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Norsk Hydro a.s
Oslo – Norway

Reservoir Evaluation of 30/7-2 Eocene Discovery.

RESERVOIR ENG. DEPT.
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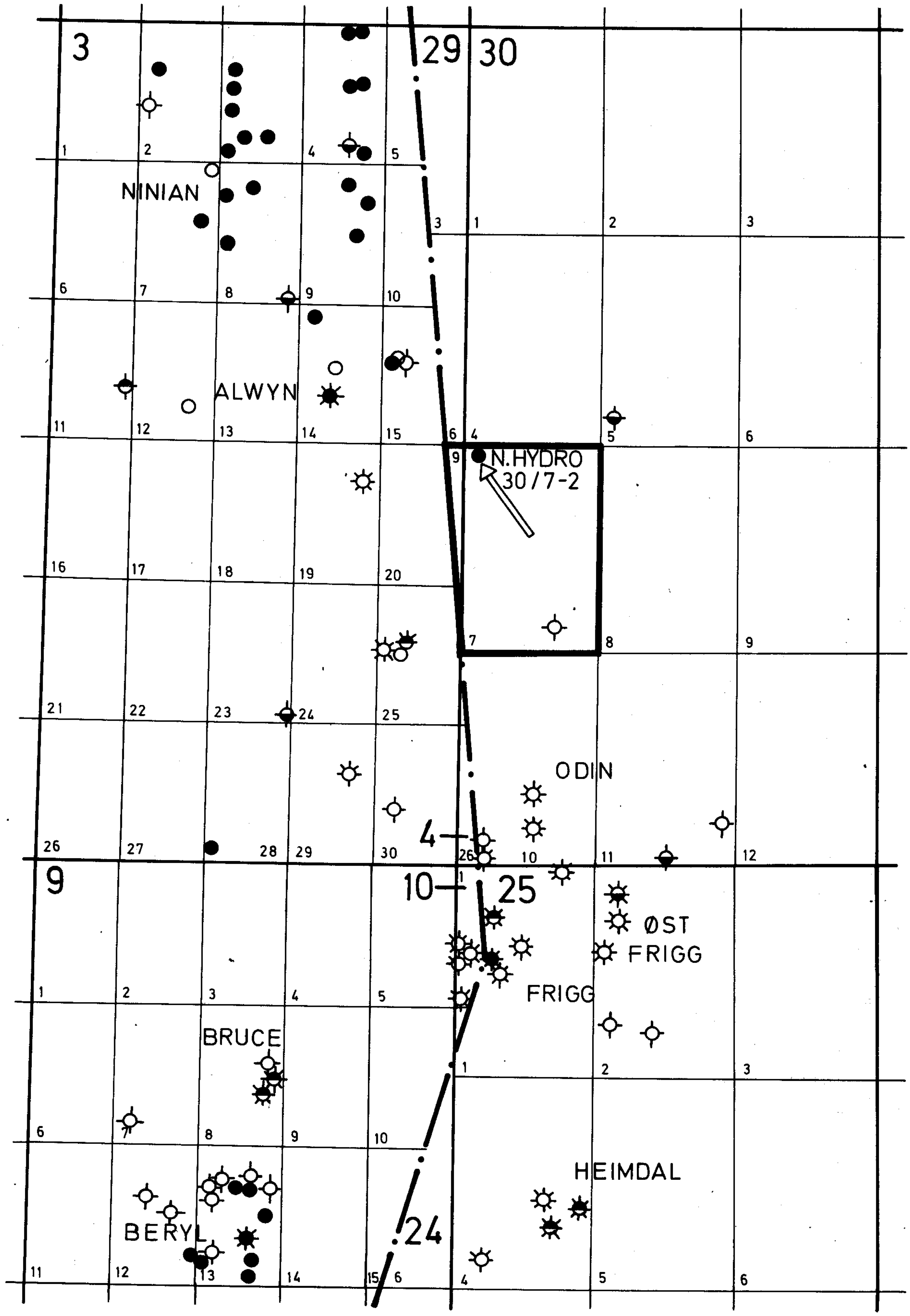
NOV. 8. 76



Norsk Hydro a.s

Oslo - Norway

PI 040 - BLOCK 30/7

NORTH SEA

Contour interval	Interpreted	Date 2 - 11 - 76
Scale 1 : 750, 000		

CONTENTS

CONCLUSIONS

1. A discovery of hydrocarbon accumulation was done at 1747 m RKB. The hydrocarbons were situated in the Eocene formation. The large Paleocene structure had only minor oil shows. The lack of hydrocarbons in the Paleocene is probably a problem of vertical sealing of shales between the various sands.

2. Analogy in geological history of 30/7-2 hydrocarbon discover and Frigg is indicated by the hydrocarbons analysis as well as by water characteristics.

3. The oil in place is in the range of $18x10^6 Nm^3$ ($113x10^6$ bbl). The low figure is due to a small net oil pay of 16.4 m as well as to the limited magnitude of the bulk volume.

4. The productivity index of the reservoir is very high, $22m^3$/day/atm, which makes rates in the range of 2500 - 5000 Bbl/day possible. There are, however , two serious limitations 1) sand movements which will request a special completion and gas and oil coning. The coning effects will limit the rate to less than 10 Bbl/day if not prevented

5. Microscopical displacement efficiency indicates that displacement behaviour is better for water drive (MDE=28.6 %) than for gas drive (MDE=7.5 %).

6. From the present study the Eocene reservoir discovered by the well 30/7-2 does not represent a reservoir to be developed.

ABSTRACT.

A resumé of all results obtained in the present study is given hereunder:

Discovery

The well 30/7-2 discovered an accumulation of oil and gas in a Middle - Lower Eocene sand reservoir. A final contour map of the Cla seismic marker was drawn in the vicinity of well 30/7-2 (Fig.1).

Reservoir parameters

Seismic marker	RKB	1747.0 m
Top of sand		1749.8 m
Gas oil contact		1762.8 m
Oil water contact		1783.0 m
Gross pay		33.2 m
Net pay		25.6 m
Net pay fraction gas zone	α_g	0.73
Net pay fraction oil zone	α_o	0.81
Porosity gas zone	Ø	22.2 %
Porosity oil zone	Ø	29.4 %
Water saturation gas zone	Sw_i	18.2 %
Water saturation oil zone	Sw_i	19.4 %
Net gas column		1.22m
Net oil column		3.89m

Testing results

Average productivity	22 m^3/day/atm.
Reservoir pressure at 1770 m	2585 psi
Reservoir temperature	53^{o}C

Due to very fast pressure rise it has not been possible to perform a pressure build up analysis on the test results. However, a permeability above 1D is indicated from the productivity index calculated.

During both DST's serious sandproblems occured and the testing equipment was badly eroded by the sand.

Core analysis

The grain size distribution analysis of the sand indicates a bimodal sand. The two classes have a d_{50} of 0.040 mm and 0.3373 mm respectively. The average d_{50} measured on all the samples is 0.183 mm.

Hydrocarbon analysis

The hydrocarbon analysis shows an absence of intermediate components. The main component in the gas zone is methane (99.6 %), whereas in the oil zone very little of light hydrocarbons are present (C_H^+ = 97.66 %)

Water analysis

The chemical water analysis has been compared to the analysis of Frigg formation water. The similar characteristics indicate similar environmental conditions during the geological history of the reservoirs.

Hydrocarbons in place

Gas cap (free gas)	$1.1 \times 10^9 Nm^3$
Gas in solution	$0.8 \times 10^9 Nm^3$
Oil in place	$18 \times 10^6 Nm^3$

Well productivity

The oil zone might be interpreted as continous or discontinous. In the last case the shale stringer in the middle of the oil zone is considered inpermeable and continous through the reservoir. The max well rate is in this case limited to 8 STB/day due to oil and gas coning In the first case mentioned above, the coning effects will reduce the rates to 5 STB/day.

Recovery factor

If the main drive mechanism is assumed to be solution gas drive, the final recovery at the end of total energy depletion estimated by various procedures, is

36% - for K = 500 md, by statistical method
38.5% " K = 1000md, " " "
24.5% calculated by Tracy's method

The microscopical displacement efficiency has been calculated by Buckley-Leverett's procedure. The result for gas expansion or water encroachment is:

M.D.E. (gas cap drive) : 7.75 %
M.D.E. (water drive) : 28.6 %

This means that recovery efficiency from gas cap expansion will be very small, mainly as a result of mobility ratio.

DISCUSSION

A. FIELD HISTORY

The Block 30/7 was opened July 12th, 1973. Seismic was shot during 1971 by Delta-Seiscon, Prakla-Seismos (for Mobil) SSl and Western. (In 1973 further seismic was done by GECO). The Isochron interpretations of these data are shown in fig. 2 and 3.

On 14th of September 1973 the Petronord group applied for concession on blocks 30/7 and 29/9. By a Royal Decree of November 15th 1974 the companies in the Petronord/ Statoil group were awarded production license No. 040 covering blocks 20/9 and 29/7 on the Norwegian shelf:

The participants and their % interest are the following:

Den norske stats oljeselskap a.s. - Statoil	50.0 %
Norsk Hydro production a.s	6.8 %
Elf Norge A/S	19.2 %
Total Marine Norsk A/S	14.4 %
Aquitaine Norge A/S	9.6 %

The production license and the participation agreement was accepted by the partners on March 17th, 1975.

1. Drilling

A first well has been drilled through the Eocene sand in block 30/7. The objective of the drilling was to reach the Maastrictian, having as a main aim to investigate the structural closure of Eocene and Paleocene.

The planned location of the first well 30/7-1 is shown in both maps on figs. 2 and 3.

Due to technical problems the well had to be abandoned after drilling 1007 m, and relocated at 150 feet east of the first location. This well was denominated 30/7-2 and its final location is N 60° 29' E 02° 01' 40.85". On November 9th, 1975 T.D. was reached at the depth of 2591 m[x].

2. Hydrocarbon shows

Two minor Hydrocarbon shows were encountered in the upper Eocene and in addition slight oil stain on cuttings was observed at 1700 m. Below 1750 m more encouraging oil shows occured in sandstone cuttings, and these shows have been confirmed in the six cores cut in the interval 1753 m to 1821.7 m. The logs indicate that a gas and oil bearing sand was located in the interval 1749.8 m - 1783 m confirming the shows. The shows have been confirmed through bottom hole samples obtained from FIT's and DST's.

x) All depths are measured from RKB.

B. GEOLOGICAL EVALUATION

1. Geophysics.

The final isochrone map and the isobath of the Cla horizon are shown in Fig. 1 and 4 respectively. For depth conversion the seismic time in 30/7-2 has been set equal to the interpolated check shot-time recorded in the well, i.e. 866 ms o.w.t. and the depth equal to 1724 m MSL, and hence the average velocity,

$$v = 1724/0.866 \text{ m/s} = 2014 \text{ m/s}$$

has been used over the area.

The depth map has been planimetered, and in Fig. 5 the depth is plotted v.s. the area. The reservoir is divided in two zones: a gas cap zone and an oil zone. The diagram of gross pay v.s. area indicates the gas oil contact at 1762.8m dividing the total height in a gross pay of 36m for the gas cap zone and 20m for the oil zone. The estimation of the gas-oil contact was based on logs interpretation.

2. Geological discussion

The reservoir, dated middle-lower Eocene, consists of an unconsolidated, medium grained sand composed of moderatly sorted subrounded quartz grains with some free mica, interbedded with large flakes of mica.

Deposition appears to have taken place in a deltaic environment, which persisted from Paleocene to Middle Eocene.

The well found an apparent oil water contact at 1783 m RKB. Seismic mapping has estimated a spill point at 1759 m MSL (1782 m RKB), and thus the structure appears spill full. The section 1783 m to 1818 m had still some oil shows on cores, and on the logs some limited oil banks can be interpretated, but they are separated by layers having 100% water saturation.

To the east of 30/7 the middle-lower Eocene sands shale out, while to the west the sands appear to thicken. Any hydrocarbons spilled from the structure will have migrated west. One geological explanation of the evidence found in 30/7-2 is that the 30/7-2 structure was formerly part of a much larger oil and gas field, which extended onto U.K. 3/20 (Total); some mechanism, e.g. tilting, leakage, gas contraction with increasing pressure, reduced the original field in hydrocarbon bulk volume, leaving a series of small hydrocarbon accumulations in what was formerly the small closed crestal culuminations of the field.

In such case the oil disc would have migrated up, from the original owc at around 1795 m SS to 1759 m SS today. This would have resulted in small hydrocarbon accumulations behind shale beds, and residual hydrocarbon throughout the section. This would appear consistent with the 30/7-2 well data.

The oil and gas found in 30/7-2 is similar to Frigg, and a similar hydrocarbon source and history seems likely. 30/7-2 did not contribute any additional evidence as to the source or hydrocarbon history, which is assumed to be Jurassic and/or Tertiary shales and subsequent alteration by bacteria.

30/7-2 found the larger Paleocene closed structure barren of significant hydrocarbons. This is consistent with the situation in the nearby areas, e.g. Frigg area, Heimdal, 3/14A (UK), 3/15 (UK), 3/25 (UK) where only the top Tertiary sand contains hydrocarbons. This is probably a problem of vertical sealing of the shales between the various sands.

C. RESERVOIR ROCK AND FLUID PROPERTIES

1. Log analysis

The well was logged from 110 m to 2590 m RKB. Two CPI's based on BHC-GR, DLL with micro spherical, CNL-FDC-GR and IES were made. The first CPI was computed as a preliminary CPI using the CORIBAND without the dual mineral presentation program, and the second CPI was run with a dual mineral presentation (mica option) with the two minerals being mica and quartz. A further evaluation of the logs was done by Norsk Hydro and the results have confirmed the CPI's estimation. In table 1 the basic log parameters are listed.

A copy of the logs run over the pay interval and the CPI computed with the mica option are presented in fig. 6. The average value of the reservoir parameters and the depth data have been calculated from the mica option CPI and reported among data of table 2.

The main hydrocarbon zone occurs in the interval 1749-1782.2 m RKB. Below 1782.2 m some sandstone stringers with oil are present with the thickest zone at 1807.5 - 1810.5 m RKB.

The cut-off factors used for calculating net pay have been chosen so that only pay with movable hydrocarbons (CPI) was included in the net pay. The following cut-offs have been used.

Gas zone $S_W > 50$
$V_{cl} > 50$

Oil zone $S_W > 50$
$V_{cl} > 30$

2. Core analysis

Six full size cores were cut in the interval 1753.0 - 1821.7 m. All the cores have shown the presence of hydrocarbons. The core report is enclosed as appendix 4.

The lithology of the formation is mainly an unconsolidated sand with shale interbeds. On the six cores a series of petrophysical measurements such as grain density and grain size distribution were measured on 36 selected samples.

The average grain density of the clean sand in the hydrocarbon zone (1762-1770 m RKB) and of the clean sand in the water zone (1777-1798 m RKB) were measured in the laboratory and found to be 2.67 g/cc and 2.66 g/cc respectively. The results are comparable to the grain size computed by the CPI.

The grain size distributions from the selected samples are plotted in fig. 7. The cumulative distribution curves have two slopes which indicates a bimodal sand.

An average distribution curve considered as the most representative sample was reexamined as two cumulative curves of two different "populations". The results are presented in fig. 8 where it might be observed that the slopes are differentiating and the geometric average diameter are:
d_{50} = 0.040 mm and d_{50} = 0.2373 mm respectively instead of d_{50} = 0.183 as it is when the two sand populations are mixed in one cumulative frequency curve.

An experimental correlation between d_{50} and intrinsic permeability suggests a permeability of 160 mD for the finest sand and 30D for the other one. A diagram from literature (5) correlating grain size, permeability and frequency distribution with the type of depositional environment is presented in fig. 9. The two classes of sand from the sample are shown as shaded curves, indicating a deposit between coarse colluvium and coarse alluvial sand.

A correlation between grain size geometric average, d_{50}, and the ratio d_{80}/d_{20} was examined versus depth (fig.10).

The grain size d_{50} indicates a value proportional to the permeability and therefore d_{50} vs. depth is showing the variation of permeability.

The curve of the d_{80}/d_{20} ratio divides the interval into three units. Between 1777 m and 1797 m the sand is quite uniform and well sorted. In the lower unit the sand is less well sorted and contains some very fine beds. In the upper unit the sand is poorly sorted, variable shaly and fine to coarse. The granulometric curves compare favourably with the Gamma ray log (fig. 6) and with the core report.

Porosity and permeability have not been measured on the cores taken in the hydrocarbon zone due to the unconsolidated nature of the sand. However, an experimental (5) correlation between the average grain size and permeability of an unconsolidated sand indicates the clean Eocene sand to have a permeability larger than 1 darcy. In the Paleocene horizontal permeabilities varying between 20 and 2000 md have been measured on consolidated samples from depth 1971 m to 1988 m RKB.

3. Well testing

4 FITs and 2 DTSs were run. A summary of the test results is given in fig. 11. DST No. 1 was run in the interval 1796.5 m to 1801 m RKB. There was no flow of formation fluid to the surface during the test, but a sample of formation water was collected from the drill string between the ARP tester and the Hydrospring.

DST No. 2 was run in the interval 1766-1776.5 m RKB. The well flowed oil and gas to the surface, but the separator did not stabilize for long enough to enable good measurement of the flow rate. The flow rate is estimated to have been in the range 80 - 140 Sm³/day stock tank oil per day (500-900 STB/d).

The type of formation fluid recovered from the DST's and the FIT's confirms the interpretation of the CPI as to the nature of the fluids being present in the Eocene sand. In DST No. 2 gauge No. 2651 seems to be recording 3.5 - 4.8 atm (50-70 psi) too high. Analysis of the final hydrostatic pressure recorded by the 4 gauges (shown in table 3 and fig. 12) confirms this.

