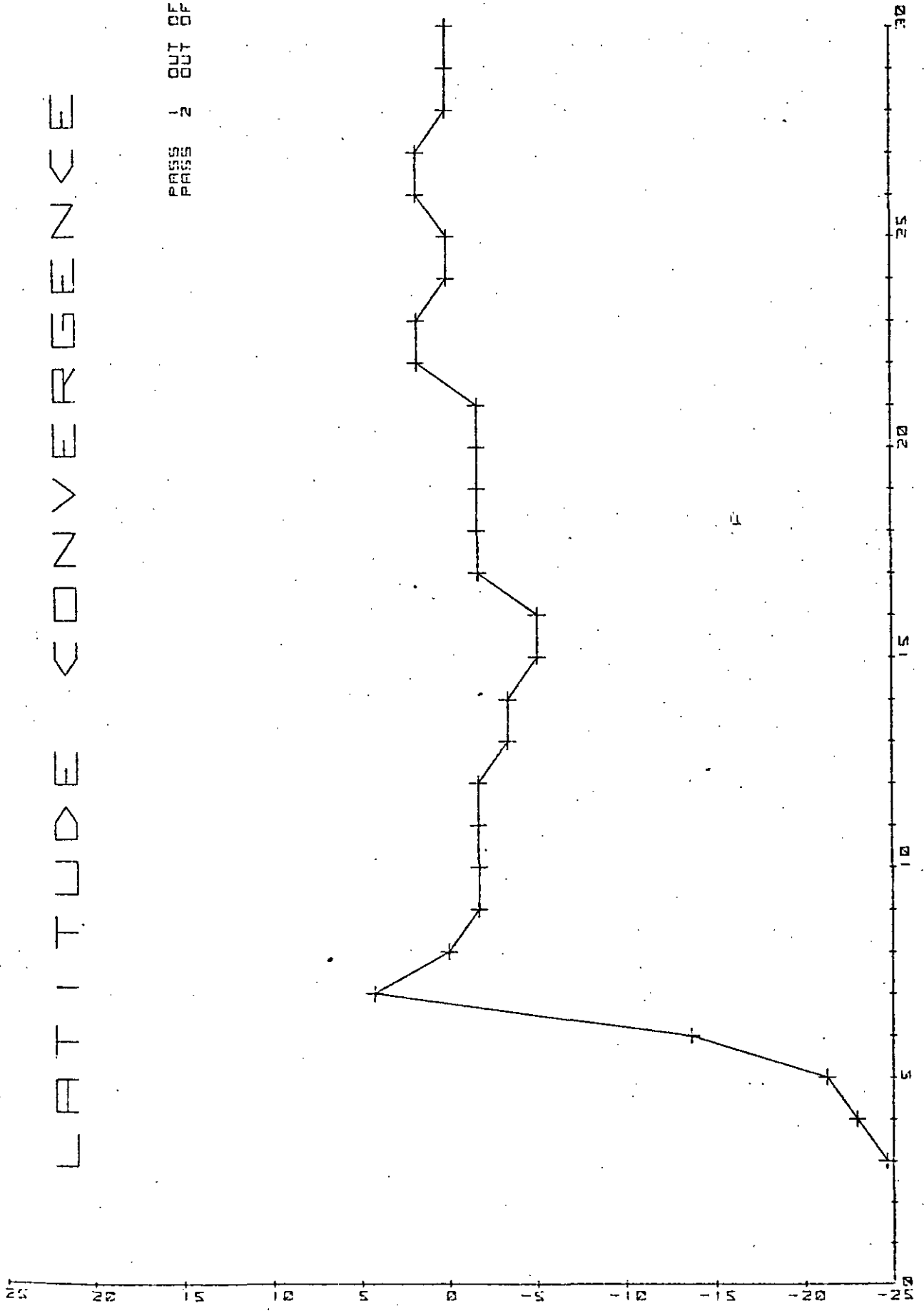
INITIAL 3D POSITION ON WGS72

LATITUDE = 57 44.811400
 LONGITUDE = 2 59.944890 E
 HEIGHT = 63.930

| Pass | Lat | Long | Height | Lat | Long | Height | Altitude |
|------|-----|----------|--------|-----|----------|--------|----------|
| 1 | 57 | 44.88189 | N | 3 | 0.96296 | E | -202.70 |
| 2 | 57 | 44.78851 | N | 3 | 0.00060 | E | 45.32 |
| 3 | 57 | 44.79812 | N | 2 | 59.95854 | E | 61.40 |
| 4 | 57 | 44.79984 | N | 2 | 59.95867 | E | 64.67 |
| 5 | 57 | 44.79995 | N | 2 | 59.94687 | E | 71.32 |
| 6 | 57 | 44.80407 | N | 2 | 59.94458 | E | 72.11 |
| 7 | 57 | 44.81369 | N | 2 | 59.94217 | E | 66.87 |
| 8 | 57 | 44.81140 | N | 2 | 59.94601 | E | 65.11 |
| 9 | 57 | 44.81048 | N | 2 | 59.94581 | E | 65.10 |
| 10 | 57 | 44.81048 | N | 2 | 59.94715 | E | 64.56 |
| 11 | 57 | 44.81048 | N | 2 | 59.94518 | E | 64.02 |
| 12 | 57 | 44.81048 | N | 2 | 59.94701 | E | 64.22 |
| 13 | 57 | 44.80957 | N | 2 | 59.94761 | E | 62.92 |
| 14 | 57 | 44.80957 | N | 2 | 59.95007 | E | 63.66 |
| 15 | 57 | 44.80865 | N | 2 | 59.95067 | E | 64.13 |
| 16 | 57 | 44.80865 | N | 2 | 59.95267 | E | 63.36 |
| 17 | 57 | 44.81048 | N | 2 | 59.95371 | E | 61.95 |
| 18 | 57 | 44.81048 | N | 2 | 59.95362 | E | 61.95 |
| 19 | 57 | 44.81048 | N | 2 | 59.95314 | E | 62.08 |
| 20 | 57 | 44.81048 | N | 2 | 59.95087 | E | 62.77 |
| 21 | 57 | 44.81048 | N | 2 | 59.94893 | E | 62.22 |
| 22 | 57 | 44.81231 | N | 2 | 59.94838 | E | 61.05 |
| 23 | 57 | 44.81231 | N | 2 | 59.94838 | E | 61.09 |
| 24 | 57 | 44.81140 | N | 2 | 59.94895 | E | 61.17 |
| 25 | 57 | 44.81140 | N | 2 | 59.94899 | E | 61.22 |
| 26 | 57 | 44.81231 | N | 2 | 59.94842 | E | 61.04 |
| 27 | 57 | 44.81231 | N | 2 | 59.94867 | E | 61.58 |
| 28 | 57 | 44.81140 | N | 2 | 59.94527 | E | 63.14 |
| 29 | 57 | 44.81140 | N | 2 | 59.94538 | E | 63.79 |
| 30 | 57 | 44.81140 | N | 2 | 59.94489 | E | 63.93 |

LATITUDE CONVERGENCE

PASS 1 OUT OF RANGE
PASS 2 OUT OF RANGE



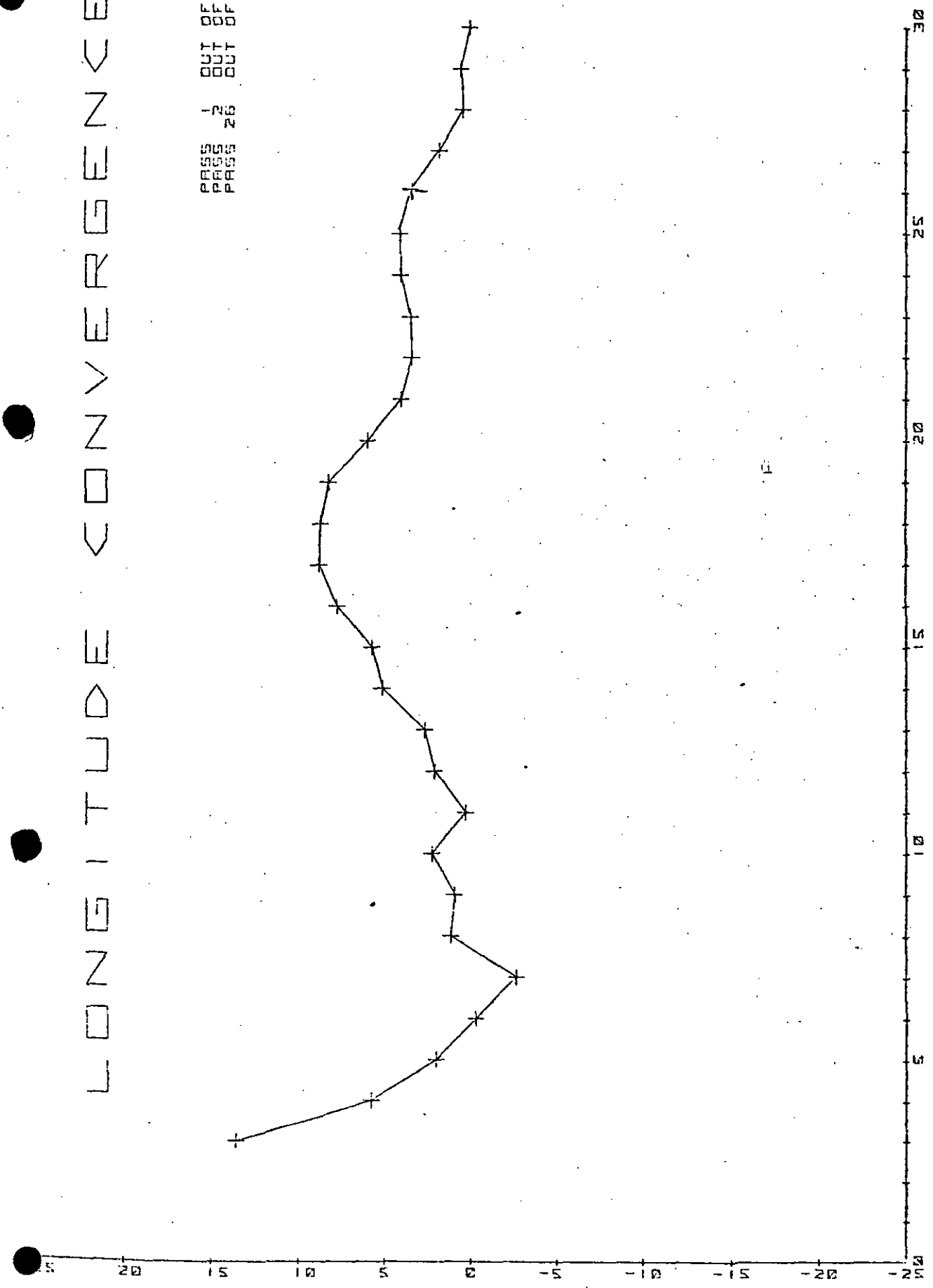
PASS NUMBER

METRES

LATITUDE

LONGITUDE CONVERGENCE

WISE
 ZZZZ
 RRRR
 PRRR
 OFFF
 OFFF
 TTTT
 OOOO
 -NS
 NS
 SSSS
 PRRR
 PRRR

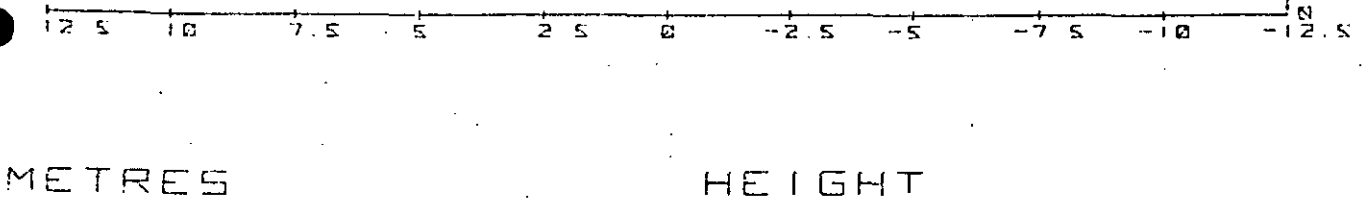


METRES LONGITUDE

PASS NUMBER

HEIGHT CONVERGENCE

PASS 2 OUT OF RANGE



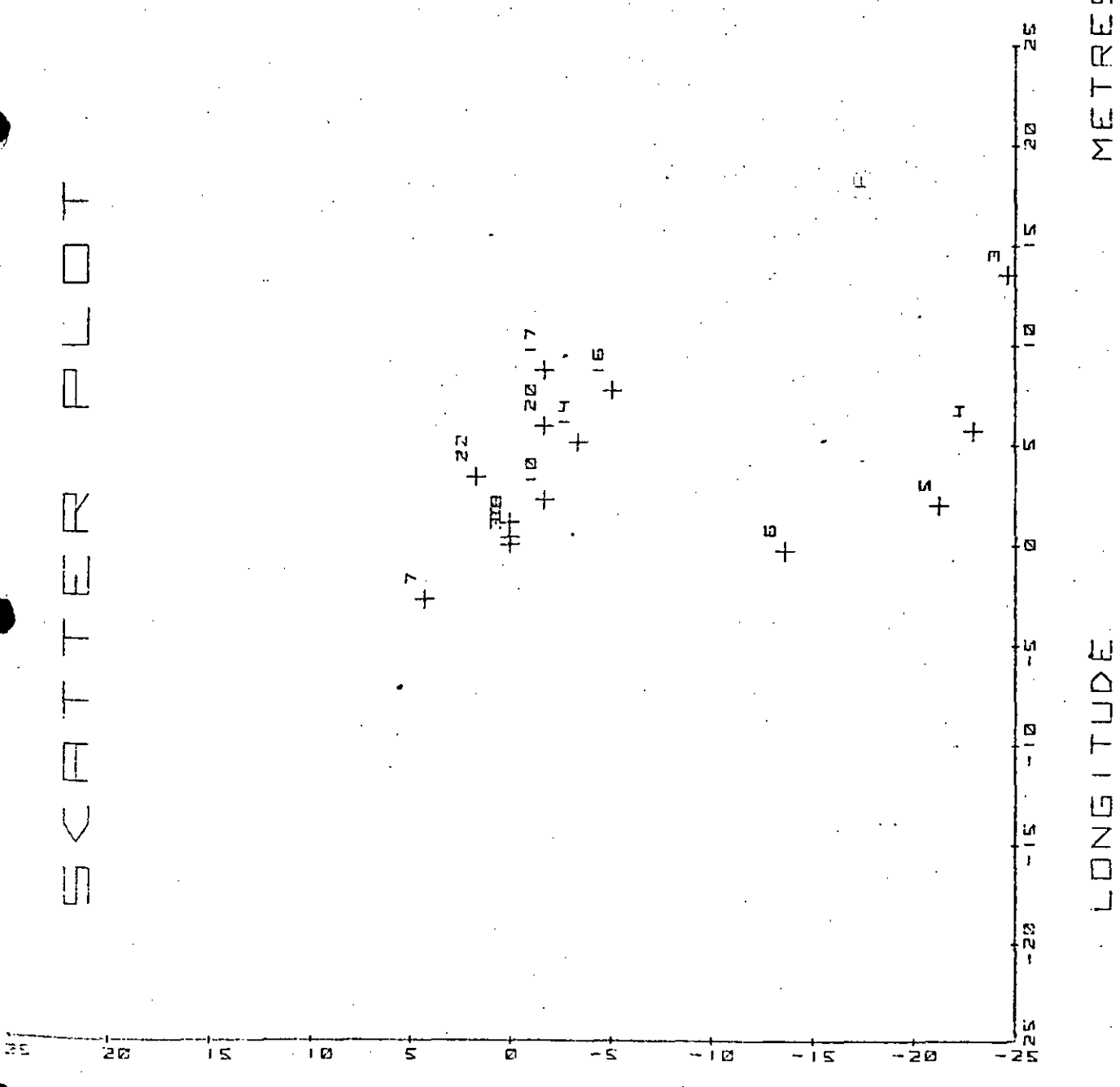
PASS NUMBER

SCATTER PLOT

```

LLLLLLLLLLLLLLLL LLL
ZZZZZZZZZZZZZZ ZZ
000000000000 00
VVVVVVVVVVVVVV VV
000000000000 00
111111111111 11
000000000000 00
SSSSSSSSSSSSSS S
SSSSSSSSSSSSSS S
ZZZZZZZZZZZZZZ ZZ
RRRRRRRRRRRRRR RR
FF000000000000 FF
00000000000000 00
TTTTTTTTTTTTTT TT
TTTTTTTTTTTTTT TT
UUUUUUUUUUUUUU UU
00XXXXXX000000 00
000000000000 00
-NN-NNNNNN-NNNNNN
-----NNNNNNNN
NNNNNNNNNNNNNN
NNNNNNNNNNNNNN
NNNNNNNNNNNNNN
NNNNNNNNNNNNNN

```



METRES

LATITUDE

METRES

LONGITUDE

SURVEY REPORT

for

UNION OIL NORSKE A/S

REFERENCE : NOR 8/4-1/507

DATED : 15/6/77 to 20/6/77

PART 2

REFERENCE : NOR 8/4-1/507

PART 2

C O N T E N T S

| | |
|-----------|---------------------------|
| | NARRATIVE |
| Section 1 | REQUIREMENTS |
| Section 2 | LOCATION COMPUTATIONS |
| Section 3 | POSITION FIXING SYSTEMS |
| Section 4 | BUOYS |
| Section 5 | FINAL POSITION OF DERRICK |
| Section 6 | CHARTING |
| Section 7 | PERSONNEL |
| Section 8 | ENCLOSURES |
| | a) ONE CHART |
| | b) SUMMARY OF EVENTS |
| | c) SUMMARY OF LANE CHECKS |

NARRATIVE

At 1200 hours on 15th June 1977 the survey vessel 'Researcher' was mobilised at Aberdeen to carry out the move of the drilling rig 'Norjarl' to Norwegian block 8/4-1.

At 1415 hours on the 16th June 1977 the 'Researcher' sailed from Aberdeen for the drilling rig 'Norskald' in Norwegian block 7/12 to calibrate and check Pulse 8 positioning equipment, arriving at 0530 hours on the 17th June 1977.

'Researcher' continued to the 8/4-1 location on completion of the Pulse 8 check arriving at 0900 hours on the same day.

A pattern of ten buoys was laid and checked during the afternoon of the 18th June 1977 and then the 'Researcher' stood by on location.

The drilling rig 'Norjarl' arrived on location at 0504 hours on the 19th June 1977 and a final transit fix was completed at 2235 hours on the same day.

NARRATIVE (continued)

'Researcher' was released from location by the 'Norjarl' at 2344 hours on the 19th June 1977 when the ship sailed for Aberdeen arriving at 1520 hours on the 20th June 1977.

'Researcher' was demobilised at 1800 hours on 20th June 1977.

The final position of the derrick as derived from corrected Pulse 8 readings of :-

| | | | |
|---------------|----------|-------------|-------|
| Pattern 1 - 5 | 47875.78 | C-0 applied | -0.14 |
| Pattern 6 - 4 | 53095.56 | C-0 applied | +0.13 |

was computed as :-

Latitude : 57° 44' 49.854" North

Longitude : 03° 00' 04.344" East

I.S.E.D. 1950

U.T.M. (Zone 31 C.M. 3° East)

Eastings : 500071.831

Northings : 6400708.653

This position is 17 metres on a bearing of 275° T from the intended location.

NARRATIVE (continued)

The final position of the derrick using observed
Pulse 8 readings of :-

Pattern 1 - 5 47875.92

Pattern 6 - 4 53095.43

Latitude : 57° 44' 50.720" North

Longitude : 03° 00' 03.452" East

I.S.E.D. 1950

U.T.M. (Zone 31 G.M. 3° East)

Eastings : 500057.081

Northings : 6400735.435

Total time at sea : 4 days 1 hour

Total time in harbour : 1 day 5 hours

Buoys laid : 10

Buoys recovered : NIL

Section 1

REQUIREMENTS

The requirements for this survey were discussed by telephone and confirmed by a telex, number 59MB dated 27th May 1977. Further to this is a letter from Mr E H East of Union Oil Co. to Mr A Cavell of Gardline Surveys, dated 10th June 1977.

The requirements are as follows :-

- a) To lay the required buoy pattern as designated by Union Oil Co.
- b) To assist the rig 'Norjarl' onto location.
- c) To fix the float positions of the 'Norjarls' anchor buoys.
- d) To fix the final position of the derrick by Pulse 8 (corrected observed).
- e) The final position to be determined by Sat. Nav.

Section 2

LOCATION COMPUTATIONS

Observed Pulse 8 readings for the 8/4-1 location were supplied by Union Oil Co. and were as follows :-

Pattern 1 - 5 47875.825

Pattern 6 - 4 53095.332

These readings were computed into the following geographicals :-

Latitude : 57° 44' 51.004" North

Longitude : 03° 00' 04.593" East

Observed Pulse 8 readings were used throughout the survey.

Section 3

POSITION FIXING SYSTEMS

Pulse 8 was used as primary control throughout this operation backed up by Vestlandet 'OE' Main Chain.

At the 8/4-1 location Pulse 8 has the following configuration :-

Pattern 1 - 5 158 metres lane width

Pattern 6 - 4 155 metres lane width

Angle of cut between 1 - 5 and 6 - 4 : 93° T.

Section 4

BUOYS

A pattern of ten buoys was laid as instructed by Union Oil Co. at the 8/4-1 location.

