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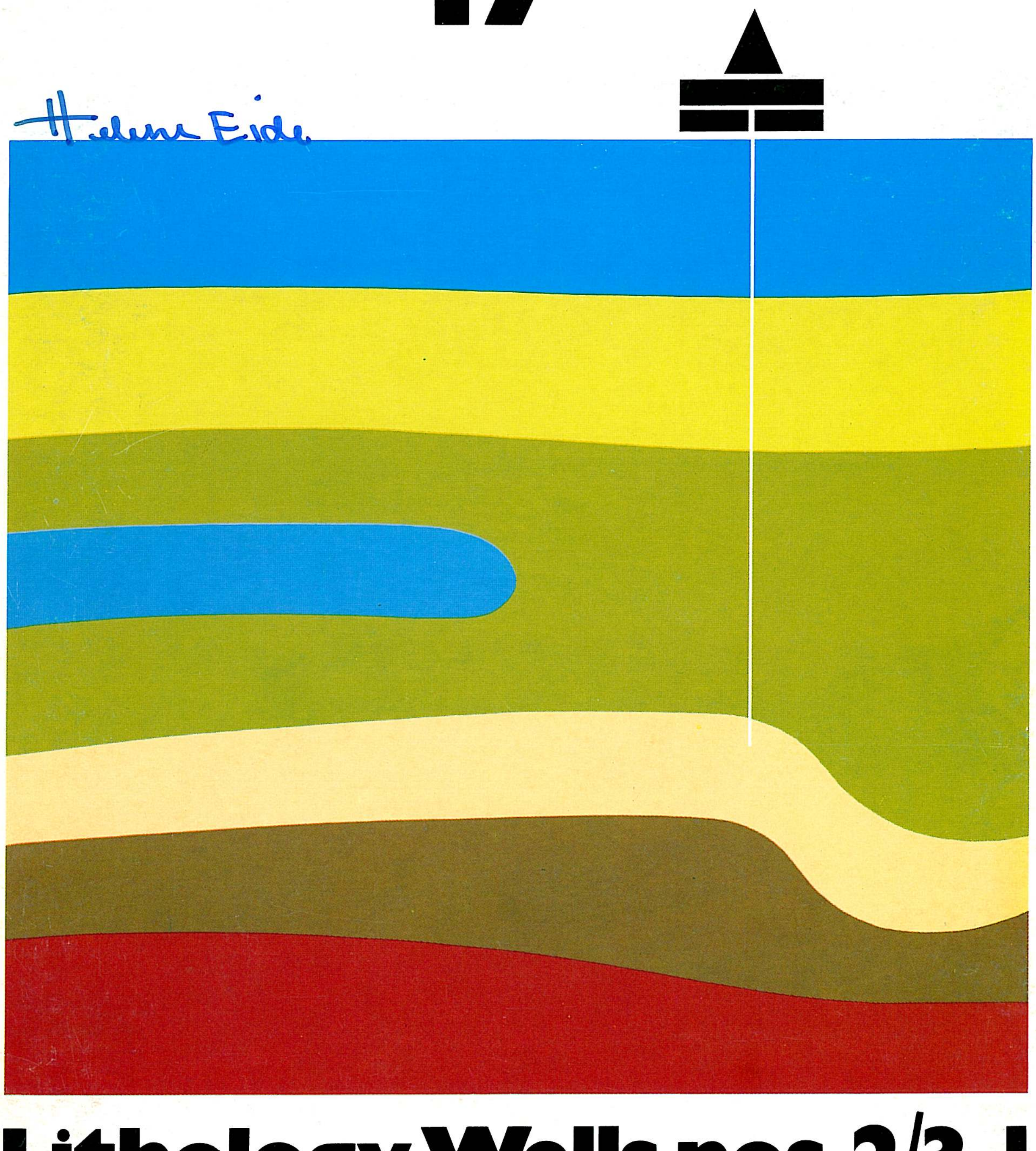

# Lithology. Wells nos. 2/3-1 2/3-2 and 2/3-3

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# Lithology. Wells 2/3-1, 2/3-2 and 2/3-3

13 Tables
3 Figures
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# Preface

The Norwegian Petroleum Directorate has, among its duties, the responsibility for publication of releasable data connected to petroleum activities on The Norwegian Continental Shelf.

In this connection it has been decided to make a standardized description of drill bit cuttings as well as cores.

The sample descriptions are based on the "Standard Legend — Exploration and Production Department of the Royal Dutch/Shell group of companies". The Directorate much appreciates the Royal Dutch/Shell companies and A/S Norske Shell Exploration and Production's permission to use their legend.

The samples and the wire line logs from the herein described well are released to scientific institutions, companies and other interested organizations for further studies. The material pertinent to the well can be examined in the Directorate. For practical reasons an application must be made in each case.

The application should state what material is to be examined, what kind of examination will be made, and the purpose of the studies. It should be addressed to:

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# Acknowledgements

The tables were compiled by Klaus Motland and Per Brandshaug, and the drafting was done by Dag Svardal. Aase Moe had made a paleontological study of a section of well 2/3-3, and this study has been used in the paper. Other colleagues have contributed during discussions on geological interpretations.

# THE BLOCK SYSTEM FOR CONCESSIONS ON THE NORWEGIAN CONTINENTAL SHELF SOUTH OF 62°N

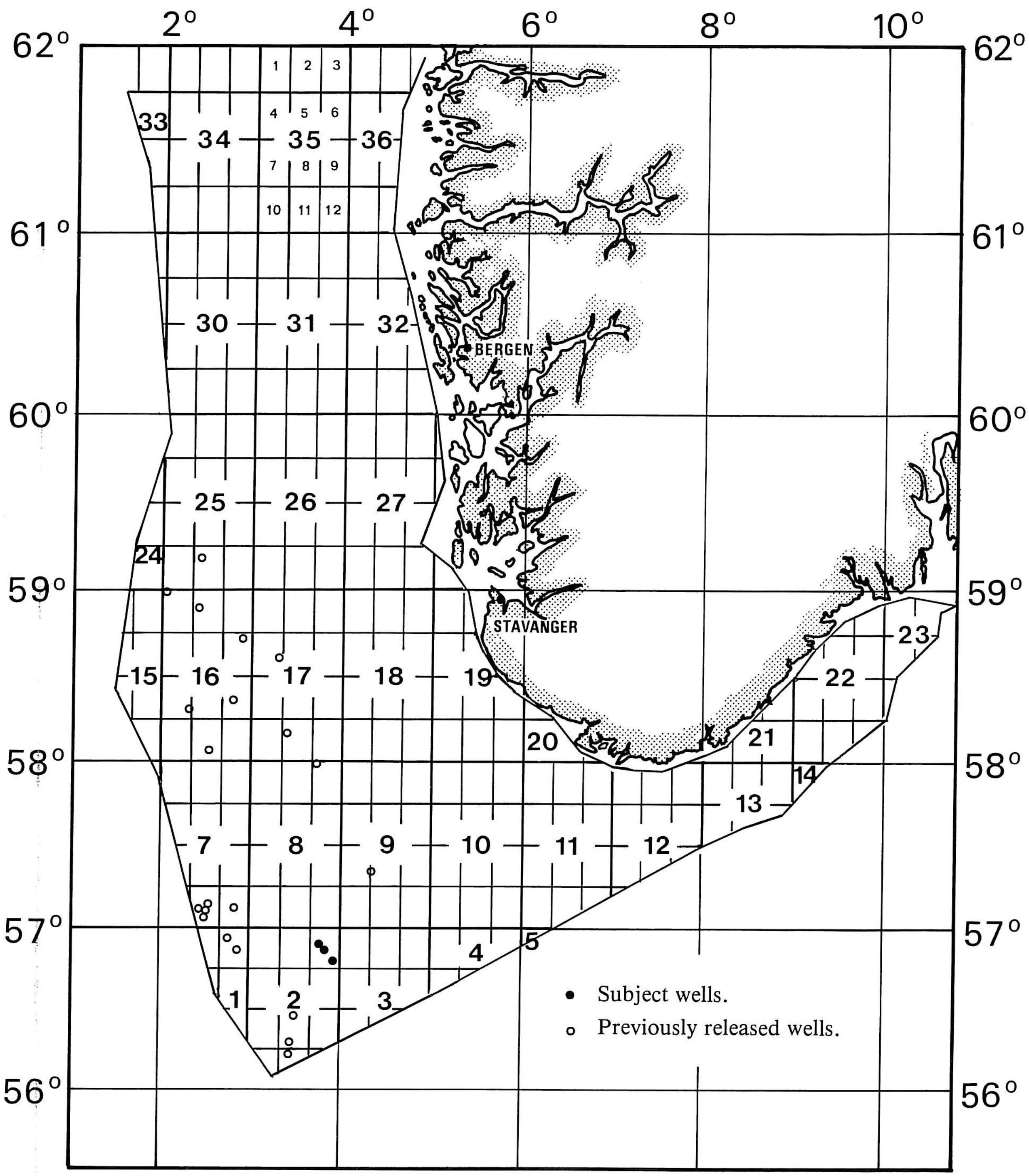


Fig. 1

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# LITHOLOGY WELLS 2/3-1, 2/3-2, 2/3-3

## Introduction

The Murphy Group was in 1965 allotted license No. 022, comprising blocks 2/3, 3/1, 3/5 and 9/10, on the Norwegian Continental Shelf.
The group consisted of:
Norske Murphy Oil Company, Pennzoil Company Norge, Wintershall Norge A/S, Amax Petroleum Norge A/S, Norske Ocean Exploration Company and K/S A/S Polaris Oil Consortium.
Murphy was operator for wells 2/3-1, 2/3-2 and 2/3-3, with permit Nos. 23,30 and 61, respectively. 2/3-1 was spudded 10th February 1969 at 56° 53' 09.5'' N, 03° 51' 38.3'' E. Objectives were to test the Tertiary and Mesozoic sediments. Some gas was encountered in sandstones of an Oligocene-Miocene age, and this was the only appearence of hydrocarbons in the well. 2/3-1 was plugged and abandoned 3rd April 1969.
The 2/3-2 well was spudded on the same structure 28th July 1969 at 56° 54' 53.7'' N, 03° 49' 02.3'' E. The main objective was the gas bearing Oligocene-Miocene sandstones found in the first well. The expected sandstone beds were well developed, but contained no hydrocarbons and the well was plugged and abandoned 12th August 1969.
After the disappointing results of 2/3-2, the next well was placed on a separate structure, south east of the first one. The 2/3-3 well was spudded 8th October 1971 at the position 56° 48' 18.9'' N, 03° 58' 11.8'' E. Objectives were Oligocene sands, Danian limestones and Jurassic sandstones. However, the well revealed no hydrocarbons and was plugged and abandoned 20th November 1971.

## Drilling operations

### WELL 2/3-1

This exploration well was drilled with the semi-submersible rig ''Ocean Traveler'', at a mean water depth of 57 m (187'). The kelly bushing (KB) elevation was 27 m (89'), and the depths used in the text and on the appended lithology log are measured from the KB. Total depth (TD) is by the driller reported to be 2933.4 m (9624'). The depths of the lithological sequence on the appended log are adjusted to the gamma-ray/sonic logs (GR/BHC-Sonic logs).
The 36'' and 26'' holes were drilled with returns to sea floor. A fresh water/gel mud was spotted in the hole in connection with running of the 30'' and 20'' casings. The 26'' hole was drilled to 463 m (1520') to set the 20' casing at this depth. However, the casing stuck in the hole and would not go below 235 m (902') where it had to be set and cemented.
A 17 1/2'' hole was drilled to 1323.5 m (4342') with a Q-Broxin/Caustic mud, which was used to TD. At around 1310 m (4300') gas cut occurred in the mud and the weight had to be raised to 11.5 ppg. The 13 3/8'' casing was successfully run, and a 12 1/4'' hole was drilled to TD. While preparing to run the next casing, a storm hit the location. The barge moved approximately 300 m (1000') off the location, and the connections to the wellhead had to be disconnected. After waiting on weather for six days, the rig was back on location and the connections were reestablished. A 7'' casing string was then set. The setting depths of the four casing strings are given in Table 1, and a summary of mud properties and components in Table 2a and 2b.
Two drill stem tests were made from the

gas bearing formations between approximately 1590 m and 1635 m. The results are listed in Table 3.
Some difficulties occurred during the logging operations through sticky clay sections, and reaming was necessary. The logs are listed in Table 4.

### WELL 2/3-2

This well was drilled with the same rig, the ''Ocean Traveler''. The KB elevation was 27 m (88.5'), and mean water depth at the borehole location was 58.5 m (191.5'). Total depth as measured by the driller is 2297 m (7536').
The well was spudded and a 36'' hole was drilled to 94.5 m (310'). A 26'' hole was then drilled to 299 m (980'), to simultaneously run the 30'' and 20'' casings. However, bridging took place, the pipe stuck and a fish was left in hole. The hole was abandoned, and the rig moved approximately 20 m (65') east of the original location. The new location became the final one, and corresponds to the coordinates given in the introduction.
2/3-2 was respudded and the 30'' and 20'' casings were run separately. The setting depths of the three casing strings used in this well are listed in Table 6.
The 36'' and 26'' holes, down to 211 m (693') were drilled with sea water and returns were to the sea floor.
The rest of the well was drilled with a Q-Broxin/ Caustic type mud, with properties and components as shown in Table 7a and 7b.
As in 2/3-1 bridging caused problems during the logging operations. This was especially evident in the 17 1/2'' hole, which had to be reamed and circulated. Still it turned out to be impossible to obtain an open hole GR/BHC-Sonic survey. The logs are listed in Table 8.
No tests were performed in the 2/3-2 well.