Therefore the readings of gauge No. 2651 have been neglected in the calculations of the static pressure.

The average formation pressure at 1710 m RKB is 2585 psig (175.9 atm). (Table 4 and fig. 13)

Due to the very fast pressure rise no pressure build-up analysis can be performed on the test results. However, with the flowrate ranging between 80 - 140 m^3 of stock tank oil per day the productivity lies in the range 16-28 m^3 stock tank oil/day/atm (6.7-12 bbl/day/psi). This indicates a permeability in the range of 1-2 darcy.

In both DST's production of sand from the unconsolidated formation created serious difficulties in the execution of the testing.

At the recovery of the tool string in DST No. 1 a large fraction of it was found to be filled with sand (no oil stains). In DST No.2 the content of sand in the produced oil exceeded 14% by volume at the start of the flow, decreasing to less than 1% after 4 hours.

4. Sampling

FIT Nos. 2 and 3 at 2010 m and 1978.5 m RKB, respectively, were found to contain only mud and mud filtrate. Fit No. 4 at 1808.5 m recovered oil and FIT No. 5 at 1753 m RKB recovered gas.

DST No. 1 recovered formation water only. A sample of water was collected from the drill string between the APR tester and the hydrospring.

DST No. 2 recovered oil and gas.

A PVT sample of gas from FIT No. 5 and separator samples of oil and gas from DST No. 2 have been analysed by the laboratory of SINTEF in Trondheim (1).

The water sample was analysed at the laboratories of NTNFK (2).

5. Analysis of the formation hydrocarbons

A NMR-spectrum indicates the oil to be paraffinic with an average molecular weight of approximately 278. In table 5 the chemical compositions of the oil and gas are given. There is a remarkable lack of intermediates in the HC-samples. Methane is the main component in the gas (99.6 %) and the oil consists mainly of n-Unedecane plus (97.6 %). A similarity to the Frigg gas and oil where the main component in the gas, Methane, represents 87.63 % and the C_7+ represents 99.6 % can be seen. The intermediates are only present in very low consentrations.

Recombination of the separator samples of gas and oil at 53.3°C (128°F) gave a bubble point pressure 174.69 atm (2568 psig) Flash liberation of gas resulted in a GOR of 46.7 Nm^3/m^3 STO (260 SCF/STB) and a formation volume factor of 1.116. The gravity of the residual oil and separator gas was respectively 20.0°API and 0.569 (air = 1). The oil has a viscosity of 5.2 cp at the saturation pressure and 53.3 °C.

A summary of the PVT data is given in Appendix 1 as tables and graphs.

6. Analysis of formation water

The formation water has a salinity of 45000 ppm. The results of the chemical water analysis are shown in table 6.

For a better understanding of the regional geology the 30/7-2 chemical water characteristics have been compared to the Frigg formation water. The possibility of a similar history or a large communication for the Frigg reservoir aquifer and the Eocene discovery of well 30/7-2 is indicated by several similar characteristics.

Various procedures have been used in the interpretation of the water data.

1) Graphical interpretation:
   a) Stiff
   b) Tickel

2. Analytical procedure:

a) Palmer

The application of the above methods on Frigg and 30/7-2 data is presented in Appendix 2. From the examination of the graphical and analytical methods it can be seen that the formation waters of the 30/7-2 Eocene structure and Frigg have similar characteristics. This similarity is not indicating a circulation of water, but equivalent environmental conditions during the reservoirs geological histories.

D. VOLUMETRIC ESTIMATE OF HYDROCARBONS IN PLACE

The contour map of the seismic marker Cla in the vicinity of well 30/7-2 shown in fig. 1 is the basic data for the bulk volume evaluation. A volumetric estimate of hydrocarbons in place in the Eocene structure has been determined by using the contour map and the reservoir parameters listed in table 2.

The bulk volume of sand saturated with hydrocarbon between the isobaths 1749.8 and 1783 m RKB as shown in fig. 5, was estimated:

$$V_B = 153 \times 10^6 m^3$$

where the bulk of gas sand is:

$$V_{BG} = 49.6 \times 10^6 m^3$$

and the bulk of oil sand is

$$V_{BO} = 103.4 \times 10^6 m^3$$

The gas volume factor B_g is

$$B_g = \frac{pT_o}{Tzp_o}$$

where z is 0.87. P and T are given in the table 2

$$\underline{Bg = 169.6 \ Nm^3/m^3}$$

The gas in place is then:

$V_{BG} \emptyset_{gas} (1-S_{wgas}) \ B_g \ \alpha g$: (gas zone) $= 1.1 \times 10^9 Nm^3$

$V_{BO} \emptyset_{oil} (1-S_{woil}) \ \alpha_{oil} \ R_s/B_o$ (oil zone) $= \underline{0.8 \times 10^9 Nm^3}$

$\underline{1.9 \times 10^9 Nm^3}$

B_o is determined from PVT data to be $1.108 m^3/STM^3$.

The oil in place is then $V_{BO} \emptyset_{oil} (1-S_{woil}) \ \alpha_{oil}/B_o = \underline{18 \times 10^6 Nm^3}$

E. WELL PRODUCTIVITY

Since the productivity index of the formation is high (PI average = $22m^3$/day/atm) well rates between 2500 bbl/day to 5000 bbl/day can be obtained for pressure drop in the range of 0.1 P_i to 0.2 P_i. However, the log data indicate that the risk of water and gas coning will limit the well productivity very severely. In fact, the oil zone, which has a gross pay of 20 m, is limited by a gas cap above and by a waterbearing zone below.

A shale layer divides the oil zone in two parts, interval 1 (7.2 m) and interval 2 (10 m) shown on fig. 6^b. This shale might be an impermeable layer continuing throughout the reservoir. In that case the production from interval 1 will be limited by gas coning and production from interval 2 by water coning. If the shale is considered to be discontinuous, the entire oil zone may be viewed as a continuous zone.

1) <u>The oil zone divided in interval 1 and interval 2</u>

Gas coning

Interval 1 in fig. 6^b is 7.2 m thick and therefore 3.6 m in the lower part was assumed perforated. Based on the equation

$$P_{c,max} = \frac{\rho_o - \rho_g}{1.0332} \times z$$

where ρ_o and ρ_g are the specific weight of oil and gas respectively and z is the height from the top of the perforations to the gas oil contact, the maximum pressure drop can be calculated

$$\rho_o = 0.866 \times 10^{-3} \text{ kg/cm}^3$$

$$\rho_g = 0.108 \times 10^{-3} \text{ kg/cm}^3$$

$$P_{c,max} = 0.264 \text{ atm}$$

When introducing the maximum pressure drop in the flowing equation the result is.

$$q = \frac{54.29\ h_p k \quad \Delta p}{\mu\ B_o \quad \ln \quad (re/rw)}$$

Where

h:	total height	7.2 m
h_p:	preforated height	3.6 m
k:	permeability	1 D
ln	re/rw	10 m
μ		5.2 cp
B_o		1.11 m^3/STM^3

Giving the well rate

q = 0.894 STM^3/day = 5,6 STB/day.

Water coning

The interval No. 2 in fig. 6^b is 10 m thick and the upper 5 m were assumed perforated.

$$P_{c,max} = \frac{\rho_w - \rho_o}{1.0332} \times Z$$

$P_{c,max}$: 0.0802 atm

Giving the well rate

q = 0.377 STM^3/day = 2.4 STB/day

To avoid oil and gas coning the total maximum rate is 8 STB/day.

2) Continous oil zone

If the exictance of impermeable layers is disregarded, the oil column is 20 m thick. The middle 10 m were considered perforated.

Gas coning

Based on the above equation $p_{c,max}$ is

$$p_{c,max} = 0.366 \text{ atm.}$$

corresponding to a well rate

$$q = 1.73 \text{ STM}^3/\text{day} = 10.8 \text{ STB/day}$$

Water coning

$$p_{c,max} = 0.0802 \text{ atm}$$

corresponding to a well rate

$$q = 0.75 \text{ STM}^3/\text{day} = 4.7 \text{ STB/day}$$

The maximum well rate possible with a water free production is in this case 5 STB/day.

F. CONSIDERATIONS ON RECOVERY FACTOR

Neglecting the fact that the oil in place is very small and well rates are limited by coning effects, a recovery factor might be evaluated as an indication of the efficiency of various drive mechanisms.

The recovery of oil through solution gas drive mechanism will be evaluated referred to unit volume of oil and is therefore independent of time or field development.

The water drive or gas cap recovery evaluation will be limited only to the evaluation of microscopical displacement efficiency without any attempt of estimating the sweep efficiency and conformance factor. In other words the evaluation is independent of field development.

1. Solution gas drive mechanism

1.1. Statistical method based on fluid properties and statistic data. The equation to be used is:

$$RE = 41.815 \times \left[\frac{\emptyset(1-S_w)}{B_{ob}}\right]^{0.1611} \times \left[\frac{k}{\mu_{ob}}\right]^{0.0979} \times \left[S_w\right]^{0.3722} \times \left[\frac{P_b}{P_a}\right]^{0.1741}$$

Where RE recovery efficiency (per cent)

$\emptyset$	porosity (fraction)	0.294
S_w	water saturation (fraction)	0.194
B_{ob}	formation volum factor for oil (bbl/bbl)	1.116
μ_{ob}	oil viscosity (cp)	5.19
k	permeability	
Pb	bubble point pressure (PSI)	2568
Pa	abandonment pressure	

In fig. 14 Pb/Pa is plotted v.s. RE. The recovery is calculated for permeabilities of 1000 md and 500 md and an abandonment pressure of 600 psi.

RE = 36% for k = 500
RE = 38.5 % for k = 1000

This method of calculating the recovery factor normally gives very optimistic results.

1.2. Solution of material balance Equation (Tracy's method)

For a fixed pressure, N_p is assumed, and the assumption is checked by solution of the following equations.

1. $$S_o = (1-S_w) \times (1-\frac{N_p}{N}) \times \frac{B_o}{B_{oi}}$$

2. $$R = \frac{k_{rg}}{k_{ro}} \frac{\mu_o \, \mu_g}{BoBg} + R_s$$

3. $$N_pR_p = (N_pR_p)_{n-1} + \frac{R_{n-1}+R_n}{2} \, (N_{pn}-(N_p)_{n-1}$$

4. $$N_pR_p = \frac{N(B_t-B_{ti})-N_p(B_t-R_{si}B_g)}{B_g}$$

The relationship P vs $^{Np}/N$ and GOR vs $^{Np}/N$ have been calculated. The results are presented in Fig. 15. The calculations are showing a maximum final recovery of 24.5%.

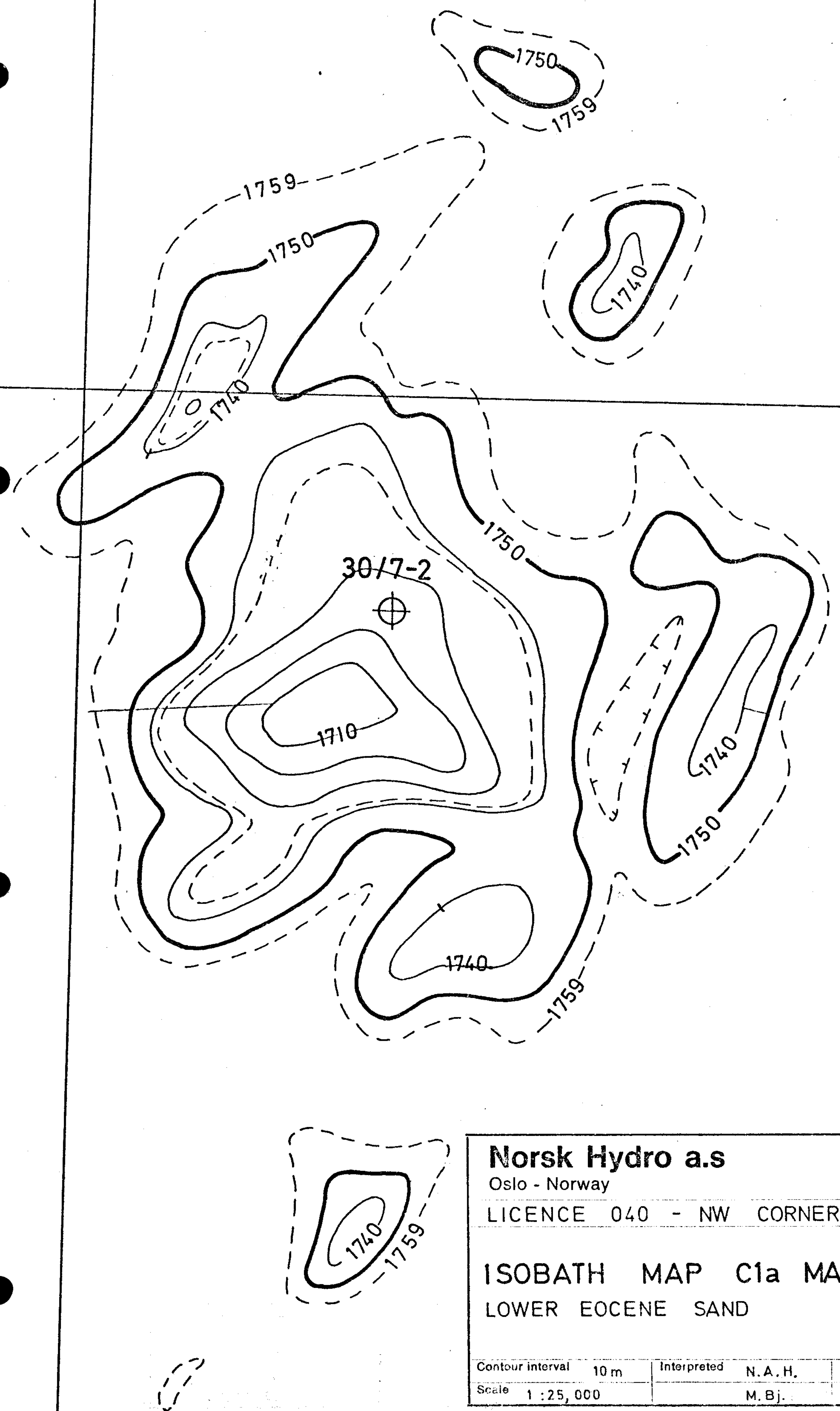
2. Water and gas displacement (Buckley Leverett)

The sweep efficiency by water and gas displacement was calculated by the Buckley-Leverett method, as shown in Fig. 16 and 17. The relative permeabilities are given in tables 7 and 8.

The microscopical displacement efficiency resulted:

MDE for water drive 28.6%
MDE for gas cap drive 7.75%

FIG. 1



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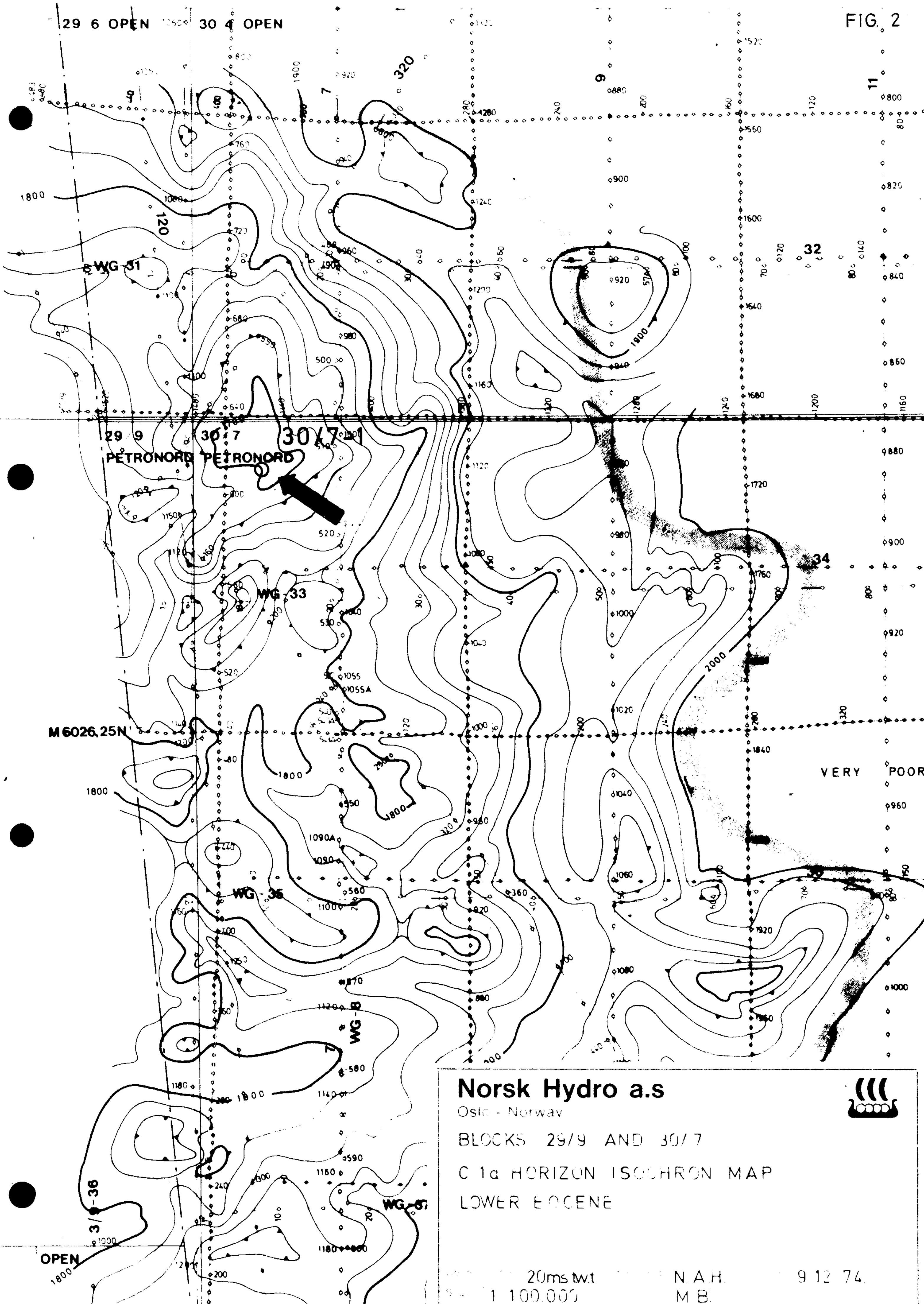
ISOBATH MAP C1a MARKER