Description of these buoys are as follows :-

| <u>Buoy No.</u> | <u>Bearing</u> | <u>Range</u> | | <u>Description</u> |
|-----------------|----------------|--------------|---------------|--------------------|
| | | <u>Feet</u> | <u>Metres</u> | <u>Flag</u> |
| 1 | 340°T | 3,300 | 1005.84 | Red/Light |
| 2 | 025°T | 3,300 | 1005.84 | Red/Light |
| 3 | 065°T | 3,300 | 1005.84 | Red/Light |
| 4 | 110°T | 3,300 | 1005.84 | Red/Light |
| 5 | 160°T | 3,300 | 1005.84 | Red/Light |
| 6 | 205°T | 3,300 | 1005.84 | Red/Light |
| 7 | 245°T | 3,300 | 1005.84 | Red/Light |
| 8 | 290°T | 3,300 | 1005.84 | Red/Light |
| Port Transit | 225°T | 200 | 60.96 | Green/Light |
| Bow Transit | 315°T | 200 | 60.96 | Yellow/Light |

Section 4

BUOYS (continued)

A true bearing and distance from the derrick of the float positions of 'Norjarls' anchor buoys was found to be :-

| <u>Buoy No.</u> | <u>Bearing</u> | <u>Distance</u> | |
|-----------------|--------------------|-----------------|---------------|
| | | <u>Feet</u> | <u>Metres</u> |
| 1 | 336 ^o T | 2936.35 | 895 |
| 2 | 047 ^o T | 2762.47 | 842 |
| 3 | 071 ^o T | 2795.28 | 852 |
| 4 | 116 ^o T | 3461.29 | 1,055 |
| 5 | 180 ^o T | 2979.00 | 908 |
| 6 | 209 ^o T | 2739.50 | 835 |
| 7 | 239 ^o T | 2667.32 | 813 |
| 8 | NO BUOY | | |

Section 5

FINAL POSITION OF THE DERRICK

The final position of the derrick was determined by taking the transits of opposite pairs of the rigs legs, and was found to be :-

Latitude : 57° 44' 49.854" North

Longitude : 03° 00' 04.344" East

I.S.E.D. 1950

U.T.M. (Zone 31 C.M. 3°East)

Eastings : 500071.831

Northings : 6400708.653

These readings are based on the corrected observed Pulse 8 readings of :-

| | | | |
|---------------|----------|------------|-------|
| Pattern 1 - 5 | 47875.78 | C-0 errors | -0.14 |
|---------------|----------|------------|-------|

| | | | |
|---------------|----------|------------|-------|
| Pattern 6 - 4 | 53095.56 | C-0 errors | +0.13 |
|---------------|----------|------------|-------|

Using observed Pulse 8 readings of :-

| | |
|---------------|----------|
| Pattern 1 - 5 | 47875.92 |
|---------------|----------|

| | |
|---------------|----------|
| Pattern 6 - 4 | 53095.43 |
|---------------|----------|

Section 5

FINAL POSITION OF THE DERRICK (continued)

The following geographicals have been computed :-

Latitude : 57° 44' 50.720" North

Longitude : 03° 00' 03.452" East

I.S.E.D. 1950

U.T.M. (Zone 31 C.M. 3° East)

Eastings : 500 057.081

Northings : 6400 735.435

Section 6

CHARTING

One chart on a scale of 1:10,000 has been produced and is included with this report, and shows :-

- a) Latitude and Longitude (I.S.E.D. 1950).
- b) Pulse 8 lattice.
- c) Vestlandet 'OE' Main Chain.
- d) U.T.M. (Zone 31 C.M. 3⁰ East).
- e) Intended location.
- f) Drop positions of marker buoys.
- g) Float positions of the rigs anchor buoys.
- h) Final position of the derrick as derived by observed Pulse 8 readings.
- i) Final position of the derrick determined by Sat. Nav.

Section 7

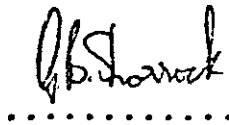
PERSONNEL

The following personnel were engaged in this operation :-

- M J Colley - Surveyor in Charge
Gardline Surveys
- M Baxter - Pulse 8 Engineer
Decca Surveys
- B Lane - Clients Consultant
- M Hursey - Union Oil Co. of Great Britain


.....

M. J. Colley
Manager, Gardline


.....

P. P. Surveyor in Charge

Section 8

ENCLOSURES

SUMMARY OF EVENTS

| <u>Date</u> | <u>Time</u> | <u>Event</u> |
|-------------|-------------|---|
| 15/6/77 | 1200 | 'Researcher' mobilised at Aberdeen. |
| 16/6/77 | 1415 | 'Researcher' sailed from Aberdeen for the drilling rig 'Norskald' in block 7/12 to calibrate Pulse 8. |
| 17/6/77 | 0530 | Calibration of Pulse 8 on the drilling rig 'Norskald'. |
| | 0533 | 'Researcher' sailed for the 8/4-1 location. |
| | 0900 | 'Researcher' arrived on location. |
| | 1145 | 'Researcher' sailed for block 7/12 to check on wellhead buoy. |
| | 1506 - 1570 | Calibrating Pulse 8 and checking on 7/12-1 wellhead buoy. |
| | 1571 | 'Researcher' sailed for 8/4-1 location. |
| | 1845 | 'Researcher' arrived on location. |
| 18/6/77 | 1314 - 1544 | Laying and checking the float positions of the buoy pattern. |
| 19/6/77 | 0331 - 0426 | Standing by No. 4. marker buoy. |
| | 0428 - 0451 | Standing by the Bow Transit buoy. |
| | 0504 | Drilling rig 'Norjarl' on location. |
| | 0505 - 0530 | Standing by No. 8. marker buoy. |
| | 0550 - 0611 | Checking float positions of the buoy pattern. |
| | 1012 - 1021 | Preliminary transit fix : 143 metres x 039 degrees T. Rig heading 314 degrees T. |
| | 1257 - 1310 | Preliminary transit fix : 60 metres x 266 degrees T. Rig heading 317 degrees T. |

Section 8

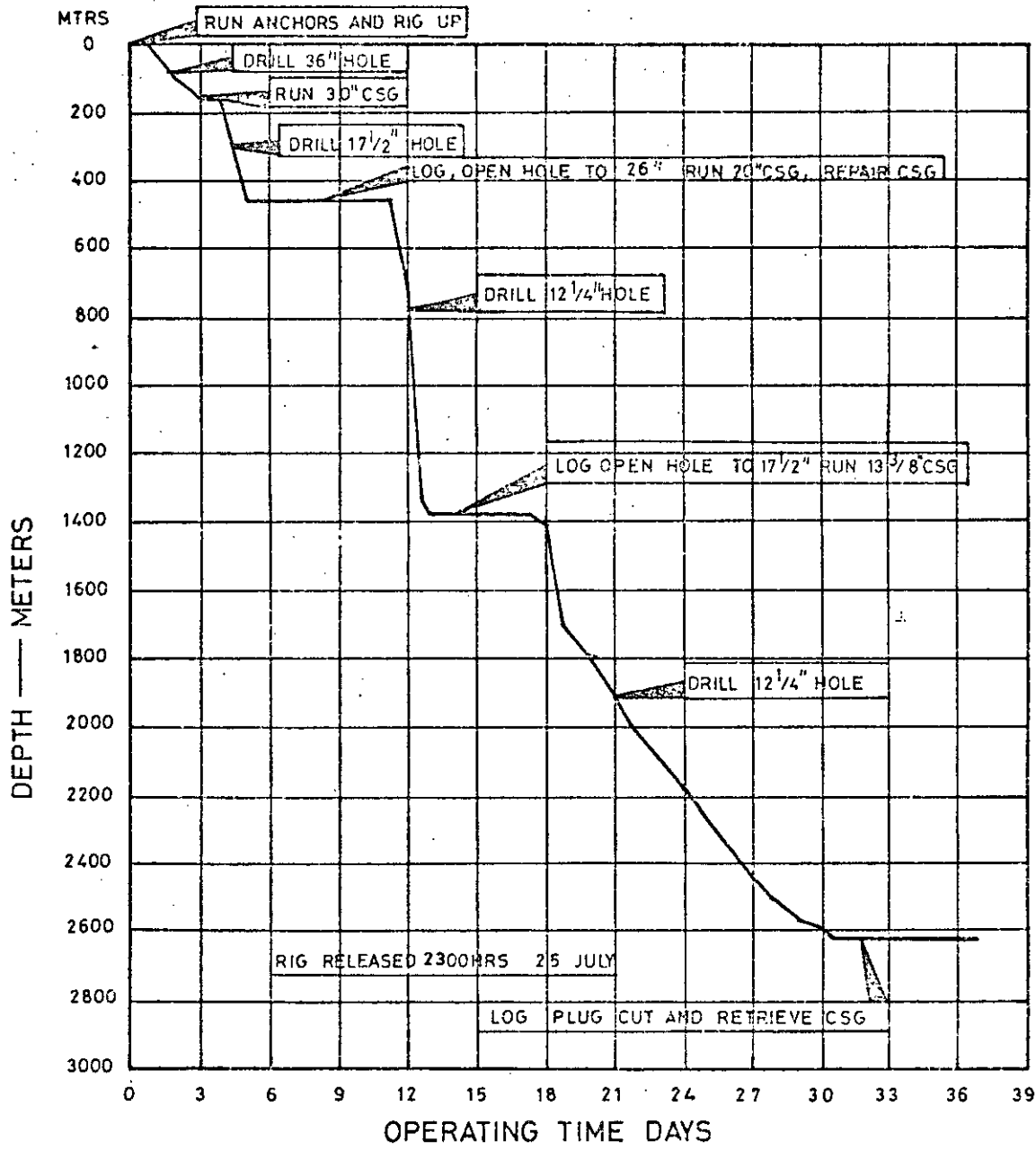
ENCLOSURES

SUMMARY OF EVENTS (continued)

| <u>Date</u> | <u>Time</u> | <u>Event</u> |
|-------------|-------------|---|
| 19/6/77 | 1421 - 1428 | Preliminary transit fix : 28 metres x 246 degrees T. Rig heading 319 degrees T. |
| | 1745 - 1756 | Preliminary transit fix : 22 metres x 238 degrees T. Rig heading 320 degrees T. |
| | 2223 - 2235 | Final transit fix on the drilling rig 'Norjarl'. |
| | 2238 - 2259 | Fixing the float positions of the 'Norjarls' anchor buoys. |
| | 2344 | 'Researcher' released from location by 'Norjarl'. |
| 20/6/77 | 1520 | 'Researcher' arrived alongside in Aberdeen. |
| | 1800 | 'Researcher' demobilised. |

APPENDIX NO. 3

DRILLING RECORD AND TIME VERSUS
DEPTH CURVE



SPUD DATE: 21st JUNE 1977
 OPERATING TIME: 37 + 4 1/2
 TIME FROM SPUD: 34 + 12
 T. D. : 2631.46 M
 RIG: "NORJARL"
 COORDINATES : 57° 44' 50.237" N
 03° 00' 03.858" E

| |
|---------------------|
| UNIONOIL NORGE A/S |
| TIME Vs DEPTH CURVE |
| 8/4 - 1 |
| union |
| J.E.F. |

| <u>DATE</u> | <u>ETD/MTRS</u> | <u>DETAILS OF OPERATIONS, DESCRIPTION & RESULTS</u> | | | | | | | | | | | | | | | | | | | | | | | | |
|------------------------------------|-----------------|---|--------------------------|---------------|------|--------|-----------|-------|--|---------------|----------------|------|--|---------------|-----------------------------|--------|--|---------------|------------------------------------|------|--|---------------|----------------------------|-------|-----------------|--------------|
| June 23 | 160m | Waited on cement 4 hours. Tagged the top of cement at 119m. Waited on cement additional 4 hours. Cleaned out cement to 160m with 75% returns. Still losing returns below 30" casing. Circulation to sea-floor outside 30" casing. Set plug no.3 with open ended drill pipe at 160m. with 408 sacks class "G" +2.5% CaCl. Cement in place at 1200 hours. Waited on cement 12 hours. Tagged top of cement at 133m. Cleaned out to 137m. Circulated with 50% returns. Set plug no.4 with open ended drill pipe at 127.7m. Cemented with 380 sacks class "G" mixed with sea water. Cement in place at 0245 hours. | | | | | | | | | | | | | | | | | | | | | | | | |
| June 24 | 433m | Waited on cement 8 hours. Tagged top of cement at 108.5m. Cleaned out cement to 131.68m, drilled to 433.12m. with 17½" bit. Made a wiper trip and circulated to log. | | | | | | | | | | | | | | | | | | | | | | | | |
| June 25 | 433m | Pulled out of the hole. Rigged up to log. Tool stopped at 137.16m. Made wiper trip. Ran GR-BHC. Tripped in hole, laid down riser. Opened 17½" hole to 26" from 124.66m to 143.26m. | | | | | | | | | | | | | | | | | | | | | | | | |
| June 26 | 433m | Opened hole to 315.17m. Hole sloughing. Pulled out of hole. Ran riser, made up underreamer. Reamed 124.66m to 315.17m without returns. | | | | | | | | | | | | | | | | | | | | | | | | |
| June 27 | 433m | Opened 17½" hole from 315.17m to 433.13m. Made a wiper trip. Displaced the hole with mud. Pulled out of hole. Laid down riser. | | | | | | | | | | | | | | | | | | | | | | | | |
| June 28 | 433m | Ran 324.53m of 20" Vetco 94 lb. casing. Casing shoe at 410.05m. Cemented with 1385 sacks class "G" with 8% gel + 2% CaCl + 13.2 ppg. slurry, followed by 500 sacks class "G" - with 2% CaCl - 15.6 ppg. slurry. Cement in place 1905 hours. Backed off left hand running tool. Ran stack and riser. | | | | | | | | | | | | | | | | | | | | | | | | |
| | | <table border="0"> <thead> <tr> <th><u>20" Casing detail</u></th> <th><u>Meters</u></th> </tr> </thead> <tbody> <tr> <td>T.D.</td> <td>433.13</td> </tr> <tr> <td>Open hole</td> <td>23.08</td> </tr> <tr> <td></td> <td><u>410.05</u></td> </tr> <tr> <td>Baker 20" F.S.</td> <td>0.61</td> </tr> <tr> <td></td> <td><u>409.44</u></td> </tr> <tr> <td>25 Jrs. Vetco type L 94 lb.</td> <td>306.51</td> </tr> <tr> <td></td> <td><u>102.63</u></td> </tr> <tr> <td>20" squnch Jt. type L pin x ST pin</td> <td>2.55</td> </tr> <tr> <td></td> <td><u>100.08</u></td> </tr> <tr> <td>18-3/4" cameron hsg. joint</td> <td>14.56</td> </tr> <tr> <td>Top 18-3/4 Hsg.</td> <td><u>85.52</u></td> </tr> </tbody> </table> | <u>20" Casing detail</u> | <u>Meters</u> | T.D. | 433.13 | Open hole | 23.08 | | <u>410.05</u> | Baker 20" F.S. | 0.61 | | <u>409.44</u> | 25 Jrs. Vetco type L 94 lb. | 306.51 | | <u>102.63</u> | 20" squnch Jt. type L pin x ST pin | 2.55 | | <u>100.08</u> | 18-3/4" cameron hsg. joint | 14.56 | Top 18-3/4 Hsg. | <u>85.52</u> |
| <u>20" Casing detail</u> | <u>Meters</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| T.D. | 433.13 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Open hole | 23.08 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <u>410.05</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| Baker 20" F.S. | 0.61 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <u>409.44</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| 25 Jrs. Vetco type L 94 lb. | 306.51 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <u>102.63</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| 20" squnch Jt. type L pin x ST pin | 2.55 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | <u>100.08</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| 18-3/4" cameron hsg. joint | 14.56 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Top 18-3/4 Hsg. | <u>85.52</u> | | | | | | | | | | | | | | | | | | | | | | | | | |
| June 29 | 433m | Tested collet connector to 5,000 psi. Tested blow-out preventors to 1,225 psi. Tagged cement at 379.48m. Attempted to test casing. Pumped away 7 bbl/min with 150 psi. Ran temperature survey. Unable to locate casing hole with temperature survey. Pumped a slug of coarse mica and calculated lag time after observing returns between 20" and 30" annulus. Lag indicated shallow leak, possibly squnch joint. Positioned open ended drill pipe 9m below lowest pipe rams. Bradenhead squeezed with 185 sacks of class "G" cement- 14.2 ppg slurry, followed with 150 sacks of class "G" cement- 15.6 ppg slurry. | | | | | | | | | | | | | | | | | | | | | | | | |

| <u>DATE</u> | <u>ETD/MTRS.</u> | <u>DETAILS OF OPERATIONS, DESCRIPTIONS & RESULTS</u> |
|-------------|------------------|--|
| | | Pressure steadily increased to 800 psi while squeezing. Pressure bled back to 200 psi with the pump stopped. Held pressure on the squeeze. |
| June 30 | 433m | Waited on cement, 12 hours. Ran in with drilling assembly. Tagged cement at 399.29m. Cleaned out to 407.52m. Attempted to test casing 300 psi, bled back to 150 psi. Pulled out of hole. Ran in hole with open ended drill pipe. Hung at 102m. Cemented with 82 sacks class "G" 15.6 ppg slurry, mixed with 2% CFR ₂ and 2% CaCl. Cement in place at 1245 hours. Closed rams squeezed 7 bbl away at 300 psi. Waited on cement. Tested casing to 600 psi. Pulled out of hole. Ran in hole with drilling assembly. No cement below pipe rams. |
| July 1 | 627m | Circulated. Drilled out cement and shoe. Good cement 3m from shoe. Took bleed off test equal to 12.5 ppg. Pulled out of hole. Ran wear bushing. Made up bottom hole assembly. Drilled 12-1/4" hole to 627m. |
| July 2 | 1354m | Drilled 12-1/4" hole to 1354m. Surveyed at 100m stations. |
| July 3 | 1388m | Drilled 12-1/4" hole to 1388m. Circulated out. Made wiper trip. Rigged up to run logs. Tool stopped at 506m. Ran in with drilling assembly. Circulated and pulled out of hole. |
| July 4 | 1388m | Rigged up Schlumberger. Tool stopped at 458.73m. Ran in open ended, built mud weight to 10.5 ppg. |
| July 5 | 1388m | Circulated and conditioned mud. Pulled out of hole and rigged up and ran ISF-Sonic and FDC-GR logs. Wireline depth 1387.47m. Rigged down Schlumberger. Picked up bottom hole assembly. Ran in hole. Reamed from 436m to 635m. |
| July 6 | 1388m | Opened hole, from 12-1/4" to 17 1/2" to 1386.86m. Made a wiper trip. Circulated hole clean prior to running casing. |
| July 7 | 1388m | Ran 106 Jts. 13-3/8" casing, 72 lb N-80 & 68 lb. K-55. Cemented first stage with 742 sacks class "G" neat at 15.6 ppg. Bumped plug with 2300 psi. Opened D.V. collar. Cemented second stage with 400 sacks class "G" neat at 15.6 ppg. Bumped plug with 2300 psi. |

| <u>13-3/8" casing details</u> | <u>Meters</u> |
|-------------------------------|----------------|
| T.D. | 1388.38 |
| Open hole | 10.24 |
| | <u>1378.14</u> |
| Float shoe | 0.62 |
| | <u>1377.52</u> |
| 1-Jt. 13-3/8" 72lb. N-80 | 12.46 |
| | <u>1365.06</u> |
| Float collar | 0.52 |
| | <u>1364.54</u> |
| 32 Jts. 13-3/8" 72lb. N-80 | 388.27 |
| | <u>976.27</u> |
| 47 Jts. 13-3/8" 68lb K-55 | 567.90 |
| | <u>408.37</u> |

| <u>DATE</u> | <u>ETD/MTRS.</u> | <u>DETAILS OF OPERATIONS, DESCRIPTIONS & RESULTS</u> |
|-------------|------------------|---|
| | | Transferred from page 3 408.37 D.V. collar 1.02 407.35 26 Jts. 13-3/8" 68lb K-55 318.37 88.98 1-13-3/8 PUP & CSG. HGR 2.19 86.79 Depth.- RT to 13-3/8" profile 86.79 00.00 |
| July 8 | 1403m | Pulled 13-3/8" landing string. Set and tested seal assembly to 1,590 psi. Tested all blow-out preventors to 3,000 psi, shear rams to 1,500 psi - ok. Ran temperature log. Drilled float collar. Tested casing to 2,000 psi - ok. Drilled float shoe. Cleaned out to 1,388.38m - Circulated. Formation leak off test to 750 psi - 14.6 ppg equivalent. |
| July 9 | 1671m | Drilled 12-1/4" hole, Surveyed at 100m stations. |
| July 10 | 1795m | Drilled 12-1/4" hole. " " " " |
| July 11 | 1909m | Drilled 12-1/4" hole. Tight hole 1785m-1757m on trip. Worked through with 50,000 lb. overpull. |
| July 12 | 1991m | Drilled 12-1/4" hole. Tight hole 1927m-1845m on trip. Worked through with 50-65,000 lb. overpull. |
| July 13 | 2083m | Drilled 12-1/4" hole. Surveyed at 100m stations. |
| July 14 | 2151m | Drilled to 2096m. Tight hole 2082m-1936m on trip. Tested blow-out preventors, all rams, lines and valves to 3,500 psi. |
| July 15 | 2250m | Drilled 12-1/4" hole. Surveyed at 100m stations. |
| July 16 | 2344m | Drilled 12-1/4" hole. " " " " |
| July 17 | 2437m | Drilled 12-1/4" hole. " " " " |
| July 18 | 2503m | Drilled 12-1/4" hole. " " " " |
| July 19 | 2568m | Drilled 12-1/4" hole. " " " " |
| July 20 | 2632m | Drilled 12-1/4" hole to 2631.6m. Circulated and conditioned mud. Ran Schlumberger ISF-Sonic from 2625m to 1376m. |
| July 21 | 2632m | Logged 24 hours, FDC-CNT, HDT, WST and sidewall cores. |
| July 22 | 1326m | Finished with sidewall cores. Set 100 sacks cement plug with open ended drill pipe at 2109.85m. Slurry weight 15.6 ppg. Cement in place at 1150 hours. Top of cement at 2077.54m. Set Howco EZCV at 1341.14m. Squeezed 250 sacks cement below tool. Dropped 50 sacks cement on top of retainers. Top of cement at 1326.4m. Cement in place at 2300 hours. |

| <u>DATE</u> | <u>ETD/MTRS.</u> | <u>DETAILS OF OPERATIONS, DESCRIPTIONS & RESULTS</u> |
|-------------|------------------|--|
| July 23 | 97m | Set open ended plug from 239.88m to 97m with 350 sacks class "G" cement 15.6 ppg slurry. Cement in place at 1000 hours. Pulled blow-out preventor stack and riser. |
| July 24 | 97m | Tagged top of cement at 97m. Cut 13-3/8" casing 8.26m below mudline. Cut 20" and 30" casing 7.6m below mudline. |
| July 25 | 97m | Retrieved all well head equipment. Divers made inspection of sea floor. All clear. Pulled all anchors. Rig released at 2300 hours, 25th July 1977. |