### WELL 2/3-3

The jack-up rig ''Ocean Tide'' was used to drill the 2/3-3 well. The KB elevation was 31.5 m (103') above mean sea level, and the mean water depth at the drill site was 56 m (183'). TD is reported by the drillers to be 2969 m (9741'). The depths of the lithological column on the appended log are adjusted to the GR/BHC-Sonic logs.
A 36'' conductor was set in a 38'' hole, followed by a 20'' casing in a 26'' hole. Sloughing of clay caused minor problems while running the latter. So far, the drilling was with sea water, but a gel slurry was spotted in the hole in connection with the casing jobs.
The 17 1/2'' hole was drilled using a Spersene /XP-20/ Caustic type mud. While running the 13 3/8'' casing it parted, but after a successful fishing job the casing was set without difficulties. The setting depths are listed in Table 10. A summary of the mud properties and components are given in Table 11a and 11b. No problems have been reported in connection with the logging operations, and a list of the logs run is presented in Table 12.
In total eight days were spent waiting on weather during the operations of this well.

## Available material

Drill bit cuttings from the three wells are stored at the Norwegian Petroleum Directorate (NPD). The sample intervals are listed in Table 5a, 9a and 13a, respectively. The number of cutting samples available, and their average weight are listed below:

| Well | No. of cutting samples | Average dry weight |
|---|---|---|
| 2/3-1 | 225 | 13 g |
| 2/3-2 | 562 | 14 g |
| 2/3-3 | 318 | 26 g |

Wet samples were collected from the 2/3-3 well. The sample intervals are listed in Table 13b, which also includes average weights after drying, and after being washed through a 74 micron sieve and dried.
Well logs are available from the three wells, and Tables 4, 8 and 12 show the types of logs run, their corresponding logging intervals and in what scales they are available.

Sidewall cores were collected in all the wells, but these are in the possession of the operator. A list of the cores and their corresponding depths are given for each of the wells in Tables 5b, 9b and 13c, respectively.
Conventional cores were not cut in any of the three wells.

# Geology

Structurally, block 2/3 is situated in the very south western part of the Norwegian Danish Basin, north of the Mandal High, which is a NNW-SSE trending, eastwardly rotated high with shallow basement (Rønnevik et al. 1975).
The subject wells are located on a north west-south east trending line (Figs. 2 & 3), almost parallel to the strike of the stepfaulted slope to the Central Trough. A map prepared in connection with the proposed nomenclature for the main structural features in the Norwegian North Sea (Rønnevik et al. 1975) is shown at the top of the appended logs.
Interpreted lithologies and lithostratigraphic subdivisions of wells 2/3-1 and 2/3-3 are summarized below and presented graphically on the appended logs. No such log has been made from 2/3-2, mainly because of the similarities to the 2/3-1 well, but also because 2/3-2 is much shallower than the other two wells. Neither will 2/3-2 be treated separately in the following text, but noteworthy differences with respect to 2/3-1 will be commented on.
In the description of the sediments, carbonate rocks are classified according to Dunham (1962) and grain size determinations are based on Wentworth's scale (Wentworth 1922). However, for practical reasons the term silt is only used when particles can be readily seen with the use of low power microscope or hand lens, i.e. greater than 20 microns. Colours are described according to the ''Rock-Color Chart'' (Geol. Soc. Am. 1970) and are based on dry samples.
The chronostratigraphy indicated in the text and on the appended logs, is mainly based on a paleontological study made by Paleoservices Ltd. and reported to the Norwegian Petroleum Directorate by the operator. From the Eocene and Paleocene of well 2/3-3, however, Aase Moe at the NPD had already made a paleontological study, which is the basis for the datings within these epochs.
The lithostratigraphic nomenclature used is based on the joint work of the UK-Norwegian lithostratigraphic committees, compiled by Deegan & Scull (1977).

## INTERPRETED LITHOLOGY AND LITHOSTRATIGRAPHY

The interpretations in this section are based on the description of drill bit cuttings and correlated to the wireline logs, primarily the GR/BHC-Sonic logs.

### *WELL 2/3-1*

The regular sampling of drill bit cuttings started at 479 m, approximately 200 m down in the 17 1/2'' hole. As only a rather unreliable GR-log is available from this portion of the hole, no differentiated lithology has been indicated above 479 m on the appended log.

#### *Nordland Group, 84-1330 m:*

The first samples obtained indicate mixed lithologies. Medium to very coarse grained sand units are present between thicker units of light olive grey clay. Shell fragments are frequent in the sand sections. The amount of sand and shells seems to decrease towards 643 m, where appreciable amounts of sand no longer was seen. Traces of carbonaceous material were observed at the base of the mixed sand/clay sequence.

The interval 643-1330 m is mainly composed of clays. These are dominantly olive grey in the upper part of the interval, with an increase of brown shades towards the base. The clays are slightly silty throughout and shell fragments were occasionally observed, but are by far as common as in the sand/clay section above.

Small amounts of limestone appeared around 860 m, and were thereafter found in samples at other depths. The carbonates are classified as mudstones, and are probably too thin to give distinct deflections on the GR/BHC-Sonic logs.

The brownish grey clay at the base of the Nordland Group seems to be gradually more compact and grades into claystone and shale.

The distinct breaks on the GR/BHC-Sonic logs, which are reported to be characteristic for the boundary between the Nordland and Hordaland Group have not been observed in 2/3-1. The boundary is therefore tentatively set at 1330 m, where a thin dolomite string occurs. In the type well for both groups in the Central North Sea, well 2/7-1 (Deegan & Scull 1977, Fig 41), dolomite is present at the very top of the Hordaland Group.

*Hordaland Group, 1330-2135 m:*

Argillaceous sediments dominate this section. The slight compaction observed at the base of the interval above, may also be seen at the top of this one. The sediment is probably best characterized as a claystone, which further down in the sequence grades into shale. The colour is brownish to olive grey down to approximately 2000 m, where lighter shades prevail. Light olive to brown shales exist down to around 2100 m, where shales in olive grey, greenish grey, medium dark grey and dark brownish grey were observed.

The argillaceous deposits of this group are mainly slightly to moderately calcareous, micaceous and occasionally silty. The lower varicoloured unit is also texturally somewhat more heterogeneous than the overlying unit.

Although claystone and shale constitute the main sediments, both sandstones and carbonates were registered. Two approximately 10-12 m thick layers of very fine to medium grained sandstone are present between 1588 m and 1637 m. These are glauconitic and exhibit light brown as well as greenish grey colours and are moderately sorted. Fair to good gas shows have been reported in the sandstones, and also in some silty shales above. Two tests were performed, one in each of the sandstones layers.

Lime mud/wackestone stringers are present throughout the Hordaland Group. They are mostly yellowish grey to light grey in colour. Some very hard, crystalline, brown dolomite was observed around 1560 m.

*Rogaland Group, 2135-2243 m:*

Three litostratigraphic units are recognized within the group in well 2/3-1; the Balder Formation, the Sele Formation and the Lista Formation.

The interval 2135-2153 m consists of varicoloured shales as described at the base of the Hordaland Group, but the shales in this interval were found to be tuffaceous. Vitric tuff is particularly present in a medium dark grey shale, and appears as light grey as well as greyish black specks. 3-4 m thick beds of light grey, lime mudstone were registered in the tuffaceous shale unit. This unit is identified as the Balder Formation. The top and base are clearly defined by the GR/BHC-Sonic logs.

Below 2153 m, varicoloured shales still exist, but a medium dark grey one dominates. Traces of tuff were found to around 2175 m.

This section of slightly tuffaceous and probably interbedded shales belongs in the Sele Formation, and is clearly separated from the Balder Formation by the log patterns.
There is no abrupt break in the lithology at 2175 m, but from approximately this depth medium grey and brownish grey shales seem to dominate and tuff was no longer observed. Traces of dark brown and red shales were still found in the samples, but it is impossible to determine whether this material is caved or not. Small amounts of fine grained, glauconitic sandstone were registered at around 2230 m.
As a whole, the interval 2175-2243 m shows greater homogeneity than the Balder and Sele Formations, and is interpreted to represent the Lista Formation. The upper boundary to the Sele Formation is based on the apparent absence of tuff, and must be seen in relation to the sampling interval of 6 m (20').

*Chalk Group, 2243-2559 m:*

This group is composed of lime mudstone throughout. However, the BHC-Sonic log tends to divide the unit into an upper rather porous part and a lower tight one. The upper section, which comprises the sediments down to 2315 m, consists of white, chalky and firm limestone. The carbonate is relatively pure, but some light grey and marly limestone is present around 2292 m. These upper 72 m of the limestone section are interpreted to belong in the Tor Formation.
The tight lime mudstones below 2315 m are white to very light grey in colour, and are harder than above. Minor amounts of light olive grey marl were observed in the limestone sequence.
These lower 44 m are difficult to place lithostratigraphically. In this part of the North Sea, the Tor Formation is very often underlain by the Hod Formation. The lithology of the Chalk Group of 2/3-1 is in accordance with this subdivision. However, the boundary between the two is usually picked on a characteristic GR/BHC-Sonic log pattern, showing higher radioactivity and lower velocity for the Hod Formation compared to the Tor Formation (Deegan & Scull 1977).
The contrary is observed in this well. The most likely explanation is probably that the lower tight part represents the lower portion of the Hod Formation, which may be very compact and show a high sonic velocity. This implies that a part of the Hod Formation is missing in 2/3-1.

*Cromer Knoll Group, 2359-2546 m:*

Both the Rødby Formation and the Valhall Formation, which constitute the group, have been recognized in the well.
There is a sharp break in lithology from the above limestones to a sediment consisting of marl and shale. The upper 12-13 m are dominated by a reddish brown and grey marl. However, medium grey, hard shale was also registered. This unit is underlain by a 2 m thick lime mudstone bed, which is very light grey in colour. This limestone bed marks the base of the Rødby Formation.
A medium grey to greenish grey shale was encountered below the limestone bed, together with some light olive grey marl. In the interval 2395-2425 m, a glauconitic sandstone is present. The sandstone is light olive grey, very fine to fine grained and has a calcareous cement. The thickest bed has its base at around 2425 m and reaches a thickness of 7 m.
Below this bed, there is a rather homogeneous section of medium dark grey, hard and calcareous shale, which persists through the rest of the interval.
The shale dominated section underlying the Rødby Formation, belongs in the Valhall Formation.

*Bream Formation, 2546-2563 m:*

This unit contains brownish grey to greyish black, micaceous shales. These are probably rich in organic material, and the GR-log shows a high radioactivity. The unit is recognized as the Børglum Member in the Bream Formation.

*Unnamed unit, 2563-2580 m (?):*

At 2563 m there is an abrupt break in the lithology from the dark shales above to a greenish grey, very fine to fine grained sandstone. Traces of glauconite and mica were registered in the sediment, and grey, calcareous shale partings are present. However, there is no sharp lower boundary of these sediments. The samples indicate a gradation from the greenish sandstones to light grey and finally to reddish brown ones over an interval of approximately 75 m. The GR/BHC-Sonic logs are not indicative of a sharp lithological break.

This sand unit is difficult to conform with confidence in the lithostratigraphy presented by Deegan & Scull (1977). It correlates relatively well to both the Haldager Formation and the Gassum Formation, although the texture and colour of this section favour the Haldager Formation.

*Skagerrak Formation, 2580(4)-2832 m:*

As indicated above, the greenish grey sandstones grade into light grey ones. The grains are mainly very fine to fine sized, but the element of medium sized grains increases downwards. Red colourations also increase downwards toward 2650 m, where the sandstone is mainly reddish brown, very fine to medium grained and poorly sorted. This sediment dominates to approximately 2740 m where light greyish red sandstones were encountered. These persist down to 2832 m. Texturally, the light greyish red sandstones have the same characteristica as the reddish brown ones above.

Shales are present throughout the interval. They appear mainly in thin stringers, but 3-4 m thicks beds occur. The shales have predominantly the same colour as the sandstones they are intercalated between.

Traces of anhydrite and lignite were observed at the base of the interval, where also the content of mica is high.

These grey and red arenaceous deposits are interpreted to belong in the Skagerrak Formation.

*Smith Bank Formation, 2832-2917 m:*

While the Skagerrak Formation consists mainly of sandstones, this unit is dominated by reddish brown shales. The shales are slightly calcareous, and carbonaceous in the upper approximately 20 m. Light brownish grey anhydrite was found in the shale sequence, particularly below 2880 m. A few very fine to fine grained sandstone beds are present. At the top of the section, the sand is mainly light grey, but in the lower part red colourations dominate.

The argillaceous red beds in this interval represent the Smith Bank Formation.

*Zechstein Group, 2917-2933 m:*

This 16 m thick interval is composed of translucent rock salt, capped by 2-3 m of white, sucrosic anhydrite.

Considerable amounts of shale appear in the samples, but are by the GR/BHC-Sonic logs interpreted to be mainly caved.