LOWER EOCENE SAND

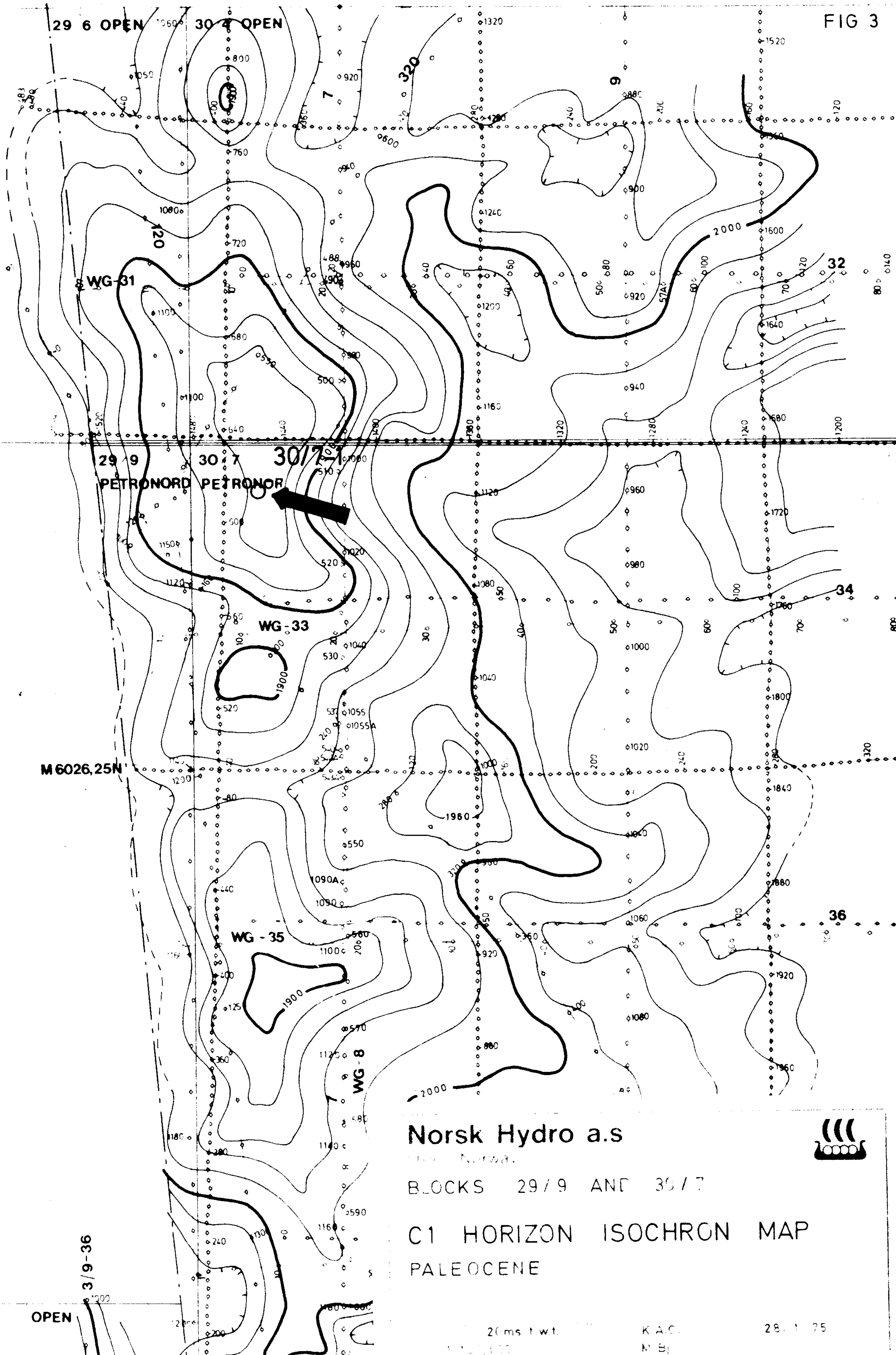
Contour interval	10 m	Interpreted	N.A.H.	Date	30. 3. 76.
Scale	1 :25,000		M.Bj.		88.105.42.15.60.M1079

FIG. 2



29 6 OPEN
30 4 OPEN
WG-31
WG-33
WG-35
WG-8
WG-36
WG-37
29 9
30 7
30/7-1
PETRONORD
PETRONORD
M 6026,25N
VERY POOR
OPEN
1800
1900
2000
Norsk Hydro a.s
Oslo - Norway
BLOCKS 29/9 AND 30/7
C 1a HORIZON ISOCHRON MAP
LOWER EOCENE
20ms twt
1 100.000
N.A.H.
M.B.
9.12.74.

FIG 3



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BLOCKS 29/9 AND 30/7

C1 HORIZON ISOCHRON MAP

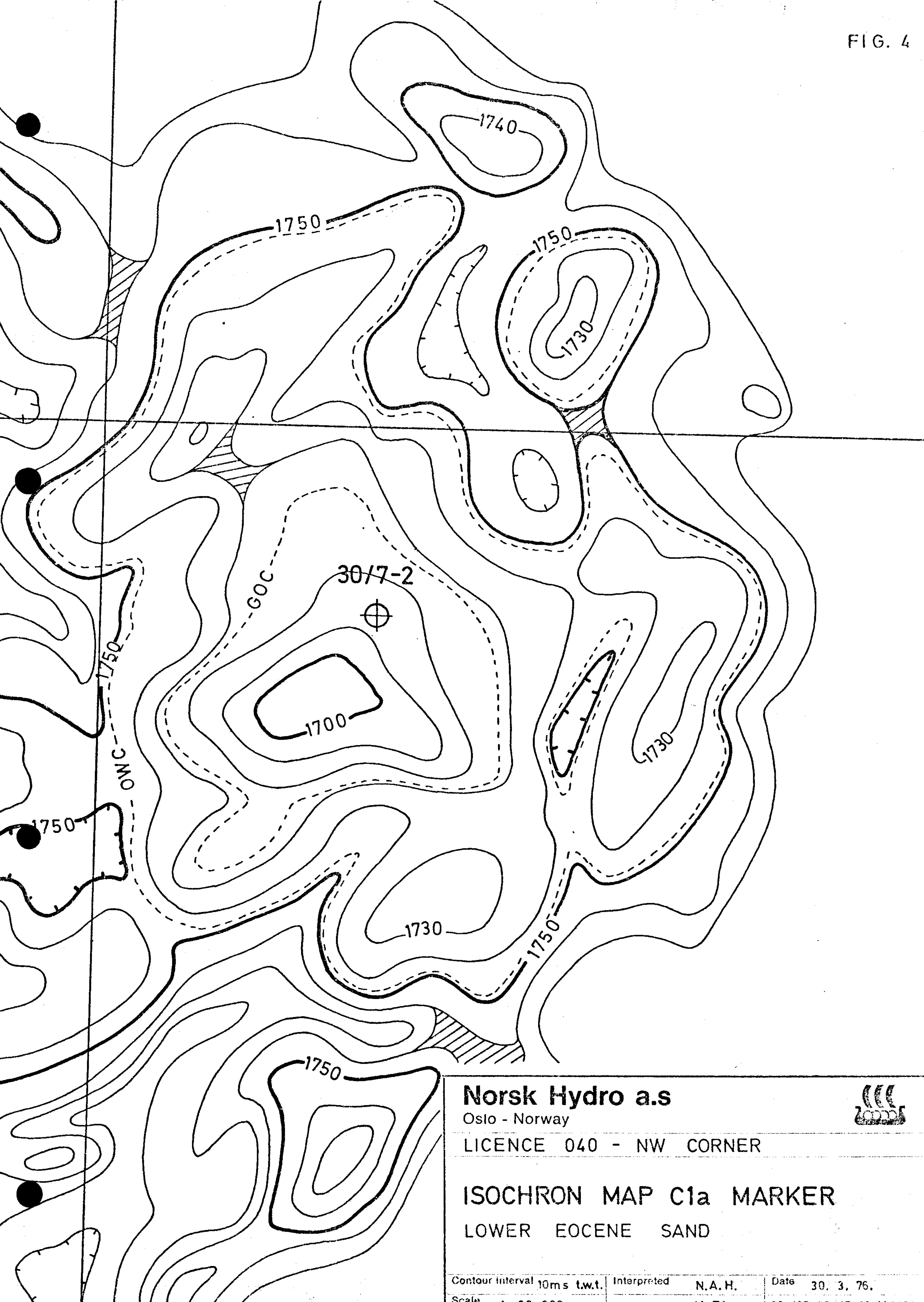
PALEOCENE

20ms t.w.t.

K.A.C.

M.B.

FIG. 4



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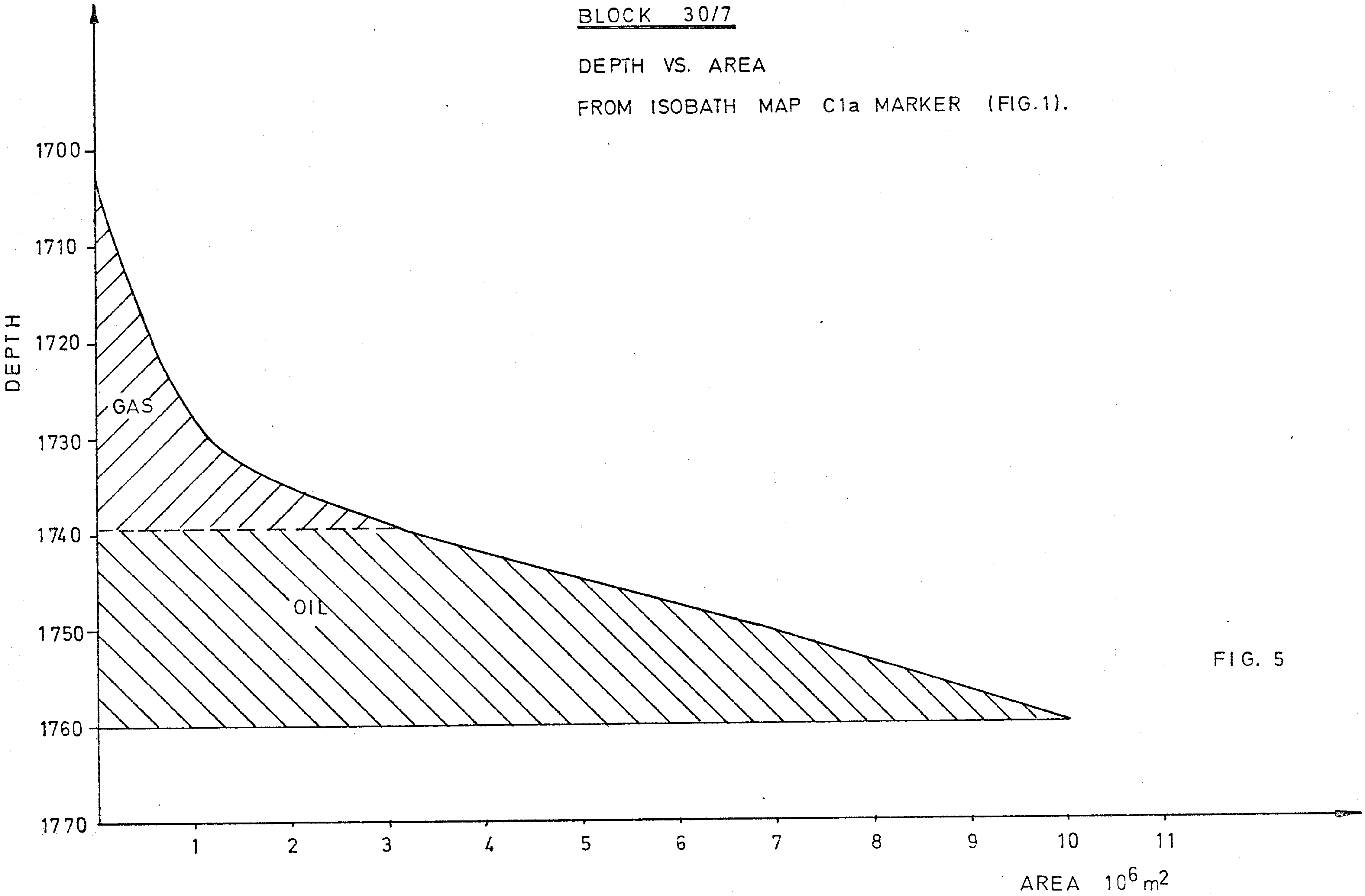
ISOCHRON MAP C1a MARKER

LOWER EOCENE SAND

Contour interval 10ms t.w.t.	Interpreted N.A.H.	Date 30. 3. 76.



BLOCK 30/7
DEPTH VS. AREA
FROM ISOBATH MAP C1a MARKER (FIG.1).
DEPTH
1700
1710
1720
1730
1740
1750
1760
1770
GAS
OIL
1
2
3
4
5
6
7
8
9
10
11
AREA 10^6 m^2