APPENDIX NO. 4

MUD, BIT AND CASING RECORD

UNIONOIL NORGE A/S BIT RECORD

WELL: 8/4-1 SPUD DATE: June 21, 1977 COMPLETION DATE: July 25, 1977
 RIG: "NORJARL" MUD TYPE: LIME DRISPAK FROM: 124.56 TO: 1756.89
 TOTAL DEPTH: 2631.46m LIGNOSULFONATE FROM: 1756.89 TO: 2631.46

| UN | SIZE | MAKE | TYPE | SERIAL NO. | JETS 32nds | | | DEPTH | MTRS PER HOUR | HOURS | WT. 1000 LBS | R.P.M. | PUMP | | PUMP No. 1 | PUMP No. 2 | MUD PROPERTIES | Drill Cond | | | REMARKS | Date | |
|----|--------|-------|-------|------------|------------|----|-----|-------|---------------|--------|--------------|--------|------|-----|------------|------------|----------------|------------|-----|-----|-----------|-----------------|-----|
| | | | | | 1 | 2 | 3 | | | | | | Line | SPR | | | | Line | SPR | Y | | | B |
| 1 | 17 1/2 | Smith | DSJ | BV 405 | 22 | 22 | 22 | 125 | 37 | 5 | 3/5000 | 70 | 500 | 7 | 114 | | SEA WATER | 1 | 1 | 1 | Open Hole | June 21 | |
| HO | 36 | Sec. | 3PT | | | | 125 | 37 | 5 | 7.4 | " | 70 | 400 | 7 | 114 | | " | | | | " | Open Hole | 21 |
| RR | 17 1/2 | Smith | DSJ | BV 405 | 22 | 22 | 22 | 433 | 308 | 11 1/2 | 0/10 | 50 | 500 | 7 | 100 | | " | | | | " | Open Hole | 24 |
| RR | 17 1/2 | " | " | " | " | " | 333 | 227 | 9 | 25.2 | 0/10 | 50 | 500 | 7 | 100 | | " | | 2 | 2 | 1 | Drig. cmt plugs | 25 |
| HO | 26 | Sec. | 3PT | | | | 333 | 227 | 9 | 25.2 | 5/30 | 160 | 1300 | 7 | 100 | | " | | | | INC | Open Hole | 25 |
| 2 | 17 1/2 | Smith | DSJ | VJ 089 | 22 | 22 | 22 | 433 | 308 | 11 | 19/30 | 90 | 1300 | 7 | 100 | | " | | | | " | Open Hole | 26 |
| 3 | HO 26 | Servo | ESP | | | | 433 | 308 | 11 | 28.0 | 0/10 | 1400 | 1400 | 7 | 100 | | " | | | | INC | Open Hole | 26 |
| RR | 17 1/2 | Smith | DSJ | VJ 089 | 22 | 22 | 22 | 433 | 308 | 0 | Conditioning | Trip | | | | | " | | | | | Open Hole | 27 |
| 3 | 12 | 1/4 | Smith | SDS | 16 | 16 | 16 | 1386 | 953 | 24 | 20/40 | 175 | 3400 | 7 | 90 | 7 | 90 | 7 | 90 | 7 | 1 | Ream | 7/3 |
| 4 | 17 1/2 | Smith | DSJ | UJ 416 | 22 | 22 | 22 | 1386 | 953 | 19 1/2 | 3/10 | 150 | 3150 | 7 | 90 | 7 | 90 | 7 | 90 | 7 | 1 | Ream | 5 |
| 5 | 12-1/4 | Smith | SDS | VV 507 | 12 | 12 | 12 | 1538 | 152 | 8 | 45 | 170 | 3250 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 9 |
| 6 | 12-1/4 | Smith | SDS | VV 638 | 14 | 14 | 14 | 1699 | 161 | 14 | 40 | 150 | 3200 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 10 |
| 7 | 12-1/4 | Smith | SDS | VV 661 | 14 | 14 | 14 | 1802 | 103 | 13 | 60 | 110 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 11 |
| 8 | 12-1/4 | Smith | SDG | VV 284 | 14 | 14 | 14 | 1927 | 125 | 18 | 50 | 110 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 12 |
| 9 | 12-1/4 | Sec. | M44N | 802264 | 14 | 14 | 14 | 1996 | 69 | 14 | 60 | 130 | 3200 | 7 | 112 | | 116 | 117 | 116 | 116 | 1 | Ream | 13 |
| 0 | 12-1/4 | Smith | SDGH | VP 126 | 14 | 14 | 14 | 2096 | 100 | 19 | 55 | 130 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 14 |
| 1 | 12-1/4 | Smith | SDGH | VV 306 | 14 | 14 | 14 | 2202 | 106 | 18 | 55 | 130 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 15 |
| 2 | 12-1/4 | Smith | SDGH | VP 053 | 14 | 14 | 14 | 2334 | 132 | 22 | 55 | 130 | 3100 | 7 | 110 | | 116 | 117 | 116 | 116 | 1 | Ream | 16 |
| 3 | 12-1/4 | Smith | SDG | 117 AF | 14 | 14 | 14 | 2437 | 93 | 16 1/2 | 55 | 130 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 17 |
| 4 | 12-1/4 | Smith | HTC | J-22 | 14 | 14 | 14 | 2552 | 115 | 24 | 25/40 | 170 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 18 |
| 5 | 12-1/4 | Smith | SDGH | VV 298 | 14 | 14 | 14 | 2602 | 54 | 17 1/2 | 55 | 110 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 19 |
| 5 | 12-1/4 | Smith | SDGH | VV 293 | 14 | 14 | 14 | 2632 | 30 | 4 | 45 | 100 | 3100 | | | | 116 | 117 | 116 | 116 | 1 | Ream | 20 |



UNIONOIL NORGE A/S

MUD RECORD

WELL: 8/4-1
 R: "NORJARL"
 TOTAL DEPTH: 2631.46M

SPUD DATE: 21st June 1977
 MUD TYPE: LIME DRISPAC
LIGNOSULPHONATE

COMPLETION DATE: 25th June 1977
 FROM: 124.66 TO: 1756.89M
 FROM: 1756.89 TO: 2631.46M

| DATE | DEPTH | WEIGHT | VISC. | W.L. | PH | SALT | OIL | SAND | SOLIDS | REMARKS |
|------|-------|--------|-------|-------------|-----------|-------|-----|------|--------|---------------------------|
| 6-22 | 125 | Sea | Water | w/ Hi | vis s/vgs | | | | | Set 30" csg |
| 6-23 | 159 | " | " | w/ Hi | vis s/vgs | | | | | Drilling 26" hole |
| 6-24 | 159 | " | " | " | " | " | | | | Drilling 17½" hole |
| 6-25 | 433 | 9.1 | 63 | 75.0 | | | | | | " 17½" " |
| 6-26 | 433 | 9.1 | 63 | 75.0 | | | | | | Reaming to 26" hole |
| 6-27 | 433 | 9.1 | 63 | 75.0 | | | | | | " " " |
| 6-28 | 433 | Sea | Water | | | | | | | " " " |
| 6-29 | 433 | Sea | Water | | | | | | | " " " |
| 6-30 | 433 | Sea | Water | | | | | | | " " " |
| 7-1 | 433 | Sea | Water | and use Hi, | vis slug | | | | | Set 20" csg. |
| 7-2 | 694 | 8.9 | 65 | 30.0 | 12.5 | 28000 | | 1% | 4 | Drilling 12-1/4" hole |
| 7-3 | 1354 | 10.0 | 47 | 21.0 | 12.5 | 26400 | | 1% | 4 | " " " |
| 7-4 | 1388 | 10.5 | 47 | 26.0 | 12.0 | 26400 | | 1% | 12 | " " " |
| 7-5 | 1388 | 10.5 | 57 | 25.0 | 12.0 | 26400 | | 1% | 13 | Opening hole to 17½" |
| 7-6 | 1388 | 11.5 | 52 | 17.0 | 12.5 | 26400 | | 1% | 17 | " " " " |
| 7-7 | 1388 | 11.5 | 52 | 17.0 | 12.5 | 26400 | | 1% | 17 | Ran 13-3/8" csg. |
| 7-8 | 1403 | 11.4 | 62 | 21.0 | 12.0 | 26400 | | Nil | 17 | Drilling 12-1/4" hole |
| 7-9 | 1671 | 11.6 | 59 | 13.0 | 12.0 | 16500 | | Nil | 18 | " " " |
| 7-10 | 1795 | 11.7 | 51 | 7.0 | 11.0 | 16500 | | Nil | 16 | " " " |
| 7-11 | 1909 | 11.6 | 49 | 6.2 | 11.0 | 23100 | | Nil | 20 | " " " |
| 7-12 | 1991 | 11.6 | 43 | 5.8 | 11.0 | 28050 | | Nil | 19 | " " " |
| 7-13 | 2083 | 11.6 | 44 | 5.0 | 11.0 | 23100 | | Nil | 16 | " " " |
| 7-14 | 2151 | 11.6 | 56 | 5.0 | 11.0 | 23100 | | Nil | 20 | " " " |
| 7-15 | 2250 | 11.6 | 46 | 3.8 | 10.5 | 21450 | | Nil | 15 | " " " |
| 7-16 | 2344 | 11.9 | 48 | 4.2 | 11.0 | 18150 | | Nil | 19 | " " " |
| 7-17 | 2437 | 12.0 | 50 | 3.8 | 11.0 | 19800 | | Nil | 18 | " " " |
| 7-18 | 2503 | 12.5 | 58 | 3.5 | 11.0 | 29700 | | Nil | 20 | " " " |
| 7-19 | 2568 | 12.5 | 53 | 3.6 | 10.3 | 16500 | | Nil | 22 | " " " |
| 7-20 | 2602 | 12.5 | 53 | 4.2 | 11.0 | 16500 | | TR | 23 | " " " |
| 7-21 | 2632 | 12.5 | 75 | 5.6 | 11.0 | 34650 | | TR | 25 | " " " |
| 7-22 | 2632 | 12.5 | 75 | 5.6 | 11.0 | 34650 | | TR | 25 | Logging with Schlumberger |
| 7-23 | 2632 | | | | | | | | | |
| | | | T.D. | | | | | | | |

UNIONOIL NORGE A/S
WELL RECORD

LEASE 005 WELL NO. 8/4-1 FIELD NEW FIELD WILDCAT
CASING & TUBING RECORD

| SIZE | WEIGHT | THREAD | DEPTH | REMARKS |
|---------|----------------|----------------|----------|--|
| 30" | 1" WALL | | 124.66m | Cemented with 250 sacks class "G" + 3% CaCl ₂ 12.5 ppg slurry weight, followed by 450sacks class "G" + 2% CaCl ₂ , 15.6 ppg slurry weight. Displaced with sea water. |
| 20" | 94 | Vetco type "L" | 410.05m | Cemented with 1385 sacks class "G" + 8% gel + 2% CaCl ₂ , 13,2 ppg slurry weight, followed by 500 sacks class "G" with 2% CaCl ₂ , 15.6 ppg slurry weight. Displaced with 362 bbl sea water. |
| 13-3/8" | 68lbs & 72 lbs | Buttress | 1378.14m | Cemented first stage with 742 sacks class "G" + 8% gel, 15.6 ppg slurry weight. Bumped plug with 2300 psi. Dropped "Bomb". Opened D.V. collar with 2950 psi. Circulated 197 bbls at 1400 psi. Mixed and pumped 400 sacks class "G" slurry weight 15.6. Bumped plug with 2300 psi. Displaced with 197 bbls mud. |

APPENDIX NO. 5

DEVIATION AND DIRECTION REPORT

SPERRY-SUN INTERNATIONAL, INC.

UNIONOIL NORGE A/S
WELL NO. 8/4

SINGLE SHOT SURVEY
25/7/77

| TOTAL MEAS. DEPTH | TOTAL VERT. DEPTH | INCLINATION DEG. MIN. | CORRECTED DIRECTION | TOTAL DISPLACEMENT |
|----------------------|----------------------|--------------------------|------------------------|-----------------------|
| 415.00 | 414.93 | 0° 30' | N75W | 00.37 4.73 |
| 531.00 | 530.91 | 1° 30' | N59E | 1.63 4.44 |
| 627.00 | 626.89 | 0° 45' | N57E | 2.63 6.04 |
| 723.29 | 723.18 | 0° 15' | N36E | 3.21 6.65 |
| 819.30 | 819.18 | 0° 15' | S23W | 3.00 7.02 |
| 1096.67 | 1096.55 | 0° 15' | S82E | 1.95 7.61 |
| 1182.93 | 1182.81 | 0° 15' | S54W | 1.58 7.70 |
| 1288.08 | 1287.96 | 0° 30' | S85W | 1.34 7.06 |
| 1387.00 | 1386.87 | 1° 00' | S70E | 0.05 6.89 |
| 1478.00 | 1477.85 | 1° 15' | S81E | 00.39 8.62 |
| 1569.00 | 1568.82 | 1° 45' | N71E | 00.18 10.99 |
| 1671.00 | 1670.78 | 1° 30' | N62E | 0.96 13.64 |
| 1757.00 | 1756.75 | 1° 15' | N49E | 2.14 15.34 |
| 1859.00 | 1858.73 | 1° 00' | N45E | 3.50 16.80 |
| 1949.00 | 1948.71 | 1° 15' | N66E | 4.50 18.26 |
| 1985.00 | 1984.70 | 1° 15' | N38E | 4.98 18.87 |
| 2080.00 | 2079.67 | 1° 45' | N32E | 7.02 20.30 |
| 2202.00 | 2201.60 | 2° 00' | N24E | 10.54 22.17 |
| 2330.00 | 2329.45 | 3° 30' | N09W | 16.63 22.97 |
| 2476.00 | 2475.12 | 4° 15' | N19W | 26.20 20.58 |
| 2602.00 | 2600.82 | 3° 30' | N24W | 34.12 17.46 |

BASED ON AVERAGE ANGLE TYPE CALCULATIONS, THE BOTTOM HOLE DISPLACEMENT = 38.33 METERS IN A DIRECTION OF N27°06'E.

APPENDIX NO.6

DITCH SAMPLE DESCRIPTION

DITCH SAMPLE DESCRIPTION

WELL 8/4-1

In the interval from the seafloor to 124.66m, 17½" hole was drilled with returns to the seafloor. At this depth 30" casing was set. At 127m, after drilling out of the 30" shoe complete returns were lost. After setting 4 cement plugs in the interval 124.66m to 159.41m drilling continued with full returns to T.D.