*WELL 2/3-2. LITHOLOGICAL DIFFERENCES AS COMPARED TO 2/3-1.*

The 2/3-2 well bottomed at 2297 m in multicoloured shales. These sediments are equivalent to the lower part of the Hordaland Group in 2/3-1.

Generally, the 2/3-2 sedimentary section shows great similartity to that of the first well, but the corresponding sequences are slightly thicker. This is particularly evident for the sand bodies described from 1588 m to 1637 m in well 2/3-1. In 2/3-2 these two beds are present between 1795 m and 1855 m, and each of them has an approximate thickness of 20-23 m compared to 10-12 m in 2/3-1. This turned out to be the only significant difference between the lithologies in the two wells, and may partly be explained by their structural positions (Figs. 2 & 3).

*WELL 2/3-3*

In this well the first cutting sample was obtained at 274 m. No information has been supplied about the sediments above. The only data available is a GR-log run in cased hole. However, the log is practically non interpretive in this part of the hole, and the lithology column above 274 m on the appended log has been left open.

*Nordland/Hordaland Groups, 87.5-2267 m:*

The first cutting samples consist of approximately equal amounts of sand and clay. The sand is mainly medium to very coarse grained, but grains of pebble size were registered as well. The clay is light olive grey and slightly calcareous and silty.

The lack of reliable logs unables a more accurate interpretation of a quantitative distribution of sand and clay layers. The samples, however, indicate a decrease in the sand content towards approximately 550 m, where the sediment is mainly clay. Shell fragments occur throughout, and they seem to be mostly associated with the sand dominated intervals. Pyrite was observed in the clay.

The clay which dominates from around 550 m is olive grey in colour, micaceous and slightly silty. A fairly homogeneous section was penetrated down to approximately 1150 m, from where brown shades were observed in the clay. From around 1050 m, thin stringers of lime mudstone are present. The limestones are mainly yellowish grey in colour.

At around 1250 m a brown to olive black argillaceous sediment was observed. It is more consolidated than the clays above, and is classified as claystone/shale. This sediment is characterized by its high content of mica and carbonaceous material. However, at around 1360 m, olive to brownish grey colours again dominate the shale, and down to approximately 2160 m the sediments are rather uniform. Various shades between olive grey and brownish grey constitute the colour of the shales, which are predominantly micaceous, slightly calcareous and in places silty. Traces of shell fragments are present throughout, and lignite was occasionally observed, especially below 1725 m.

Limestone stringers are evenly distributed in the shale sequence, as light grey, yellowish grey and brownish grey mud/wackestones. A dark brown, very hard dolomite bed is present at 2025 m.

Traces of coarse sandstone were found at approximately 2035 m.

From around 2160 m a greenish grey, waxy shale appears together with the shales described above. It becomes more prominent downwards, and from approximately 2240 m also dark brownish, light olive grey shales and traces of reddish brown shales were registered. These varicoloured sediments mark the base of the Hordaland Group.

The boundary between the Nordland and the Hordaland Groups has not been indicated, as neither the log patterns nor the lithology of the 2/3-3 well give a conclusive boundary.

*Rogaland Group, 2267-2440 m:*

Within this group the same three lithostratigraphic formations as recognized in well 2/3-1, are probably present. These are the Balder Formation, the Sele Formation and the Lista Formation.

The interval 2267-2287 m is composed of grey, brown, red and green shales as are present at the base of the Hordaland Group. However, volcanic material was found in the shales, and particularly in a medium grey, silty one. The tuff probably contributes to the characteristic BHC—Sonic log pattern in this interval. A few white, lime mudstone stringers are also present in the unit, which belongs in the Balder Formation.

Below 2287 m, a medium grey, slightly tuffaceous shale tends to dominate, although brown, green and red sediments were still

registered. Tuff has not been observed below approximately 2330 m, which consequently has been interpreted to be close to the base of the Sele Formation.
However, there is no sharp lithological break at 2330 m as the medium grey shale continues to be the main sediment. Traces of very fine grained glauconitic sandstone is present around 2335 m and 2425 m, and a few lime mudstone stringers occur.
This argillaceous section reaches down to 2440 m and is interpreted to represent the Lista Formation.

### *Chalk Group, 2440-2678 m:*

The group, which is entirely composed of carbonate rocks, is in 2/3-3 divided into three formations.
The upper 42 m consists of a white, chalky and rather soft lime mudstone. The porosity is high as evidenced by the BHC-Sonic log. ''Milky'' white chert is common in this unit, which is identified as the Ekofisk Formation.
This formation is underlain by a harder and less porous limestone. The colour is white to very light grey, and chert is less common than above. Thin porous streaks as well as thin medium grey shale stringers make a rather serratic BHC-Sonic log pattern. This unit, which is recognized as the Tor Formation, extends down to 2628 m.
The underlying carbonates show GR/BHC-Sonic log patterns very similar to those reflected by the 2/3-1 well, with a rather high acoustic velocity compared to the Tor Formation. The lithology consists of white to light grey lime mudstones, which are hard and have, according to the BHC-Sonic logs, a low porosity. Traces of very coarse quartz grains were found in the limestone.
Since both the lithology and the wireline logs suggest that this unit is equivalent to the one underlying the Tor Formation in 2/3-1, the same discussion on the lithostratigraphy applies. This concluded for 2/3-1 that the lower tight section most likely represents the lower part of the Hod Formation, which often has a very high velocity as opposed to the upper part. If so, the same part of the Hod Formation is represented from 2628 m to 2678 m in 2/3-3, as between 2515 m and 2559 m in 2/3-1.

### *Cromer Knoll Group, 2678-2825 m:*

Both the Rødby Formation and the Valhall Formation are recognized in well 2/3-3. The base of the Chalk Group is marked by a very sharp deflection on the logs. This reflects an abrubt lithological break from the limestones above, to sandstone, marl and shale. The interval 2678-2706 m is dominated by a reddish brown, soft marl. Coarse to very coarse grained sandstone is present at the top of the interval, and greenish grey shale was observed more or less throughout. At the base of the marl section, there is a 4 m thick lime mudstone bed. The limestone has a yellowish brown colour, is slightly dolomitic and marks the base of the Rødby Formation.
A medium grey, calcareous shale was encountered below the Rødby Formation. Both the samples and the wireline logs indicate that these grey shales constitute a very homogeneous unit down to 2825 m. The section is only interrupted by a few thin dolomite and limestone stringers, and is interpreted to belong in the Valhall Formation.

### *Bream Formation, 2825-2849 m:*

From around 2825 m the grey shales described above grade into darker, more carbonaceous shales. The colour varies between dark grey, olive grey and brownish grey, and the GR log shows a rather high radioactivity. The shales are micaceous, partly calcareous and probably rich in organic material. These highly radioactive dark shales probably represent the Børglum Member, which is a member of the Bream Formation.

*Unnamed units, 2849-2890 m (?):*
The Børglum Member is underlain by medium grey to brownish grey shales, which occasionally are calcareous. The GR/BHC-Sonic logs indicate a sharp contact between these and the sediments of the Børglum Member. The grey shales extend down to 2875 m, where a greenish grey, very fine to medium grained sandstone was encountered. The sand is moderately sorted, micaceous and contains stringers of greenish grey shale. This sediment seems to persist to approximately 2890 m, although there is no sharp boundary.
The sandy section from 2875 m to 2890 m, probably corresponds to the interval 2563-2580 m in well 2/3-1. Accordingly, the same discussion on the lithostratigraphy prevails, which concluded that the sand section may represent either the Haldager Formation or the Gassum Formation. If the sand belongs in the latter, the overlying grey shales probably belong in the Fjerritslev Formation.

*Skagerrak Formation, 2890-2930 m (?);*
At approximately 2890 m, the colour of the sandstone grades from the greenish grey, to light brownish grey. The latter is mainly very fine to fine grained and micaceous. From around 2915 m the colour is reddish brown, and the sandstone shows a rather poor sorting, as medium to coarse grains also occur. White anhydrite was observed below 2915 m, and brown, calcareous shale is present througout the sand sequence.
This sandstone dominated section is interpreted to be a part of the Skagerrak Formation. It is very thin compared to its equivalent in 2/3-1, approximately 40 m versus more than 250 m.

*Zechstein Group, 2930 (?) - 2669 m (TD):*
The boundary between the Skagerrak Formation and this group is difficult to pick. Neither the samples nor the wireline logs indicate a sharp lithological break. However, greenish grey dolomite appears from 2930 m to 2940 m, interbedded with olive grey shale. White, sucrosic anhydrite was registered in this interval, and dominates below 2940 m. These mixed lithologies are indicative of the Zechstein Group (Deegan & Scull 1977). The GR/BHC-Sonic logs indicate a high degree of interbedding. Fair amounts of shale are also present.
Although rock salt never appeared in the samples, the Formation Density log may indicate that the well drilled a few meters into the salt.

## DISCUSSION

In this section the interpreted lithology, presented in the previous section, is the main basis for comments on the depositional environments.
The 2/3 block is located in the eastern segment of the Northern Permian Basin (Ziegler 1977). Both 2/3-1 and 2/3-3, which are approximately 11 km apart, drilled into evaporites of a Late Permian age. The seismic section (Fig. 2), traverses all the three well locations, and shows that halokinesis probably played an important part in the evolution of the two structures on which the wells were drilled. The north western domal structure, on which 2/3-1 and 2/3-2 are situated, have been considerably uplifted by the salt. A number of faults may be traced on the top the structure and most of them are probably caused by the halokinetic activity. There seems to be a depression of the overlying sediments on the crest of the structure, which may indicate a collapse of the salt.
The south eastern prospect seen in Fig. 2 & 3 is less developed, suggesting that the salt movements by far reached the same level as in the north western one. The sediments capping the salt thus seem to be mainly undisturbed. Well 2/3-3 was placed crestally on this gently dipping structure.
The red beds overlying the Permian evaporites in both wells, are barren of fossils. The series are, however, probably of a Triassic age, based on regional lithological correlations.
Both the argillaceous Smith Bank Formation

and the arenaceous Skagerrak Formation were laid down under continental conditions. The sequence may represent a system of prograding alluvial fans, starting with distal fine grained material, which was overlain by poorly sorted, coarser material. In 2/3-3, the argillaceous Smith Bank Formation is missing, and only approximately 50 m of the Skagerrak Formation is present. Salt movements and rifting probably caused local uplifts with subsequent erosion or non deposition during parts of the Triassic, whereas the area around 2/3-1 contains a more complete sequence. The greenish grey sandstones, which in both wells overly the red beds, are also barren of fossils. As there are no fossils, the Triassic/Jurassic boundary has tentatively been set to coincide approximately with the lithostratigraphic boundary between the Skagerrak Formation and the unnamed sand unit above. While the first probably has been deposited under continental conditions, the greenish, slightly glauconitic sands of a probable Jurassic age reflect a deposition in a marine or possibly coastal-deltaic environment. In the Central North Sea, the Triassic and Jurassic sediments are often separated by an unconformity (Deegan & Scull 1977), which suggests the presence of a hiatus although the sediments do not show a distinct lithological break.

The shales overlying the Jurassic sands have paleontologically been dated to be of a Kimmeridgian age up to approximately 2545 m in 2/3-1 and 2820 m in 2/3-3. As indicated in the lithological section, the same highly radioactive, dark and probably organic shales were registered in both wells, the Børglum Member. These sediments were deposited in a marine environment with high organic productivity and restricted bottom circulation (Ager 1975, Johnson 1975). The grey shales underlying the Børglum Member at the 2/3-3 location, are probably local deposits. The sharp break on the GR/BHC-Sonic logs indicates an erosional contact to the Børglum Member.

The shales overlying the Kimmeridgian deposits are in both wells dated to be of an Early Cretaceous age. The Jurassic/Cretaceous boundary probably presents a regional unconformity, which is referred to as the Late Kimmerian unconformity (Ziegler 1977). The Early Cretaceous uniform grey, argillaceous sediments may have been deposited in an open marine environment with rather continuous subsidence of the basin floor. A regional transgression submerged the Jurassic highs, and decreased the supply of coarse clastic material. In 2/3-1, however, the low energy deposits are interrupted by a marine sandstone bed at around 2425 m. It is likely to think of a major, still emerged high on the Vestland Arch, probably the Hidra High or the Mandal High, as being the source for this sandstone.

In the later parts of the Early Cretaceous fairly pure lime mud was deposited, and it is seen in both wells. This initiated the sedimentation of lime as well as clay material, resulting in the marls and calcareous shales of the Rødby Formation.

The boundary between Early- and Late Cretaceous is probably also represented by an unconformity. The paleontological datings indicate a Santonian/Campanian age of the lower part of the limestone sequences in both wells. Although the Aptian/Albian ages were dominated by a basinwide transgression (Ziegler 1977), rifting took place simultaneously and possibly resulted in uplifts of the 2/3 area. The Late Cretaceous transgression then first submerged the area during the middle part of the Senonian and enabled the deposition of lime mud. 40-50 m of Santonian/Campanian limestones in each of the wells are overlain by Maastrichtian limestones. In the 2/3-1 well these are overlain by Paleocene shales, while 2/3-3 revealed approximately 40 m of Paleocene Danian limestones on top the Maastrichtian carbonates.