FIG. 5

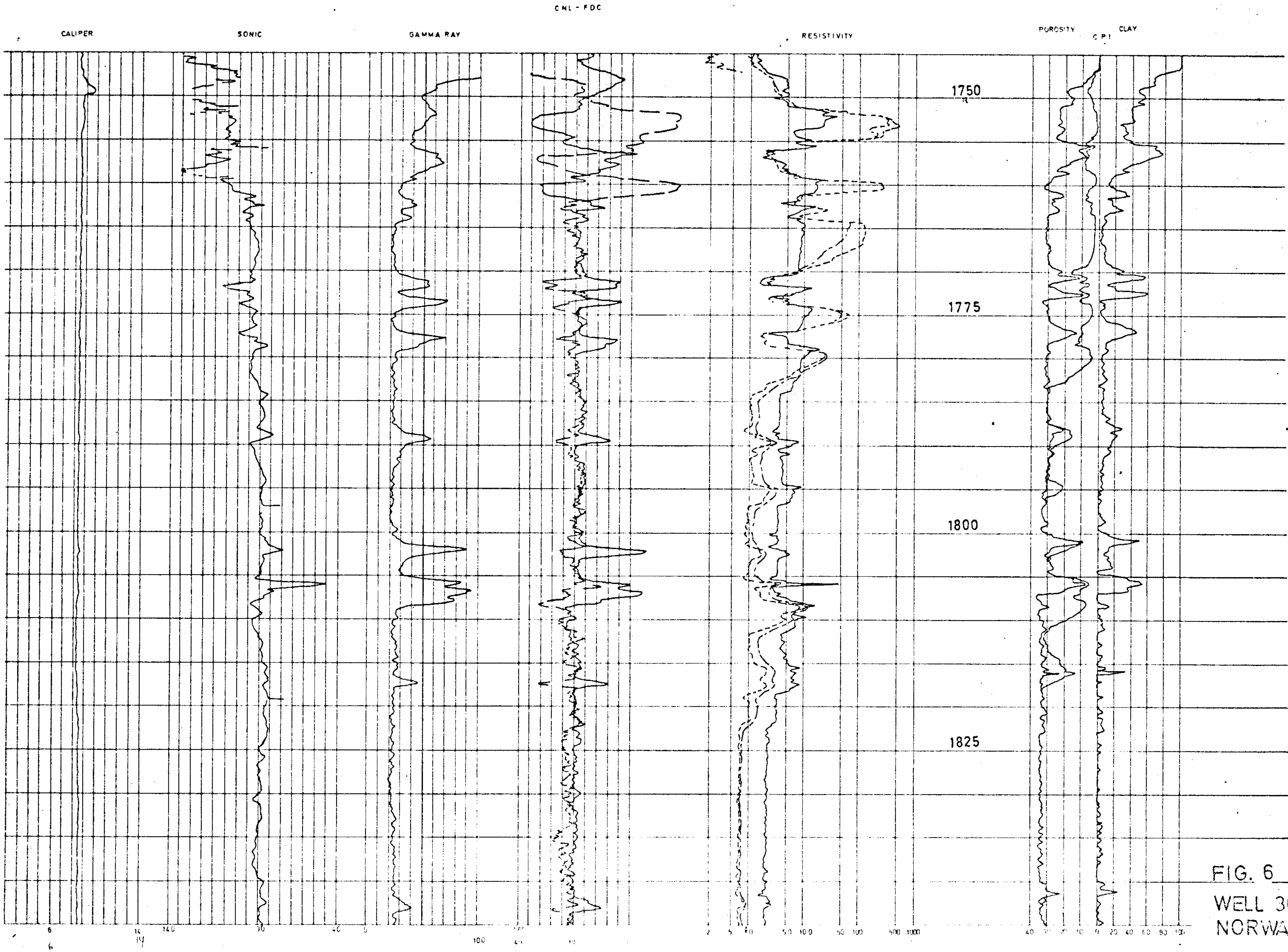
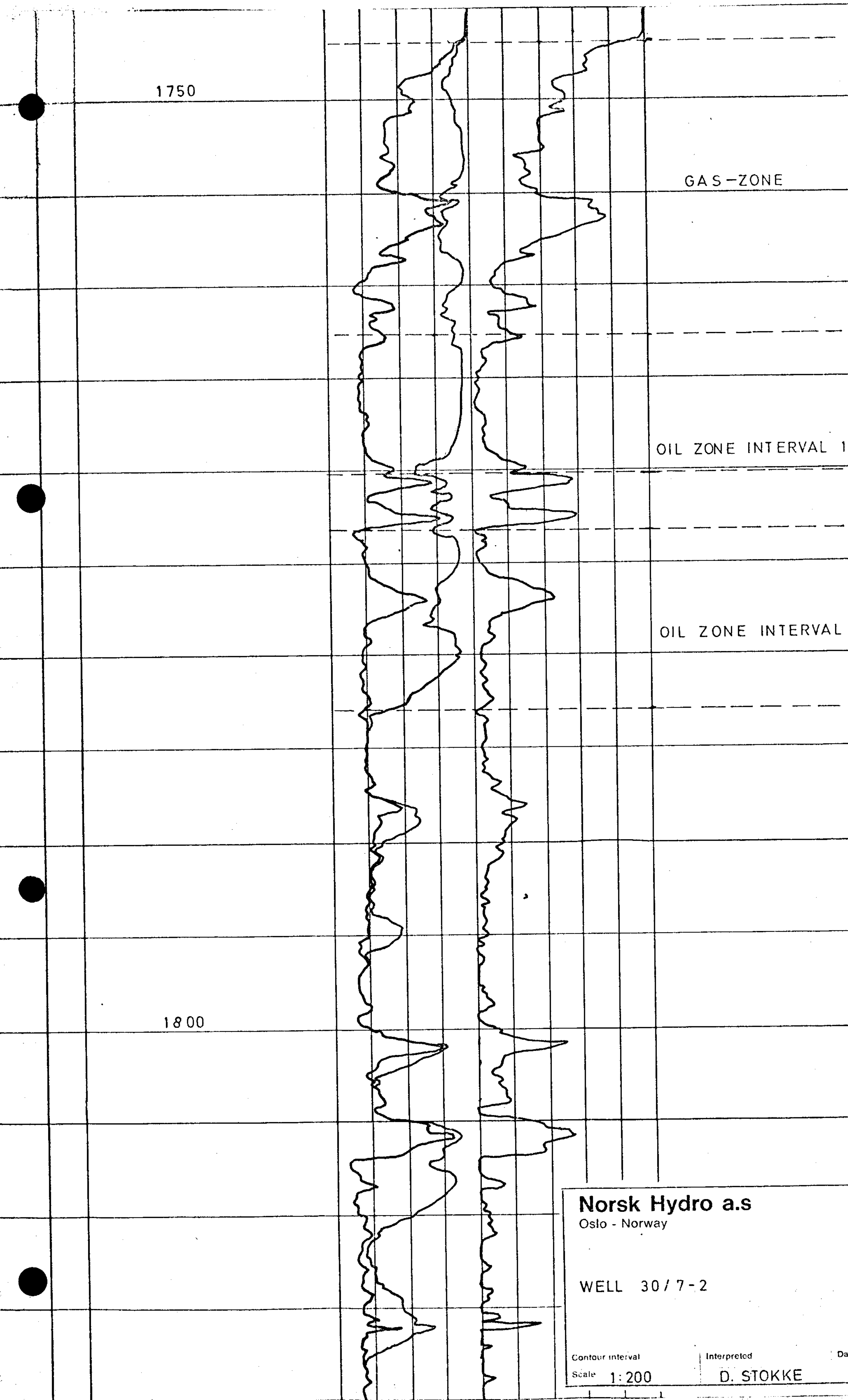


FIG. 6

WELL 30/7-2
NORWAY

FIG. 6 b



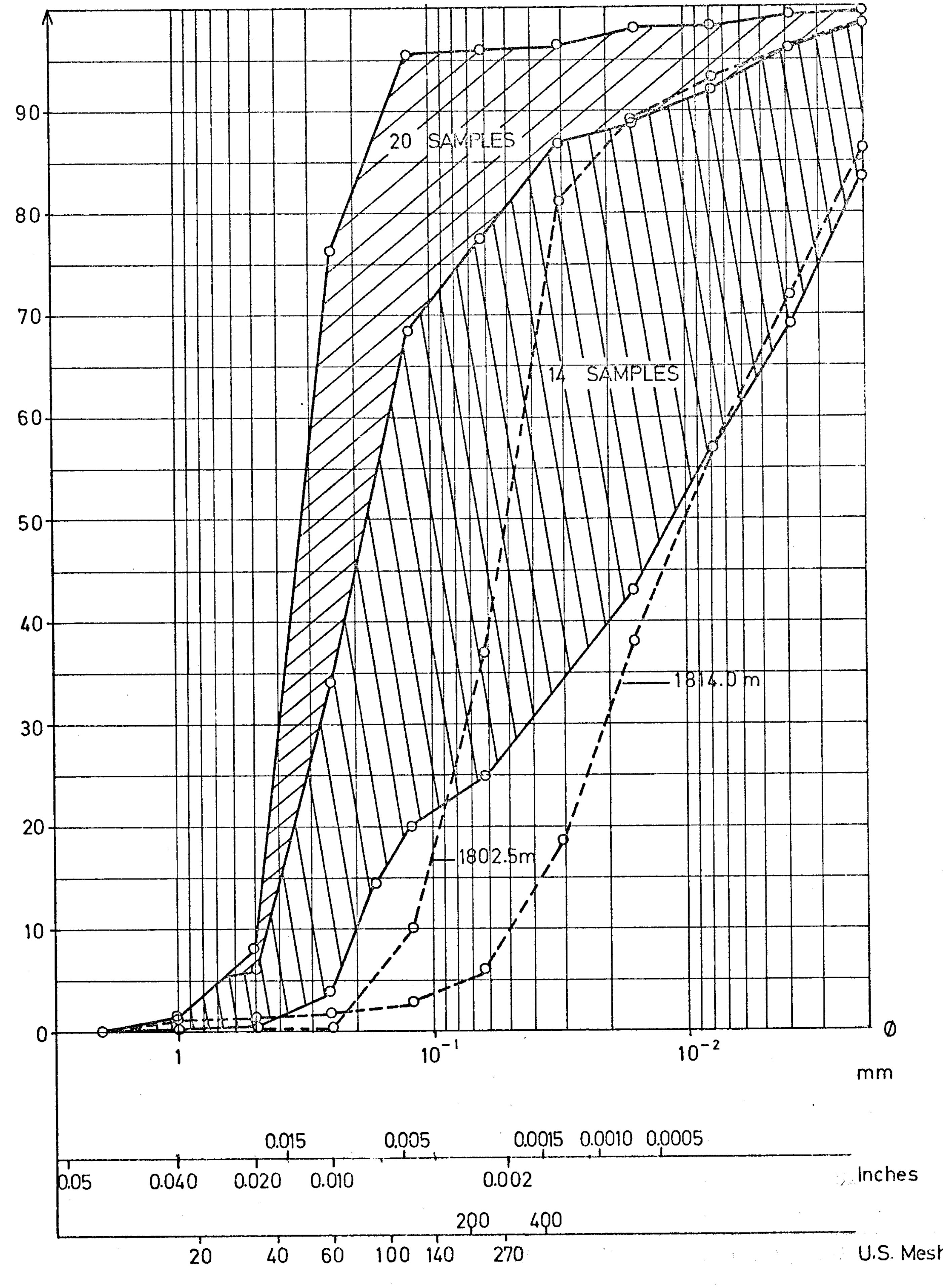
Norsk Hydro a.s
Oslo - Norway

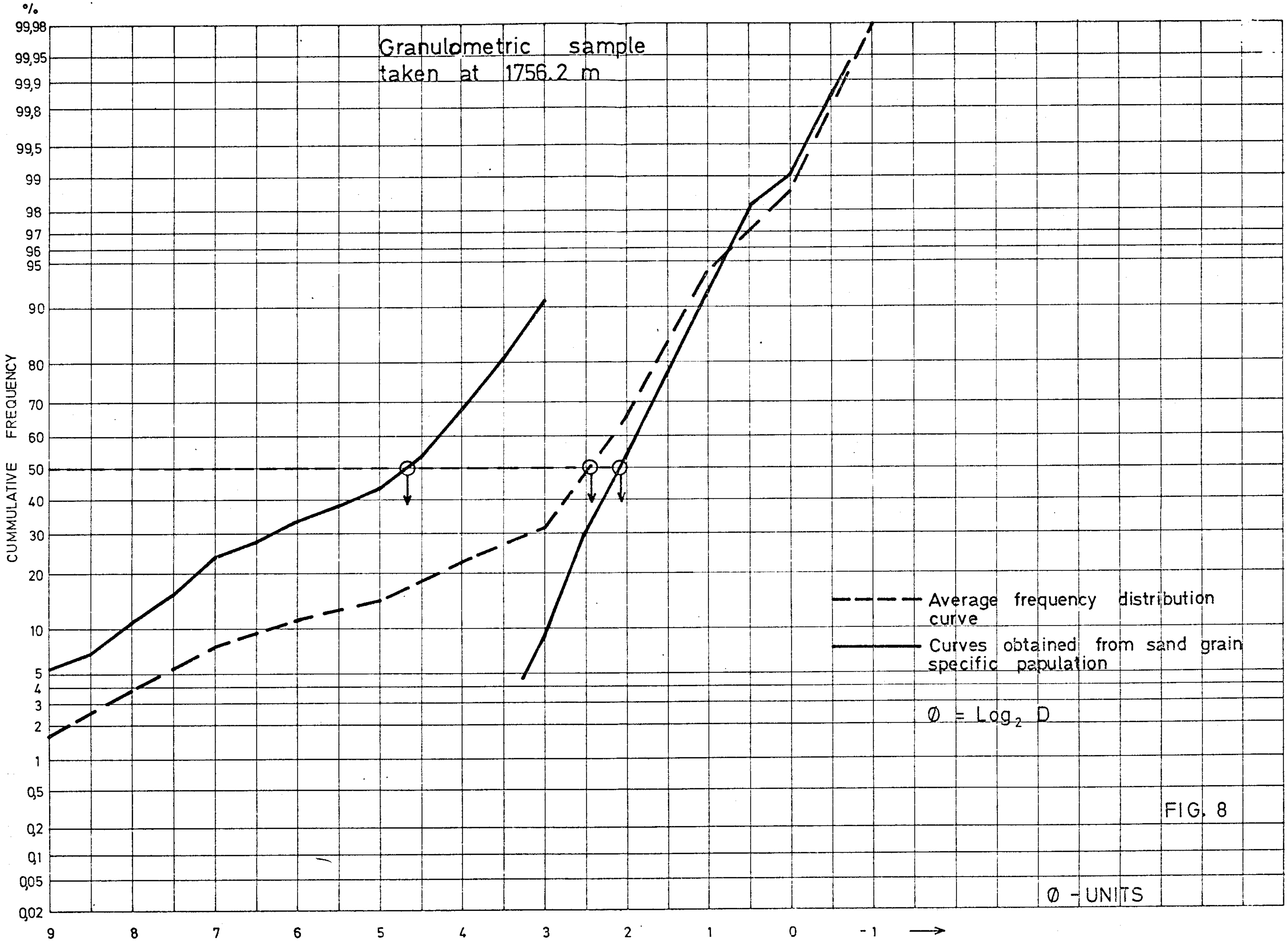
WELL 30/7-2

Contour interval	Interpreted	Date
Scale 1:200	D. STOKKE	19-3-76

Well 30/7-2
GRAIN SIZE DISTRIBUTION
IN SAMPLES TAKEN IN THE
INTERVAL 1753.0 -1821.7 m

FIG. 7

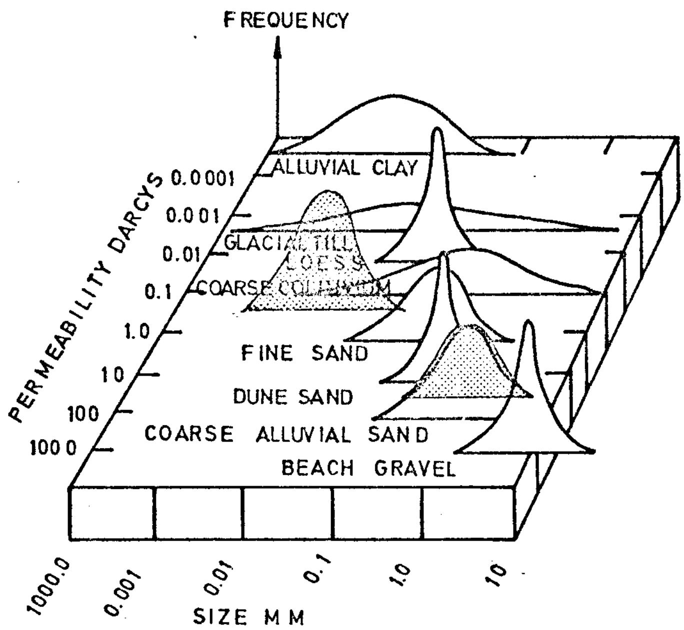




Granulometric sample
taken at 1756.2 m
%
99,98
99,95
99,9
99,8
99,5
99
98
97
96
95
90
80
70
60
50
40
30
20
10
5
4
3
2
1
0,5
0,2
0,1
0,05
0,02
CUMMULATIVE FREQUENCY
9
8
7
6
5
4
3
2
1
0
- 1
Average frequency distribution curve
Curves obtained from sand grain specific papulation
Ø = Log2 D
Ø - UNITS

FIG. 8

PERMEABILITY OF NATURAL MATERIALS [5]

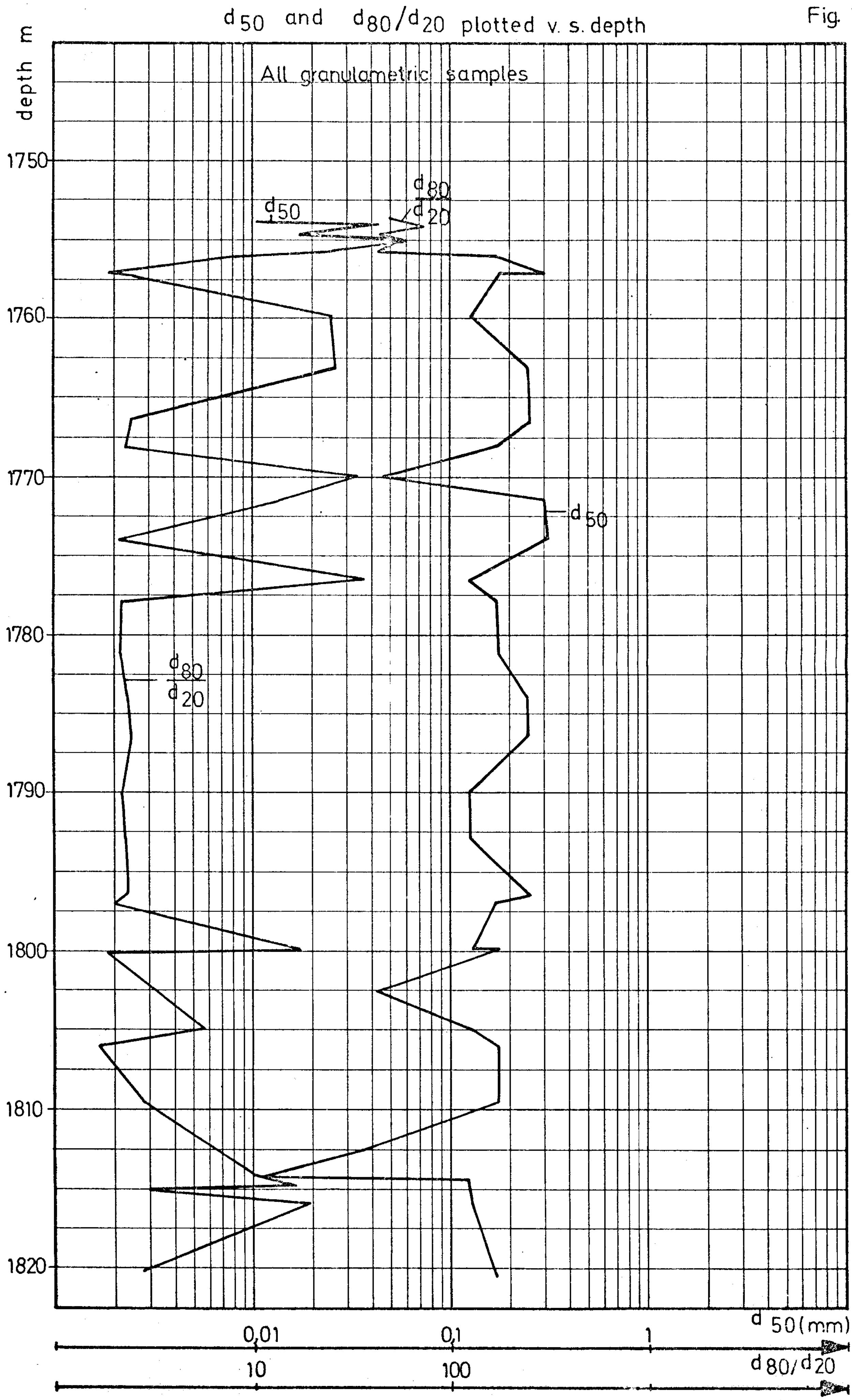


From R.J.M. De Wiest [5]

The two classes of sand from analysed samples (Fig. 8).