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 159.41m - 160m | 100% | Sand and sandstone, clear to milky white, crystal quartz, probably of high temperature volcanic origin, minor rose quartz, garnet, 95% of sample consists of quartz grains; trace cubic pyrite (probably secondary), minor black, grey-green, metamorphic (?) lithic fragments. Some quartz grains have green chloritic inclusions. Sand loose, unconsolidated, no visible cement or matrix, predominantly medium grained, subangular to subrounded, some polished grains, well sorted, very mature sand. Probable environment of deposition, water sorted glacial sands. |
| | Trace | Chlorite (Glauconite); light to dark green, subrounded in part, some grains exhibit platy cleavage. |
| 160m - 170m | 90% | Sand and sandstone as in 159.41m-160m. This sample has a higher percentage of lithic metamorphic fragments than in the previously described sand, some grey to green foliated metamorphic grains. Minor pyrite (could be primary as well as secondary) medium grained, well sorted, fair porosity, clastic constituents dominantly subangular. |
| | 10% | Clay, grey, soft, sticky, calcareous, soluble, minor shell fragments. |
| | Trace | Chlorite (Glauconite). |
| 170m - 180m | 80% | Sand and sandstone as in 160m-170m. Sand coarsening downwards, not as well sorted or as rounded as described in 159.41m-160m. Metamorphic lithic fragments dominant. Also a fine sand component, composition as in coarser component. |
| | 20% | Clay as in 160m-170m. |
| 180m - 190m | 80% | Clay as in 160m-170m, shell fragments. |
| | 20% | Sand as in 170m-180m, fine component now dominant. |
| 190m - 200m | 50% | Sand, clear, milky, and yellow quartz grains, quartz fragments constitute 90% of the sand component. Moderately well sorted, rounded, fine to medium grained, loose unconsolidated, minor metamorphic lithic fragments. |
| | 50% | Clay as in 170m-180m. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 200m - 210m | 70% | Clay as in 170m-180m, grey to light brown, sticky, calcareous, moderately soluble. |
| | 30% | Sand, fine grained quartz, subrounded, moderately well sorted, unconsolidated. |
| 210m - 220m | 100% | Clay, as in 200m-210m. |
| | Trace | Sand as in 200m-210m. |
| 220m - 230m | 100% | Clay as in 200m-210m |
| 230m - 240m | 60% | Sand and sandstone, clear white, milky, yellow quartz grains, grey, black, green lithic fragments, some quartz grains contain inclusions of chlorite (Glauconite?) and pyrite along their fracture planes, loose unconsolidated, fine to medium grained, fairly well sorted, subrounded, good porosity and permeability, lithic fragments are of metamorphic origin. Mature sandstone. |
| | 40% | Clay as in 200m-210m. Minor pyrite, claystone. |
| 240m - 250m | 100% | Sand as in 230m-240m. |
| | Trace | Shell fragments. |
| 250m - 260m | 80% | Sand as in 230m-240m. |
| | 20% | Clay as in 230m-240m, soft, sticky, soluble, gummy. |
| 260m - 270m | 60% | Sand as in 230m-240m. Minor garnet, well sorted. |
| | 40% | Clay as in 230m-240m, grey to light grey, calcareous, shell fragments. |
| 270m - 280m | 80% | Clay, light grey to grey, soft, soluble, sticky, plastic in part. |
| | 20% | Sand as in 260m-270m, tends to be fine to very fine grained. |
| 280m - 290m | 90% | Clay as in 270m-280m. |
| | 10% | Sand and sandstone as in 260m-270m. |
| | Trace | Chlorite (glauconite). |
| 290m - 300m | 90% | Clay as in 270m-280m. |
| | 10% | Sand as in 260m-270m. |
| 300m - 310m | 80% | Clay as in 270m-280m. |
| | 20% | Sand, dominantly crystal clear quartz, fine grained, subrounded, fairly well sorted. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|---|----------|--|
| 310m - 320m | 100% | Clay as in 270m-280m. |
| | Trace | Sand as in 300m-310m. |
| 320m - 330m | 100% | Clay as in 270m-280m. |
| | Trace | Sand as in 300m-310m. |
| 330m - 340m | 100% | Clay as in 270m-280m. Bluish grey to light grey, soft, moderately calcareous, minor shell fragments. |
| | Trace | Sand as in 300m-310m. Very fine grained, tending to silt sized grains. |
| 340m - 350m | 100% | Clay as in 330m-340m. |
| | Trace | Sand as in 330m-340m. Decrease in the amount of sand. |
| 350m - 360m | 100% | Clay, bluish grey, soft, soluble, minor pyrite, plastic, calcareous. |
| | Trace | Silt, dominantly loose clear quartz grains. |
| 360m - 370m | 100% | Clay as in 350m-360m, minor shell fragments. |
| 370m - 380m | 100% | Clay as in 350m-360m. |
| 380m - 390m | 100% | Clay, light brown to grey, in part tan, slightly firmer, in part silty, calcareous, sticky, in part lumpy. |
| | Trace | Lignite, brown, soft-firm. |
| 390m - 400m | 100% | Clay as in 380m-390m. |
| | Trace | Silt as in 380m-390m. |
| 400m - 410m | 100% | Clay, bluish grey to light grey, soft very sticky, gumbo, slightly soluble, plastic, calcareous, shell fragments. |
| 410m - 420m | 100% | Clay as in 400m-410m. |
| 420m - 433.12m | 100% | Clay as in 400m-410m. Rare shell fragments. |
| 433.12m - 440m | 100% | Clay, grey to light grey, occasionally light brown, abundant carbonaceous specks throughout, slightly calcareous, minor shell fragments, pyrite nodules, generally soft, sticky, soluble to very soluble, minor calcareous nodules, silty in part. |
| NOTE: | | |
| Sample heavily contaminated with cement from below the casing shoe. | | |
| 440m - 450m | 100% | Clay as in 433.12m-440m. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 450m - 460m | 100% | Clay as in 433.12m-440m. Pyrite, forams, very slightly calcareous to noncalcareous in part. |
| 460m - 470m | 100% | Clay as in 450m-460m. |
| 470m - 480m | 100% | Clay as in 450m-460m. |
| 480m - 490m | 100% | Clay as in 450m-460m. Minor amber. Occasionally medium grained, angular to subrounded, crystal clear quartz grains. Thin laminae of carbonaceous material throughout clay, soft, sticky. |
| 490m - 500m | 100% | Clay as in 480m-490m, some dark brown very carbonaceous partly pyritized nodules, carbonaceous material lignitic in part, lignite, black-brown, soft, brittle. Minor quartz grains to pebble size scattered throughout clay, dominantly crystal clear quartz and chert. |
| 500m - 510m | 100% | Clay as in 490m-500m. Very high sulphur content, slightly calcareous to noncalcareous. |
| 510m - 520m | 100% | Clay as in 500m-510m. In part olive grey & slightly firmer. |
| 520m - 530m | 100% | Clay as in 500m-510m. Light grey, soft, sticky. |
| 530m - 540m | 100% | Clay as in 500m-510m. Light grey, soluble, soft, sticky in part, noncalcareous, abundant pyrite appears to be in the shape of animal/worm burrows, some pyrite exhibits good cubic form suggesting a diagenetic origin, rare sulphur balls containing pyrite. |
| 540m - 550m | 100% | Clay as in 530m-540m. Fine sand component, fine grained, subangular to subrounded, clear to milky white quartz. Pyrite burrow shaped as in 530m-540m. |
| 550m - 560m | 100% | Clay as in 540m-550m. |
| 560m - 570m | 100% | Clay as in 540m-550m. |
| 570m - 580m | 100% | Clay as in 540m-550m. |
| 580m - 590m | 100% | Clay as in 540m-550m. |
| 590m - 600m | 100% | Clay as in 540m-550m. |
| 600m - 610m | 100% | Clay as in 540m-550m. Light grey to grey, noncalcareous, pyritic, shell fragments. Fine grained sand component, micromicaceous. |
| 610m - 620m | 100% | Clay as in 600m-610m. |
| 620m - 630m | 100% | Clay, grey to light grey, noncalcareous, pyritic, minor calcareous fragments, (bivalves), micritic fragments, micromicaceous. |
| 630m - 640m | 100% | Clay as in 620m-630m. Minor fragments of limestone, microcrystalline, sugary, micritic, burrow shaped pyrite nodules, abundant pyrite, minor intercalations |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | | of carbonaceous material mainly occurring as specks, some firm claystone very slightly calcareous, clay slightly calcareous. |
| | Trace | Sand, fine grained, subangular to subrounded quartz fragments. |
| 640m - 650m | 100% | Clay, grey to light grey, plastic, soft, in part lumpy, firm in part, minor claystone, dominantly soluble, increasingly sticky, slightly carbonaceous, noncalcareous. |
| | Trace | Limestone, grey, yellow, tan, dirty, noncrystalline, hard, dolomitic in part; often associated with the pyrite. |
| | Trace | Sand, fine grained, dominantly fine to subrounded, minor well rounded fragments. |
| 650m - 660m | 100% | Clay as in 640m-650m. Noncalcareous, pyritic. |
| | Trace | Sand, quartz, smokey in part, polygenetic, igneous, metamorphic. |
| | Trace | Limestone as in 640m-650m. |
| 660m - 670m | 100% | Clay as in 650m-660m. |
| 670m - 680m | 100% | Clay as in 650m-660m, abundant pyrite, clay becoming firmer, micromicaceous. |
| 680m - 690m | 100% | Clay as in 670m-680m. Claystone browner in colour, in part greyish maroon to greyish blue. |
| | Trace | Volcanic fragments (TUFF), cryptocrystalline, red groundmass, fragments of clear angular crystal quartz? throughout. |
| 690m - 700m | 100% | Clay as in 680m-690m, olive grey to light grey, grey, abundant pyrite, trace limestone, tan, brown, crystalline, clayey, slightly dolomitic. |
| | Trace | Sand and sandstone, quartzose, fine clay matrix, firm, slightly carbonaceous, dominance of clear quartz grains, minor rose quartz. |
| 700m - 710m | 100% | Clay as in 680m-690m, abundant shell fragments and forams, micromicaceous, pyrite. |
| 710m - 720m | 100% | Clay as in 690m-700m. Pyrite in burrow(?) shapes. |
| 720m - 730m | 100% | Clay as in 690m-700m. Micromicaceous. |
| 730m - 740m | 100% | Clay as in 690m-700m. Pyrite, clay light green, olive green, greenish grey. |
| 740m - 750m | 100% | Clay as in 730m-740m, greener clays are slightly calcareous, while grey clays are noncalcareous, green clays soapy texture, soft, firm, slightly fissile |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 750m - 760m | 100% | Clay as in 740m-750m. Clays are now darker grey, minor light greenish grey as in 730m-740m. Minor glauconite, dark green to black, round, firm, fine grained. |
| 760m - 770m | 100% | Clay, dark grey to reddish grey, slightly carbonaceous, micromicaceous, pyritized forams, pyritized worm burrows, calcareous, high sulphur content, minor glauconite. |
| 770m - 780m | 90% | Clay as in 760m-770m. |
| | 10% | Glauconite as 750m-760m. |
| | Trace | Limestone, tan, brownish yellow, micro to cryptocrystalline, dolomitic in part, in part micritic. |
| | Trace | Sand, fine grained, subangular to subrounded, dominantly crystal milky quartz, minor chert. |
| 780m - 790m | 100% | Clay as in 760m-770m. |
| | Trace | Glauconite as in 750m-760m. |
| | Trace | Limestone as in 770m-780m. Shell fragments (bivalves). |
| 790m - 800m | 90% | Clay, dark grey to reddish grey in part, soft sticky, slightly soluble, micromicaceous, pyrite throughout. Shell fragments, light green soapy, soft, clay component. |
| | 10% | Glauconite as in 750m-760m. |
| | Trace | Limestone, very hard, conchoidal fracture, tan to brown, high clay content. |
| | Trace | Sand, fine quartz. |
| 800m - 810m | 90% | Clay as in 790m-800m. |
| | 10% | Glauconite as in 750m-760m. |
| 810m - 820m | 100% | Clay, two clay populations, one dark grey, brown to reddish brown, micaceous, firm in part, occasionally fissile, slightly carbonaceous, noncalcareous, sticky in part, abundant pyrite, other light grey to grey to light greenish grey, soft, firm to sticky, noncalcareous. |
| | Trace | Limestone as in 790m-800m. |
| | Trace | Sand as in 790m-800m. |
| 820m - 830m | 100% | Clay as in 810m-820m. |
| | Trace | Glauconite, pyrite, shell fragments, limestone and sand. |
| 830m - 840m | 90% | Clay as in 810m-820m. |
| | 10% | Limestone, tan, yellowish brown, cryptocrystalline, conchoidal fracture, hard to brittle, dolomitic in part, shell fragments. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | Trace | Glauconite as in 750m-760m black to green, fine grained, Black glauconite aggregates More commonly dark green single elongate particles well rounded. |
| 840m - 850m | 85% | Clay as in 830m-840m. |
| | 10% | Limestone as in 830m-840m. |
| | 5% | Glauconite, often single dark green nodules as described in 830m-840m are cemented together by cubic pyrite. Abundant pyrite in the shape of worm burrows. |
| | Trace | Sand, fine to medium grained, well rounded to angular, unconsolidated. |
| 850m - 860m | 100% | Clay, dark grey, greyish brown, noncalcareous, sticky, firm in part, soluble, plastic in part, slightly silty Also a light greenish grey clay component, slightly fissile. |
| | Trace | Glauconite, black to dark green occasionally cemented by a clay matrix. |
| | Trace | Limestone as in 830m-840m. |
| 860m - 870m | 100% | Clay as in 850m-860m, dark grey claystone, partly fissile, grading into shale, elongated particles of crystalline pyrite. |
| | Trace | Limestone, medium brown to tan, hard, very calcareous, streaks of clear yellow, white calcite. |
| | Trace | Sand, quartz, clear, milky, fine to medium grained. |
| | Trace | Shell fragments (bivalves?) and forams. |
| 870m - 880m | 100% | Clay as in 860m-870m. |
| | Trace | Glauconite often in aggregate form, fine green, glauconite grains being held together by a light green clay matrix, noncalcareous. |
| | Trace | Pyrite, trace shell fragments. |
| 880m - 890m | 100% | Clay as in 860m-870m, grey to light grey, grey-green, soft, swelling, pyritic in part silty, micromicaceous, intercalations of carbonaceous particles. |
| | Trace | Glauconite. |
| | Trace | Sand as in 860m-870m. |
| 890m - 900m | 100% | Clay, light grey, greenish grey as in 880m-890m. |
| | Trace | Pyrite, shell pyrite, shell fragments. |
| 900m - 910m | 100% | Clay as in 880m-890m. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| | Trace | Limestone. |
| 910m - 920m | 100% | Clay as in 880m-890m. |
| | Trace | Pyrite, shell fragments. |
| | Trace | Sand, medium grained, angular quartz. |
| 920m - 930m | 100% | Clay as in 880m-890m. Grey, soft, soluble, swelling. |
| 930m - 940m | 100% | Clay as in 880m-890m. |
| | Trace | Glauconite. |
| 940m - 950m | 100% | Clay, grey to dark grey, in part brown, soft, sticky, plastic in part, swelling, micaceous, glauconite more common in the clay component which is lighter green in colour. |
| | Trace | Pyrite, shell fragments, sand (quartz grains). |
| 950m - 960m | 100% | Clay as in 940m-950m, very soluble. |
| | Trace | Limestone, tan to dirty yellow brown, clayey, crystalline to microcrystalline. |
| 960m - 970m | 100% | Clay, grey to grey brown, sticky, soft, noncalcareous. |
| | Trace | Pyrite, burrow replacement. |
| | Trace | Shell fragments. |
| | Trace | Glauconite. |
| 970m - 980m | 100% | Clay as in 940m-950m. |
| | Trace | Glauconite, shell fragments, pyrite, forams. |
| 980m - 990m | 100% | Clay as in 940m-950m. |
| | Trace | Pyrite. |
| 990m - 1000m | 100% | Clay as in 940m-950m. |
| | Trace | Glauconite. |
| | Trace | Pyrite, shell fragments. |
| 1000m - 1010m | 100% | Clay, greyish brown, reddish brown in part, soft, sticky, swelling, calcareous in part, incalations of noncalcareous clay, which is light greenish grey. |
| | Trace | Glauconite, well rounded, fine grained, bright dark green to black. |
| | Trace | Pyrite (burrow replacement). |
| 1010m - 1020m | 100% | Clay as in 1000m-1010m. |
| | Trace | Glauconite, pyrite, shell fragments. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 1020m - 1030m | 100% | Clay as in 1010m-1020m, noncalcareous, slightly calcareous in part. |
| | Trace | Glauconite. |
| 1030m - 1040m | 100% | Clay as in 1010m-1020m, forams, unconsolidated glauconite. |
| 1040m - 1050m | 100% | Clay as in 1010m-1020m. A light clay in this sample appears to be a well weathered tuff, it contains angular pyroclasts(?) in a fine groundmass. |
| | Trace | Pyrite, shell fragments. |
| | Trace | Glauconite, minor fragments. |
| 1050m - 1060m | 100% | Clay as in 1010m-1020m. |
| 1060m - 1070m | 100% | Clay, grey to grey brown, soluble, soft, sticky, plastic in part, swelling, noncalcareous. |
| | Trace | Pyrite. |
| | Trace | Glauconite, forams. |
| 1070m - 1080m | 100% | Clay as in 1060m-1070m. Soft, swelling, soluble, glauconite, light grey. |
| 1080m - 1090m | 100% | Clay as in 1060m-1070m. Grey swelling, soluble. Pyrite replacement of burrows. |
| 1090m - 1100m | 100% | Clay as in 1060m-1070m. |
| | Trace | Glauconite. |
| | Trace | Pyrite. |
| 1100m - 1110m | 100% | Clay, light grey to greenish grey, micromicaceous, fine specks and streaks of carbonaceous material, glauconite, silty in part, swelling, pyrite, shell fragments, forams. |
| 1110m - 1120m | 100% | Clay as in 1100m-1110m. Only slightly carbonaceous, slightly silty. |
| 1120m - 1130m | 100% | Clay, grey, glauconitic, soft, swelling, soluble, <u>calcareous</u> , noticeable lack of pyrite. |
| 1130m - 1140m | 100% | Clay as in 1120m-1130m. Ostacads, gastropods, broken shells (bivalves), micromicaceous, minor glauconite, clay and claystone becoming firmer with depth, shale in part, minor argillaceous siltstone, micaceous. |
| 1140m - 1150m | 90% | Clay, grey, grey brown, dark grey brown, calcareous, dominantly soft, grading into silt, in part shaley. |
| | 10% | Of clay fraction shale, minor glauconite, slightly carbonaceous, blocky, plastic, subfissile in part, swelling, shell fragments (bivalves) pyritic (cubic |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | | crystal form rather than the previously elongated burrow shaped form) not as carbonaceous as shallower samples, very calcareous. |
| 1150m - 1160m | 100% | Clay as in 1140m-1150m |
| | Trace | Shale as in 1140m-1150m. |
| 1160m - 1170m | 80% | Clay as in 1140m-1150m. Calcareous. |
| | 10% | Shale as in 1140m-1150m |
| | 10% | Claystone, grading into siltstone, grey to brownish grey, in part brown, calcareous, firm, subfissile in part, minor glauconite. |
| 1170m - 1180m | 80% | Clay as in 1140m-1150m. |
| | 20% | Claystone, brownish grey to grey, firm, in part hard, subfissile in part, calcareous, shell fragments, minor pyrite, glauconite. |
| | Trace | Limestone, grey to yellowish brown, micritic to crystalline, chalky in part, dominantly hard, conchoidal fracture, pyrite, calcite veining, argillaceous. |
| | Trace | Fossil fragments, glauconite. |
| 1180m - 1190m | 80% | Clay as in 1140m-1150m. |
| | 20% | Claystone as in 1170m-1180m. |
| | Trace | Glauconite. |
| 1190m - 1200m | 80% | Clay as in 1140m-1150m. Rare carbonaceous specks, very to moderately calcareous. |
| | 20% | Claystone as in 1170m-1180m. |
| | Trace | Glauconite. |
| 1200m - 1210m | 80% | Clay as in 1190m-1200m. |
| | 20% | Claystone and siltstone as in 1170m-1180m. |
| | Trace | Pyrite aggregates (cubic form) minor light green claystone (tuffaceous). |
| 1210m - 1230m | 80% | Clay as in 1140m-1150m. Rare carbonaceous specks, very to moderately calcareous, abundant pyrite. |
| | 20% | Claystone as in 1170m-1180m. |
| | Trace | Glauconite. |
| | Trace | Limestone, grey to tan, brownish, hard, conchoidal fracture, microcrystalline to cryptocrystalline. |
| 1230m - 1240m | 80% | Clay as in 1210m-1230m. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 1240m - 1250m | 20% | Claystone as in 1170m-1180m. Forams, glauconite. |
| | 60% | Clay as in 1210m-1220m, also a light green, soft, friable, clay, noncalcareous, micaceous. Dominant clay component, reddish brown, soft, soluble, swelling, blocky, plastic, in part sticky. |
| | 40% | Claystone, reddish brown, brown, dark brown, in part black, silty in part, calcareous, firm, micaceous. |
| | Trace | Pyrite, glauconite, shell fragments, chert (red hard, conchoidal fracture). |
| 1250m - 1260m | 70% | Clay as in 1240m-1250m, black to very dark brown in part, calcareous. |
| | 30% | Claystone as in 1240m-1250m. |
| | Trace | Limestone, tan, yellow, brown, hard, conchoidal fracture, cryptocrystalline. |
| | Trace | Pyrite. |
| 1260m - 1270m | Trace | Crystal clear quartz, fine to medium grained, angular to subrounded. |
| | 60% | Clay as in 1250m-1260m, dark grey. |
| | 40% | Claystone as in 1240m-1250m, dark grey to black in part. |
| | Trace | Pyrite, forams, glauconite. |
| 1270m - 1290m | 60% | Clay, dark grey to grey black, in part light grey, slightly calcareous to very calcareous, soft, plastic, firm in part, minor pyrite, shell fragments. |
| | 40% | Claystone as in 1260m-1270m. |
| | Trace | Pyrite |
| | Trace | Glauconite |
| 1290m - 1300m | 60% | Clay as in 1270m-1290m, smokey grey to black, grading into a silt. |
| | 40% | Claystone as in 1260m-1270m. |
| | Trace | Limestone as in 1250m-1260m. |
| | Trace | Pyrite, glauconite, shell fragments (bivalves) |
| 1300m - 1310m | Trace | Sand, minor quartz grains, fine grained to subangular to subrounded, dominantly crystal clear quartz. |
| | 60% | Clay as in 1270m-1290m, firm to friable. |
| | 30% | Claystone as in 1260m-1270m, silty. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 10% | Limestone as in 1280m-1290m, appears to be thin stringers interbedded with the clay and claystone. |
| 1310m - 1320m | 60% | Clay as in 1270m-1280m. |
| | 35% | Claystone as in 1260m-1270m. |
| | 5% | Limestone as in 1300m-1310m, very hard, brittle, occasionally sandy in part, tan to yellow brown, honey coloured, minor pyrite veining. |
| | Trace | Shell fragments, glauconite. |
| 1320m - 1330m | 50% | Clay, dark grey to black, more massive than previously described, very calcareous, firm, in part sticky to plastic, silty in part. |
| | 45% | Claystone, dark grey to smokey black, silty grading to very fine sand in part, hard to firm, subfissile in part. |
| | 5% | Limestone as in 1300m-1310m. Crystalline in part, cream brown to tan, crystal calcite common. |
| 1330m - 1340m. | 50% | Clay as in 1320m-1330m, very calcareous. |
| | 50% | Claystone as in 1320m-1330m. |
| | Trace | Limestone as in 1320m-1330m. |
| 1340m - 1350m. | 70% | Clay as in 1320m-1330m, very calcareous, very dark grey to dark brown in colour. |
| | 30% | Claystone as in 1320m-1330m. |
| | Trace | Limestone as in 1320m-1330m. |
| | Trace | Glauconite. |
| 1350m - 1360m | 70% | Clay as in 1340m-1350m. |
| | 30% | Claystone as in 1320m-1330m. |
| 1360m - 1370m | 80% | Clay as in 1340m-1350m, slightly sticky, plastic, soluble, trace glauconite, forams (replaced by pyrite). |
| | 20% | Claystone as in 1320m-1330m. |
| | Trace | Limestone as in 1320m-1330m. |
| 1370m - 1380m | 80% | Clay as in 1360m-1370m. |
| | 20% | Claystone as in 1320m-1330m. |
| | Trace | Glauconite, shell fragments. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|------------------|--------------|---|
| 1380m - 1388.36m | 80% | Clay as in 1360m-1370m. |
| | 20% | Claystone as in 1320m-1330m. Pyrite is elongated form as through it has replaced worm burrows, glauconite aggregates, forams. |
| | Trace | Limestone, tan, hard, cryptocrystalline. |
| 1388.36m - 1405m | 60% | Clay as in 1360m-1370m. |
| | 40% | Claystone as in 1320m-1330m. |
| 1405m - 1410m | 50% | Clay, light grey, green-medium brown, soft, plastic, silty, calcareous. |
| | 50% | Claystone, light grey green, soft-firm, blocky, calcareous, carbonaceous. |
| | Trace | Pyrite. |
| 1410m - 1415m | 80% | Clay, cream, light grey green, soft, silty, moderately calcareous grading to marl. |
| | 20% | Claystone, some grey-brown. |
| | Trace | Glauconite. |
| 1415m - 1420m | 60% | Clay, medium grey to grey brown. Some grey green, soft, plastic, grading to claystone in part. Calcareous as above. |
| | 40% | Claystone as above. |
| | Trace | Glauconite, pyrite. |
| 1420m - 1425m | 60% | Clay as above. |
| | 40% | Claystone, medium-brown, soft-firm, blocky, slightly carbonaceous, micromicaceous, slightly calcareous. |
| | Trace | Glauconite, pyrite. |
| 1425m - 1430m | 60% | Clay as above. |
| | 40% | Claystone as above. |
| | Trace | Limestone, tan, microcrystalline hard, slightly argillaceous. |
| 1430m - 1435m | Trace | Glauconite, pyrite. |
| | 70% | Clay as above. |
| | 30% | Claystone as above. |
| 1435m - 1440m | Slight trace | Glauconite, pyrite. |
| | 50% | Clay, light-medium grey-greybrown, some grey-green, soft, sticky, slightly calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| | 50% | Claystone, medium grey to grey brown, soft-firm, blocky, occasionally subfissile, slightly calcareous in part. |
| | Trace | Glauconite. |
| 1440m - 1445m | 75% | Clay, grey-green, soft, plastic, slightly silty, calcareous. |
| | 20% | Claystone, carbonaceous. |
| | 5% | Glauconite |
| | Trace | Pyrite |
| 1445m - 1450m | 70% | Clay mostly grey-green (20%) red-grey, (10%) red brown. Soft, sticky, slightly calcareous, the red brown clay grading to marl. |
| | 30% | Claystone as above. |
| | Trace | Glauconite. |
| 1450m - 1455m | 30% | Clay, red-brown, soft, sticky, very calcareous grading to marl. |
| | 20% | Clay, grey-green as above, very calcareous. |
| | 20% | Clay, light-medium grey to brown-grey, soft-firm silty. Grading to claystone. |
| | 30% | Claystone as above. |
| 1455m - 1460m | 50% | Clay, predominantly grey-green and grey-brown with some red-brown, moderately calcareous. |
| | 50% | Claystone medium grey soft-firm, silty, carbonaceous. |
| 1460m - 1465m | 30% | Clay as for 1455m-1460m. |
| | 70% | Claystone, medium grey, some grey-green and brown, soft-firm, blocky, calcareous, silty. |
| | Trace | Limestone, tan-light yellow brown, hard, micro-crystalline. |
| 1465m - 1470m | | As for 1460m-1465m. |
| 1470m - 1475m | 80% | Claystone as above, micromicaceous. |
| | 20% | Clay as above. |
| | Trace | Glauconite. |
| 1475m - 1480m | 70% | Claystone as above. |
| | 30% | Clay, grey, soft-sticky, slightly calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 1480m - 1485m | 80% | Claystone as above. |
| | 20% | Clay, medium grey, soft, slightly calcareous. |
| | Trace | Limestone, glauconite. |
| 1485m - 1490m | | As for 1480m-1485m. |
| 1490m - 1495m | 80% | Claystone, medium-dark grey, soft -firm, blocky, silty, slightly calcareous. |
| | 20% | Clay, medium grey as above. |
| | Trace | Glauconite, pyrite, limestone. |
| 1495m - 1500m | 70% | Claystone as above, in part slightly calcareous. |
| | 30% | Clay as above,. |
| | Trace | Pyrite, glauconite, limestone. |
| 1500m - 1505m | 80% | Claystone, medium grey, firm, blocky-platey, in part carbonaceous, silty, slightly calcareous. |
| | 20% | Clay as above. |
| | Trace | Glauconite, pyritized burrows and limestone. |
| 1505m - 1510m | 70% | Claystone as above. |
| | 30% | Clay as above. |
| | Trace | Siltstone, grey-brown, soft, friable, very fine sand, argillaceous, glauconitic, micromicaceous. |
| 1510m - 1515m | | As for 1505m-1510m. Trace limestone. |
| 1515m - 1520m | 60% | Claystone, medium grey, light grey-green, some red brown, soft-firm, blocky, generally noncalcareous. |
| | 30% | Clay, light grey-green, soft, sticky, noncalcareous. |
| | 10% | Siltstone, grading to sandstone, medium grey-brown, soft, friable, argillaceous, very fine sand, very glauconitic, noncalcareous. |
| 1520m - 1525m | | As for 1515m-1520m. |
| 1525m - 1530m | | As for 1515m-1520m. |
| 1530m - 1535m | 60% | Claystone predominantly grey-green, some medium-light grey, firm, blocky, noncalcareous. |
| | 20% | Clay as above. |
| | 20% | Siltstone becoming sandstone in part, medium grey, very fine sand, argillaceous, soft, friable, very glauconitic, micromicaceous, noncalcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 1535m - 1540m | 90% | Claystone, light green to light grey-green, soft-firm, blocky, noncalcareous to slightly calcareous in part. |
| | 10% | Clay, grey-green, soft, sticky. |
| | Trace | Glauconite, pyrite. |
| 1540m - 1545m | 100% | Claystone as above. Good trace pyrite. |
| 1545m - 1550m | 100% | Claystone, light grey-green to light grey, firm, blocky, noncalcareous. |
| 1550m - 1555m | 100% | Claystone, light grey, increasingly medium grey, firm, blocky, in part subfissile, slightly calcareous in part. |
| | Trace | Limestone, tan to light orange brown, hard crystalline. |
| 1555m - 1560m | 100% | Claystone as above. |
| 1560m - 1565m | 100% | Claystone, medium grey, some grey-green, blocky-subfissile, firm, occasionally hard, some silty. |
| | Trace | Glauconite, pyrite. |
| 1565m - 1570m | 100% | Claystone, predominantly, medium grey-greybrown, firm, blocky, silty, occasionally sandy. |
| | Trace | Glauconite. |
| 1570m - 1575m | 100% | Claystone, medium to dark grey, firm to hard, blocky, subfissile becoming shale in part, noncalcareous. |
| | Trace | Limestone, cream, tan, hard, microcrystalline. |
| 1575m - 1580m | 100% | Claystone as above. |
| | Trace | Pyrite. |
| 1580m - 1585m | 100% | Claystone as above. Predominantly subfissile. |
| | Trace | Siltstone, medium grey-greybrown, very fine sand, argillaceous. |
| 1585m - 1590m | 100% | Claystone, medium to dark grey, some light grey to light grey-green, firm, blocky, slightly calcareous. |
| | Trace | Siltstone as above, micromicaceous, glauconitic. |
| | Trace | Pyrite. |
| 1590m - 1595m | 100% | Claystone as for 1585m-1590m. |
| 1595m - 1600m | 100% | Claystone, light grey-green to medium to dark grey, firm, blocky to subfissile, slightly micromicaceous. |
| | Trace | Siltstone as above grading to very fine grained argillaceous sandstone. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 1600m - 1605m | 90% | Claystone as above. |
| | 10% | Siltstone, grey brown, very fine sand, argillaceous, soft, friable, glauconitic, micromicaceous, carbonaceous. |
| 1605m - 1610m | 70% | Claystone as above. |
| | 30% | Chalk, cream-off white, soft-firm, micritic, argillaceous in part, amorphous. |
| | Trace | Siltstone as above. |
| 1610m - 1615m | 70% | Claystone as above. |
| | 30% | Chalk as above. |
| 1615m - 1620m | 50% | Claystone, light grey-green and medium to dark grey, firm, blocky-subfissile, noncalcareous. |
| | 50% | Chalk as above. |
| 1620m - 1625m | 60% | Claystone as above. |
| | 40% | Chalk, white-off white, soft-firm, amorphous, micritic locally argillaceous. |
| | Trace | Chert, pale milky white, opaque, hard, crystalline. |
| 1625m - 1630m | 30% | Claystone as above. |
| | 50% | Chalk as above. |
| | 20% | Chert as above. |
| 1630m - 1635m | 30% | Claystone as above. |
| | 40% | Chalk as above. |
| | 30% | Chert as above. |
| 1635m - 1640m | 20% | Claystone as above. |
| | 40% | Chalk as above. |
| | 40% | Chert as above. |
| 1640m - 1645m | 30% | Claystone as above. |
| | 40% | Chalk as above. |
| | 30% | Chert as above. |
| 1645m - 1650m | 30% | Claystone as above. |
| | 40% | Chalk as above, becoming hard. |
| | 30% | Chert as above. |
| 1650m - 1655m | 20% | Claystone as above. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 40% | Chalk as above. |
| | 40% | Chert as above. |
| 1655m - 1660m | 30% | Claystone as above. |
| | 40% | Chalk as above. |
| | 30% | Chert as above. |
| 1660m - 1665m | 20% | Claystone as above. |
| | 50% | Chalk as above. |
| | 30% | Chert as above. |
| 1665m - 1670m | 30% | Claystone as above. |
| | 50% | Chalk as above. |
| | 20% | Chert as above. |
| 1670m - 1675m | 10% | Claystone, light grey-grey, green-dark grey, firm, blocky-subfissile, noncalcareous. |
| | 80% | Chalk, white-light grey, cream, soft-firm, blocky-amorphous, in part argillaceous, generally very pure. |
| | 10% | Chert, milky white, translucent, hard, crystalline. |
| 1675m - 1680m | 20% | Claystone as above. |
| | 80% | Chalk as above. |
| | Trace | Chert. |
| 1680m - 1685m | 10% | Claystone as above. |
| | 90% | Chalk, white-cream, firm-hard, brittle, micritic, pure. |
| 1685m - 1690m | 10% | Claystone as above. |
| | 90% | Chalk as above. |
| 1690m - 1695m | 30% | Claystone as above. |
| | 70% | Chalk as above. |
| | Trace | Limestone, tan-light brown, cryptocrystalline, some sucrosic. |
| 1695m - 1700m | 70% | Chalk, white, soft, occasionally firm or hard, micritic. |
| | 30% | Claystone as above. |
| | Trace | Siltstone, grey brown, very fine sand, friable. |
| 1700m - 1705m | 70% | Chalk. As for 1695m-1700m. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 30% | Claystone as above. |
| 1705m - 1710m | 70% | Chalk as above. |
| | 30% | Claystone as above. |
| 1710m - 1715m | 90% | Chalk, white-cream, soft-firm, very occasionally hard, amorphous-blocky, pure. |
| | 10% | Claystone as above. |
| 1715m - 1720m | 90% | Chalk, becoming sandy in part. |
| | 10% | Claystone as above. |
| 1720m - 1725m | 90% | Chalk as above. |
| | 10% | Claystone as above. |
| 1725m - 1730m | 100% | Chalk, white-cream, soft-firm-hard, in part sucrosic or sandy, blocky. |
| | Trace | Claystone, medium-dark grey, grading to shale, sub-fissile, firm-hard, noncalcareous. |
| 1730m - 1735m | 100% | Chalk as above. |
| | Trace | Claystone as above. |
| | Trace | Pyrite. |
| 1735m - 1740m | 100% | Chalk as above. |
| | Trace | Claystone. |
| 1740m - 1745m | 90% | Chalk as above. |
| | 10% | Claystone. |
| 1745m - 1750m | 100% | Chalk, white-cream, soft-firm-hard, brittle becoming crystalline. |
| | Trace | Claystone. |
| 1750m - 1755m | 90% | Chalk as above. |
| | 10% | Claystone as above. |
| 1755m - 1760m | 90% | Chalk, white-cream, soft-firm, occasionally hard, in part sandy and some slightly argillaceous. |
| | 10% | Claystone. |
| 1760m - 1765m | 90% | Chalk as above. |
| | 10% | Claystone as above. |
| 1765m - 1770m | 100% | Chalk as above. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| | Trace | Claystone as above. |
| 1770m - 1775m | 100% | Chalk as above. |
| 1775m - 1780m | 100% | Chalk, white-cream, soft, in places argillaceous. |
| | Trace | Limestone, tan, hard, crystalline. |
| 1780m - 1785m | 100% | Chalk as above, argillaceous in part. |
| 1785m - 1790m | 100% | Chalk as above. Soft, pure. |
| 1790m - 1795m | 100% | Chalk as above. |
| 1795m - 1800m | 100% | Chalk as above. |
| 1800m - 1805m | 100% | Chalk, white-cream, soft, occasionally firm or hard, amorphous, blocky, pure. |
| | Trace | Pyrite, claystone. |
| 1805m - 1810m | 100% | Chalk as above, light grey. |