The Late Cretaceous epoch is characterized by low energy deposits. All structural highs were submerged during the transgression, and a relatively pure lime mud was deposited. The lack of core data makes it impossible to determine whether the thin clay seams observed in the carbonates, are of primary or secondary origin. Other wells in the Central North Sea indicate a combination of the two. Diagenesis is probably the main reason for the tightness of the Santonian/Campanian section in both wells, interpreted to represent the lower part of the Hod Formation. This feature has also been reported from other wells in the Central North Sea, and may have been triggered by slight textural differences in the lime mud (Hancock & Scholle 1975).

The fact that Danian limestones are present in 2/3-3 but not in 2/3-1, only about 11 km to the north west, may be related to a smaller degree of salt movements at the 2/3-3 location. It may, however, also be related to the Early Paleocene Laramide rifting phase, which probably caused local uplifts and erosion. Danian carbonates may originally have blanketed the 2/3-1 location, but were subsequently eroded as a result of local uplifts (Figs. 2 & 3). At the 2/3-3 location, however, the tectonic activity was smaller and less erosion, if any at all, took place. It is likely that the 2/3 area, and in particular the northwestern part of the block, acted as one of the sources for the redeposited, conglomeratic Paleocene limestones observed in the Central Trough, which has been named Maureen Formation (Deegan & Scull 1977). The Laramide phase combined with a probable halokinetic activity initiated a regional subsidence of the basins parallelled by uplifting of the flanks (Ziegler 1977). This started a new sedimentary regime, and argillaceous marine sediments were deposited. By the close of the Paleocene, volcanic activity resulted in deposition of tuffs, which mixed with the clay and caused the "rough" apperance of the sediment. It is assumed that the various colours of the shales above, within and below the tuffaceous Balder Formation, are associated with physical/chemical phenomena in the sea water and bottom, caused by the ash fall (Norw. Petr. Dir. 1977 b).

The Balder Formation spans the Paleocene/Eocene boundary in both wells. The Eocene epoch is characterized by a rather uniform, low energy sedimentation in an open marine environment. In 2/3-3, sediments of an Early Eocene age are present to around 2150 m, from where the fauna suggests an undifferentiated Middle/Late Eocene age up to approximately 2020 m.

The 2/3-1 section indicates Eocene sediments up to approximately 1975 m.

The open marine environments persisted into the Oligocene. In 2/3-3, the uniformity of the sediments even indicates similar conditions throughout the Oligocene and into the Miocene, without major interruptions. In 2/3-1 and 2/3-2, however, marine sand units were encountered, and have been assigned an Oligocene-Miocene age. The sands which reach 10—12 m in 2/3-1 and 20—23 m in 2/3-2, thus reflect different sedimentary environments than indicated through the corresponding period at the 2/3-3 location. As 2/3-2 lies approximately 4 km northwest of 2/3-1, the source of the arenaceous sediments is probably north or west of 2/3-2. The nearest and most likely potential source is the Hidra High, but other features on the Vestland Arch may have contributed. These marine shelf sands, which did not reach the 2/3-3 location, indicate a high energy of deposition probably in fairly shallow waters, interrupted by periods of quiescence when clay and carbonates were deposited.

The argillaceous sediments overlying the sand deposits in 2/3-1 and 2/3-2 indicate that the area attained the same low energy, open marine environments as reflected by the 2/3-3 section. The basin was probably subject to a rather continuous subsidence and the same type of sedimentation persisted during the Miocene.

Poor and partly non-diagnostic faunas are reported for the post-Oligocene sediments, and this makes the chronostratigraphy very uncertain. The boundaries indicated on the appended logs are therefore partly based on correlations to nearby wells.

While the pre-Pliocene Tertiary sediments mainly indicate deposition in a moderately deep water, the Pliocene sections in all the three wells suggest a shoaling up. Carbonate stringers are very rare, the clay becomes silty and sand stringers occur in the upper part of the sequences. Also at this level, however, the 2/3-1 and 2/3-2 wells were probably closer to the source than the 2/3-3 as they contain more coarse material.

The upper sections in all three wells, are considered to be Quaternary deposits related to the glacial activity. These sediments seem to have approximately the same thickness of 450—500 m in the wells.

## Summary

The Murphy Group drilled three wells in block 2/3. The block is situated in the south western part of the Norwegian Danish Basin, close to the Mandal High.

The wells 2/3-1 and 2/3-2 were drilled in 1969 on a salt dome. The first well was drilled on the crest of the structure, and revealed gas in two 10-12 m thick sandstone layers of an Oligocene-Miocene age. The second well, however, situated on the north western flank of the structure was dry.

Well 2/3-3 was drilled in 1971 on a separate structure, some 11 km south east of well 2/3-1. The well was placed on the crest of the structure, which is formed by a salt pillow. None of the sedimentary sequences penetrated by 2/3-3 showed hydrocarbons.

Both 2/3-1 and 2/3-3 drilled through the Cenozoic and Mesozoic sediments and into evaporites of a Late Permian age. The sections penetrated by the two wells are fairly comparable but especially the Late Cretaceous and Triassic sections show considerable differences in thickness between the wells. This may indicate local tectonic activities as well as salt movements during the Mesozoic in this part of the Norwegian Danish Basin.

Well 2/3-2 bottomed in argillaceous sediments of an Eocene age.

# Summary chart

The following chart shows the main rock types and depositional environments as seen in the wells 2/3-1 and 2/3-3.

| Stratigraphic classification | | | mill. years | Rock type ( not represented) | Sedimentary environments and geological events |
|---|---|---|---|---|---|
| QUATERNARY | | | 0 | clay, sand | glacial activity |
| TERTIARY | PLIOCENE | | | | |
| | MIOCENE | | | clay | marine |
| | | | | shale, sand (in 2/3-1) | open marine/marine |
| | OLIGOCENE | | | | |
| | | | | shale | open marine |
| | EOCENE | | 50 | | |
| | | | | tuff | volcanic activity |
| | PALEOCENE | | | shale | marine<br>tectonic movements |
| | | DANIAN | | shale, lime mudstone (in 2/3-3) | open marine |
| CRETACEOUS | LATE | MAASTRICHTIAN | | | |
| | | CAMPANIAN | | lime mudstone | open marine |
| | | SANTONIAN | | | |
| | | | | | transgression |
| | | CONIACIAN | | | |
| | | TURONIAN | | | erosion/non deposition |
| | | CENOMANIAN | | | |
| | | | 100 | | uplifting |
| | EARLY | ALBIAN | | | |
| | | APTIAN | | marl, shale (+ sand) | marine |
| | | BARREMIAN | | | |
| | | HAUTERIVIAN | | | |
| | | VALANGINIAN | | ? | |
| | | BERRIASIAN | | | erosion/non deposition |
| JURASSIC | LATE | PORTLANDIAN | | ? | erosion/non deposition |
| | | KIMMERIDGIAN | 150 | black shale | marine |
| | | OXFORDIAN | | sand | marine (coastal — deltaic) |
| | | | | ? | |
| | MIDDLE | | | | |
| | EARLY | | | | erosion/non deposition |
| | | | | ? | |
| TRIASSIC | LATE | | 200 | | |
| | | | | sandstone (+ shale) | continental (alluvial) |
| | MID. | | | | |
| | EARL | | | | |
| PERMIAN | LATE | | 230 | anhydrite, rock salt<br>2/3-1 and 2/3-3 bottomed in Permian evaporites. | super saline sea |

Chronostratigraphy after F. W. B. van Eysinga, 3rd Edition, 1975.

Fig. 2: Interpreted seismic record.
Line 13

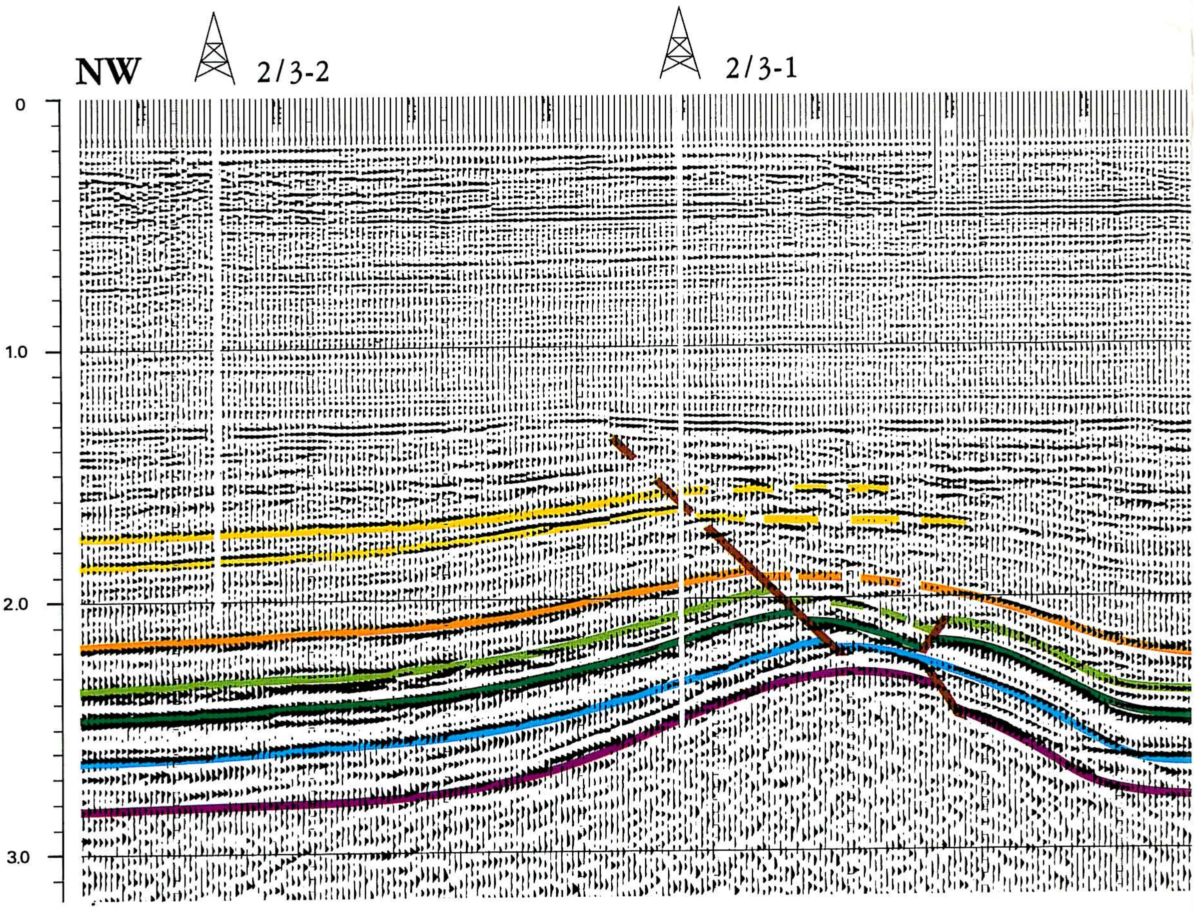
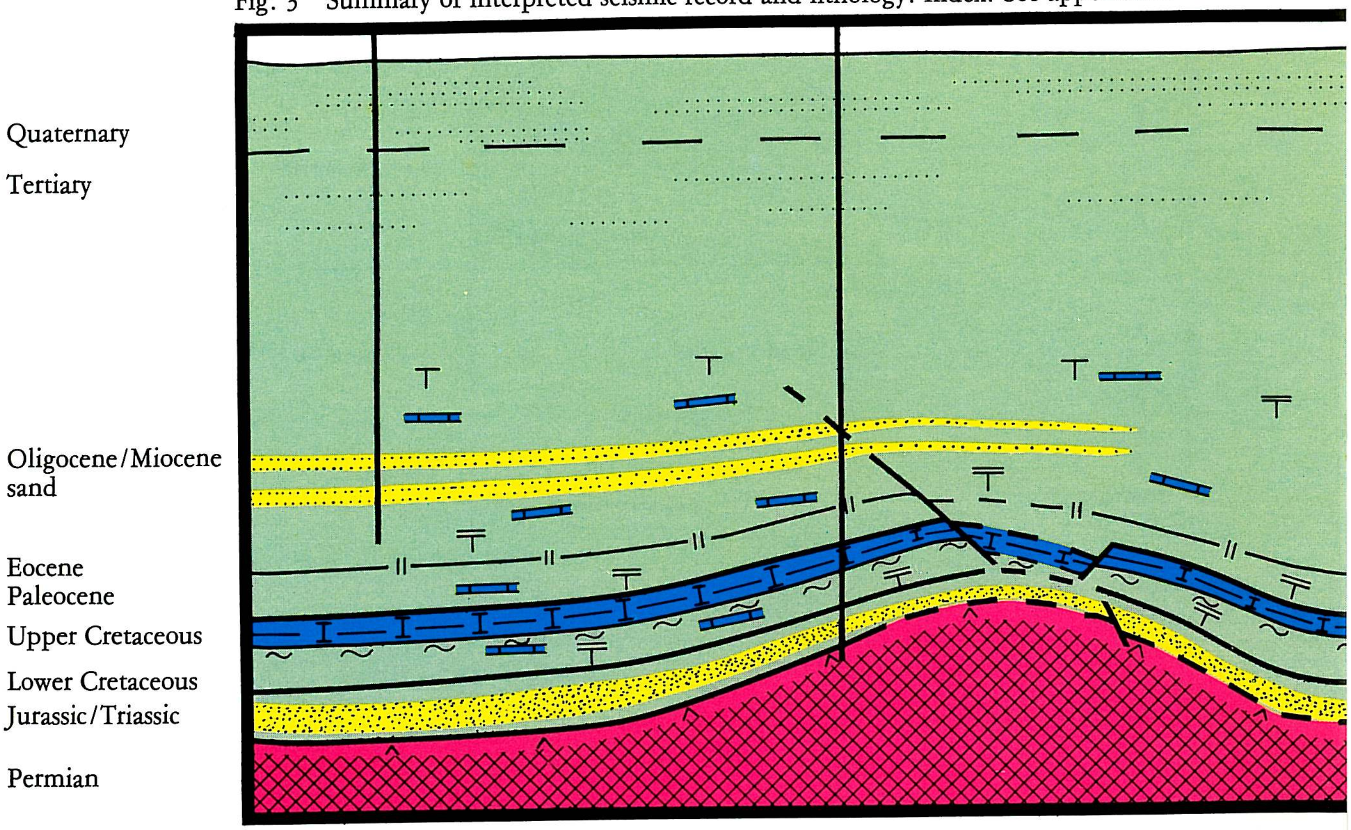
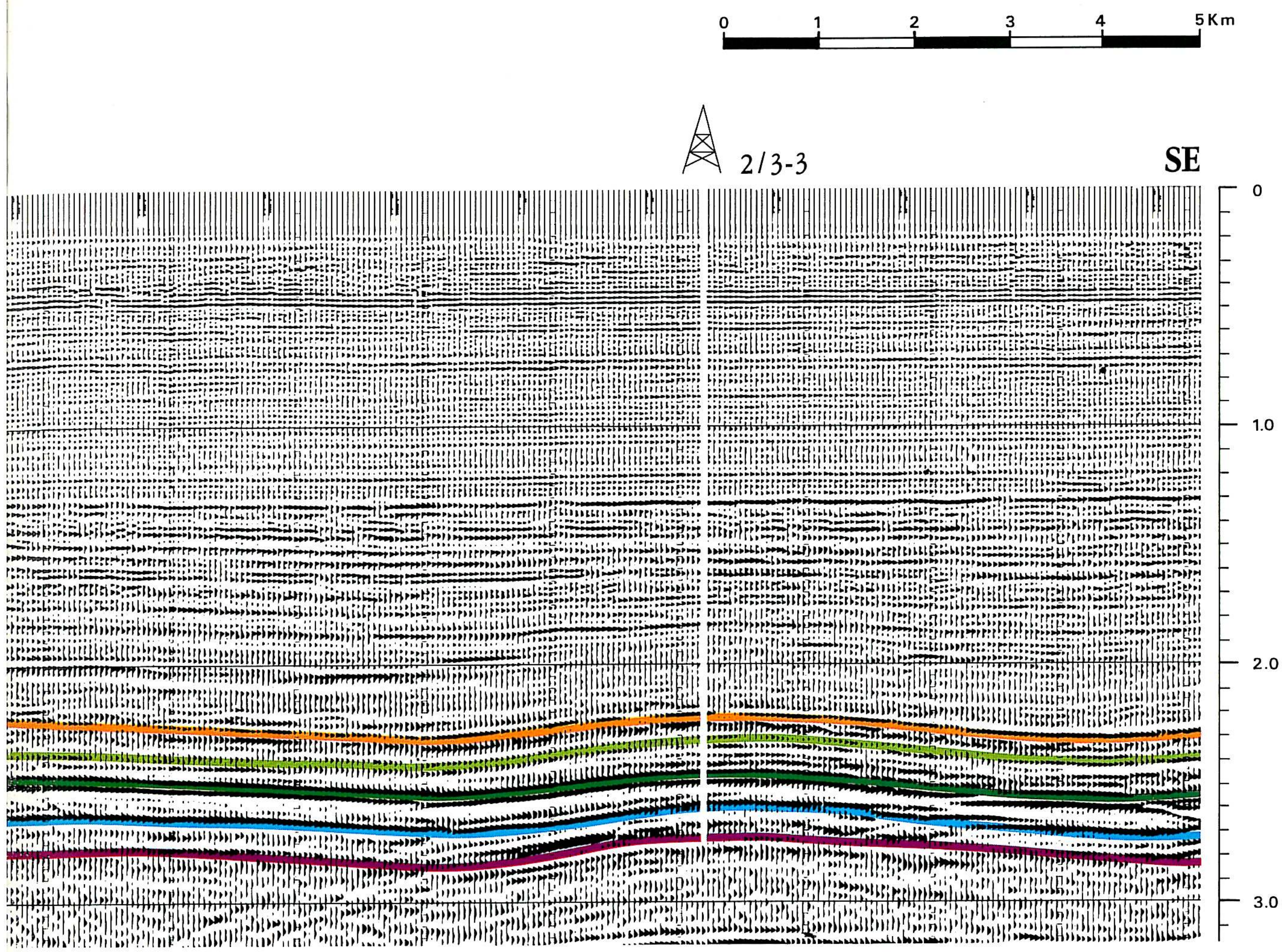