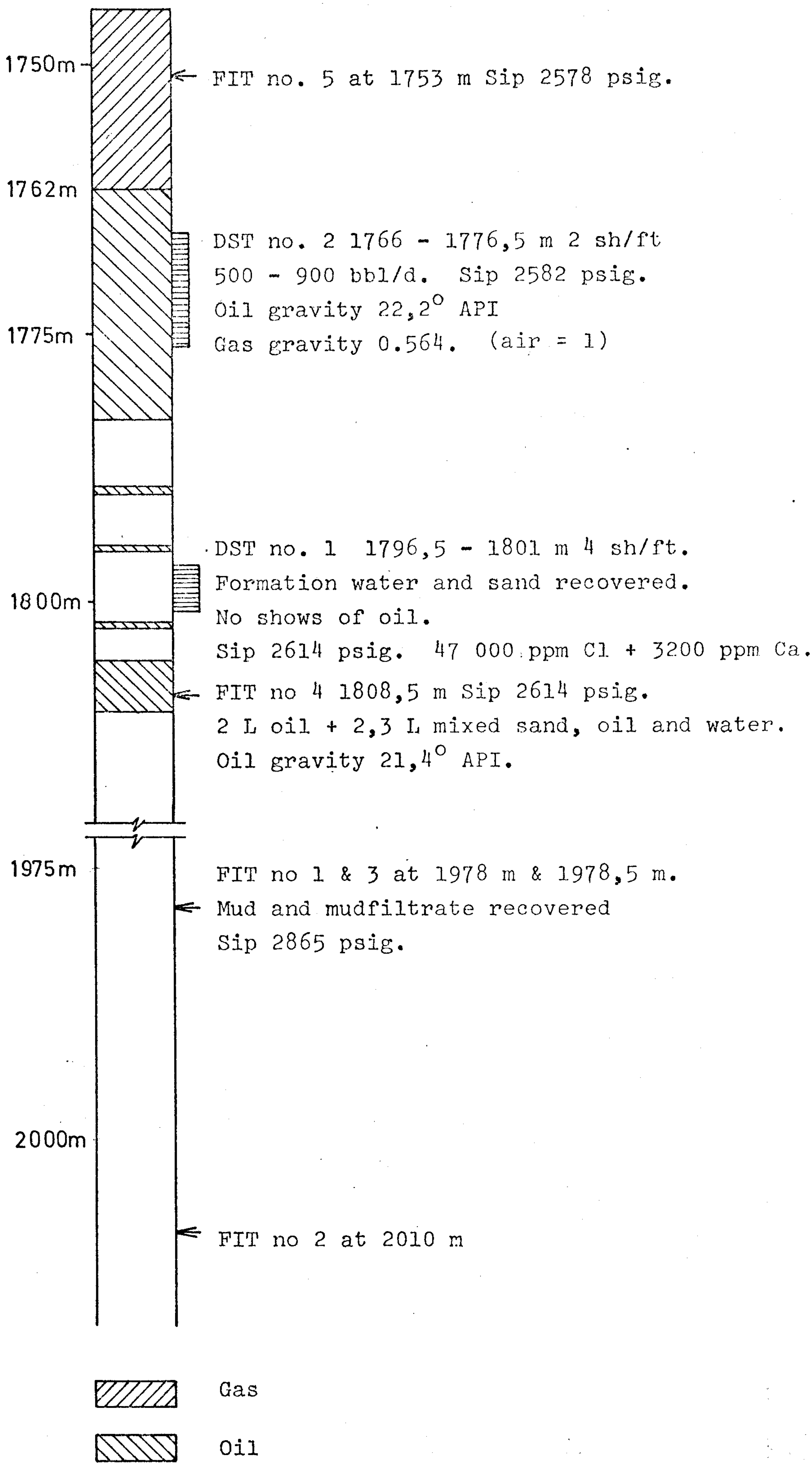
Well 30/7-2

Fig. 10



30/7-2 SUMMARY OF TEST RESULTS

FIG. 11



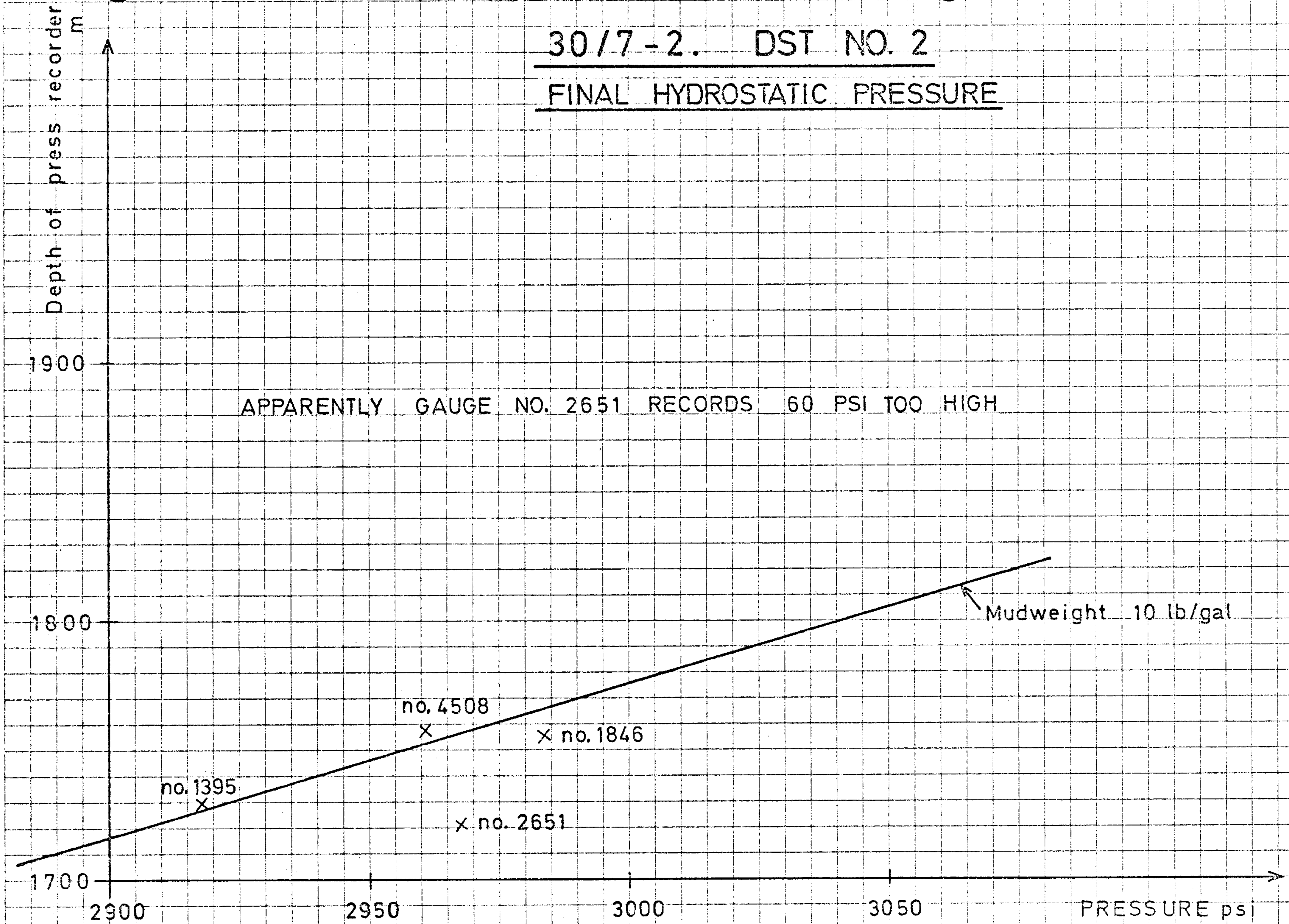
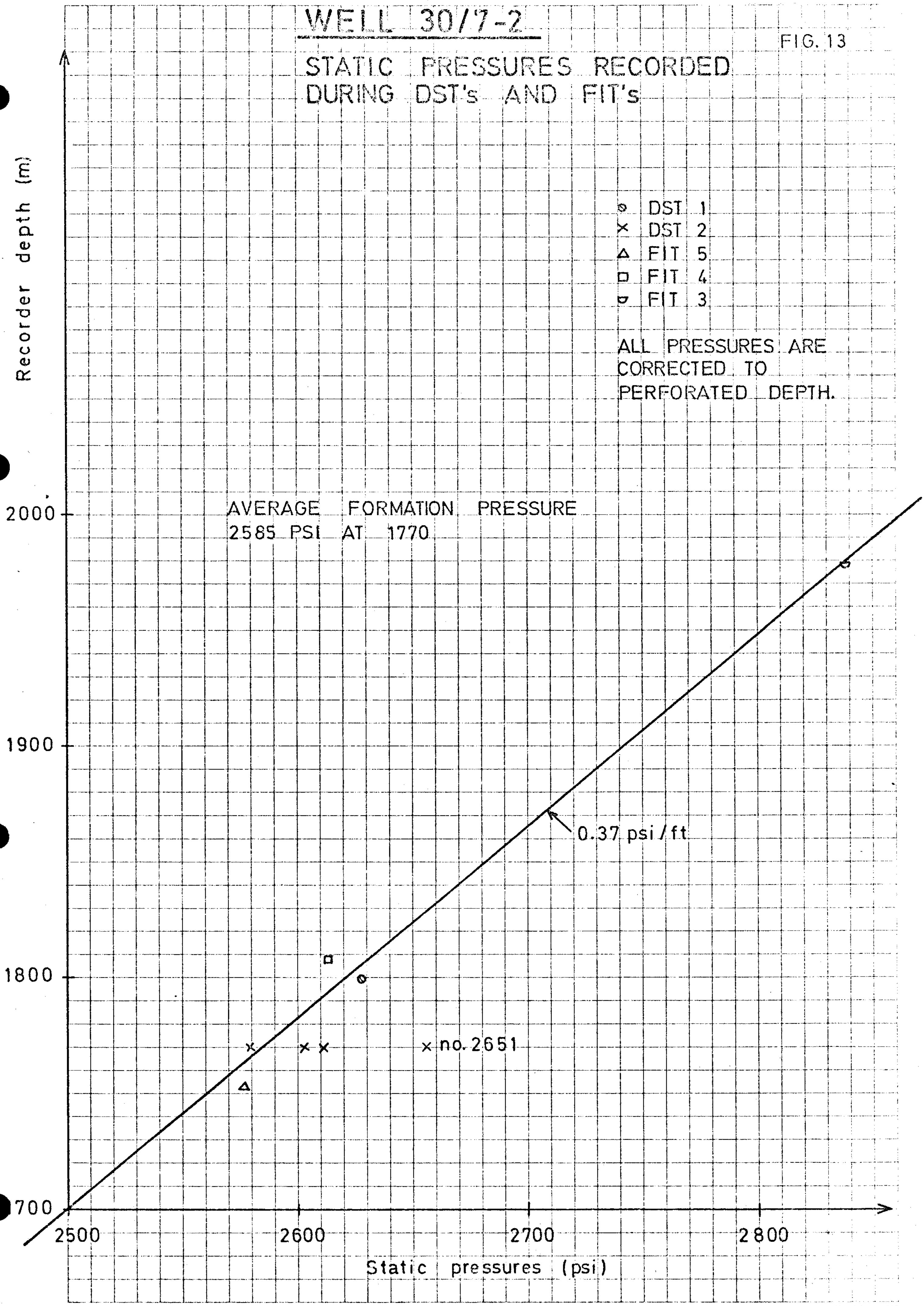
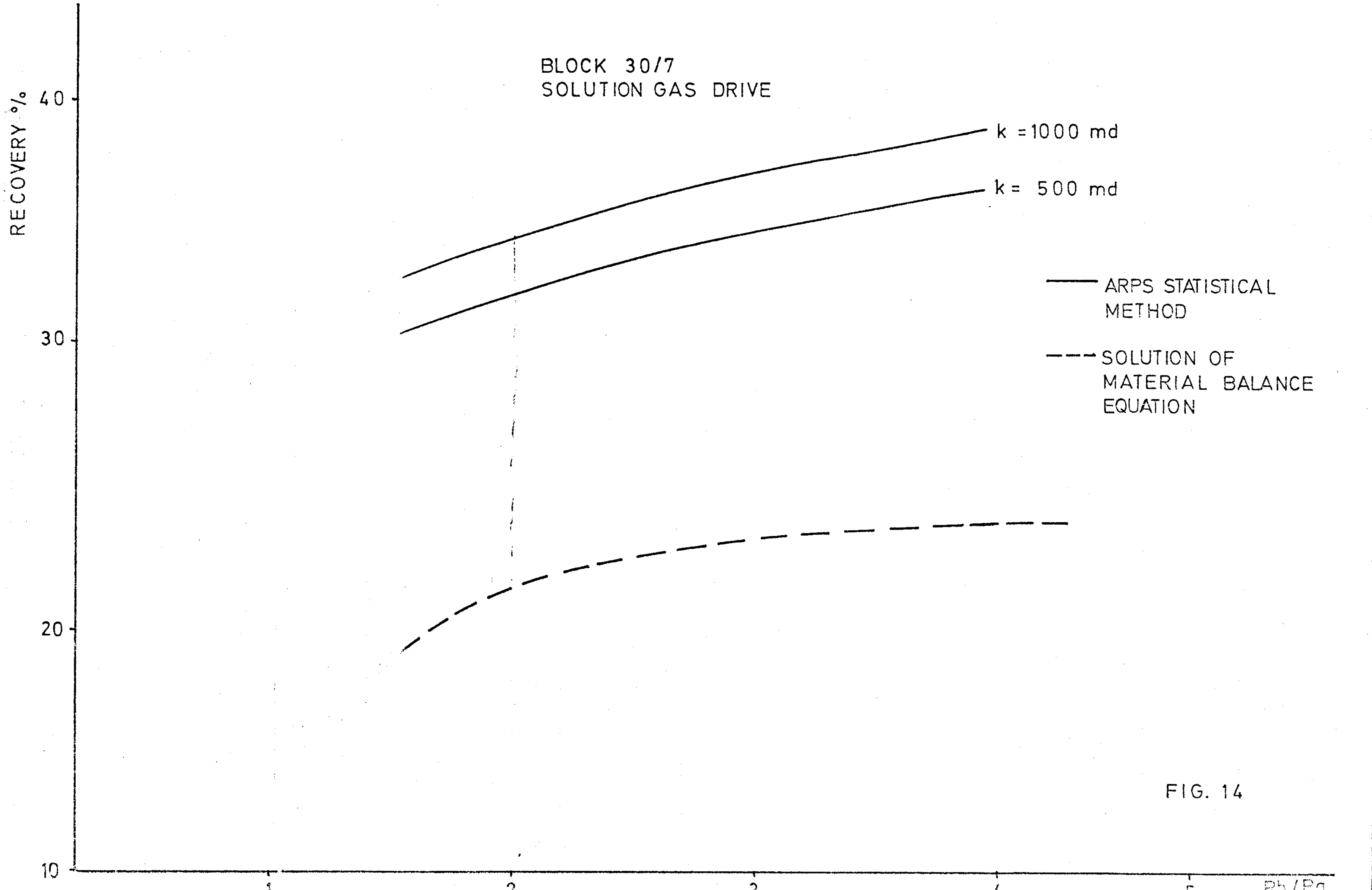

30/7-2. DST NO. 2
FINAL HYDROSTATIC PRESSURE
Depth of press recorder m
1900
1800
1700
APPARENTLY GAUGE NO. 2651 RECORDS 60 PSI TOO HIGH
Mudweight 10 lb/gal
no. 4508
no. 1846
no. 1395
no. 2651
2900
2950
3000
3050
PRESSURE psi

FIG. 12

FIG. 13



WELL 30/7-2
STATIC PRESSURES RECORDED DURING DST's AND FIT's
DST 1
DST 2
FIT 5
FIT 4
FIT 3
ALL PRESSURES ARE CORRECTED TO PERFORATED DEPTH.
AVERAGE FORMATION PRESSURE
2585 PSI AT 1770
0.37 psi / ft
no. 2651
Recorder depth (m)
2000
1900
1800
1700
2500
2600
2700
2800
Static pressures (psi)



BLOCK 30/7
SOLUTION GAS DRIVE
RECOVERY %
40
30
20
10
k =1000 md
k = 500 md
ARPS STATISTICAL METHOD
SOLUTION OF MATERIAL BALANCE EQUATION