| 1810m - 1815m | 100% | Chalk as above. |
| 1815m - 1820m | 100% | Chalk as above, becoming firm. |
| 1820m - 1825m | 100% | Chalk as above. |
| 1825m - 1830m | 100% | Chalk as above. |
| 1830m - 1835m | 100% | Chalk as above. |
| 1835m - 1840m | 100% | Chalk, white-cream-light grey, soft-firm, blocky, some argillaceous laminations and calcite veining. |
| 1840m - 1845m | 100% | Chalk as above, pure. |
| 1845m - 1850m | 100% | Chalk as above. |
| 1850m - 1855m | 100% | Chalk as above. |
| | Trace | Foraminifera. |
| 1855m - 1860m | 100% | Chalk, white-cream, occasionally light grey, soft-firm, some brittle. |
| | Trace | Limestone, tan, hard, crystalline. |
| 1860m - 1865m | 100% | Chalk as above. |
| 1865m - 1870m | 100% | Chalk as above. |
| 1870m - 1875m | 100% | Chalk as above. |
| 1875m - 1880m | 100% | Chalk as above. |
| | Trace | Pyrite. |
| 1880m - 1885m | 100% | Chalk as above. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | Trace | Limestone |
| 1885m - 1890m | 100% | Chalk as above. |
| 1890m - 1895m | 100% | Chalk as above. |
| 1895m - 1900m | 100% | Chalk as above. |
| 1900m - 1905m | 100% | Chalk as above. |
| 1905m - 1910m | 100% | Chalk as above. |
| 1910m - 1915m | 100% | Chalk, white-cream, soft-firm, amorphous, blocky, pure. |
| | Trace | Limestone, tan, crystalline, hard, platy. |
| 1915m - 1920m | 100% | Chalk as above. |
| 1920m - 1925m | 100% | Chalk as above. |
| 1925m - 1930m | 100% | Chalk as above. |
| 1930m - 1935m | 100% | Chalk as above. |
| 1935m - 1940m | 100% | Chalk as above. |
| 1940m - 1945m | 100% | Chalk as above. |
| 1945m - 1950m | 100% | Chalk, white-light grey, cream, soft-firm, blocky, some limestone as above. |
| 1950m - 1955m | 100% | Chalk, white-cream, soft-firm, blocky, amorphous. |
| | Trace | Siltstone, dark- grey green, very fine sand, argillaceous, carbonaceous, micaceous, subfissile. |
| 1955m - 1960m | 100% | Chalk as above. |
| | Trace | Siltstone as above. |
| 1960m - 1965m | 100% | Chalk as above. |
| | Trace | Siltstone as above. |
| 1965m - 1970m | 100% | Chalk as above. |
| | Trace | Siltstone as above. |
| 1970m - 1975m | 100% | Chalk as above. |
| | Trace | Siltstone as above. |
| 1975m - 1980m | 100% | Chalk, light grey, white soft, sandy, argillaceous in part. |
| 1980m - 1985m | 100% | Chalk as above, argillaceous laminations. |
| 1985m - 1990m | 100% | Chalk, light grey, some white, argillaceous in part, some silty and sandy, becoming hard and brittle. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 1990m - 1995m | 100% | Chalk as above. |
| | Trace | Limestone, crystalline, tan, hard. |
| 1995m - 2000m | 100% | Chalk as above, argillaceous. |
| 2000m - 2005m | 100% | Chalk as above. |
| 2005m - 2010m | 100% | Chalk, white-light grey, soft, sticky, argillaceous, grading to marl in part. |
| 2010m - 2015m | 100% | Chalk as above. |
| 2015m - 2020m | 60% | Chalk as above, grading to marl. |
| | 40% | Marl, light-medium grey, soft, amorphous, sticky, silty, glauconitic. |
| 2020m - 2025m | 80% | Chalk, white-cream-light grey, soft-firm, argillaceous. |
| | 20% | Marl as above. |
| | Trace | Limestone, tan, hard, crystalline. |
| 2025m - 2030m | 90% | Chalk as above. |
| | 10% | Marl as above. |
| 2030m - 2035m | 100% | Chalk as above. |
| | Trace | Shale, dark grey, hard fissile, micaceous, calcareous. |
| 2035m - 2040m | 100% | Chalk, white, soft, relatively pure, in part grading to marl. |
| 2040m - 2045m | 100% | Chalk as above. |
| 2045m - 2050m | 100% | Chalk as above. |
| 2050m - 2055m | 100% | Chalk as above. |
| 2055m - 2060m | 100% | Chalk, white-cream-light green grey, soft, amorphous, argillaceous grading to marl. |
| 2060m - 2065m | 100% | Chalk as above. |
| 2065m - 2070m | 100% | Chalk as above. |
| 2070m - 2075m | 100% | Chalk as above, predominantly argillaceous. |
| 2075m - 2080m | 100% | Chalk as above, pyritized locally. |
| 2080m - 2085m | 100% | Chalk, white-cream, soft. In part becoming limestone, crystalline, hard, sucrosic. |
| 2085m - 2090m | 100% | Chalk, grading towards limestone, cream, tan, crystalline, sucrosic, hard, brittle. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 2090m - 2095m | 100% | Chalk as above. |
| | Trace | Sandstone, medium grey, very fine, friable, silty, argillaceous, glauconitic. |
| 2095m - 2100m | 100% | Chalk as above. |
| | Trace | Sandstone as above. |
| | Trace | Shale, black, firm-hard, subfissile, micromicaceous. |
| 2100m - 2105m | 100% | Chalk as above. |
| | Trace | Siltstone, medium grey, very fine sand, argillaceous, grading in part to sandstone, soft, friable. |
| 2105m - 2110m | 90% | Chalk as above. |
| | 10% | Siltstone as above. |
| 2110m - 2115m | 50% | Chalk as above. |
| | 40% | Clay, red-redbrown, soft, sticky, soluble. |
| | 10% | Shale, red-redbrown, firm, subfissile, micromicaceous, now calcareous, silty, slightly sandy. |
| 2115m - 2120m | 20% | Chalk as above. |
| | 60% | Clay, grading to marl, red, soft, sticky, soluble. |
| | 20% | Shale as above. |
| 2120m - 2125m | 100% | Clay as above, grading to marl. |
| 2125m - 2127m | 100% | Clay, medium grey, soft, sticky, plastic, very calcareous, grading to marl. |
| 2127m - 2130m | 100% | Clay, medium grey green, soft, sticky, amorphous, plastic, fairly calcareous. |
| 2130m - 2133m | 100% | Clay, medium grey to dark grey, soft, sticky, fairly calcareous. |
| 2133m - 2136m | 100% | Clay as above. |
| 2136m - 2139m | 100% | Clay, medium grey, medium grey-green, soft, sticky silty, slightly to fairly calcareous. |
| 2139m - 2142m | 100% | Clay as above. |
| 2142m - 2145m | 100% | Clay, medium-dark red, soft, sticky, plastic, soluble, moderately calcareous, locally grading to marl, silty. |
| 2145m - 2148m | 100% | Clay as above. |
| 2148m - 2151m | 100% | Clay as above, moderately calcareous. |
| 2151m - 2154m | 100% | Clay as above. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| | Trace | Shale, red-brown, silty, fissile. |
| 2154m - 2157m | 100% | Clay as above. |
| 2157m - 2160m | 100% | Clay, red, soft, soluble, sticky, grading to marl. |
| 2160m - 2163m | 100% | Clay, grading predominantly to marl, red, soft, soluble, very calcareous. |
| 2163m - 2166m | 100% | Clay as above. Some grey-green marl. |
| 2166m - 2169m | 100% | Clay, grading predominantly to marl, brick red, soft, plastic, very soluble, very calcareous. |
| 2169m - 2172m | 100% | Clay as above. |
| 2172m - 2175m | 100% | Clay as above. |
| 2175m - 2178m | 100% | Clay, red, soft, soluble, moderately calcareous, grading in part into marl. |
| 2178m - 2181m | 100% | Clay as above. |
| | Trace | Grey-green clay, very calcareous. |
| 2181m - 2184m | 100% | Clay as above. |
| 2184m - 2187m | 100% | Clay as above. |
| 2187m - 2190m | 100% | Clay, predominantly red, plastic soluble, moderately to very calcareous, 30% grey-green clay, soft, sticky, very calcareous grading to marl. |
| 2190m - 2193m | 100% | Clay, red, plastic, soft, very soluble, grading to marl, some grey-green. |
| 2193m - 2196m | 100% | Clay as above, grading to marl. |
| 2196m - 2199m | 100% | Clay as above. |
| 2199m - 2202m | 100% | Clay as above. |
| 2202m - 2205m | 100% | Clay, predominantly grey-green, soft, sticky, very calcareous, mostly grading to marl. 40% is red-brown, very soluble, moderately to very calcareous |
| 2205m - 2208m | 100% | Clay, red brown, soft, sticky, very soluble, moderately calcareous. |
| 2208m - 2211m | 100% | Clay, grading to marl, red, soft, sticky, soluble, very calcareous, in part grey-green. |
| 2211m - 2214m | 100% | Clay, grading to marl, mostly light grey-green, soft, sticky, some red. |
| 2214m - 2217m | 100% | Clay, grading to marl, light red and light grey-green, soft, silty, moderately to very calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 2217m - 2220m | 100% | Clay, light grey, some pale green and light red as above. |
| 2220m - 2223m | 100% | Clay as above. |
| 2223m - 2226m | 100% | Clay as above, very soluble. |
| 2226m - 2229m | 100% | Clay, grading to marl, pale red, medium red, soft, sticky, soluble, moderately to very calcareous. some blocky, subfissile. |
| 2229m - 2232m | 100% | Clay as above. |
| | Trace | Shale, red, grey-green, firm, subfissile, some splintery, calcareous. |
| 2232m - 2235m | 100% | Clay as above, becoming brown. |
| | Trace | Shale as above. |
| 2235m - 2238m | 100% | Clay as above, very calcareous. |
| 2238m - 2241m | 100% | Clay, red, some brown and grey-green, soft, silty, very calcareous, grading to marl. |
| | Trace | Shale as above. |
| 2241m - 2244m | 100% | Clay as above, becoming greyish. |
| 2244m - 2247m | 100% | Clay as above. |
| 2247m - 2250m | 100% | Clay, grading to marl, grey-green, soft, sticky, very soluble becoming claystone and shale in part. |
| 2250m - 2253m | 100% | Clay as above. |
| 2253m - 2256m | 100% | Clay as above. |
| 2256m - 2259m | 100% | Clay as above. |
| 2259m - 2262m | 100% | Clay, medium to dark grey, soft-firm, very calcareous, grading to claystone and shale, blocky-subfissile. |
| 2262m - 2265m | 100% | Clay/claystone, grey-green, soft-firm, blocky-subfissile, moderate to very calcareous, becoming marl in part. |
| 2265m - 2268m | 100% | Clay/claystone as above. |
| | Trace | Glauconite. |
| 2268m - 2271m | 100% | Clay/claystone as above. |
| 2271m - 2274m | 100% | Clay/claystone as above. |
| 2274m - 2277m | 100% | Clay/claystone, predominantly grey-green, soft-firm, very calcareous, some shale, firm, subfissile, platy, silty, calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 2277m - 2280m | 100% | Clay/claystone as above. |
| 2280m - 2283m | 100% | Clay/claystone as above. |
| 2283m - 2286m | 100% | Clay/claystone as above. |
| 2286m - 2289m | 100% | Clay/claystone as above. |
| 2289m - 2292m | 100% | Clay/claystone, red-brown, some green, soft-firm soluble, moderately to very calcareous. |
| 2292m - 2295m | 100% | Clay/claystone, red-brown, soft, sticky, soluble, very calcareous, grading to marl. |
| 2295m - 2298m | 100% | Clay/claystone as above. |
| 2298m - 2301m | 100% | Clay/claystone as above. |
| 2301m - 2304m | 100% | Clay/claystone as above. |
| 2304m - 2307m | 100% | Clay/claystone as above. |
| 2307m - 2310m | 100% | Clay/claystone, red, red-brown, soft, soluble, amorphous-blocky, very calcareous. |
| | Trace | Shale, chocolate brown, platy, fissile, micromicaceous, very calcareous. |
| 2310m - 2313m | 100% | Clay/claystone as above. |
| 2313m - 2316m | 100% | Clay/claystone as above, some light grey-green interbeds. |
| 2316m - 2319m | 100% | Clay/claystone as above. |
| 2319m - 2322m | 100% | Clay/claystone as above. |
| 2322m - 2325m | 100% | Clay/claystone as above. |
| 2325m - 2346m | 100% | Clay/claystone, red, grey-green, grey, samples heavily contaminated by cavings. |
| 2346m - 2349m | 100% | Clay, grading to marl, light grey, soft, sticky, soluble, moderate to very calcareous. |
| | Trace | Shale, dark grey, noncalcareous. |
| | Trace | Sand, coarse quartz grains. |
| 2349m - 2352m | 50% | Marl/claystone as above. |
| | 50% | Shale medium grey-brown, soft, subfissile-fissile carbonaceous, silty, pyritic, micaceous. |
| 2352m - 2355m | 10% | Claystone/marl as above |
| | 90% | Shale as above, calcareous, lignitic, silty micaceous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 2355m - 2358m | 10% | Claystone/marl as above. |
| | 90% | Shale as above |
| 2358m - 2361m | 100% | Shale, medium grey-brown, soft, silty, carbonaceous, very finely laminated with biotite mica on bedding planes, calcareous. |
| 2361m - 2364m | 100% | Shale, in part grading to siltstone as above, becoming dark grey. |
| | Trace | Limestone, tan, crystalline, hard, micritic. |
| 2364m - 2367m | 100% | Shale, grading to siltstone, medium dark grey-brown, very finely laminated, very micaceous, (biotites) slightly carbonaceous, |
| | Trace | Pyrite and calcite. |
| 2367m - 2370m | 100% | Shale as above, calcareous. |
| | Trace | Coal, black, shiny, hard, some calcite veining. |
| 2370m - 2373m | 100% | Shale, dark grey-brown, soft becoming firm, block slightly micaceous, calcareous. |
| 2373m - 2376m | 100% | Shale as above, soft, amorphous, slightly micaceous. |
| 2376m - 2379m | 100% | Shale as above, generally blocky, some fissile, with fine laminations of mica, pyrite. |
| 2379m - 2382m | 100% | Shale as above. |
| 2382m - 2385m | 100% | Shale, dark grey-brown, silty, blocky, slightly micaceous, slightly carbonaceous, some laminated, calcareous, pyrite. |
| 2385m - 2388m | 100% | Shale as above, predominantly finely laminated, very micaceous, calcareous. |
| 2388m - 2391m | 100% | Shale as above. |
| 2391m - 2394m | 100% | Shale as above. |
| 2394m - 2397m | 100% | Shale as above, some blocky, slightly micaceous, silty. |
| 2397m - 2400m | 100% | Shale as above, moderately calcareous, silty. |
| 2400m - 2403m | 100% | Shale, grading to siltstone, dark grey-brown, generally very finely laminated, micaceous, carbonaceous, calcareous, pyrite. |
| 2403m - 2406m | 100% | Shale as above. |
| | Trace | Sand, white, very fine grained, poorly sorted, silty, calcareous, glauconitic. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 2406m - 2409m | 80% | Shale as above. |
| | 20% | Sandstone, white, fine-medium, friable, fair sorting, glauconitic, sand loose, clear to translucent fine-medium, subround. |
| | Trace | Pyrite. |
| 2409m - 2412m | 60% | Shale as above. |
| | 40% | Sandstone, white-light grey, fine-medium, well sorted, friable, calcareous, glauconitic, loose sand, clear-translucent, subround. |
| 2412m - 2414m | 50% | Shale as above. |
| | 50% | Sand, loose, fine-medium, clear, sorted. Sandstone, white, fine grained, well sorted. Subangular to subround, dolomite cement, some light grey, fine, silty, friable, very glauconitic (chlorite?). |
| 2414m - 2416m | 30% | Shale as above. |
| | 70% | Sand, loose as above, occasional coarse grains, some consolidated as above, very glauconitic. |
| 2416m - 2418m | 30% | Shale as above. |
| | 70% | Sand, clear-translucent, fine, coarse predominant, medium coarse, some very coarse, subround, occasionally round, poor sorting. Some consolidated, white, friable, fair sorting, dolomite cement, very glauconitic, in part silty with argillaceous laminations, calcareous, pyrite. |
| 2418m - 2420m | 20% | Shale as above. |
| | 80% | Sand, clear, fine gravel, predominantly coarse, subround to round, poor sorting, some consolidated, light grey to white, medium, dolomite cement, with abundant glauconite and argillaceous laminations, pyrite. |
| 2420m - 2422m | 20% | Shale as above. |
| | 80% | Sand as for 2418m-2420m. |
| 2422m - 2424m | 30% | Shale as above. |
| | 70% | Sand, clear-translucent, fine-coarse, predominantly fine-medium, subround, fair sorting. |
| | Trace | Limestone, light grey, tan, silty, argillaceous, hard, dolomitic. |
| 2424m - 2426m | 20% | Shale as above. |
| | 80% | Sand as above, medium to coarse. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | Trace | Coal, black, firm-hard, argillaceous, pyrite. |
| 2426m - 2428m | 50% | Coal, black, dull, shiney, hard, blocky, argillaceous. |
| | 50% | Sand as above. |
| 2428m - 2430m | 80% | Sand, clear, fine to coarse, predominantly medium fair sorting, subround, some sandstone, white, fine grained, subround fair sorting, dolomite cement, friable in part. |
| | 10% | Coal as above. |
| | 10% | Shale as above |
| 2430m - 2432m | 90% | Sand as above. |
| | 10% | Shale as above. |
| 2432m - 2434m | 80% | Sand, clear-translucent, medium to very coarse, subround to round, poor-fair sorting, sandstone, white, fine-medium, subround, fair sorting, hard dolomitic, clean. |
| | 20% | Dolomite, white, crystalline, hard, in part sucrosic, calcareous. |
| 2434m - 2436m | 100% | Sand and sandstone, dominantly composed of quartz minor metamorphic fragments, medium to very coarse grained, angular to subrounded, predominantly sub angular to subrounded, poor to fair sorting, in part sandstone cemented by dolomite in part by a calcareous clay, secondary cubic pyrite, fraction cemented by dolomite is hard, tight, sample predominantly loose, unconsolidated, crystal clear to milky quartz, clean, glauconitic. |
| 2436m - 2438m | 100% | Sand and sandstone as in 2434m-2436m. Milky and clear translucent quartz, medium grained, fair to well sorted, minor rose quartz, in part white to yellow, calcareous clay matrix, some of the sandstone has glauconite particles as inclusions, pyrite, micaceous (biotite). |
| | Trace | Dolomite, fawn, hard, tight, brittle, calcareous. |
| 2438m - 2440m | 100% | Sand and sandstone as in 2436m-2438m, fine to medium grained, well sorted, quartzose, pyrite, micaceous, biotite and muscovite, calcareous, firm to unconsolidated, rounded to subrounded, glauconite. |
| 2440m - 2442m | 100% | Sand and sandstone as in 2438m-2440m, medium grained, odd grain coarse grained, subrounded, moderately well sorted, clean, minor mica. |
| | Trace | Limestone, chalky, micritic. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 2442m - 2444m | 100% | Sand and sandstone as in 2440m-2442m. Pyrite (cubic form). Fine grained, calcareous clay matrix, mica, red and green lithic fragments, biotite, muscovite, chlorite, (glauconite), subrounded quartz fragments, clean, a secondary sandstone component is very argillaceous, dark grey, calcareous matrix. |
| 2444m - 2446m | 100% | Sand and sandstone, fine grained, dominantly quartz, calcareous, cream, yellow, pale green, pyritized bryozan stems, micaceous. |
| 2446m - 2448m | 100% | Sand and sandstone, cream, milky white, dominantly pale green, fine to very fine grained, subangular to subrounded, micaceous, biotite (dark brown to black), muscovite, pyrite, calcareous cement, slightly argillaceous. |
| 2448m - 2450m | 100% | Sand and sandstone, cream, offwhite, pale green, quartzose, basically clean, minor pyrite, trace clay, greenish grey, firm, calcareous, glauconitic, micaceous in part. |
| 2450m - 2452m | 100% | Sand and sandstone, offwhite, yellow, pale green, calcareous, abundant muscovite, biotite, fine grained, loose to firm, calcareous cement, subrounded to rounded. |
| 2452m - 2454m | 100% | Sand and sandstone, quartzose, fine grained, loose, unconsolidated, pyrite, clear, translucent and milky white quartz, calcareous, micaceous. |
| 2454m - 2456m | 100% | Sand and sandstone, quartzose as in 2452m-2454m, frosted quartz. |
| 2456m - 2458m | 100% | Sand and sandstone, offwhite, cream, loose to firm, slightly calcareous. |
| 2458m - 2460m | 100% | Sand and sandstone, fine to very fine grained, dominantly quartz, minor chlorite (glauconite) along the fracture planes of some of the quartz grains, biotite, muscovite, pyrite, in part a calcareous matrix, good apparent porosity. |
| 2460m - 2462m | 100% | Sand and sandstone as in 2458m-2460m, calcareous clay matrix, loose in part, pyrite, micaceous. |
| 2462m - 2464m | 100% | Sand and sandstone as in 2458m-2460m, fine to medium grained, quartzose, subangular to subrounded. |
| 2464m - 2466m | 100% | Sand and sandstone, medium grained, loose, unconsolidated, subangular to subrounded, fair sorting minor calcareous clay matrix, pyrite, micaceous, green chloritic inclusions in some of the quartz grains. |
| 2466m - 2468m | 100% | Sand and sandstone as in 2464m-2466m, quartzose fine to medium grained, subangular to subrounded, micaceous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| 2468m - 2470m | 100% | Sand and sandstone as in 2464m-2466m, quartzose. |
| 2470m - 2472m | 100% | Sand and sandstone as in 2464m-2468m, cream, off-white, yellow, red, pale green, fine grained, poor to fair sorting, calcareous, white clay matrix, green and black lithic fragments within sandstone clear crystal quartz, milky white quartz, minor rose quartz, minor rusty red quartzose sand component. |
| | Trace | Dolomite, fawn, grey, argillaceous, hard, tight, slightly calcareous. |
| 2472m - 2474m | 100% | Sand and sandstone as in 2470m-2472m. |
| 2474m - 2476m | 100% | Sand and sandstone, offwhite, light grey, greyish yellow, light green, fine grained, very calcareous micritic matrix grading into a micritic limestone in part, chalky, firm dominantly quartz clasts, shell fragments, micaceous, biotite, muscovite, chlorite, pyrite, fair to poor sorting glauconite. |
| | Trace | Limestone, white, soft to very soft, in part hard, conchoidal fracture, dominantly chalky, poor apparent porosity. |
| 2476m - 2478m | 100% | Sand and sandstone as in 2474m-2476m, slightly coarser, fine to medium grained, well sorted, subangular to subrounded, tending from subrounded to rounded in part, pyrite, slightly less calcareous than 2474m-2476m. |
| | Trace | Limestone as in 2474m-2476m. |
| 2478m - 2480m | 100% | Sand and sandstone as in 2476m-2478m, very clayey in part, soft, soluble, fine to medium grained, fair sorting, a proportion of the sandstone population is fine to very fine grained, dark green to green, subangular to subrounded, chloritic. |
| 2480m - 2482m | 100% | Sand and sandstone as in 2478m-2480m, minor mica, mica within the sands is not as dominant as 20m higher up the hole, fine to medium grained, subangular to subrounded, pyrite. |
| 2482m - 2484m | 100% | Sand and sandstone, offwhite to pale green to light grey to fawn, fine to medium grained, minor percentage of sand grading to coarse grained, subrounded to rounded, glauconitic, basically clean. |
| 2484m - 2486m | 100% | Sand and sandstone, offwhite to pale green, medium to coarse grained, in part, very coarse grained, coarser fraction is well rounded, dominantly translucent and milky white quartz, minor chert, glauconite. |
| 2486m - 2488m | 100% | Sand and sandstone as in 2484m-2486m, becoming argillaceous, light grey to offwhite, silty in part, pyrite, chlorite. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 2488m - 2490m | 100% | Sand and sandstone, offwhite to grey to green, poorly sorted, fine to coarse grained, angular to rounded, argillaceous. |
| 2490m - 2492m | 100% | Sand and sandstone, dominantly pale green to green, fine to medium grained, odd coarse grain, chloritic, grading to silt in part, subangular to subrounded, coarser fraction often well rounded, very calcareous. |
| | Trace | Limestone, grey to offwhite, cream, soft, chalky, micritic. |
| 2492m - 2494m | 100% | Sand and sandstone, cream, offwhite, yellow, dominantly loose, unconsolidated translucent crystal quartz and milky white quartz, minor chert, medium to very coarse grained, approaching a conglomerate, rounded to well rounded, also finer sandstone fraction as in 2490m-2492m, glauconite? inclusions in some of the quartz grains. |
| 2494m - 2496m | 100% | Sand and sandstone, very argillaceous in part, soft, sticky to firm, white to grey, calcareous, micritic in part, chert, rose quartz, milky and crystal quartz, fine grained to coarse. |
| | Trace | 10% clay, red, firm to hard, subfissile in part, micromicaceous, slightly carbonaceous. |
| | Trace | Limestone, white, chalky, soft. |
| 2496m - 2498m | 50% | Clay, red, orange, light brown, ochre, firm to soft, slightly arenaceous in part, sticky, soluble, calcareous. |
| | 30% | Silt, grey, light grey, offwhite, soft, sticky, calcareous. |
| | 20% | Sand and sandstone, grey, fine grained, subangular to subrounded, calcareous, poorly sorted. |
| 2498m - 2500m | 100% | Sand and sandstone, pale green, cream, offwhite, glauconitic, often quartz grains have glauconite inclusions, fine to medium grained, calcareous matrix (clay), in part slightly micaceous very fine grained in part, moderately well sorted, basically clean. |
| 2500m - 2502m | 100% | Sand and sandstone, cream, offwhite, pale green, glauconitic in part, dominant calcareous clay matrix (micritic), fine grained, fair sorting, subangular to subrounded, clean in part, fair visible porosity. |
| | Trace | Limestone, grey, white, offwhite, chalky, micritic, argillaceous. |
| 2502m - 2504m | 100% | Sand and sandstone as in 2500m-2502m, yellow, offwhite, cream, slightly calcareous, basically clean. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|--|
| | Trace | Limestone as in 2500m-2502m. |
| 2504m - 2506m | 100% | Sand and sandstone, pale green, grey, offwhite, firm, calcareous matrix, dominantly translucent crystal quartz and milky white quartz, pyrite, glauconite, subangular to subrounded, in part well rounded. |
| | Trace | Limestone, chalky, white, soft to firm. |
| 2506m - 2508m | 100% | Sand and sandstone as in 2504m-2506m, abundant <u>pyrite</u> more than previously seen in the Jurassic sands, sands very white, clean, minor calcareous clay matrix, fine grained, occasional coarser well rounded grain, minor glauconite. |
| 2508m - 2510m | 100% | Sand and sandstone as in 2506m-2508m, abundant cubic pyrite, fine to medium grained, clean, offwhite, pale green. |
| 2510m - 2512m | 100% | Sand and sandstone as in 2506m-2508m, offwhite, cream, fine to medium grained, pyrite, less glauconite than in higher samples. |
| 2512m - 2514m | 100% | Sand and sandstone, brick-red, red-brown, fine to medium grained, iron oxide cement, (iron oxide staining) well cemented, fair sorting, slightly calcareous, dominantly crystal clear quartz, red beds, noticeable torquing up of a bit at formation change, probable top of the Triassic. |
| 2514m - 2516m | 100% | Sand and sandstone as in 2512m-2514m, reddish-brown, brick-red, friable, slightly calcareous, iron oxide matrix/cement, quartzose, subangular to subrounded. |
| | Trace | Limestone, grey, argillaceous, firm to hard, dark grey in part, microcrystalline. |
| 2516m - 2518m | 100% | Sand and sandstone as in 2514m-2516m, brick-red, reddish brown, fine grained, fairly well sorted, iron oxide coating of the quartz grains, subangular. |
| 2518m - 2520m | 100% | Sand and sandstone as in 2516m-2518m, reddish brown, slightly calcareous cement. |
| 2520m - 2522m | 100% | Sand and sandstone as in 2516m-2518m, red iron oxide cement, calcareous. |
| 2522m - 2524m | 100% | Sand and sandstone as in 2516m-2518m, brick-red, reddish brown, fine grained well sorted, dominantly translucent quartz. |
| | Trace | Limestone, grey, argillaceous, hard, tight, microcrystalline to cryptocrystalline. |
| 2524m - 2526m | 80% | Sand and sandstone as in 2516m-2518m, fining downwards, calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 20% | Clay, reddish-brown, brick-red, soft, soluble, sticky, plastic in part, calcareous. |
| 2526m - 2528m | 45% | Clay as in 2524m-2526m. |
| | 55% | Sandstone and sand as in 2516m-2518m. |
| 2528m - 2530m | 70% | Clay as in 2524m-2526m. |
| | 30% | Sand and sandstone as in 2516m-2518m. |
| 2530m - 2532m | 60% | Clay as in 2524m-2526m, brick-red, soluble, sticky in part, gummy. |
| | 20% | Sand and sandstone as in 2516m-2518m. |
| | 20% | Limestone, grey, hard, argillaceous, tight. |
| 2532m - 2534m | 80% | Sand and sandstone, brick-red, reddish-brown, fine grained, subangular to subrounded, firm to loose and unconsolidated, abundant muscovite mica, red iron oxide cement, calcareous. |
| | 20% | Clay as in 2524m-2526m. |
| 2534m - 2536m | 50% | Clay, brick-red, reddish-brown, soft, soluble, plastic, sticky, calcareous. |
| | 50% | Sand and sandstone as in 2532m-2534m, fine grained, subangular to subrounded, red iron oxide cement, calcareous. |
| 2536m - 2538m | 50% | Clay as in 2534m-2536m, brick-red, calcareous. |
| | 50% | Sand and sandstone as in 2532m-2534m, brick-red, fine grained, subangular to subrounded. |
| 2538m - 2540m | 60% | Sand and sandstone as in 2532m-2534m, brick-red, reddish-brown, fine grained, fair sorting, subangular to subrounded, calcareous, iron oxide cement. |
| | 40% | Clay, reddish-brown, brick-red, calcareous, sticky, soluble. |
| 2540m - 2542m | 60% | Clay as in 2538m-2540m, very calcareous brick-red, sticky, gummy, soluble. |
| | 10% | Shale, dark grey, black in part, fissile, very calcareous, micaceous along cleavage planes. |
| | 30% | Sand and sandstone as in 2532m-2534m. |
| 2542m - 2544m | 60% | Clay as in 2538m-2540m, brick-red. |
| | 30% | Shale as in 2540m-2542m, dark grey. |
| | 10% | Sand as in 2532m-2534m, brick-red, calcareous, fine grained. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| 2544m - 2546m | 80% | Clay as in 2538m-2549m, very soluble, soft, brick-red, calcareous. |
| | 10% | Shale as in 2540m-2542m. |
| | 10% | Sand and sandstone as in 2532m-2534m. |
| 2546m - 2548m | 100% | Clay, brick-red, reddish-brown, firm, slightly less calcareous than previous Triassic samples, sticky. |
| | Trace | Anhydrite. |
| | Trace | Limestone. |
| 2548m - 2550m | 80% | Clay, brick-red, reddish-brown, firm, expanding, soluble in part, subfissile in part, slightly silty, calcareous, sticky, plastic, micromicaceous. |
| | 15% | Shale, dark-grey to pale green, firm, fissile, noncalcareous to calcareous, high iron content. |
| | 5% | Limestone, grey, white, dirty, argillaceous, soft to firm, slightly dolomitic. |
| 2550m - 2552m | 100% | Clay, brick-red, reddish-brown, dark brown, high percentage very soluble, gummy, firm in part, subfissile, 40% of clay fraction claystone, trace shale as in 2548m-2550m. |
| 2552m - 2554m | 60% | Clay, brick-red, reddish-brown, calcareous, soft soluble, firm in part, sticky, plastic. |
| | 40% | Claystone, brick-red, firm, occasionally hard, noncalcareous. |
| 2554m - 2556m | 60% | Clay, brick-red, soft, sticky, soluble. |
| | 40% | Claystone, brick-red, reddish-brown, firm, subfissile, micromicaceous in part. |
| 2556m - 2558m | 60% | Clay, brick-red, soft, sticky, soluble, firm in part. |
| | 40% | Claystone, brick-red, firm. |
| 2558m - 2560m | 40% | Clay, brick-red, as in 2556m-2558m. |
| | 60% | Claystone, brick-red, firm, subfissile. |
| 2560m - 2562m | 60% | Clay, brick-red, red, reddish-brown, soft, soluble, sticky, plastic, calcareous. |
| | 40% | Claystone, brick-red, red, firm, subfissile in part, firm, hard in part, slightly arenaceous, noncalcareous, slightly calcareous in part. |
| 2562m - 2564m | 60% | Clay, brick-red, red, plastic, sticky, soluble, very slightly calcareous. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 40% | Claystone, brick-red, red, brownish red, firm, subfissile, slightly calcareous to noncalcareous |
| 2564m - 2566m | 60% | Claystone, brick-red, red, brownish red, firm, subfissile, flakey, slightly calcareous. |
| | 40% | Clay, brick-red, soft, soluble, plastic, slightly calcareous. |
| | Trace | Limestone, grey, offwhite, olive green, dark grey argillaceous, massive, hard, tight, noncrystalline. |
| | Trace | Anhydrite, grey, offwhite, amorphous, hard, occurs as thin laminae within the claystone. |
| 2566m - 2568m | 60% | Claystone as in 2564m-2566m. |
| | 40% | Clay as in 2564m-2566m, soluble, slightly calcareous. |
| | Trace | Limestone as in 2564m-2566m. |
| 2568m - 2570m | 60% | Clay, varicoloured, dominantly brick-red, brownish-red, grey, green, often red streaks through green fraction and vice versa, apparently due to different degrees of oxidation resulting in different amounts of ferric anhydride forming, soft to firm, slightly calcareous, sticky, gummy |
| | 40% | Claystone, brick-red to green, dominantly brick-red, firm, micromicaceous, slightly arenaceous, calcareous in part. |
| 2570m - 2572m | 40% | Clay, brick-red, minor grey to greenish grey, sticky, firm in part, slightly calcareous. |
| | 60% | Claystone, brick-red, brownish-red, micaceous, conchoidal fracture in part, calcareous in part. |
| 2572m - 2574m | 80% | Claystone as in 2568m-2570m, brick-red, hard, conchoidal in part, flakey, micromicaceous, dominantly noncalcareous. |
| | 20% | Clay as in 2570m-2572m. |
| 2574m - 2576m | 60% | Claystone, brick-red, brownish-red, ferric anhydride coating, calcareous, firm, hard, flakey in part. |
| | 40% | Clay, brick-red,, brownish-red, calcareous, soft soluble, green-grey clay slightly more calcareous. |
| | Trace | Limestone, grey, argillaceous, hard, conchoidal fracture, dolomitic. |
| 2576m - 2578m | 60% | Claystone as in 2574m-2576m, brick-red. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|-----------------|----------|---|
| | 40% | Clay as in 2574m-2576m, brick-red. |
| | Trace | Dolomitic limestone as in 2574m-2576m. |
| 2578m - 2580m | 50% | Claystone as in 2574m-2576m, brick-red, calcareous, firm to hard, micaceous, silty. |
| | 50% | Clay, brick-red, brownish-red, slightly calcareous, soft, soluble, gummy. |
| 2580m - 2582m | 40% | Claystone as in 2574m-2576m, brick-red, brownish red, firm, calcareous, micromicaceous in part. |
| | 40% | Clay as in 2574m-2576m, brick-red, soft, soluble calcareous. |
| | 20% | Anhydrite, white, offwhite, grey, light grey, amorphous, soft, firm, blocky in part, argillaceous, in part finely crystalline. |
| | Trace | Gypsum, yellow, light yellow, light grey, crystalline, monoclinic. |
| | Trace | Dolomite, grey, green, translucent, interbedded with anhydrite. |
| 2582m - 2584m | 100% | Anhydrite, soft, amorphous, offwhite, white, massive, crystalline, pink tinge throughout possibly due to potassium carbonate. |
| | Trace | Gypsum as in 2580m-2582m. |
| | Trace | Limestone, grey, grey-green, dolomitic, argillaceous, hard, brittle, conchoidal fracture. |
| 2584m - 2586m | 85% | Anhydrite, white, dominantly soft, in part firm to hard where crystalline, minor pyrite crystals (?) interbedded, with the anhydrite. |
| | 15% | Shale, grey, hard, brittle, calcareous. |
| 2586m - 2588m | 90% | Anhydrite, white, soft, crystalline, amorphous. |
| | 10% | Shale, brown, black, green, calcareous. |
| | Trace | Gypsum, crystalline, as in 2580m-2582m. |
| 2588m - 2590m | 100% | Anhydrite, white, soft, amorphous, argillaceous in part. |
| | Trace | Gypsum, yellow, grey, fibrous. |
| | Trace | Shale, green, calcareous. |
| 2590m - 2592m | 100% | Anhydrite, white, soft, trace dolomite. |
| 2592m - 2594m | 100% | Anhydrite, white, soft, amorphous, finely crystalline. |