Fig. 3 Summary of interpreted seismic record and lithology. Index: See appendices.

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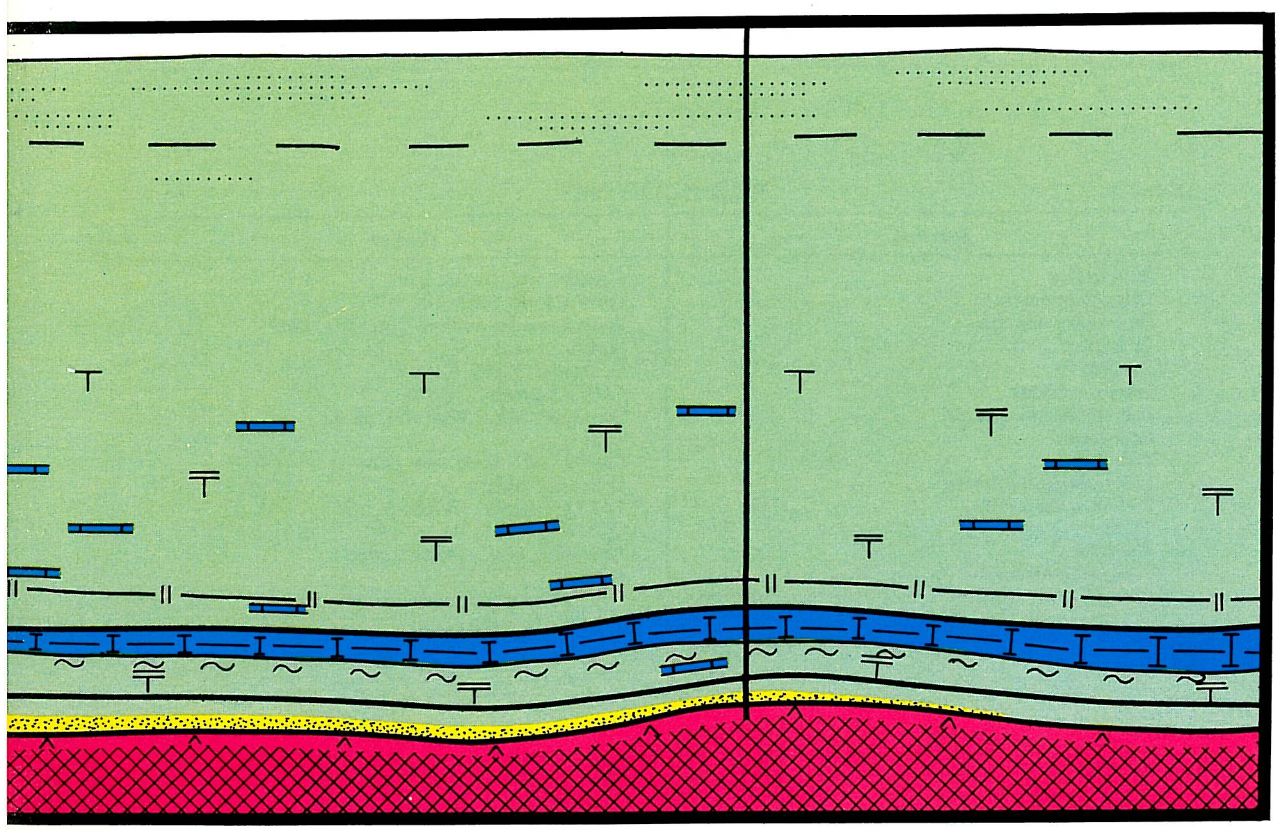

# TABLES WELL 2/3-1

Table 1 CASINGS

| Diameter | Depth below KB | |
|---|---|---|
| | m | ft |
| 30'' | 123.7 | 404 |
| 20'' | 247.9 | 902 |
| 13 3/8'' | 1297.8 | 4258 |
| 7'' | 1669.1 | 5477 |

Table 2 a MUD PROGAMME

| Depth below KB | | Weight ppg | Funnel visc. sec | Filt loss $cm^3$ | % oil | Remarks | Mud components |
|---|---|---|---|---|---|---|---|
| m | ft | | | | | | |
| 98 | 320 | 8.6 | 60 | | | | |
| 124 | 406 | 8.8 | 200 + | | | Pumped in 470 bbls heavy viscosity gel mud. | A fresh water gel mud was used for spotting in open hole to 1520'. From here to TD a sea water-Q-Broxin-caustic mud was used. A high dilution rate was necessitated by a solids problem. |
| 297 | 976 | Sea water | | | | Sand fell in and 150 bbls mud was pumped in to free pipe. | |
| 463 | 1520 | 8.8 | 108 | | | Displaced hole with 700 bbls 75 viscosity mud. | |
| 695 | 2280 | 9.0 | 46 | | | | |
| 1023 | 3355 | 10.3 | 57 | 10.2 | 4 | | |
| 1308 | 4290 | 11.2 | 43 | 6.7 | 3 | Started getting gas cut mud, 10.6—9.6 ppg. | |
| 1323 | 4342 | 11.5 | 70 | 7.0 | | Circulated and conditioned gas cut mud. Raised weight from 10.6 to 11.5. | |
| 1527 | 5010 | 12.0 | 65 | 5.6 | | | |
| 2400 | 7874 | 12.3 | 90 | 7.6 | | | |
| 2650 | 8694 | 12.1 | 58 | 8.0 | | | |
| 2933 | 9624 | 12.2 | 70 | 7.2 | | | |

Table 2 b MUD ADDITIVES

| Function | Product |
|---|---|
| Bactericides | Caustic Soda, Surflo, Lime |
| Calcium removers | Caustic Soda, Soda Ash |
| Corrosion inhibitors | Formaldehyde, Sodium Chromate, Lime |
| Defoamer | Surflo |
| Emulsifiers | Q-Broxin, CC-16, Con Det |
| Filtrate reducers | CMC, Q-Broxin, CC-16 |
| Lost circulation material | Bentonite, Mica, Wall Nut, Flosal |
| Lubricants | Lime |
| pH control | Caustic Soda, Soda Ash, Lime |
| Shale control inhibitors | Q-Broxin, Aktaflo-S |
| Surface active agents | Con Det, Surflo, Aktaflo-S |
| Thinners | Q-Broxin, CC-16 |
| Viscosifiers | Bentonite, CMC, Flosal, Zeogel |
| Weighting materials | Barite |

Table 3

## TESTS

| Type | Depth below KB | | Choke size | Recovery | | | Final shut-in pressure psi | Final flow pressure psi |
|---|---|---|---|---|---|---|---|---|
| | m | ft | | Oil BPD | Gas MMCFD | Other fluids | | |
| DST no. 1 | 1624-1635 | 5328-5368 | 30/64" | — | 10.75 | Two bbls condensate | 2692 | 2608 |
| DST no. 2 | 1588-1600 | 5210-5250 | 30/64" | — | 9.25 | in 10 hrs flow | 2687 | 2662 |

Table 4

## AVAILABLE LOGS

| Type | Run No. | Depth below KB | | Scales available | |
|---|---|---|---|---|---|
| | | m | ft | 1/200 | 1/500 |
| IES | 1 | 275—1316 | 902—4317 | » | » |
| » | 2 | 1298—2396 | 4258—7860 | » | » |
| » | 3 | 2402—2924 | 7880—9593 | » | » |
| GR | 1 | 107— 462 | 350—1515 | » | » |
| GR/BHC | 1 | 462—1315 | 1515—4313 | » | » |
| GR/BHC-C | 1 | 1298—2393 | 4258—7850 | » | » |
| » | 2 | 2368—2930 | 7770—9612 | » | » |
| LL—7 | 1 | 275—1316 | 902—4316 | » | » |
| » | 2 | 1524—1798 | 5000—5900 | » | » |
| » | 2 | 1966—2042 | 6450—6700 | » | » |
| » | 2 | 2134—2164 | 7000—7100 | » | » |
| » | 2 | 2240—2395 | 7350—7857 | » | » |
| » | 3 | 2371—2922 | 7780—9585 | » | » |
| MLL—C | 1 | 1158—1316 | 3800—4318 | » | » |
| » | 2 | 1524—1664 | 5000—5460 | » | » |
| » | 2 | 1740—1777 | 5710—5830 | » | » |
| » | 2 | 2134—2158 | 7000—7080 | » | » |
| » | 2 | 2240—2362 | 7350—7750 | » | » |
| » | 3 | 2408—2438 | 7900—8000 | » | » |
| » | 3 | 2560—2865 | 8400—9400 | » | » |
| SNP | 1 | 1579—1653 | 5180—5424 | » | » |
| FDC | 1 | 1579—1653 | 5/80—5424 | » | » |
| CBL | 1 | 1158—1652 | 3800—5421 | » | » |
| Mud | 1 | 466—2933 | 1530—9624 | | » |