FIG. 14

RECOVERY CALCULATION
ON
EOCENE DISCOVERY OF WELL 30/7-2

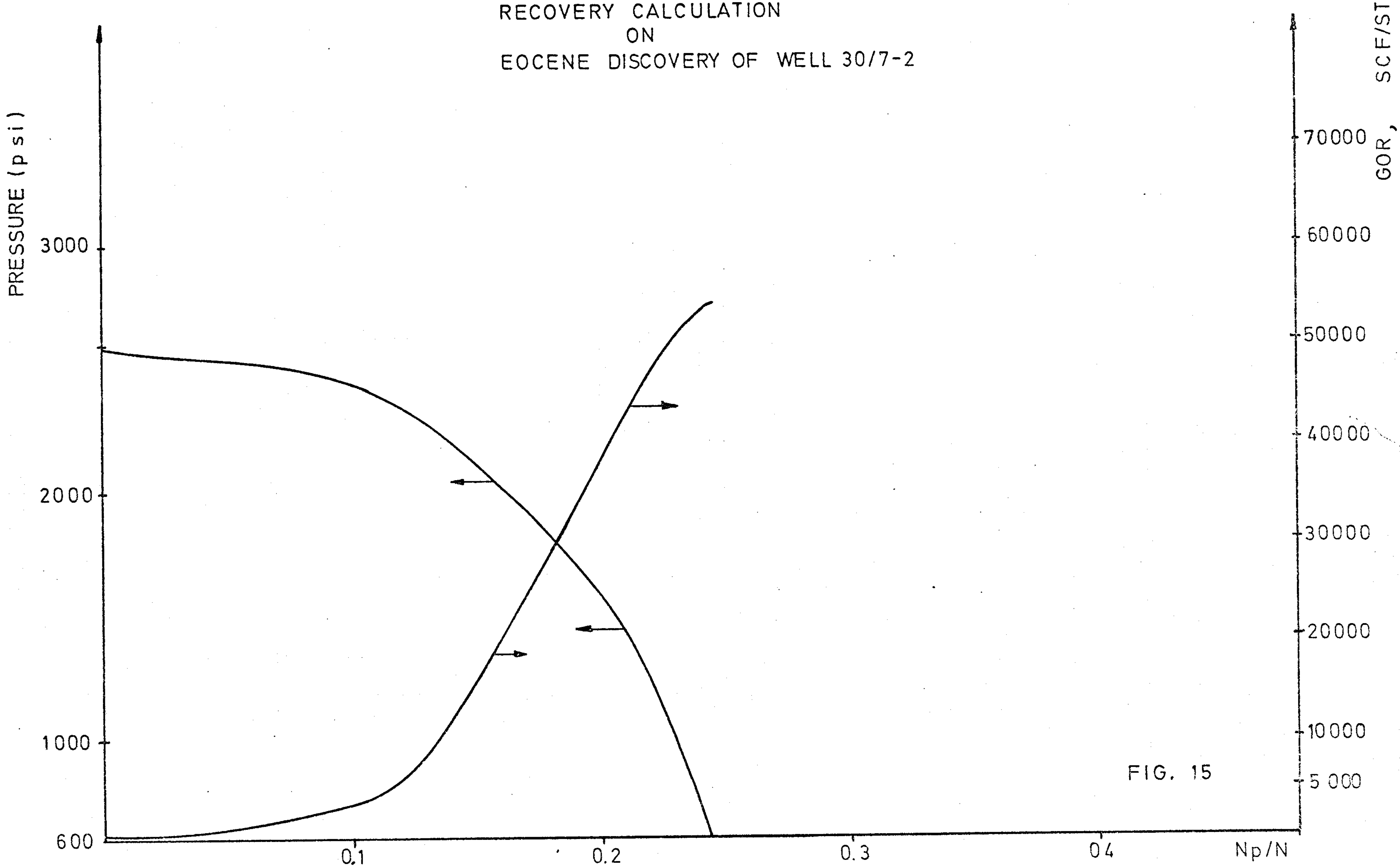
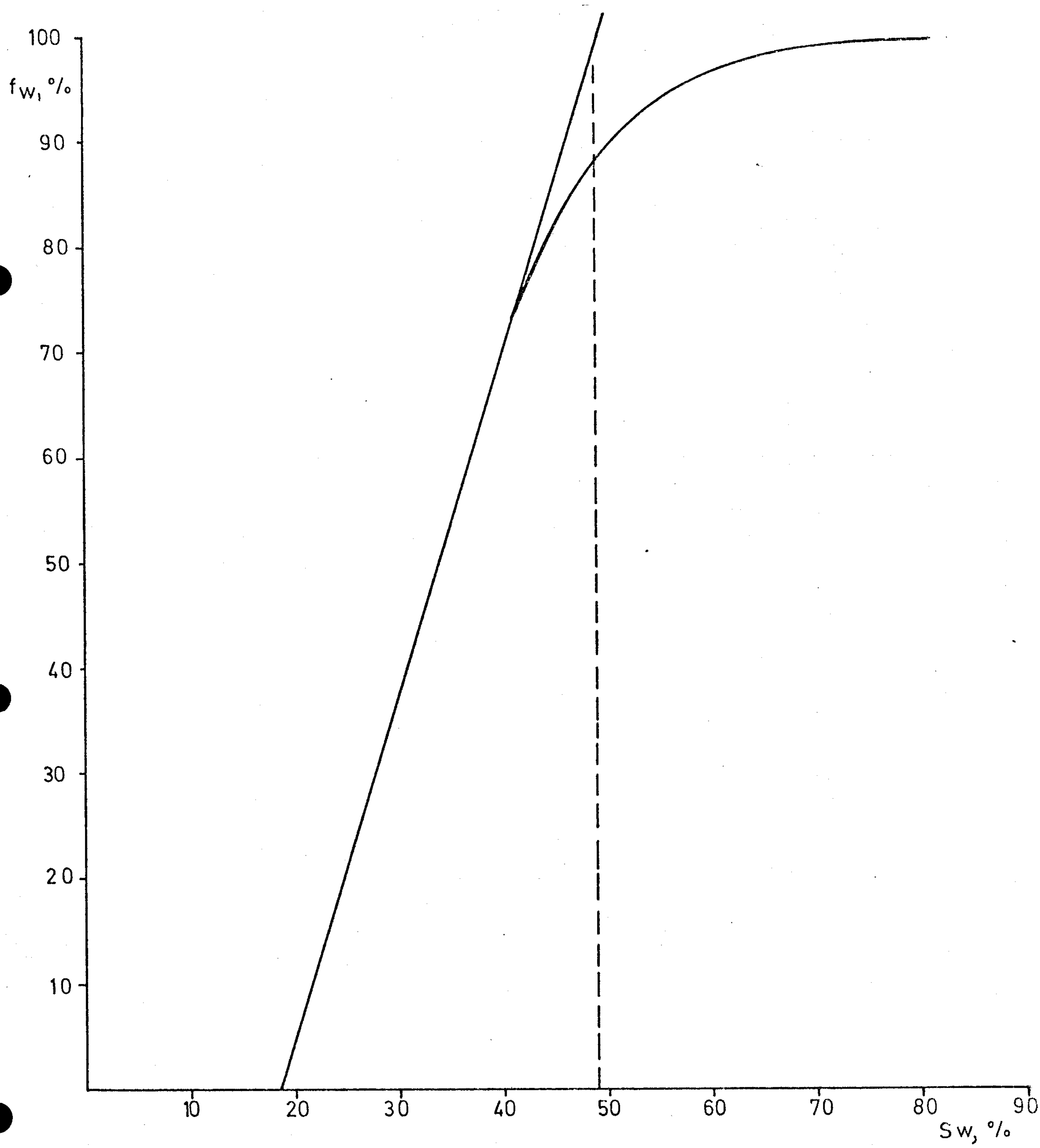


FIG. 15

MICROSCOPICAL DISPLACEMENT EFFICIENCY WATER
EOCENE DISCOVERY OF WELL 30/7-2



MICROSCOPICAL DISPLACEMENT EFFICIENCY GAS
EOCENE DISCOVERY OF WELL 30/7-2

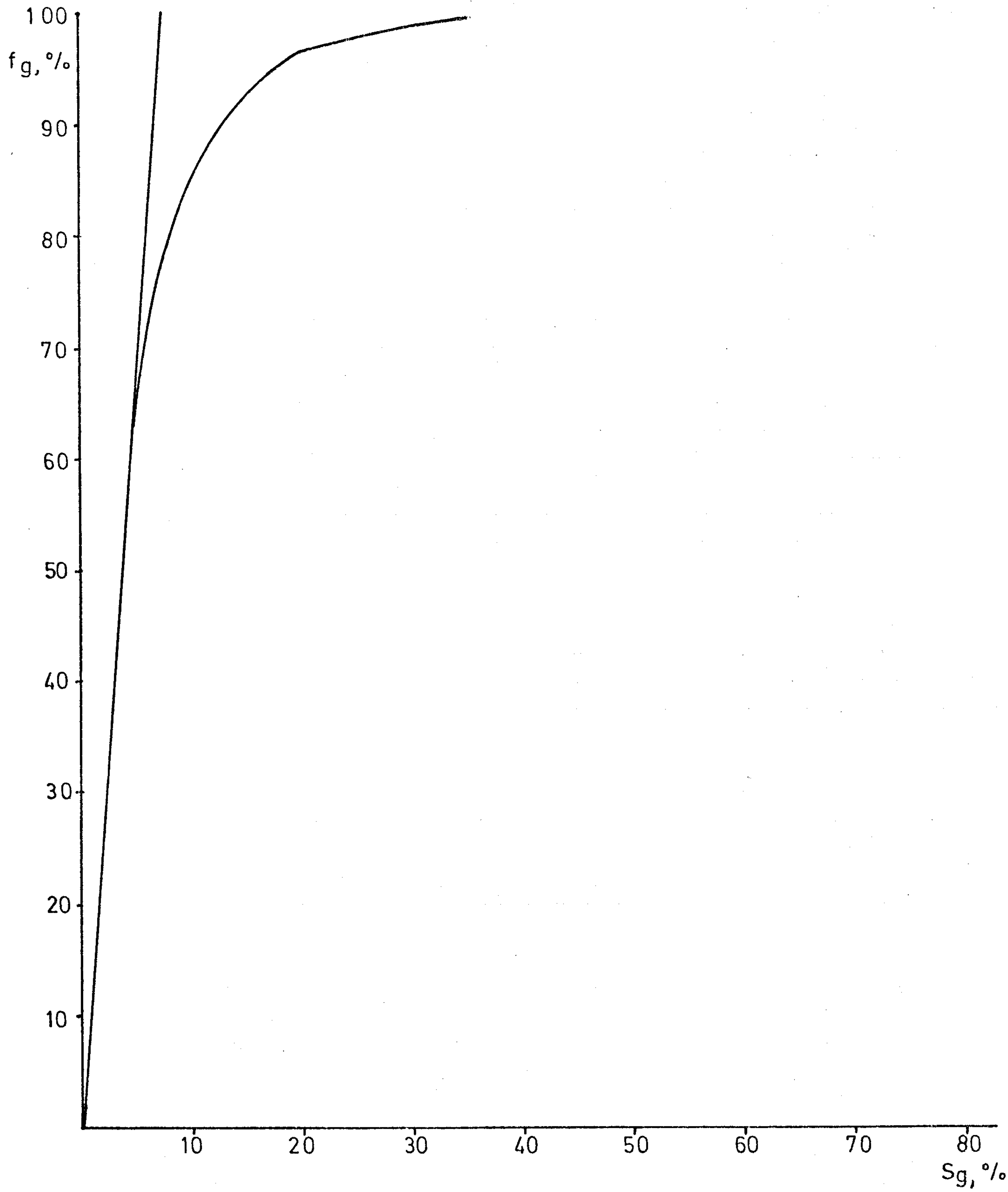


Table 1

WELL 30/7-2

Basic log parameters

	Depth interval	R_w (Ω-m^2/m)	R_{mf} (Ω-m^2/m)	R_{cl} (Ω-m^2/m)	t_{cl} (μ-sec/ft)	ϕ_{Ncl} (%)	ρ_{bcl} (g/cc)	GR_{min} (API-units)	GR_{max} (API-units)	T^oF
CPI	1891.5-1762	0.068	0.298	0.83	130	45	2.31	18	75	117
CPI	1762-1737.5	0.071	0.310	0.83	130	45	2.31	18	75	112
NH	1891.5-1762	0.11	0.298	0.83	140	54	2.10	22	70	117
NH	1762-1737.5	0.11	0.310	0.83	140	54	2.10	22	70	112

Table 2

Well 30/7-2

Results from log interpretation based on CPI.

Seismic marker RKB+	1747.0 m
Top of sand RKB	1749.8 m
Gas oil contact RKB	1762.8 m
Oil water contact RKB	1783.0 m
Gross pay	33.2 m
Net pay gas	9.2 m
Net pay oil	16.4 m
Total net pay	25.6 m
Net/gross gas α_g	0.73
Net/gross oil α_o	0.81
Average porosity gas zone	22.2 %
Average porosity oil zone	29.4 %
Average water saturation gas zone	18.2 %
Average water saturation oil zone	19.4 %
Net gas column	1.22m
Net oil column	3.89m
Reservoir pressure at 1770 m	176.9 ata
Resvoir temperature	53°C

The depth data is referring to the sonic log.

+RKB elevation 22.9 m.

Table 3

Recorded Static Pressures.

Test	Depth of Gauge m	Recorded Pressures psig	Depth of Perforation m	Calculated Pressures psig
FIT 5	1753	2578	1753	2578
DST 2	1723	2595	1770	2657+
DST 2	1725	2553	1770	2612+
DST 2	1756	2586	1770	2604+
DST 2	1758	2565	1770	2581+
DST 1	1792	2619	1799	2692++
FIT 4	1808	2614	1808	2614
FIT 3	1978	2858	1978	2858
FIT 2	2010	No flow	2010	-

Hydrostatic Pressures of DST no 2.

Gauge no.	Depth of Gauge m	Final Hydrostatic Pressure psig
2651	1723	2968
1395	1725	2918
1846	1756	2984
4508	1758	2961

+Recorded gauge pressure has been corrected to the average depth of perforation by assuming an oil column of 0.93 gravity in the test string.

++Recorded gauge pressure has been corrected to the average depth of perforation by assuming a water column of 1.03 gravity in the test string.

Table 4

AVERAGE RESERVOIR PRESSURE

TEST	DEPTH OF RECORD m	PRESS. psi	PRESS. @ DATUM psi (1770 m)
FIT 5	1753	2578	2596
DST 2	1725	2612	2612
DST 2	1756	2604	2604
DST 2	1758	2581	2581
DST 1	1792	2619	2589
FIT 4	1808	2614	2650
FIT 3	1978	2858	2555

Average pressure at datum = 2585 psi

Table 5

Analysis of Hydrocarbon Samples from

DST No. 2 and FIT No. 5

	Recombined Reservoir Fluid	DST 2 Oil	DST 2 Gas	FIT 5 Gas
CH_4	0.37913		.99617	.99550
C_2	0.00146		.00383	.00450
b-C_3				
n-C_4				
n-C_5				
n-C_6	0.00188	.0030		
n-C_7	0.0619	.00996		
n-C_8	0.00015	.00217		
n-C_9	0.00019	.00030		
n-C_{10}	0.00520	.00840		
n-C_{11}	0.60580	.97617		

TABLE 6

Analysis of water from DST 1

Specific gravity	1.0318
Resistivity at 20°C	77.5 millimohs/cm
Cations	**g/l**
Ca^{++}	1.87
Mg^{++}	0.576
Sr^{+}	0.390
Na^{+}	17.2
Ba^{++}	0.000
Fe^{+++}	0.00027
Total	20.03627
Anions	**g/l**
Cl^{-}	33.11
SO_4^{--}	0.000
CO_3^{--}	0.000
CO_3H^{-}	0.180
Total	33.290

Table 7

Relative permeability of oil and water

Statistical data.[7]

S_w (%)	$\frac{k_o}{k_w}$
80.6	0
79.6	0.0063
75.4	0.0225
71.2	0.994
67.0	0.11
62.8	0.215
58.6	0.357
50.3	1.000
41.9	3.125
33.5	9.250
25.1	32.000

Table 8

Relative permeability of gas and water

Statistical data.[7]

S_g %Hydrocarbon Porevolume	k_g/k_o
0	0
5	0.0063
10	0.0225
15	0.055
20	0.11
25	0.215
30	0.357
40	1.000
50	3.125
60	9.250
70	32.000
80	91.000

APPENDIX 1

FLUID DATA

Summary of Fluid Proporties

1. Bubble point pressure	2568 psig at 128°F
2. Density of bubble point oil	0.866 gm/cc 54.01 lb/ft^3
3. Viscosity of bubble point oil	5.19 centipoise
4. Gas solubility of bubble point oil	
a. Differential gas liberation at 128°F	260 Scf/B. Resid. Oil
b. Single flash separation at 128°F	277 Scf/B. St.Oil
5. Relative volume factor of bubble point oil, differential test	1.116 B/B Resid. Oil
6. Formation volume factor of bubble point oil, above separation conditions	1.108 B/B. St. Oil

7. Compressibility of under-saturated reservoir oil

Varies almost linearly from 3.44 (10^{-6}) psi^{-1} at 5600 psig to 5.78(10^{-6})psi^{-1} at 2600 psig.