| <u>INTERVAL</u> | <u>%</u> | <u>DESCRIPTION</u> |
|------------------|----------|---|
| 2594m - 2596m | 100% | Anhydrite, white, offwhite, occasional grey calcareous streak, soft to firm in part, sticky, filter cake type skin, microcrystalline in part. |
| 2596m - 2598m | 100% | Anhydrite, white, offwhite,, soft, finely crystalline. |
| 2598m - 2600m | 100% | Anhydrite, white, soft, spongy, firm in part. |
| 2600m - 2602m | 100% | Anhydrite, white, soft, amorphous. |
| 2602m - 2604m | 100% | Anhydrite, white, amorphous, finely crystalline in part. |
| | Trace | Shale, black to green, fissile carbonaceous. |
| 2604m - 2606m | 100% | Anhydrite, white, cleavage 120° , monoclinic. |
| 2606m - 2608m | 100% | Halite, colourless, translucent, pinkish in part, crystalline, massive, brittle, salty taste occasional polyhalite, crystalline. |
| 2608m - 2610m | 100% | Halite, colourless to milky white, (anhydritic). |
| 2610m - 2612m | 100% | Halite, as in 2606m-2608m, returns very poor. |
| 2612m - 2614m | 100% | Halite, as in 2606m-2608m. |
| 2614m - 2616m | 100% | Halite, as in 2606m-2608m. |
| 2616m - 2618m | 100% | Halite, as in 2606m-2608m. |
| 2618m - 2620m | 100% | Halite, as in 2606m-2608m. |
| 2620m - 2622m | 100% | Halite, as in 2606m-2608m. |
| 2622m - 2624m | 100% | Halite, as in 2606m-2608m. |
| 2624m - 2626m | 100% | Halite, as in 2606m-2608m. |
| 2626m - 2628m | 100% | Halite, as in 2606m-2608m. |
| 2628m - 2630m | 100% | Halite, as in 2606m-2608m. |
| 2630m - 2631.46m | 100% | Halite as in 2606m-2608m. |