Table 5 a

## DRILL BIT CUTTINGS

| Depth below KB | | Sample interval | | Depth below KB | | Sample interval | |
|---|---|---|---|---|---|---|---|
| m | ft | m | ft | m | ft | m | ft |
| 479— 488 | 1570—1600 | 9 | 30 | 2073—2097 | 6800—6880 | 24 | 80 |
| 488— 494 | 1600—1620 | 6 | 20 | 2097—2109 | 6880—6920 | 12 | 40 |
| 494— 512 | 1620—1680 | 18 | 60 | 2109—2121 | 6920—6960 | 6 | 20 |
| 512— 756 | 1680—2480 | 30 | 100 | 2121—2183 | 6960—7160 | 12 | 40 |
| 756— 777 | 2480—2550 | 2 | 70 | 2183—2195 | 7160—7200 | 6 | 20 |
| 777— 808 | 2550—2650 | 15 | 50 | 2195—2219 | 7200—7280 | 12 | 40 |
| 808— 817 | 2650—2680 | 9 | 30 | 2219—2225 | 7280—7300 | 6 | 20 |
| 817— 829 | 2680—2720 | 12 | 40 | 2225—2262 | 7300—7420 | 12 | 40 |
| 829— 847 | 2720—2780 | 9 | 30 | 2262—2298 | 7420—7540 | 6 | 20 |
| 847— 869 | 2780—2850 | 21 | 70 | 2298—2310 | 7540—7580 | 12 | 40 |
| 869— 878 | 2850—2880 | 9 | 30 | 2310—2371 | 7580—7780 | 6 | 20 |
| 878— 884 | 2880—2900 | 6 | 20 | 2371—2384 | 7780—7820 | 12 | 40 |
| 884— 920 | 2900—3020 | 12 | 40 | 2384—2457 | 7820—8060 | 6 | 20 |
| 920— 951 | 3020—3120 | 6 | 20 | 2457—2460 | 8060—8070 | 3 | 10 |
| 951— 960 | 3120—3150 | 9 | 30 | 2460—2469 | 8070—8100 | 9 | 30 |
| 960—1021 | 3150—3350 | 15 | 50 | 2469—2512 | 8100—8240 | 6 | 20 |
| 1021—1033 | 3350—3390 | 12 | 40 | 2512—2536 | 8240—8320 | 24 | 80 |
| 1033—1039 | 3390—3410 | 6 | 20 | 2536—2573 | 8320—8440 | 6 | 20 |
| 1039—1067 | 3410—3500 | 9 | 30 | 2573—2585 | 8440—8480 | 12 | 40 |
| 1067—1079 | 3500—3540 | 12 | 40 | 2585—2591 | 8480—8500 | 6 | 20 |
| 1079—1161 | 3540—3810 | 9 | 30 | 2591—2603 | 8500—8540 | 12 | 40 |
| 1161—1173 | 3810—3850 | 12 | 40 | 2603—2627 | 8540—8620 | 24 | 80 |
| 1173—1295 | 3850—4250 | 15 | 50 | 2627—2640 | 8620—8660 | 12 | 40 |
| 1295—1323 | 4250—4340 | 27 | 90 | 2627—2640 | 8660—8700 | 6 | 20 |
| 1323—1335 | 4340—4380 | 6 | 20 | 2640—2652 | 8700—8760 | 18 | 60 |
| 1335—1347 | 4380—4420 | 12 | 40 | 2670—2676 | 8760—8780 | 6 | 20 |
| 1347—1353 | 4420—4440 | 6 | 20 | 2676—2798 | 8780—9180 | 12 | 40 |
| 1353—1378 | 4440—4520 | 12 | 40 | 2798—2813 | 9180—9230 | 15 | 50 |
| 1378—1384 | 4520—4540 | 6 | 20 | 2813—2825 | 9230—9270 | 6 | 20 |
| 1384—1920 | 4540—6300 | 12 | 40 | 2825—2899 | 9270—9510 | 9 | 30 |
| 1920—1932 | 6300—6340 | 6 | 20 | 2899—2911 | 9510—9550 | 6 | 20 |
| 1932—2067 | 6340—6780 | 12 | 40 | 2911—2920 | 9550—9580 | 3 | 10 |
| 2067—2073 | 6780—6800 | 6 | 20 | 2920—2932 | 9580—9620 | 6 | 20 |

Table 5 b

## SIDEWALL CORES

| No. | Depth below KB | | Recovery length, in. | No. | Depth below KB | | Recovery length, in. |
|---|---|---|---|---|---|---|---|
| | m | ft | | | m | ft | |
| 1 | 1587 | 5208 | 1/4 | 23 | 1630 | 5349 | 1 1/4 |
| 2 | 1588 | 5210 | 1 | 24 | 1631 | 5352 | 1 |
| 3 | 1589 | 5212 | 1 1/4 | 25 | 1633 | 5356 | 1 |
| 4 | 1589 | 5213 | 1 1/4 | 26 | 1634 | 5361 | 3/4 |
| 5 | 1589 | 5214 | 1 1/4 | 27 | 1635 | 5363 | 1/2 |
| 6 | 1590 | 5216 | 1 1/2 | 28 | 1636 | 5368 | 1 1/2 |
| 7 | 1591 | 5218 | 1 1/4 | 29 | 2368 | 7768 | * |
| 8 | 1592 | 5224 | 1 1/4 | 30 | 2381 | 7812 | |
| 9 | 1593 | 5228 | 1 1/4 | 31 | 2389 | 7838 | |
| 10 | 1595 | 5232 | 1 1/4 | 32 | 2421 | 7942 | |
| 11 | 1597 | 3239 | 1 | 33 | 2423 | 7948 | |
| 12 | 1597 | 5240 | 1 | 34 | 2464 | 8085 | |
| 13 | 1598 | 5244 | 1 | 35 | 2557 | 8390 | |
| 14 | 1600 | 5249 | 3/4 | 36 | 2564 | 8411 | |
| 15 | 1601 | 5251 | 1 | 37 | 2572 | 8438 | |
| 16 | 1624 | 5329 | 1/2 | 38 | 2657 | 8717 | |
| 17 | 1625 | 5332 | 3/4 | 39 | 2664 | 8739 | |
| 18 | 1626 | 5333 | 3/4 | 40 | 2704 | 8871 | |
| 19 | 1627 | 5337 | 3/4 | 41 | 2773 | 9097 | |
| 20 | 1628 | 5341 | 1 1/4 | 42 | 2824 | 9264 | |
| 21 | 1629 | 5344 | 1 | 43 | 2827 | 9276 | |
| 22 | 1630 | 5349 | 1 1/4 | | | | |

* Below this depth the samples were poor and very poor.

# TABLES WELL 2/3-2

Table 6 CASINGS

| Diameter | Depth below KB | |
|---|---|---|
| | m | ft |
| 30" | 116.4 | 382 |
| 20" | 211.2 | 693 |
| 13 3/8" | 1050.3 | 3446 |

Table 7 a MUD PROGRAMME

| Depth below KB | | Weight | Funnel visc. | Filt loss | % oil | Remarks |
|---|---|---|---|---|---|---|
| m | ft | ppg | sec. | $cm^3$ | | |
| 246 | 806 | 8.8 | 30 | | | Drilled first to 980'. Hole fell in. Reamed and circ.. with salt water. Washed and redrilled from 383' to 806' with gel-mud. |
| 494 | 1620 | 8.9 | 38 | | | |
| 985 | 3230 | 10.5 | 52 | 14.7 | | Drilling Gumbo. |
| 1079 | 3540 | 10.5 | 55 | 16.0 | | Circulated to run logs. |
| 1080 | 3542 | 11.5 | 53 | 8.6 | 3.0 | |
| 1289 | 4230 | 12.2 | 52 | 9.0 | 2.0 | |
| 1502 | 4928 | 12.1 | 50 | 8.2 | 3.0 | |
| 1732 | 5683 | 12.1 | 50 | 8.2 | 2.0 | |
| 1982 | 6502 | 12.0 | 58 | 7.3 | 2.0 | |
| 2093 | 6967 | 12.0 | 60 | 7.6 | 2.0 | Circulated and made wiper trip back to the 13 3/8" casing. |
| 2292 | 7520 | 12.0 | 55 | 7.6 | 1.0 | Short trip and circulation, before running casing. |
| 2312 | 7536 | 12.0 | 53 | 8.0 | 1.0 | Running logs. |

Table 7 b MUD ADDITIVES

| Function | Product |
|---|---|
| Bactericides | Caustic Soda, Lime, Soda Ash. |
| Corrosion inhibitor | Lime |
| Emulsifier | Q-Broxin |
| Filtrate reducers | CMC, Dextrid, Q-Broxin. |
| Lubricant | Lime |
| pH control | Caustic Soda, Lime. |
| Shale control inhibitors | Q-Broxin, Lime. |
| Thinner | Q-Broxin. |
| Viscosifiers | Flosal, Zeogel, Dextrid. |
| Weighting material | Barite. |

Table 8

# AVAILABLE LOGS

| Type | Run no. | Depth below KB m | Depth below KB ft | Scales available |
|---|---|---|---|---|
| GR | 1 | 85— 544 | 280—1786 | 1/200 |
| GR/BHC | 1 | 211— 544 | 694—1786 | » |
| GR | 2 | 503—2293 | 1650—7524 | » |
| GR/BHC-C | 2 | 1050—2293 | 3446—7524 | » |
| SNP | 1 | 1250—1341 | 4200—4400 | 1/200, 1/500 |
| » | 1 | 1585—1707 | 5200—5600 | » |
| » | 1 | 1768—1890 | 5800—6200 | » |
| » | 1 | 1950—2012 | 6400—6600 | » |
| » | 1 | 2195—2270 | 7200—7450 | » |
| IES | 1 | 212—1038 | 694—3407 | 1/200 |
| » | 2 | 1050—2092 | 3446—6862 | » |
| » | 3 | 1737—2296 | 5700—7533 | » |
| MLL-C | 1 | 1280—1341 | 4200—4400 | 1/200, 1/500 |
| » | 1 | 1585—1707 | 5200—5600 | » |
| » | 1 | 1768—1890 | 5800—6200 | » |
| » | 1 | 1950—2012 | 6400—6600 | » |
| » | 1 | 2195—2270 | 7200—7450 | » |
| Mud | 1 | 245—2297 | 805—7536 | 1/500 |

Table 9 a

# DRILL BIT CUTTINGS

| Depth below KB | | Sample interval | | Depth below KB | | Sample interval | |
|---|---|---|---|---|---|---|---|
| m | ft | m | ft | m | ft | m | ft |
| 256— 280 | 840— 920 | 12 | 40 | 805— 814 | 2640—2670 | 9 | 30 |
| 280— 286 | 920— 940 | 6 | 20 | 814— 820 | 2670—2690 | 6 | 20 |
| 286— 304 | 940—1000 | 18 | 60 | 820— 857 | 2690—2810 | 9 | 30 |
| 304— 316 | 1000—1040 | 12 | 40 | 857— 863 | 2810—2830 | 6 | 20 |
| 316— 341 | 1040—1120 | 24 | 80 | 863— 872 | 2830—2860 | 9 | 30 |
| 341— 366 | 1120—1200 | 12 | 40 | 872— 890 | 2860—2920 | 18 | 60 |
| 366— 384 | 1200—1260 | 9 | 30 | 890— 945 | 2920—3100 | 9 | 30 |
| 384— 402 | 1260—1320 | 18 | 60 | 945— 960 | 3100—3150 | 15 | 50 |
| 402— 430 | 1320—1410 | 9 | 30 | 960— 988 | 3150—3240 | 9 | 30 |
| 430— 448 | 1410—1470 | 18 | 60 | 988—1015 | 3240—3330 | 27 | 90 |
| 448— 476 | 1470—1560 | 9 | 30 | 1015—1024 | 3330—3360 | 9 | 30 |
| 476— 494 | 1560—1620 | 18 | 60 | 1024—1036 | 3360—3400 | 12 | 40 |
| 494— 518 | 1620—1700 | 24 | 80 | 1036—1042 | 3400—3420 | 6 | 20 |
| 518— 527 | 1700—1730 | 9 | 30 | 1042—1079 | 3420—3540 | 9 | 30 |
| 527— 546 | 1730—1790 | 18 | 60 | 1079—1085 | 3540—3560 | 6 | 20 |
| 546— 555 | 1790—1820 | 9 | 30 | 1085 —1146 | 3560—3760 | 12 | 40 |
| 555— 677 | 1820—2220 | 12 | 40 | 1146—1152 | 3760—3780 | 6 | 20 |
| 677— 695 | 2220—2280 | 9 | 30 | 1152—1274 | 3780—4180 | 12 | 40 |
| 695— 713 | 2280—2340 | 18 | 60 | 1274—1420 | 4180—4660 | 6 | 20 |
| 713— 732 | 2340—2400 | 9 | 30 | 1420—1433 | 4660—4700 | 12 | 40 |
| 732— 744 | 2400—2440 | 12 | 40 | 1433—1573 | 4700—5160 | 6 | 20 |
| 744— 762 | 2440—2500 | 9 | 30 | 1573—1585 | 5160—5200 | 12 | 40 |
| 762— 799 | 2500—2620 | 12 | 40 | 1585—2292 | 5200—7520 | 6 | 20 |
| 799— 805 | 2620—2640 | 6 | 20 | 2292—2297 | 7520—7536 | 5 | 16 |