WELL: 30/7 - 2A

COMPANY: NORSK HYDRO A/S

SINTEF RESERVOIR FLUID STUDY

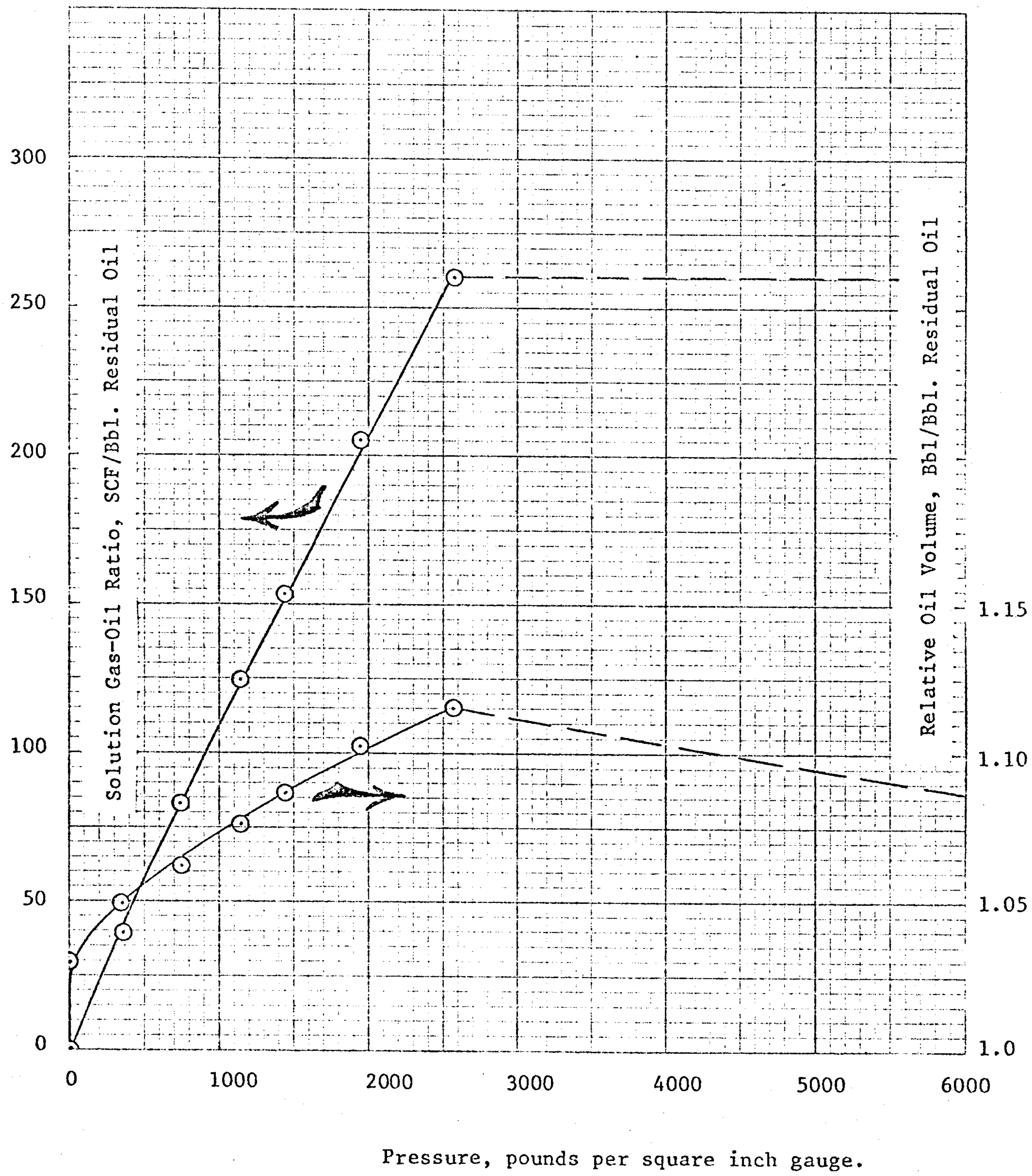


Figure 2. Experimental gas solubility and relative oil volume data vs pressure. Differential gas liberation process. Temperature 128°F.

WELL: 30/7 - 2A

COMPANY: NORSK HYDRO A/S

SINTEF RESERVOIR FLUID STUDY

DST-gas, A - 1309

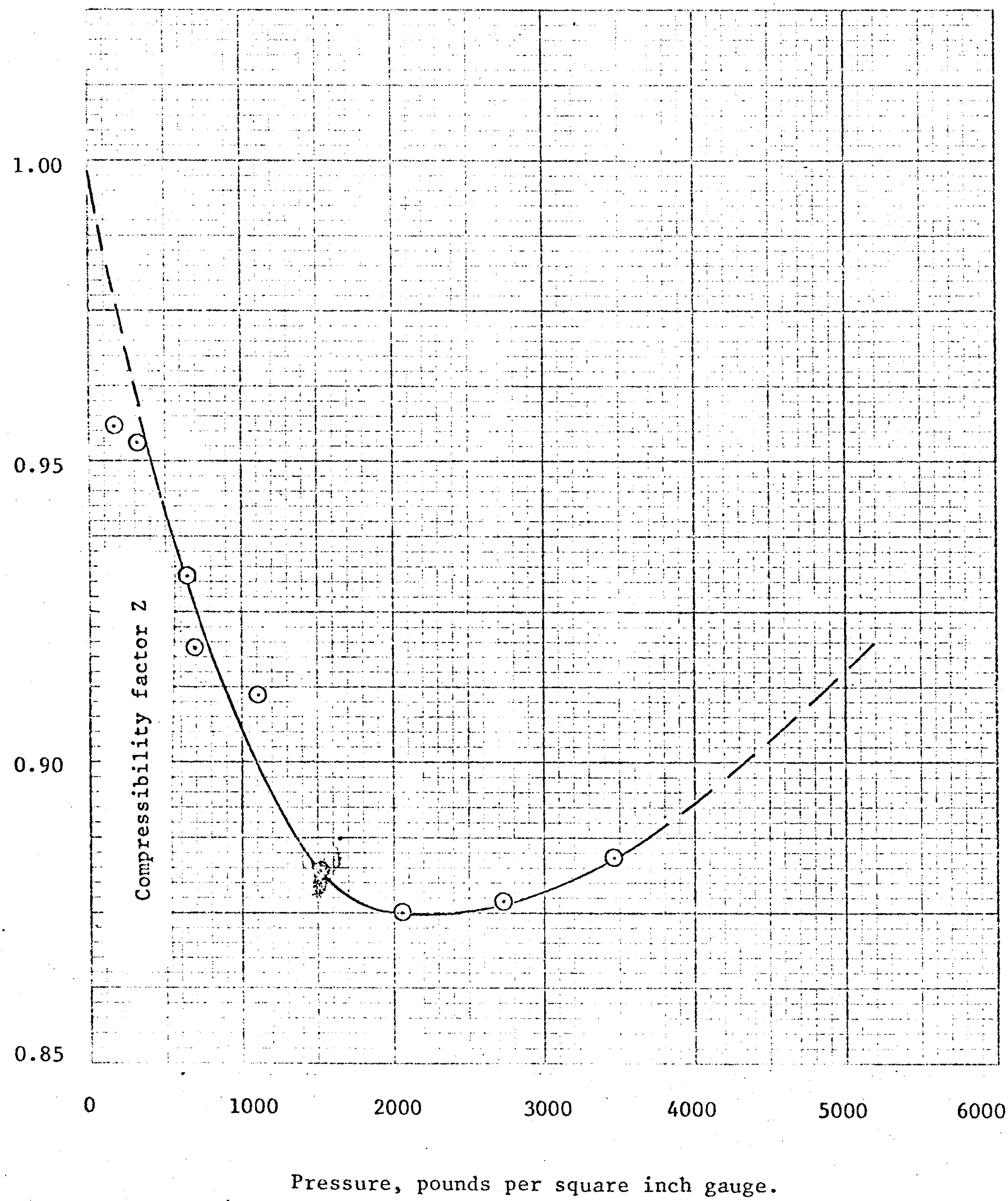


Figure 5. Experimental compressibility factor data vs pressure. Temperature 128°F.

SINTEF RESERVOIR FLUID STUDY

FIT-gas, A - 1306

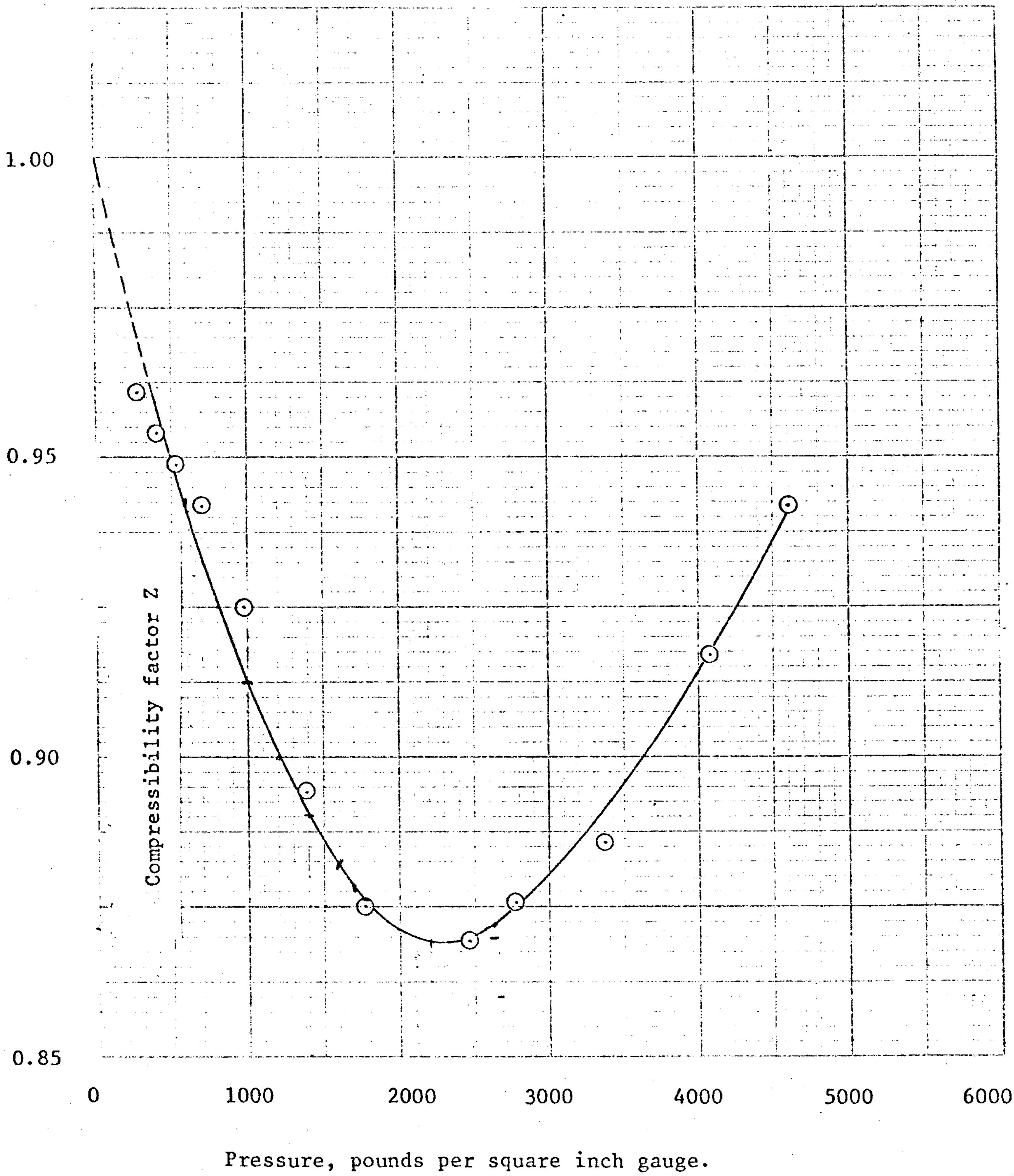


Figure 4. Experimental compressibility factor data vs pressure.
Temperature 128°F.

WELL: 30/7 -2A

COMPANY: NORSK HYDRO A/S

SINTEF RESERVOIR FLUID STUDY

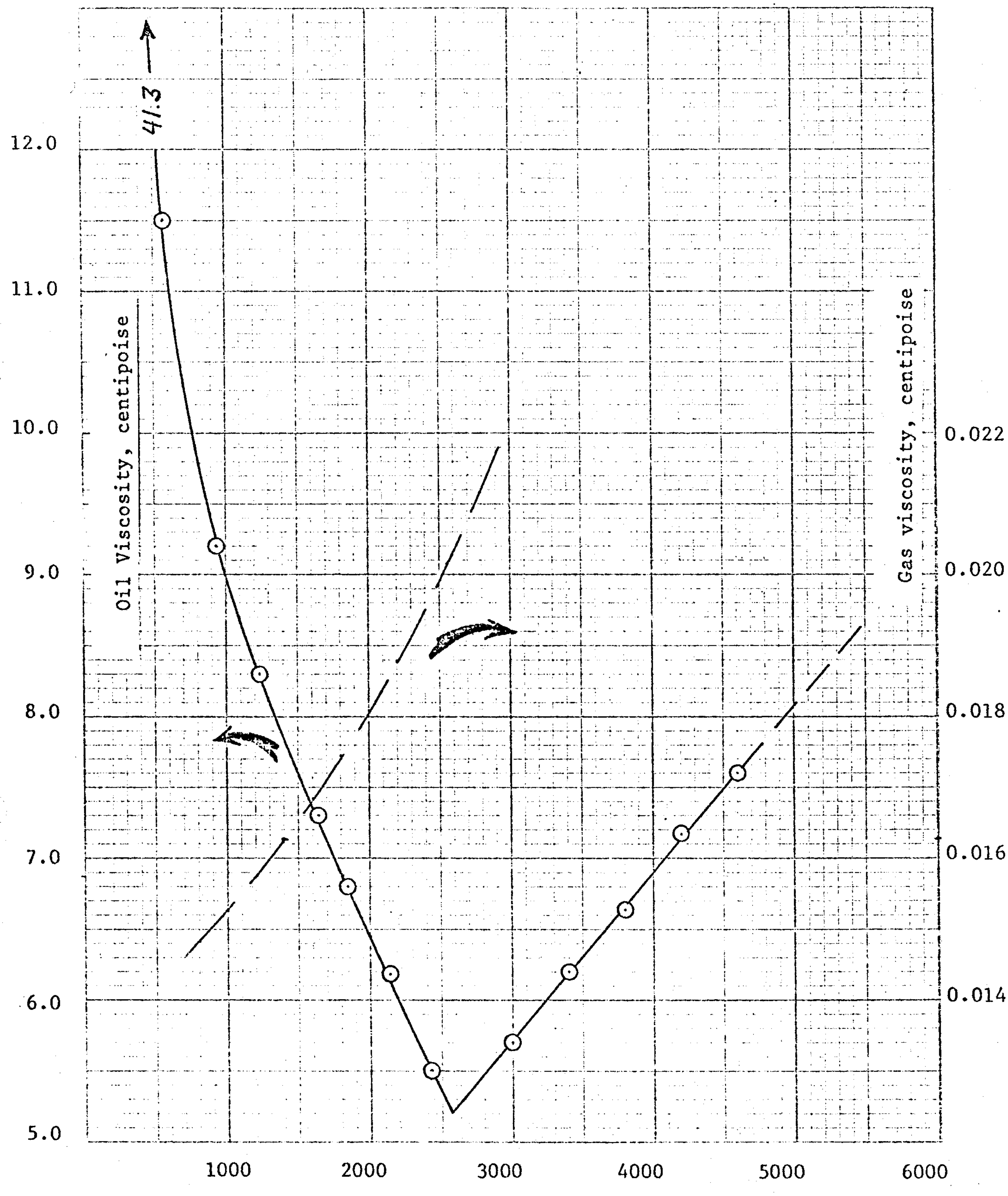


Figure 3. Experimental oil viscosities and calculated gas viscosities vs pressure. Temperature 128°F.

WELL: 30/7 - 2A

COMPANY; NORSK HYDRO A/S

SINTEF RESERVOIR FLUID STUDY

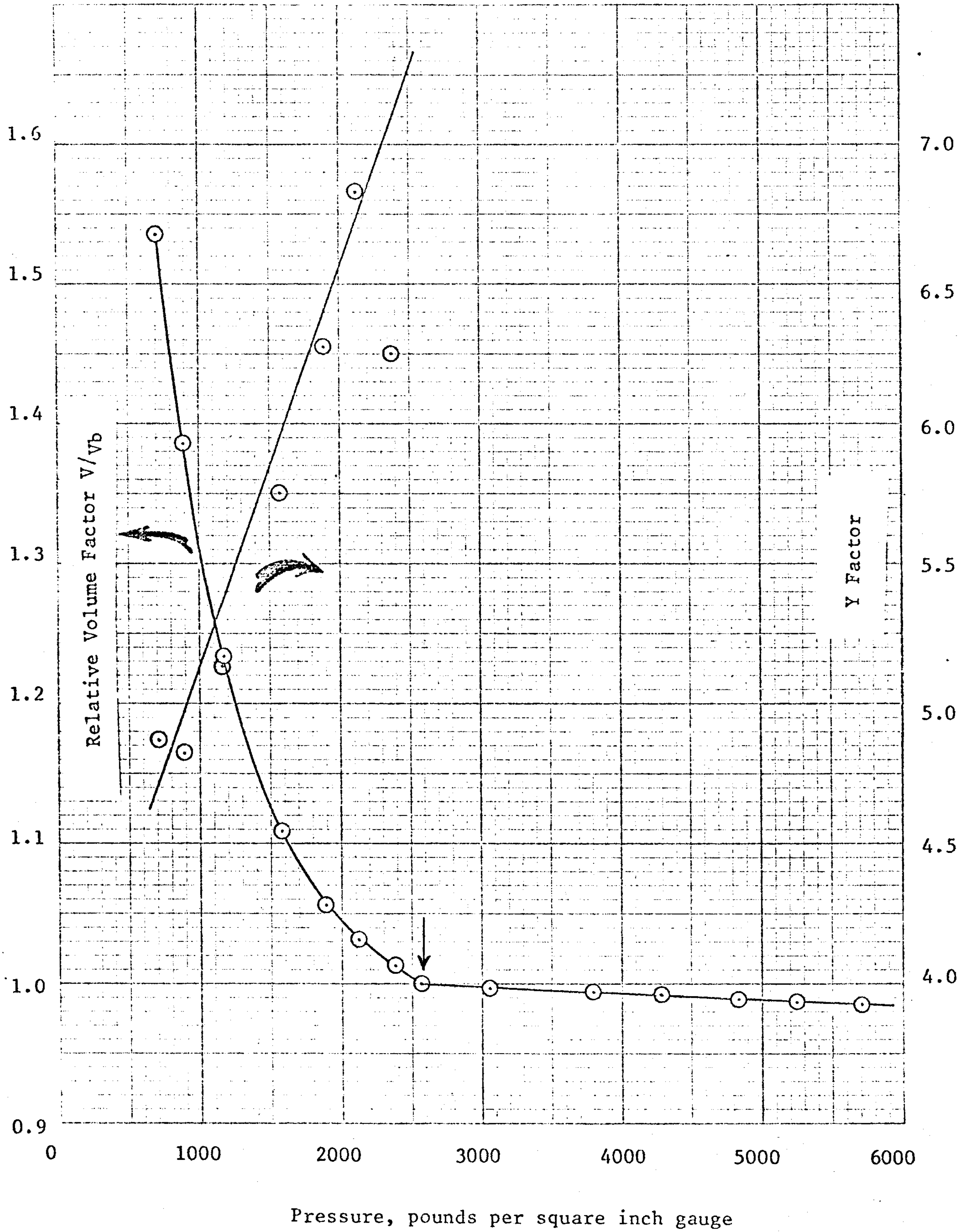


Figure 1. Experimental constant-composition pressure volume and y factor vs pressure. Temperature 128°F.