APPENDIX NO. 7

SIDEWALL CORE DESCRIPTIONS AND
SIDEWALL CORE ANALYSIS RESULTS



STATEX A/S LABORATORY

FINAL REPORT

statex as

Company UNIONOIL NORGE A/S Date 27.7. 1977
 Well 8/4-1 Core SIDEWALL
 Field _____ State NORWAY

| DEPTH FOOT METER | PERMEABILITY MILLIDARCY | | HELIUM POROSITY % | SATURATION POROSITY % | PORE SATURATION | | FLUOR ESEENCE | FORMATION DESCRIPTION |
|-----------------------------------|----------------------------|------|-------------------------|-----------------------------|--------------------|-----|------------------|--|
| | KA | KL | | | SO | STW | | |
| 2541.5 | | | | | | | NONE | S.ST. RD/BR. F.GR. Sub.Ang. w/Mica |
| 2526.0 | | | | | | | NONE | A.A. Poor. cemented |
| 2521.00 | | | | | | | NONE | A.A. |
| 2517.00 | | | | | | | NONE | A.A. |
| 2510.00 | | | | | | | NONE | S.ST. Wh/Gy F.GR. Sub. Ang. w/org. matte. |
| 2491.00 | 26 | 21 | | 17.7 | | | NONE | A.A. |
| 2482.00 | | | | | | | NONE | S.ST. Gy/Gr V.F.GR. Sub.Ang. w/Mica |
| 2462.00 | | | | | | | NONE | S.ST. Gy/Wh F.GR. V/FR. |
| 2449.00 | 19 | 15 | | 23.5 | | | NONE | S.ST. Gy/Wh F.GR. w/Mica |
| 2433.00 | | | | | | | NONE | S.ST. Gy/Wh F.GR. V.W. cemented |
| 2420.5 | 302 | 272 | | 18.1 | | | NONE | S.ST. Gy/Br. V.F.GR. Sub RD w/Mica |
| 2417.0 | | | | | | | NONE | S.ST. Gy/Wh V.F.GR. Sub RD Poor cemented |
| 2153.0 | 0.14 | 0.09 | | 8.2 | | | NONE | SILT.ST. Gy/Br. |
| 1627.5 | | | | | | | NONE | Clay. Wh. Soft |
| 1620.0 | 0.55 | 0.36 | | 9.5 | | | NONE | Ch/L.ST. Gy/Wh w/Mica |
| 1615.0 | 0.32 | 0.20 | | 5.1 | | | NONE | A.A. |
| 1610.0 | | | | | | | NONE | Clay. Wh/Gy Soft |
| 1521.0 | 21 | 17 | | 15.5 | | | NONE | S.ST. LAM. w/Black STR. OF/org. matter V. |
| | | | | | | | | |
| | | | | | | | | |

APPENDIX NO. 8

LIST OF WIRELINE LOGS

LIST OF WIRELINE LOGS
WELL 8/4-1

All logs were recorded on magnetic tape.

| <u>RUN</u> | <u>TYPE OF LOG</u> | <u>SCALE</u> | <u>INTERVAL</u> | <u>DATE</u> |
|------------|--------------------|----------------|-----------------|----------------|
| 1 | ✓ GR | 1:200 1:500 | 85-433 | 25th June 1977 |
| | ✓ BHC-SONIC | 1:200 1:500 | 106-433 | 25th June 1977 |
| 2 | Thermometer log | 1:200 1:500 | 86-397 | 29th June 1977 |
| | ✓ Caliper log | 1:200 1:500 | 43-397 | 29th June 1977 |
| 3 | ✓ ISF/SONIC-GR | 1:200 1:500 | 412-1385.3 | 4th July 1977 |
| | ✓ FDC-GR | 1:200 1:500 | 412-1384 | 4th July 1977 |
| 4 | Temperature log | 1:200 1:500 | 100-1350 | 7th July 1977 |
| 5 | ✓ ISF/SONIC-GR | 1:200 1:500 | 1376.5-2623 | 21st July 1977 |
| | ✓ FDC-CNL-GR | 1:200 1:500 | 1376.5-2600.5 | 21st July 1977 |
| | ✓ HDT | 1:200 | 1376.5-2602.5 | 22nd July 1977 |
| | WST | | 155-2600 | 22nd July 1977 |
| | CST | | 1521-2541.5 | 22nd July 1977 |

APPENDIX NO. 9

WELLSITE LOG ANALYSIS

LOG ANALYSIS CONCLUSIONS

A complete log analysis was performed over the electrically logged portion of the hole from 85m to 2361.46m.

A more detailed study was conducted over the porous sections of the Upper Cretaceous chalk and the sands of the Middle Jurassic and Triassic.

This analysis indicated that there were no zones of moveable hydrocarbon in 8/4-1.

This conclusion was substantiated by the lack of shows in the sidewall cores which were shot in the zones of interest. Two sidewall cores at 2417 and 2462 had weak residual oil shows. These two points had calculated water saturations of 100%.

Using a 30% VSH cut off and a corrected porosity of 10% the net chalk in 8/4-1 is 146m. A 35% VSH cut off parameter was applied to the sands with a corrected porosity (effective porosity) of 15%. Using these parameters there is 13.5m of net sand in the Jurassic and 4.5 m of net sand in the Triassic.

The calculated porosities used for the water saturation calculations compare favourably with those derived from the core analysis.

VELOCITY SURVEY

The velocity survey was conducted by Schlumberger in conjunction with G.S.I. 25 check shots were taken in the interval from 155m to 2600m.

The results of this survey have been/will be distributed.

UNIONOIL NORGE A/S

LOG EVALUATION SHEET

Well : 8/4-1
 Run : 3
 Interval : 1377 - 2631.6
 Geologist : J. C. Ellice-Flint
 Date : 21st July 1977
 UPPER CRETACEOUS (CHALK)

LOG DATA

GR min : 10
 GR max : 103
 R+ sh : 0.5

| Interval Depth | GR | V sh | pbsh | pb | ϕ_{dc} | ϕ_{nsh} | ϕ_n | ϕ_{nc} | ϕ_c | Rw | Rmf | RIld | RIIs | Rxo | Di | Rt | Sw | Sxo | Remarks | |
|----------------|----|------|------|------|-------------|--------------|----------|-------------|----------|------|------|------|------|-----|----|----|----|-----|---------|--|
| 1604-1630 | | | | | | | | | | | | | | | | | | | | |
| 1605 | 27 | 0.18 | 2.07 | 2.35 | 0.14 | 42 | 22.5 | 15 | 14 | 0.04 | 0.12 | 1.3 | 1.2 | | | | 83 | 100 | WET | |
| 1606 | 30 | 0.22 | 2.07 | 2.34 | 0.14 | 42 | 24 | 15 | 14 | 0.04 | 0.12 | 1.2 | 1.2 | | | | 83 | 100 | " | |
| 1607 | 24 | 0.15 | 2.07 | 2.38 | 0.14 | 42 | 23 | 17 | 14 | 0.04 | 0.12 | 1.3 | 1.4 | | | | 88 | 100 | " | |
| 1608 | 21 | 0.12 | 2.07 | 2.35 | 0.17 | 42 | 23.5 | 19 | 17 | 0.04 | 0.12 | 1.3 | 1.2 | | | | 82 | 100 | " | |
| 1609 | 19 | 0.10 | 2.07 | 2.36 | 0.17 | 42 | 19 | 15 | 16 | 0.04 | 0.12 | 1.3 | 1.4 | | | | 88 | 100 | " | |
| 1610 | 18 | 0.09 | 2.07 | 2.36 | 0.17 | 42 | 21 | 17 | 17 | 0.04 | 0.12 | 1.3 | 1.4 | | | | 86 | 100 | " | |
| 1611 | 23 | 0.14 | 2.07 | 2.39 | 0.13 | 42 | 18.5 | 13 | 13 | 0.04 | 0.12 | 1.4 | 1.5 | | | | 92 | 100 | " | |
| 1612 | 23 | 0.14 | 2.07 | 2.34 | 0.16 | 42 | 21.5 | 16 | 16 | 0.04 | 0.12 | 1.3 | 1.2 | | | | 82 | 100 | " | |
| 1613 | 22 | 0.13 | 2.07 | 2.33 | 0.17 | 42 | 23.5 | 18 | 18 | 0.04 | 0.12 | 1.2 | 1.1 | | | | 82 | 100 | " | |
| 1614 | 25 | 0.16 | 2.07 | 2.37 | 0.14 | 42 | 19 | 12 | 13 | 0.04 | 0.12 | 1.4 | 1.4 | | | | 87 | 100 | " | |
| 1615 | 19 | 0.10 | 2.07 | 2.40 | 0.15 | 42 | 18 | 14 | 14 | 0.04 | 0.12 | 1.5 | 1.5 | | | | 92 | 100 | " | |
| 1616 | 16 | 0.06 | 2.07 | 2.40 | 0.16 | 42 | 18 | 15 | 16 | 0.04 | 0.12 | 1.6 | 1.6 | | | | 89 | 100 | " | |
| 1617 | 15 | 0.05 | 2.07 | 2.39 | 0.17 | 42 | 18.5 | 16 | 17 | 0.04 | 0.12 | 1.6 | 1.6 | | | | 86 | 100 | " | |
| 1618 | 18 | 0.09 | 2.07 | 2.43 | 0.13 | 42 | 17 | 13 | 13 | 0.04 | 0.12 | 1.7 | 1.7 | | | | 94 | 100 | " | |
| 1619 | 19 | 0.10 | 2.07 | 2.44 | 0.12 | 42 | 16 | 12 | 12 | 0.04 | 0.12 | 1.8 | 1.8 | | | | 96 | 100 | " | |
| 1620 | 25 | 0.16 | 2.07 | 2.45 | 0.09 | 42 | 16 | 0.09 | 0.09 | 0.04 | 0.12 | 1.8 | 1.7 | | | | 99 | 100 | " | |
| 1621 | 17 | 0.08 | 2.07 | 2.42 | 0.14 | 42 | 17.5 | 14 | 14 | 0.04 | 0.12 | 1.8 | 1.8 | | | | 89 | 100 | " | |

UNIONOIL NORGE A/S

LOG EVALUATION SHEET

Well : 8/4-1
 Run : 3
 Interval : 1376.5 - 2631.6
 Geologist : J.C. Elllice-Elint
 Date : 21st July 1977

LOG DATA

GR min : 10
 GR max : 103
 R+ sh : 1.3

M. JURASSIC - TOP DOGGER SAND

| Interval Depth | GR | V sh | pbsh | pb | φdc | φnsh | φn | φnc | φc | Rw | Rmf | Rlld | RIIs | Rxo | Di | Rt | Sw | Sxo | Remarks |
|----------------|----|------|------|------|------|------|------|-----|----|----|-----|------|------|-----|----|----|-----|-----|---------|
| 2409-2425.5 | | | | | | | | | | | | | | | | | | | |
| 2410 | 36 | 0.28 | 2.40 | 2.43 | 0.09 | 36 | 30 | 23 | 12 | | | 1.0 | 1.1 | | | | 100 | 100 | WET |
| 2411 | 37 | 0.29 | 2.40 | 2.38 | 0.12 | 36 | 19.5 | 12 | 12 | | | 0.72 | 1.2 | | | | 100 | 100 | |
| 2412 | 37 | 0.29 | 2.40 | 2.35 | 0.14 | 36 | 23 | 15 | 14 | | | 0.58 | 1.1 | | | | 100 | 100 | |
| 2413 | 34 | 0.26 | 2.40 | 2.33 | 0.15 | 36 | 27.5 | 21 | 17 | | | 0.73 | 1.1 | | | | 98 | 100 | |
| 2414 | 36 | 0.28 | 2.40 | 2.45 | 0.08 | 36 | 20.5 | 13 | 9 | | | 1.8 | 2.0 | | | | 93 | 100 | |
| 2415 | 26 | 0.17 | 2.40 | 2.36 | 0.15 | 36 | 15.5 | 13 | 14 | | | 1.0 | 1.0 | | | | 100 | 100 | |
| 2416 | 29 | 0.20 | 2.40 | 2.25 | 0.21 | 36 | 21 | 17 | 20 | | | 0.40 | 0.65 | | | | 100 | 100 | |
| 2417 | 27 | 0.18 | 2.40 | 2.25 | 0.21 | 36 | 26 | 23 | 22 | | | 0.21 | 0.40 | | | | 100 | 100 | |
| 2418 | 24 | 0.15 | 2.40 | 2.25 | 0.22 | 36 | 21.5 | 19 | 21 | | | 0.18 | 0.31 | | | | 100 | 100 | |
| 2419 | 32 | 0.24 | 2.40 | 2.32 | 0.16 | 36 | 22 | 17 | 16 | | | 0.20 | 0.25 | | | | 100 | 100 | |
| 2420 | 36 | 0.28 | 2.40 | 2.48 | 0.06 | 36 | 22 | 15 | 8 | | | 2.0 | 2.0 | | | | 96 | 100 | |
| 2421 | 30 | 0.22 | 2.40 | 2.47 | 0.08 | 36 | 12 | 7 | 8 | | | 2.0 | 2.0 | | | | 100 | 100 | |
| 2422 | 30 | 0.22 | 2.40 | 2.44 | 0.09 | 36 | 15 | 10 | 10 | | | 1.0 | 1.6 | | | | 100 | 100 | |
| 2423 | 27 | 0.18 | 2.40 | 2.33 | 0.17 | 36 | 18 | 15 | 16 | | | 0.40 | C.48 | | | | 100 | 100 | |
| 2424 | 36 | 0.28 | 2.40 | 2.33 | 0.15 | 36 | 20 | 13 | 15 | | | 0.35 | 0.49 | | | | 100 | 100 | |
| 2425 | 47 | 0.40 | 2.40 | 2.36 | 0.13 | 36 | 21 | 9 | 12 | | | 0.60 | 1.0 | | | | 100 | 100 | |

UNIONOIL NORGE A/S

LOG EVALUATION SHEET

LOG DATA

GR min : 10
 GR max : 103
 R+sh : 1.3

Well : 8/4-1
 Run : 3
 Interval : 1376.5 - 2631.6
 Geologist : J.C. Elllice-Elint
 Date : 21st July 1977

M. JURASSIC

| Interval Depth | GR | V sh | pb sh | pb | ϕ_{dc} | ϕ_{nsh} | ϕ_n | ϕ_{nc} | Rw | Rmf | Rlld | RIIs | Rxo | Di | Rt | Sw | Sxo | Remarks | | |
|----------------|----|------|-------|------|-------------|--------------|----------|-------------|----|-----|------|------|-----|----|----|-----|-----|----------|---|---|
| 2432.5-2438 | | | | | | | | | | | | | | | | | | | | |
| 2433 | 33 | 0.25 | 2.40 | 2.52 | 0.04 | 36 | 14.5 | 9 | 5 | | 2.0 | 3.0 | | | | 100 | 100 | Dolomite | | |
| 2434 | 37 | 0.29 | 2.40 | 2.51 | 0.04 | 36 | 16.5 | 9 | 5 | | 3.0 | 5.0 | | | | 98 | 100 | " | | |
| 2435 | 34 | 0.26 | 2.40 | 2.55 | 0.02 | 36 | 18.0 | 12 | 4 | | 1.9 | 1.8 | | | | 100 | 100 | " | | |
| 2436 | 25 | 0.16 | 2.40 | 2.76 | — | 36 | 10.0 | — | — | | 3.0 | 3.0 | | | | T | I | G | H | T |
| 2437 | 32 | 0.24 | 2.40 | 2.60 | — | 36 | 10.0 | 5 | 1 | | 2.9 | 5.0 | | | | T | I | G | H | T |
| 2459-2495 | | | | | | | | | | | | | | | | | | | | |
| 2462 | 37 | 0.29 | 2.40 | 2.30 | 17 | 36 | 18.0 | 10 | 15 | | 0.48 | 0.95 | | | | 100 | 100 | | | |
| 2465 | 34 | 0.26 | 2.40 | 2.28 | 19 | 36 | 18.5 | 12 | 17 | | 0.40 | 0.77 | | | | 100 | 100 | | | |
| 2473.5 | 29 | 0.20 | 2.40 | 2.66 | — | 36 | 3.0 | — | — | | 8.0 | 14.0 | | | | 100 | 100 | Tight | | |
| 2482 | 38 | 0.30 | 2.40 | 2.48 | 6 | 36 | 13.0 | 5 | 6 | | 1.4 | 1.6 | | | | 100 | 100 | Tight | | |
| 2491 | 34 | 0.26 | 2.40 | 2.45 | 8 | 36 | 15.0 | 9 | 8 | | 1.4 | 2.0 | | | | 100 | 100 | Tight | | |
| 2436 | 25 | 0.16 | 2.40 | 2.76 | — | 36 | 10.0 | 4 | — | | 3.0 | 3.0 | | | | 100 | 100 | | | |

APPENDIX NO. 10

MICROPALAENTOLOGICAL REPORT

There is a close agreement between the micropalaeontological breakdown of the 8/4-1 well and the "tops" picked during the drilling of the well. The top Triassic pick as used in this report and on the Composite Log is based on the sudden appearance of red beds at 2513 m.