Table 9 b

## SIDEWALL CORES

| No. | Depth below KB | | No. | Depth below KB | |
|---|---|---|---|---|---|
| | m | ft | | m | ft |
| 1 | 1252 | 4108 No recovery | 22 | 1815 | 5954 |
| 2 | 1254 | 4115 | 23 | 1835 | 6021 |
| 3 | 1255 | 4118 | 24 | 1837 | 6026 |
| 4 | 1257 | 4124 | 25 | 1839 | 6032 |
| 5 | 1262 | 4142 | 26 | 1841 | 6039 |
| 6 | 1477 | 4845 | 27 | 1848 | 6064 |
| 7 | 1497 | 4910 | 28 | 1850 | 6071 |
| 8 | 1602 | 5255 | 29 | 1854 | 6082 |
| 9 | 1625 | 5335 repeated | 30 | 1872 | 6143 |
| 10 | 1628 | 5341 | 31 | 1922 | 6305 |
| 11 | 1634 | 5361 | 32 | 1970 | 6464 |
| 12 | 1636 | 5368 | 33 | 1997 | 6551 |
| 13 | 1649 | 5409 | 34 | 2203 | 7228 repeated |
| 14 | 1653 | 5424 | 35 | 2213 | 7259 |
| 15 | 1668 | 5471 | 36 | 2214 | 7265 |
| 16 | 1796 | 5892 | 37 | 2218 | 7277 |
| 17 | 1797 | 5894 | 38 | 2227 | 7307 |
| 18 | 1800 | 5904 | 39 | 2236 | 7335 |
| 19 | 1803 | 5915 | 40 | 2247 | 7373 |
| 20 | 1806 | 5925 | 41 | 2249 | 7380 |
| 21 | 1807 | 5928 | 42 | 2254 | 7396 |

# TABLES WELL 2/3-3

Table 10 CASINGS

| Diameter | Depth below KB | |
|---|---|---|
| | m | ft |
| 36'' | 122.8 | 403 |
| 20'' | 263.9 | 866 |
| 13 3/8'' | 1083.4 | 3554 |

Table 11 a MUD PROGRAMME

| Depth below KB | | Weight | Funnel visc. | Filt loss | % oil | Remarks |
|---|---|---|---|---|---|---|
| m | ft | ppg | sec. | $cm^3$ | | |
| 274 | 900 | 8.7 | 49 | 11 | | Drilled to 915' with no returns |
| 636 | 2085 | 11.0 | 46 | 12 | 4.5 | Built up mudweight from 10.6 to 11 ppg. |
| 884 | 2900 | 11.1 | 84 | 10.1 | 3 | |
| 1097 | 3600 | 12.0 | 64 | 11.0 | 3 | 750 bbl mud lost on shaker/ and pit. |
| 1097 | 3600 | 12.4 | 52 | 12.8 | 5 | Built up weight to 12.4 ppg. |
| 2149 | 7050 | 13.1 | 69 | 8.8 | 5 | |
| 2649 | 8690 | 13.1 | 45 | 4.8 | 5 | |
| 2667 | 8752 | 13.6 | 68 | 4.5 | 4 | |
| 2795 | 9171 | 13.3 | 78 | 4.5 | 2.5 | |
| 2997 | 9734 | 13.2 | 53 | 4.4 | 4 | |
| 2997 | 9734 | 13.5 | 48 | 4.6 | 4 | |

Table 11 b MUD ADDITIVES

| Function | Product |
|---|---|
| Bactericides | Caustic Soda, Lime |
| Calcium remover | Soda Ash |
| Corrosion inhibitor | Lime |
| Defoamer | Magconol |
| Emulsifier | D-D, Salinex, Magcophos, Diesel Oil |
| Filtrate reducers | CMC, Salinex, Spersene |
| Lubricant | Lime |
| pH control | Caustic Soda, Soda Ash, Lime |
| Shale control inhibitors | Lime, XP-20 |
| Surface active agents | D-D |
| Thinners | Spersene, XP-20 |
| Viscosifiers | Salt Gel, Visquick |
| Weighting material | Magcobar |
| Clays | Magcogel |

Table 12

## AVAILABLE LOGS

| Type | Run no. | Depth below KB | | Scales available |
|---|---|---|---|---|
| | | m | ft | |
| GR* | 1 | 91—2970 | 300—9743 | 1/200, 1/500 |
| GR/BHC-C | 1 | 1084-–2970 | 3557—9743 | » |
| FDC | 1 | 1084—2972 | 3557—9752 | » |
| DIL | 1 | 1084—2970 | 3557—9743 | » |
| CDM | 1 | 1083—2972 | 3552—9752 | » |
| Mud | 1 | 97—2967 | 320—9734 | 1/500 |

*Logged in cased hole.

Table 13 a

## DRILL BIT CUTTINGS

| Depth below KB | | Sample interval | | Depth below KB | | Sample interval | |
|---|---|---|---|---|---|---|---|
| m | ft | m | ft | m | ft | m | ft |
| 274—1094 | 900—3590 | 9 | 30 | 2771—2775 | 9090—9105 | 4.5 | 15 |
| 1094—1102 | 3590—3615 | 8 | 25 | 2803—2807 | 9195—9210 | » | » |
| 1102—1450 | 3615—4755 | 4.5 | 15 | 2812—2816 | 9225—9240 | » | » |
| 1458—1998 | 4785—6555 | 4.5 | 15 | 2821—2826 | 9255—9270 | » | » |
| 1998—2021 | 6555—6630 | 23 | 75 | 2830—2835 | 9285—9300 | » | » |
| 2021—2222 | 6630—7290 | 4.5 | 15 | 2839—2844 | 9315—9330 | » | » |
| 2222—2231 | 7290—7320 | 9 | 30 | 2848—2853 | 9345—9360 | » | » |
| 2231—2565 | 7320—8415 | 4.5 | 15 | 2862—2867 | 9390—9405 | » | » |
| 2565—2574 | 8415—8445 | 9 | 30 | 2867—2871 | 9405—9420 | » | » |
| 2574—2684 | 8445—8805 | 4.5 | 15 | 2903—2908 | 9525—9540 | » | » |
| 2716—2720 | 8910—8925 | » | » | 2912—2917 | 9555—9570 | » | » |
| 2725—2729 | 8940—8955 | » | » | 2922—2926 | 9585—9600 | » | » |
| 2734—2737 | 8970—8985 | » | » | 2931—2783 | 9615—9130 | » | » |
| 2748—2752 | 9015—9030 | » | » | 2940—2944 | 9645—9600 | » | » |
| 2757—2761 | 9045—9060 | » | » | 2949—2954 | 9675—9690 | » | » |

Table 13 b

## WET SAMPLES

| Depth below KB | | Sample interval | | Average weights in g | | | Average % retained |
|---|---|---|---|---|---|---|---|
| m | ft | m | ft | Gross | Dried | Retained * | |
| 280— 317 | 920—1040 | 9 | 30 | 128 | 104 | 74 | 71 |
| 317— 335 | 1040—1100 | 18 | 60 | 99 | 76 | 22 | 29 |
| 335— 390 | 1100—1280 | 27 | 90 | 272 | 255 | 31 | 12 |
| 390— 408 | 1280—1340 | 18 | 60 | 263 | 211 | 76 | 36 |
| 408— 518 | 1340—1700 | 9 | 30 | 262 | 236 | 94 | 40 |
| 518— 609 | 1700—2000 | 9 | 30 | 170 | 151 | 8 | 5 |
| 609— 628 | 2000—2060 | 18 | 60 | 206 | 151 | 8 | 5 |
| 628— 674 | 2060—2210 | 9 | 30 | 149 | 122 | 8 | 7 |
| 674— 692 | 2210—2270 | 18 | 60 | 127 | 88 | 7 | 8 |
| 692— 701 | 2270—2300 | 9 | 30 | 157 | 116 | 9 | 8 |
| 701— 719 | 2300—2360 | 18 | 60 | 145 | 110 | 8 | 7 |
| 719— 792 | 2360—2600 | 9 | 30 | 178 | 150 | 10 | 7 |
| 792— 820 | 2600—2690 | 27 | 90 | 112 | 79 | 6 | 8 |
| 820— 838 | 2690—2750 | 18 | 60 | 148 | 108 | 9 | 8 |
| 838— 856 | 2750—2810 | 9 | 30 | 101 | 89 | 7 | 8 |
| 856— 893 | 2810—2930 | 36 | 120 | 79 | 57 | 7 | 12 |
| 893— 930 | 2930—3050 | 9 | 30 | 144 | 106 | 11 | 10 |
| 930— 948 | 3050—3110 | 18 | 60 | 90 | 73 | 4 | 5 |
| 948— 957 | 3110—3140 | 9 | 30 | 69 | 56 | 4 | 7 |
| 957— 994 | 3140—3260 | 18 | 60 | 120 | 106 | 7 | 6 |
| 994—1021 | 3260—3350 | 9 | 30 | 196 | 154 | 9 | 6 |
| 1021—1039 | 3350—3410 | 18 | 60 | 176 | 121 | 5 | 4 |
| 1039—1094 | 3410—3590 | 9 | 30 | 63 | 60 | 7 | 12 |
| 1094—1102 | 3590—3615 | 7.6 | 25 | 54 | 44 | 19 | 43 |
| 1102—1202 | 3615—3945 | 4.5 | 15 | 82 | 71 | 8 | 11 |
| 1202—1210 | 3945—3970 | 7.6 | 25 | 103 | 72 | 8 | 11 |
| 1210—1212 | 3970—3975 | 1.5 | 5 | 170 | 119 | 12 | 10 |
| 1212—1225 | 3975—4020 | 13.7 | 45 | 100 | 90 | 9 | 10 |
| 1225—1238 | 4020—4060 | 12 | 40 | 104 | 83 | 19 | 23 |
| 1238—1244 | 4060—4080 | 6 | 20 | 54 | 44 | 18 | 41 |
| 1244—1349 | 4080—4425 | 4.5 | 15 | 66 | 55 | 13 | 24 |
| 1349—1350 | 4425—4430 | 1.5 | 5 | 114 | 97 | 14 | 14 |
| 1350—1358 | 4425—4430 | 7.5 | 5 | 133 | 102 | 34 | 33 |
| 1358—1363 | 4455—4470 | 4.5 | 15 | 136 | 105 | 13 | 12 |
| 1363—1366 | 4470—4480 | 3 | 10 | 74 | 67 | 8 | 12 |
| 1366—1379 | 4480—4525 | 4.5 | 15 | 111 | 101 | 14 | 14 |
| 1379—1402 | 4525—4600 | 23 | 75 | 100 | 73 | 13 | 18 |
| 1402—1414 | 4600—4640 | 12 | 40 | 83 | 78 | 10 | 13 |
| 1414—1420 | 4640—4660 | 6 | 20 | 100 | 85 | 11 | 13 |
| 1420—1425 | 4660—4675 | 5 | 15 | 79 | 73 | 12 | 16 |
| 1425—1434 | 4675—4705 | 9 | 30 | 127 | 100 | 21 | 21 |
| 1434—1439 | **4705—4720 | 4.5 | 15 | 120 | 98 | 35 | 36 |
| 1439—1445 | 4720—4740 | 6 | 20 | 177 | 132 | 45 | 34 |
| 1445—1655 | 4740—5430 | 4.5 | 15 | 105 | 88 | 22 | 25 |
| 1655—1658 | 5430—5440 | 3 | 10 | 70 | 59 | 15 | 25 |
| 1658—1664 | 5440—5460 | 6 | 20 | 69 | 63 | 14 | 22 |
| 1664—1710 | **5460—5610 | 4.5 | 15 | 97 | 75 | 15 | 20 |
| 1710—1720 | 5610—5640 | 9 | 30 | 65 | 52 | 3 | 6 |
| 1720—1724 | 5640—5655 | 4.5 | 15 | 122 | 94 | 6 | 6 |
| 1724—1733 | 5655—5685 | 9 | 30 | 137 | 101 | 9 | 9 |
| 1733—1737 | 5685—5700 | 4.5 | 15 | 128 | 93 | 15 | 16 |
| 1737—1756 | 5700—5760 | 18 | 60 | 121 | 85 | 14 | 16 |
| 1756—1770 | 5760—5805 | 4.5 | 15 | 102 | 78 | 21 | 27 |
| 1770—1771 | 5805—5810 | 1.5 | 5 | 120 | 89 | 10 | 11 |
| 1771—1774 | 5810—5820 | 3 | 10 | 78 | 65 | 7 | 11 |
| 1774—1779 | 5820—5835 | 4.5 | 15 | 69 | 54 | 5 | 9 |
| 1779—1786 | 5835—5860 | 7.5 | 25 | 104 | 78 | 5 | 6 |
| 1786—1788 | 5860—5865 | 1.5 | 5 | 77 | 62 | 11 | 18 |
| 1788—1797 | 5865—5895 | 9 | 30 | 78 | 61 | 5 | 8 |
| 1797—1888 | **5895—6195 | 4.5 | 15 | 107 | 86 | 20 | 23 |
| 1888—1897 | 6195—6225 | 9 | 30 | 114 | 88 | 16 | 18 |
| 1897—1934 | 6225—6345 | 4.5 | 15 | 164 | 122 | 24 | 20 |
| 1934—1943 | 6345—6375 | 9 | 30 | 197 | 141 | 32 | 23 |

Table 13 b contd.

## WET SAMPLES

| Depth below KB | | Sample interval | | Average weights in g | | | Average % retained |
|---|---|---|---|---|---|---|---|
| m | ft | m | ft | Gross | Dried | Retained* | |
| 1943—1993 | **6375—6540 | 4.5 | 15 | 123 | 89 | 17 | 19 |
| 1993—2021 | 6540—6630 | 27 | 90 | 125 | 94 | 16 | 17 |
| 2021—2030 | **6630—6660 | 9 | 30 | 196 | 145 | 41 | 28 |
| 2030—2135 | 6660—7005 | 4.5 | 15 | 105 | 82 | 18 | 22 |
| 2135—2144 | 7005—7035 | 9 | 30 | 71 | 67 | 11 | 16 |
| 2144—2149 | 7035—7050 | 4.5 | 15 | 116 | 105 | 39 | 37 |
| 2149—2158 | 7050—7080 | 9 | 30 | 108 | 100 | 15 | 15 |
| 2158—2185 | 7080—7170 | 4.5 | 15 | 97 | 88 | 21 | 24 |
| 2185—2195 | 7170—7200 | 9 | 30 | 93 | 85 | 22 | 26 |
| 2195—2213 | 7200—7260 | 4.5 | 15 | 123 | 109 | 38 | 35 |
| 2213—2231 | 7260—7320 | 18 | 60 | 114 | 107 | 25 | 23 |
| 2231—2323 | 7320—7620 | 4.5 | 15 | 130 | 121 | 58 | 48 |
| 2323—2332 | 7620—7650 | 9 | 30 | 93 | 65 | 50 | 83 |
| 2332—2337 | 7650—7665 | 4.5 | 15 | 86 | 69 | 35 | 51 |
| 2337—2345 | 7665—7695 | 9 | 30 | 104 | 98 | 32 | 33 |
| 2345—2387 | 7695—7830 | 4.5 | 15 | 114 | 107 | 36 | 34 |
| 2387—2396 | 7830—7860 | 9 | 30 | 97 | 93 | 27 | 29 |
| 2396—2397 | 7860—7865 | 1.5 | 5 | 167 | 159 | 50 | 31 |
| 2397—2400 | 7865—7875 | 3 | 10 | 111 | 108 | 20 | 19 |
| 2400—2423 | 7875—7950 | 4.5 | 15 | 124 | 115 | 45 | 39 |
| 2423—2432 | 7950—7980 | 9 | 30 | 144 | 138 | 25 | 18 |
| 2432—2446 | 7980—8025 | 4.5 | 15 | 98 | 96 | 28 | 29 |
| 2446—2455 | 8025—8055 | 9 | 30 | 90 | 88 | 21 | 24 |
| 2455—2469 | 8055—8100 | 4.5 | 15 | 153 | 149 | 34 | 23 |
| 2469—2483 | 8100—8145 | 14 | 45 | 79 | 78 | 37 | 47 |
| 2483—2538 | **8145—8325 | 4.5 | 15 | 130 | 129 | 44 | 34 |
| 2538—2551 | 8325—8370 | 14 | 45 | 148 | 148 | 40 | 27 |
| 2551—2565 | 8370—8415 | 4.5 | 15 | 82 | 81 | 17 | 21 |
| 2565—2579 | 8415—8460 | 14 | 45 | 101 | 100 | 17 | 17 |
| 2579—2611 | 8460—8565 | 4.5 | 15 | 119 | 118 | 26 | 22 |
| 2611—2620 | 8565—8595 | 9 | 30 | 63 | 62 | 13 | 21 |
| 2620—2624 | 8595—8610 | 4.5 | 15 | 99 | 99 | 35 | 35 |
| 2624—2633 | 8610—8640 | 9 | 30 | 77 | 76 | 22 | 29 |
| 2633—2643 | 8640—8670 | 4.5 | 15 | 97 | 95 | 43 | 45 |
| 2643—2652 | 8670—8700 | 9 | 30 | 140 | 137 | 50 | 36 |
| 2652—2702 | 8700—8865 | 4.5 | 15 | 132 | 130 | 27 | 21 |
| 2702—2711 | 8865—8895 | 9 | 30 | 107 | 106 | 8 | 7 |
| 2711—2752 | **8895—9030 | 4.5 | 15 | 118 | 118 | 41 | 35 |
| 2752—2761 | 9030—9060 | 9 | 30 | 119 | 119 | 46 | 39 |
| 2761—2789 | 9060—9150 | 4.5 | 15 | 100 | 100 | 36 | 36 |
| 2789—2798 | 9150—9180 | 9 | 30 | 101 | 101 | 38 | 38 |
| 2798—2848 | 9180—9345 | 4.5 | 15 | 109 | 109 | 38 | 35 |
| 2848—2858 | 9345—9375 | 9 | 30 | 87 | 87 | 10 | 11 |
| 2858—2867 | **9375—9405 | 4.5 | 15 | 90 | 90 | 13 | 14 |
| 2967—2885 | 9405—9465 | 18 | 60 | 82 | 82 | 31 | 38 |
| 2885—2912 | 9465—9555 | 4.5 | 15 | 88 | 87 | 16 | 18 |
| 2912—2922 | **9555—9585 | 9 | 30 | 64 | 64 | 6 | 9 |
| 2922—2963 | 9585—9720 | 4.5 | 15 | 101 | 101 | 42 | 42 |
| 2963—2967 | 9720—9743 | 4.2 | 14 | 81 | 81 | 46 | 57 |

* This table shows the average weight of the dried wet samples and after washing through a 74 micron sieve and dried.

** There were taken two samples.

Table 13 c SIDEWALL CORES

| No. | Depth below KB | |
|---|---|---|
| | m | ft |
| 1 | 2375 | 7792 |
| 2 | 2396 | 7862 Not recovered |
| 3 | 2410 | 7906 |
| 4 | 2422 | 7946 |
| 5 | 2429 | 7969 |
| 6 | 2434 | 7985 |
| 7 | 2438 | 8000 |
| 8 | 2448 | 8030 Not recovered |
| 9 | 2463 | 8081 |
| 10 | 2482 | 8142 |
| 11 | 2492 | 8175 |
| 12 | 2516 | 8253 |
| 13 | 2534 | 8314 |
| 14 | 2578 | 8458 |
| 15 | 2629 | 8624 |
| 16 | 2666 | 8748 Not recovered |
| 17 | 2693 | 8835 |
| 18 | 2835 | 9300 |
| 19 | 2844 | 9332 |
| 20 | 2860 | 9382 Not recovered |
| 21 | 2875 | 9434 |
| 22 | 2879 | 9444 Not recovered |
| 23 | 2888 | 9476 Not recovered |
| 24 | 2903 | 9525 |
| 25 | 2911 | 9549 |
| 26 | 2913 | 9556 |
| 27 | 2915 | 9564 |
| 28 | 2921 | 9584 |
| 29 | 2924 | 9595 Not recovered |
| 30 | 2927 | 9602 Not recovered |

From 30 attempts, 22 cores were recovered. 7 were empty and one bullet was lost. Recoveries were poor, 1/4 inch and less.

# Abbreviations

| | |
|---|---|
| ab | = above |
| abn | = abundant |
| amr | = amorphous |
| ang | = angular |
| Anhd | = Anhydrite |
| arg | = argillaceous |
| Bar | = Barremian |
| Bc | = Breccia |
| bd | = bedded |
| becom | = becoming |
| BHC-Sonic | = Bore Hole Compensated — Sonic Log |
| BHP | = Bottom Hole Pressure |
| BHC-C | = Bore Hole Compensa-ted Sonic with Caliper Log |
| Biot | = Biotite |
| Biv | = Bivalve |
| bl | = blue |
| Bld | = Boulders |
| blk | = black |
| Blm | = Belemnite |
| brit | = brittle |
| brn | = brown |
| CAL | = Caliper |
| Calc | = Calcite |
| calc | = calcareous |
| carb | = carbonaceous |
| Cbl | = Cobbles |
| CDM | = Continuous Dipmeter |
| Cgl | = Conglomerate |
| Chk | = Chalk |
| Chl | = Chlorite |
| Cht | = Chert |
| Cl | = Clay |
| cl | = clayey |
| Clst | = Claystone |
| cmt | = cement |
| col | = colour(ed) |
| cont | = contorted |
| conv | = convolute |
| crs | = coarse |
| crm | = cream |
| csg | = casing |
| DIR | = Directional log |
| distr | = distribute(ion) |
| dk | = dark |
| dns | = dense |
| Dol | = Dolomite |
| dol | = dolomitic |
| DLL | = Dual Laterolog |
| dsk | = dusky |
| Ech | = Echinoid |
| f | = fine |
| FDC | = Formation Density log |
| fib | = fibrous |
| filt | = filtration |
| fis | = fissile |
| fl | = floor |
| Fld | = Feldspar |
| frag | = fragment |
| fri | = friable |
| Foram | = Foraminifera |
| Fos | = Fossils |
| Gast | = Gastropode |
| glac | = glacial |
| Glc | = Glauconite |
| glc | = glauconitic |
| Gn | = Gneiss |
| gn | = green |
| Gran | = Granules |
| gran | = granular |
| GR | = Gamma Ray log |
| Gr | = Granite |
| grd | = graded |
| grns | = grains |
| Gvl | = Gravel |
| gvl | = gravelly |
| gy | = grey |
| Gyp | = Gypsum |
| h | = horizontal |
| hd | = hard |
| hom | = homogeneous |
| IES | = Induction Electrical Survey |
| ig | = Igneous |
| Ill | = Illite |
| incr | = increasing |
| intbd | = interbedded |
| irreg | = irregular |
| Kaol | = Kaolin |
| KB | = Kelly Bushing |
| Kimm | = Kimmeridgian |
| lam | = laminated |
| LCM | = Lost Circulation Material |
| Lig | = Lignite |
| lig | = lignitic |
| lith | = lithic |
| LL | = Laterolog |
| lns | = lens |
| Ls | = Limestone |
| lse | = loose |
| lt | = light |
| m | = medium |
| matr | = matrix |
| met | = metamorphic |
| mdst | = mudstone |
| mic | = micaceous |
| mid | = middle |
| ML-C | = Microlog - Caliper |
| MLL-C | = Microlaterolog — Caliper |
| mod | = moderate |
| Mrl | = Marl |
| mrl | = marly |
| mtl | = mottled |
| Musc | = Muscovite |
| nod | = nodular |
| n.s. | = no sample |
| o | = oil |
| occ | = occasional(ly) |
| olv | = olive |
| orng | = orange |
| pa | = pale |
| Pbl | = Pebble |
| Pbl | = Pepple |
| pel | = pellet |
| Pelc | = Peleycopod |
| pkst | = packstone |
| pk | = pink |
| plast | = plastic |
| Pleist | = Pleistocene |
| por | = porosity, porous |
| ppg | = lb/gallon |
| predom | = predominant |
| pres | = pressure |
| psi | = lb/sq. in. |
| purp | = purple |
| Pyr | = Pyrite |
| pyr | = pyritic |
| Qtz | = Quartz |
| qtz | = quartzitic |
| rec | = recovery |
| red | = red(dish) |
| Rk | = Rock |
| rnd | = rounded |
| S | = Sand |
| s | = sandy |
| sc | = scattered |
| Sch | = Schist |
| sec | = second |
| sft | = soft |
| Sh | = Shale |
| Si | = Silicon |
| Sid | = Siderite |
| Sks | = Slickenside |
| Slt | = Silt |
| slt | = silty |
| Sltst | = Siltstone |
| SNP | = Sidewall Neutron Porosity |
| sph | = sphericity |
| spic | = spicules |
| SRS | = Seismic Reference Survcy |
| srt | = sorted |
| Sst | = Sandstone |
| stnd | = stained |
| strgs | = strings |
| Styl | = Stylolite |
| suc | = sucrose(ic) |
| surf | = surface |
| text | = texture |
| TD | = Total Depth |
| Tf | = Tuff |
| tf | = tuffaceous |
| tot | = total |
| trsl | = translucent |
| trsp | = transparent |
| TS | = Temperature Survey |
| v | = vertical |
| visc | = viscosity |
| vn | = vein |
| vy | = very |
| w | = with |
| wkst | = wackestone |
| wh | = white |
| xln | = crystalline |
| yel | = yellow |

Examples of quantitative expressions: (for silt)
(slt) - slightly silty, slt - moderately silty, slt - very silty

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