As can be seen from the Micropalaeontological Report by Robertson Research International top Triassic is picked somewhat higher at 2440 m, and is also based on lithology.

This report will be provided under separate cover.

APPENDIX NO. 11

AFTERSITE SURVEY

A special ammendment to the 8/4-1 Well Completion Report will be prepared and forwarded after the After-site survey is completed.

This will include comparisons of the side-scan-sonar, echo sounder and sparker profiles of the Pre-site survey with that of the After-site survey.

APPENDIX NO. 12

REPORTS ON WELL HEAD AND SEA FLOOR

UNION

Sandnes, July 29. 1977

VR/kh

Oljedirektoratet
Boks 600

4001 STAVANGER

Att: B. Frøyland

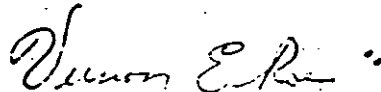
Your letter of July 26, 1977 reference number OD 8889/
77/BF/GJ/permission to plug 8/4-1 received.

Concerning the qualifications to this permission following
is a progress report:

1. The additional 30 meter cement plug was laid at 2110 meters as per the request.
2. The wellhead was inspected by yourself and Mr. Knudsen on July 27. It is being moved to Cameron Iron Works to be reconditioned so it can be reused.
3. Please see the enclosed report of diving inspection.

Geoteam has been contacted to run a side scan sonar survey, however, no firm date has been named to conduct this survey.

Yours truly


Vernon E. Roe
Operations Manager

OCEANEERING INTERNATIONAL

To: Mr C. Blackburn (UNION OIL)

Date: 25/7/77

From: A. R. Jackson (Oceaneering Int. AG)

Subject: Seabed Clearance

A survey of the seabed below D.B. NORJARL on location 8/4-1 was carried out on the above date by divers of Oceaneering Int. AG

The survey was made by a lock out dive from the diving bell in a circular search with a radius of 55 feet around the well position, the visibility was approximately 60 feet, this making a searched radius of 115 feet.

The seabed was found to be clear of any protusions or debris.

Respectfully

A. R. Jackson.

Oceaneering Diving Supervisor

D.B. NORJARL

APPENDIX NO. 13

GEOCHEMICAL ANALYSIS

This report will be provided under separate cover.

APPENDIX NO. 14

PRESSURE REPORT

FINAL PRESSURE REPORT

SUMMARY OF PRESSURE DETECTION ANALYSIS

for

UNIONOIL NORGE A/S

WELL 8/4-1

JUNE - JULY 1977

EXPLORATION LOGGING OVERSEAS INC.

The following summary has been taken from the final well analysis which was submitted by the exploration pressure logging engineers on 8/4-1. This appendix also includes, drilling data, wireline data, overburden gradient versus depth curve and a Conclusion Log.

FORMATION PRESSURE GRADIENT

The formation pressure gradient (F.P.G.) values are presented on the Conclusion Log.

Abnormal pressures were encountered.

(A) 30" casing shoe 124.66 m to 20" casing depth 410.05 m

From knowledge of other wells drilled in the general area, a normal pore pressure gradient of 8.8 ppg. EMW (0.458 psi/ft) was assumed.

Trend establishment for the data plotted at this shallow depth is difficult due to the unconsolidated nature of the sediments, coupled with the non-establishment of a normal compaction trend within these shallow sediments. Clay predominated in the lower section but the DXC values derived from it are questionable because of the jetting action of the bit.

Shale factor values only served to confirm the unconsolidated and uncompacted nature of the sediments.

The temperature plot was for the most part unestablished due to the mixing and addition of mud to the active system.

Background gas did increase and therefore possibly indicates an increase in pore pressure.

The sonic log run for this section of hole, gave high transit time values suggesting porous, uncompacted young sediments with maybe an indication of slight abnormal pressure. Placement of a normal trend line representing a normal rate of compaction and normal pressure was tentatively established and deviation from this normal indicated an increase in pore pressure. It appears likely that the pore pressure at the 20" casing shoe is around 8.9 - 9.0 ppg. EMW.

(B) 20" casing 410.05 m to 13-3/8" casing depth 1378.14 m

Clay predominated throughout this section and was drilled without any parameters being controlled. For this reason, the DXC is quite meaningful and the trend established from it indicates a gradual increase in pore pressure down to 899 m. where it is approximately 9.3 ppg. EMW. From this point the pore pressure gradient increase more rapidly and at 1377 m it is approximately 11.6 ppg. EMW.

Temperature follows a constant trend with one discontinuity caused by a trip at 625 m. However, at 899 m, the gradient steepens and remains like this down to the casing point. This has no quantitative value but tends to confirm 899 m at the top of the "major overpressure".

The readings of total gas are not particularly helpful as they will be masked by the gradually increasing mud weight. Uphole sections averaged approximately 15 units. This figure drops to 5 - 10 units below 900 m but this does coincide with a increase in mud weight from 9.3 to 9.7 ppg.

Towards the bottom (1200 m), the gas rises again to 15 units despite a mud weight in excess of 10.0 ppg. These values are not very high, but they probably reflect the impermeable nature of the formations as for the most part of this section it can be seen from the Conclusion Log that it was drilled slightly underbalanced.

Shale factor has been determined every hundred meters but it appears to show no variation from its trend of 15 at 100 m to 12.5 at 1360 m. There is a slight rise below 899 m but this is within experimental error.

Shale density is only available from the F.D.C. log and follows a near vertical trend. This suggests a gradually increasing pressure, but as no good uphole normal trend could be established, its use is restricted.

The sonic does appear to deviate at 899 m and continues to do so, giving an approximate value of 11.6 ppg. EMW for pore pressure casing depth.

The resistivity in this instance only serves to qualify the presence of overpressure and not quantify it. A reverse trend exists but is of such magnitude that it appears likely that formation chemistry or some other factor has influenced the readings. They are far lower than normal and this cannot be immediately explained.

From the caliper it appears that apart from a section between 2400 - 2650 ft. (740 - 800 m) the uphole section is in gauge or slightly over but below 3100 ft. (950m) it is predominantly under gauge. This would tend to suggest that the clays were swelling in this region and was probably due to the underbalanced hydrostatic at the time of running wireline logs.

(C) 13-3/8" casing shoe 1378.14 m to T.D. at 2631.46 m

A major unconformity at 1604 m between the paleocene and Upper Cretaceous interrupts this section, and it is likely that below it there is a return to a normal pressure regime.

Down to the unconformity there is a continuing pore pressure increase evidence for which is supported by DXC, background gas, temperature shale factor and wireline logs. A pore pressure of 12.6 ppg. EMW is estimated just above the unconformity and it is in fact the highest pore pressure in the well.

As there is no empirical data available it can only be assumed that the pore pressure below the unconformity returns to normal as this is generally the case in this area of the North Sea. However, the shift in DXC, the low gas readings and the general hole behaviour tends to support that this is in fact the case.

Few shale points exist so the usefulness of most pore pressure indicators is reduced to a minimum. Normal trends for this section are almost impossible to establish.

Background gas averaged only 1 or 2 units to T.D. with little trip and no connection gases, reflect the overbalanced situation that existed when this section of hole was drilled.

A pore pressure of about 9.0 - 9.2 ppg. EMW probably exists below the unconformity to T.D. at 2630 m.

All pore pressure figures are tentative but are obtained from a thorough appraisal of the whole situation and all of the monitored and recorded data gathered from the well and are presented on the Conclusion Log.

FORMATION FRACTURE GRADIENT

The formation fracture gradient (F.F.G.) values are presented on the Conclusion Log.

The plotted fracture gradient values have been derived from a combination of methods, namely, the theoretical method proposed by Mathews and Kelly, and Eaton and the empirical methods of formation testing and determining the maximum and minimum E.C.D. reached.

The formation directly below the 30" casing was not tested but when drilled using an 8.8. ppg seawater-gel, circulation was lost. Here, therefore, is an isolated zone (probably a sand) where the fracture pressure is lower than 8.8. ppg. EMW.

The 20" casing shoe was set at 410.05 m and drilled out using a 9.0 ppg mud weight. The formation was tested to leak-off and this occurred at 12.5 ppg. EMW was compared with the theoretical fracture of 11.9 - 12 ppg. for this depth.

A leak-off test at the 13-3/8" casing shoe at 1378.14 m produced a fracture equivalent to 14.7 ppg. and this compares with a theoretical fracture of 13.9-14 ppg. EMW.

No mud losses occurred from this point to T.D. and no further leak-off tests were conducted so therefore a theoretical fracture gradient has been assumed in the open hole below the 13-3/8" casing.

CONCLUSION

Three pressure regimes exist in this well.

The first includes the Upper Tertiary sediments and is only very slightly overpressured reaching approximately 9.2 ppg. at its base at 2950 ft. (899m). This is the top of the second regime and marks the unconformity between the Upper Tertiary and Eocene sediments. The Eocene and the Paleocene below, exhibit an increasing pore pressure with depth reaching a maximum of approximately 12.6 ppg. EMW above the Paleocene/Upper Cretaceous unconformity at 5261 ft. (1604 m). The third regime extends to T.D. and is assumed to be near normally pressured.

CONCLUSION LOG

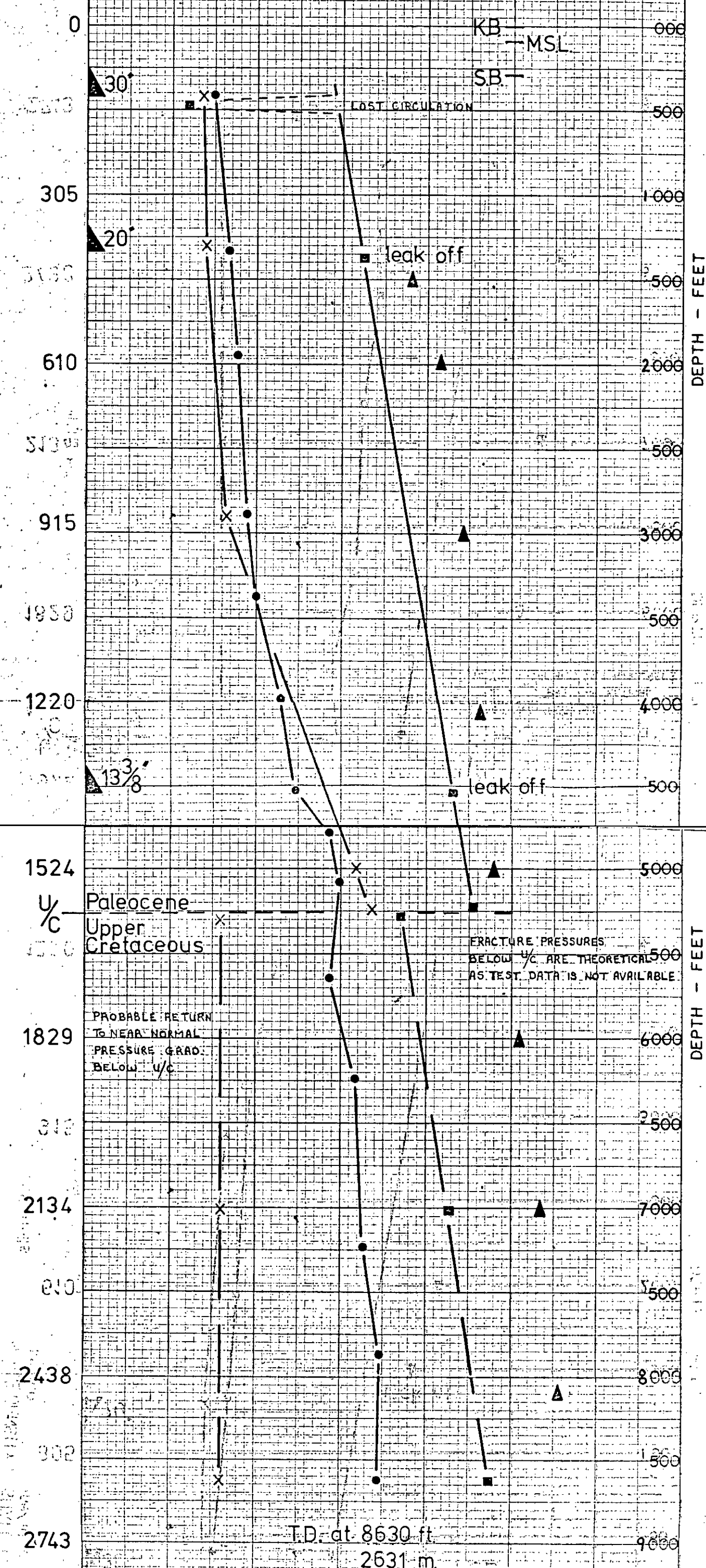
WELL 8/4-1

DATE June-July '77

LEGEND
 X PORE PRESS ● MUD WT ■ FRAC PRESS ▲ OBG

EQUIVALENT POUNDS PER GALLON

80 100 120 140 160 180



DEPTH - FEET

DEPTH - FEET

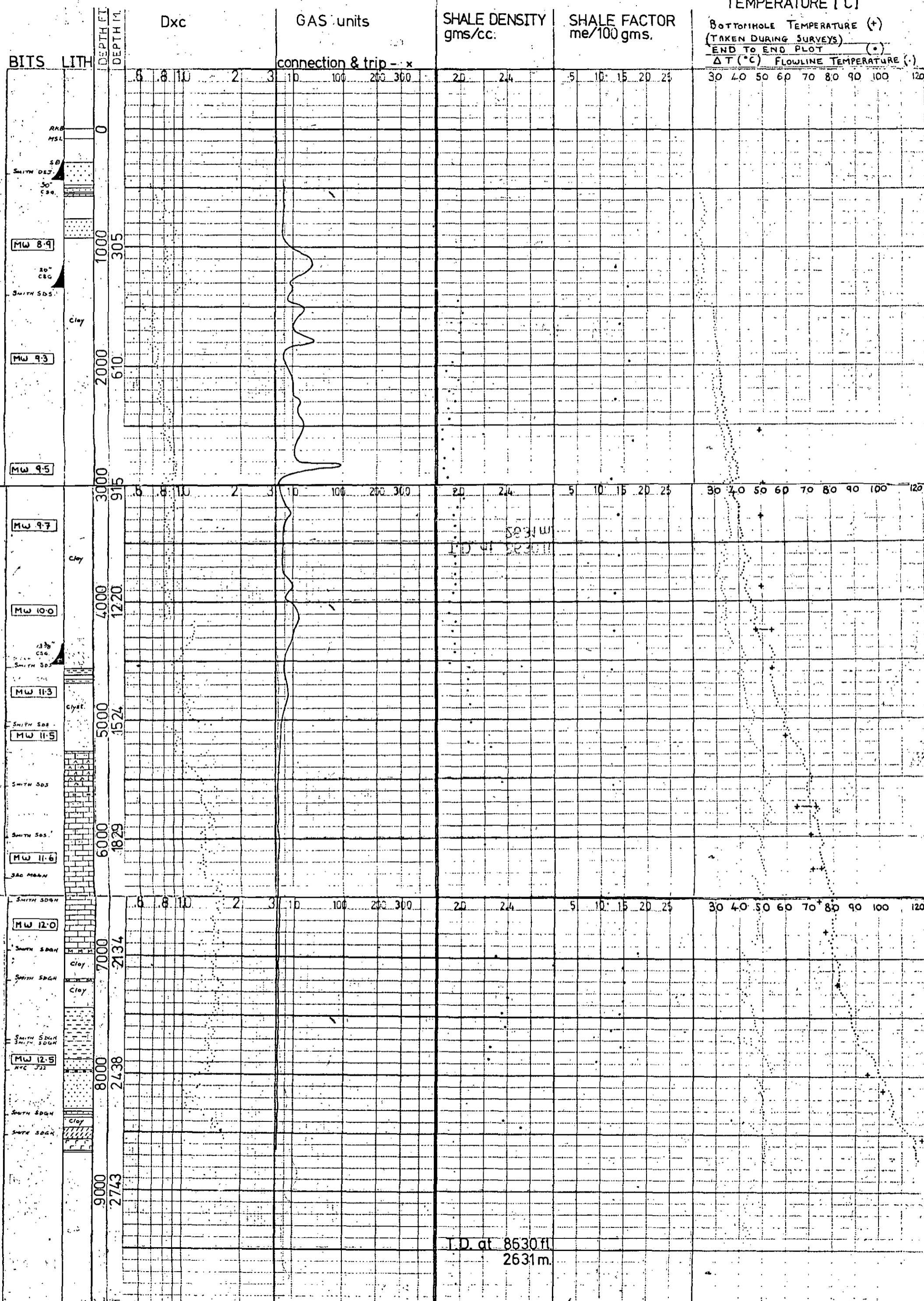
DATE

TIME

PAGE

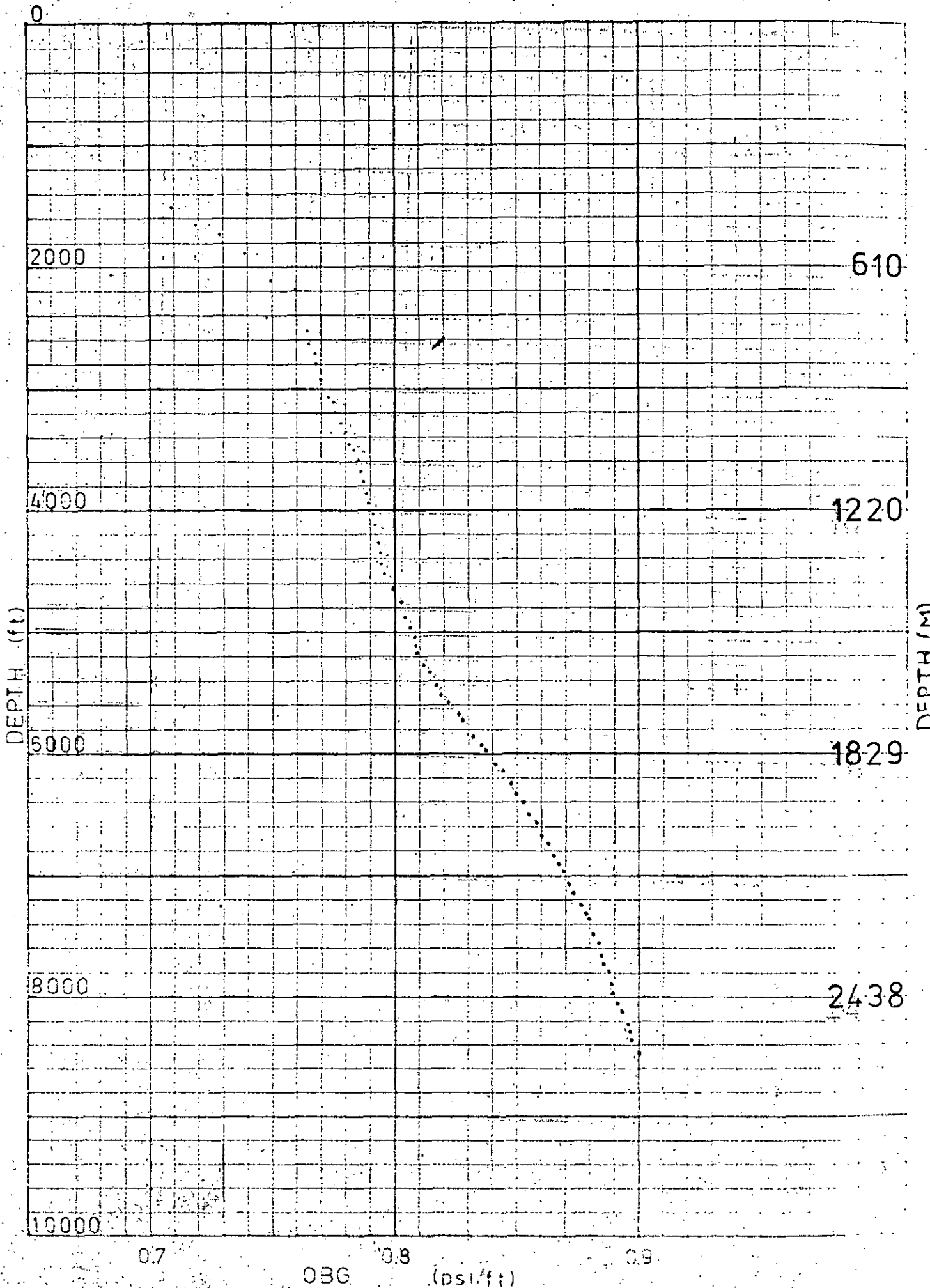
EXPLORATION LOGGING
DRILLING DATA LOG.

COMPANY. Unionoil Norge A/S
WELL. 8/4-1



T.D. at 8630 ft
2631 m.

OBG vs. DEPTH



WIRELINE DATA LOG

WELL 8/4-1

| SONIC Δt m - sec / ft. | INDUCTION RESISTIVITY ohm - m | DENSITY gm / cc |
|--------------------------------|-------------------------------|-----------------|
| 0 | | |
| 500 | | 152 |
| 1000 | | 305 |
| 1500 | | 457 |
| 2000 | | 610 |
| 2500 | | 762 |
| 3000 | | 914 |
| 3500 | | 1067 |
| 4000 | | 1219 |
| 4500 | | 1372 |
| 5000 | | 1524 |
| 5500 | | 1676 |
| 6000 | | 1829 |
| 6500 | | 1981 |
| 7000 | | 2133 |
| 7500 | | 2286 |
| 8000 | | 2438 |
| 8500 | | 2591 |
| 9000 | | 2743 |

Comp. 100

0

0

0

0