APPENDIX 2

Interpretation of chemical water analysis
Frigg and 30/7-2 Eocene discovery

ANALYTICAL INTERPRETATION OF CHEMICAL WATER ANALYSIS

PALMER METHOD

The concentration of anions and cations for Frigg and 30/7-2 are listed in the table on page 58.

Basis:

If $C_{Na+} + C_{K+} + C_{Li+} < C_{Cl^-} + C_{SO_4^{--}} + C_{NO_3^-}$

then $S_1 = 2\ (C_{Na+} + C_{K^+} + C_{Li+})$

$S_2 = 2\ \left[(C_{Cl^-} + C_{SO_4^{--}} + C_{NO_3^-}) - (C_{Na+} + C_{K^-} + C_{Li+})\right]$

$A_2 = 2\ (C_{CO_3^{--}} + C_{HCO_3^-} + C_{HS^-} + C_{S^{--}})$

FRIGG	30/7-2
$C_{Na+} + C_{K^+} + C_{Li^+}$ = 987.67	$C_{Na^+} + C_{K^+} + C_{Li^+}$ 748.
$C_{Cl^-} + C_{SO_4^{--}} + C_{Na_3^-}$ = 1087.11	$C_{Cl^-} + C_{SO_4^{--}} + C_{NO_3^-}$ = 933.
	S_1 = 1496.4
S_1 = 987.77	S_2 = 371.40
S_2 = 198.88	A_2 = 5.90
A_2 = 60	

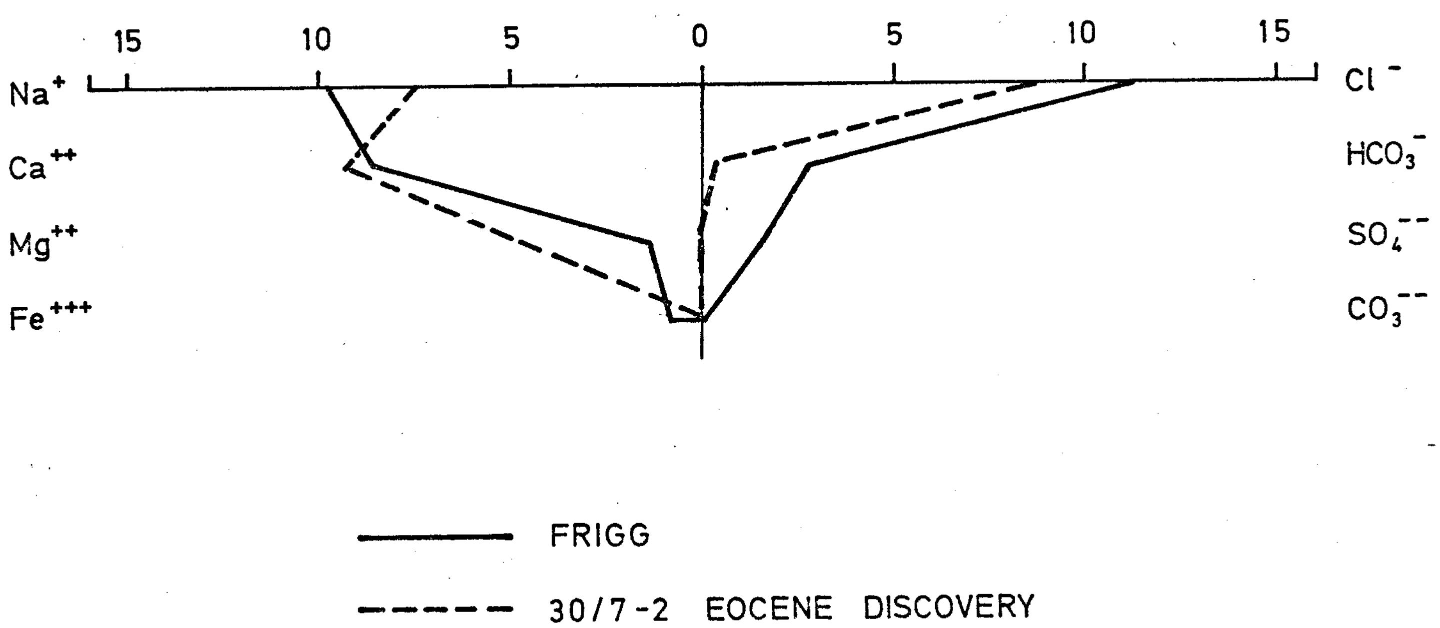
Both formation waters are class 3 waters.

Graphical interpretation of chemical water analysis
STIFF[8]

SCALE

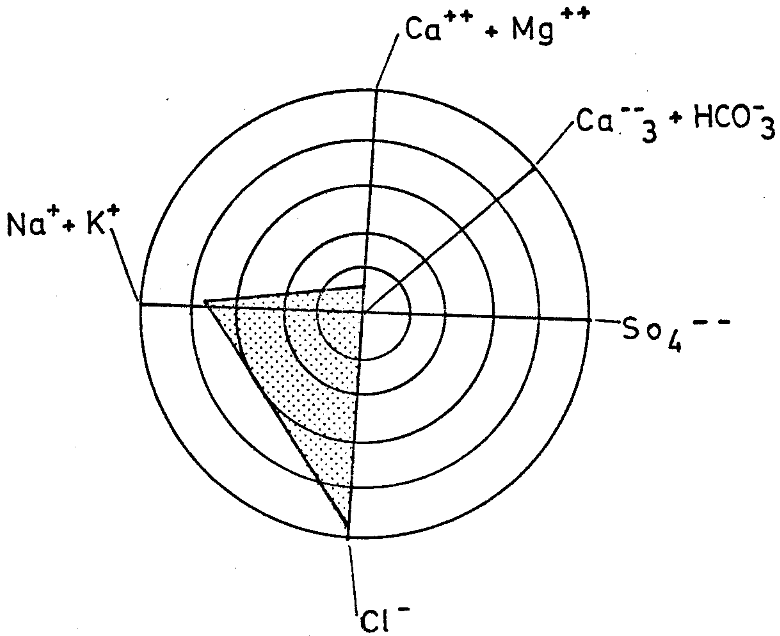
⊗ Cl and Na : 1 unit = 100 milliequivalents

⊗ The other ions : 1 unit = 10 milliequivalents

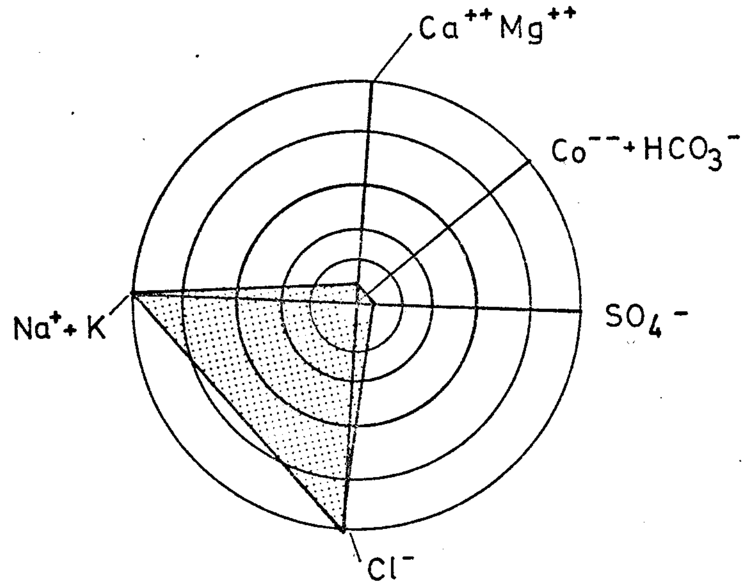


GRAPHICAL INTERPRETATION OF CHEMICAL WATER ANALYSIS. TICKEL

30/7-2



FRIGG



EACH CIRCLE 200 MILLIEQUIVALENTS

30/7-2 Eocene discovery and Frigg.

Concentration of anions and cations in the formation waters.

	FRIGG		30/7-2	
	g/l	milliequivalents	g/l	milliequvivalents
Anions				
Ca^{++}	1.713	85.98	1.87	93.3
Mg^{++}	0.162	13.32	0.576	47.4
K^{+}	0.307	7.85		
Na^{+}	22.533	979.82	17.2	748.2
Fe^{+++}	0.168	9.02	0.00027	0.0145
Cations				
Cl^{-}	37.939	1070.00	33.11	933.9
SO_4^{--}	0.822	17.11	0	0
CO_3^{--}	0	0	0	0
HCO_3^{-}	1.830	30.00	0.180	2.95

APPENDIX 3

Log analysis well 30/7-2

Log analysis - well 30/7-2

Depth	R_t	$\emptyset_{CNL}$	ρ_b FDC	GR	V_{cl}	$\emptyset$
1848.1	0.6	32	2.10	24	0.04	32.3
1846.3	0.6	34	2.09	25	0.06	32.6
1838.1	0.7	32	2.10	25	0.06	31.6
1835.1	0.7	32	2.11	25	0.06	31.2
1831.1	0.7	31	2.10	23	0.02	32.8
1827.1	0.7	31.5	2.10	22	0	33.7
1822.4	0.7	32.5	2.12	22	0	33.0
1812.1	1.0	31.5	2.11	26	0.08	30.3
1808.2	8.0	31.5	2.07	25	0.06	32.9
1803.5	1.0	29.5	2.11	28	0.04	31.4
1789.1	1.0	30	2.10	28	0.09	30.3
1792.0	1.1	29	2.14	24	0.04	29.8
1785.1	1.0	28	2.12	22	0	32.0
1781.6	5.5	30	2.10	22	0	34.3
1767.1	60	28	2.13	24	0.04	31.0
1762.3	20	29	2.11	30	0	33.7

APPENDIX 4

CORE REPORT

WELL NO: 30/7-2

NORSK HYDRO a.s

PETROLEUM DIVISION

CORE REPORT

CORE NO'S 1 (SHEET 1)

AREA: NORWEGIAN NORTH SEA
WELL RKB: 22·9 m
INTERVAL: 1753m - 1765,2m CUT: 12,25 RECOVERY: 94·4% (11·5 m)
SCALE: 1:50 (1cm = 05 m)
GEOLOGIST: FELLOWES LEIVESTAD DATE: 27·9·75

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS (m)	LITHOLOGICAL DESCRIPTIONS	SHOWS
			1753·0	Intbd Sst, mic, gy, f, ang, m-crs, subrdd, fm, poor srt, abd Mic + Sh lt gy, fm, subfiss, wxy	No oil stain. Scat strong yel flu on crs grn, no vis cut.
1754			1753·6	Sh a/a grdg to Sst mic a/a.	No flu from arg material
			1754·1	Sst lt gy f ang m-crs ang-sub rdd, hd, abd Musc, scat basic minerals: olivine, horneblende: poorly srt.	Patchy oilstain in crs grn, fair yel flu, no vis cut strong yel flu cut.
1755			1755·0	Sst dk gy abd arg material, abd Musc, scat Ligh: (rm)(srt).	a/a
1756			1755·3	Sd unconsol, lt gy, clr Qtz, m, subrdd, occ f, sub ang, occ (fm) scat Musc (srt.)	a/a
1757			1757·5	a/a, m-crs, more rdd.	Patchy oilstain, pale wh-yel flu, no vis cut, instant streaming strong pale yell flu cut.
1758			1758·4	Sd, patchy brn (oil stain) f-m subrdd, scat Musc	Patch oil stain, strong yel flu, inst streaming dk brn cut, yel flu cut.
1759			1758·9	Sltst mic dk gy rr m-crs Qtz (hd), fri abd Musc abd arg material and: Sd brn f-m subang subrdd rr scat Musc	No flu from arg material. Shows on Sd above.
1760			1760·0	Sd unconsol brn f-m, subang-subrdd, abd dk minerals, scat Musc, moderately srt.	Patchy hearily oil stain bright yel-wh flu, inst streaming dk brn vis cut, wh flu cut.
			1760·75	Sst dk gy arg (fm) fri abd Musc + Biot (srt))	Patchy stain in crs grn, a/a
1761			1761·0	Sd, unconsol a/a	Oil saturated, a/a
1762			1761·75	Sd unconsol lt brn, m, subrdd, occ f, subang, rr crs-crs, rdd, clean, srt.	Oil sat strong strong light oil odour, strong bright yel flu inst streaming brn vis cut, strong bright yel flu cut.
1763					

STRONG – FAIR PETROLIFEROUS ODEUR

NORSK HYDRO a.s

PETROLEUM DIVISION

CORE REPORT

WELL NO: 30/7-2

CORE NO'S 1 (SHEET 2)

AREA: CONTINUED FROM SHEET 1
WELL RKB:
INTERVAL: CUT: RECOVERY:
SCALE: 1: 50 (1cm = 0,5m)
GEOLOGIST: DATE:

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS (m)	LITHOLOGICAL DESCRIPTIONS	SHOWS
				Sd, v uncons, a.a.	A.a.
1764			1764	NO RECOVERY	
1765			1765·2		

NORSK HYDRO a.s
PETROLEUM DIVISION
CORE REPORT

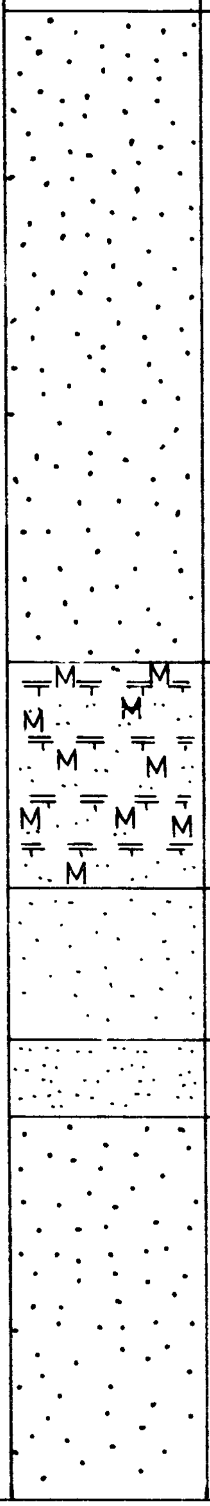
WELL NO: 30 / 7-2

CORE NO'S 2 (SHEET 1)

AREA: NORWEGIAN NORTH SEA
WELL RKB: 22·9 m
INTERVAL: 1765·2 – 1775 m CUT: 1765·2 - 1780 m RECOVERY 100% (15·0 m)
SCALE: 1:50 (1cm = 0,5 m)
GEOLOGIST: FELLOWES, LEIVESTAD DATE: 28.9.75.

Depth scale: 1766, 1767, 1768, 1769, 1770, 1771, 1772, 1773, 1774, 1775

Lithological column:



DEPTHS (m)	LITHOLOGICAL DESCRIPTIONS	SHOWS
1765·2	Sd, unconsol, lt brn (oil stain), mostly m, subrnd tr, Musc, mod-poor srtd.	Very strong lt oil odour heavily oil stain, bright yel-wht flu, instant streaming vis cut dk brn yel-wht flu cut.
1769·5	Sh dk gy firm-hd, subfis-fis abn Musc, tr Biot, tr Lign, and mica Sltst, dk gy firm occ m-crs Qtz, abn Musc abn arg mat.	No shows
1771·0	Sd, unconsol, lt brn, (oil stain), mostly m, occ crs, subrnd, arg at top and base, w srtd.	As in Sd above.
1772·0	Mica Sltst, dk gy firm occ m-crs abn Musc, tr Biot, occ subtis	No shows
1772·5	Sd unconsol, dk brn (oil saturated) rare scat Musc increasing at base, mod-w srtd poor at base.	As in Sd above.

WELL NO: 30/7 - 2

NORSK HYDRO a.s

PETROLEUM DIVISION

CORE REPORT

CORE NO'S 2 (SHEET 2)

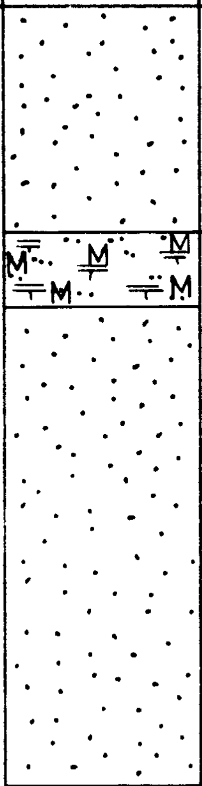
AREA: CONTINUED FROM SHEET 1

WELL RKB:

INTERVAL: CUT: RECOVERY:

SCALE: 1:50 (1cm = 0,5m)

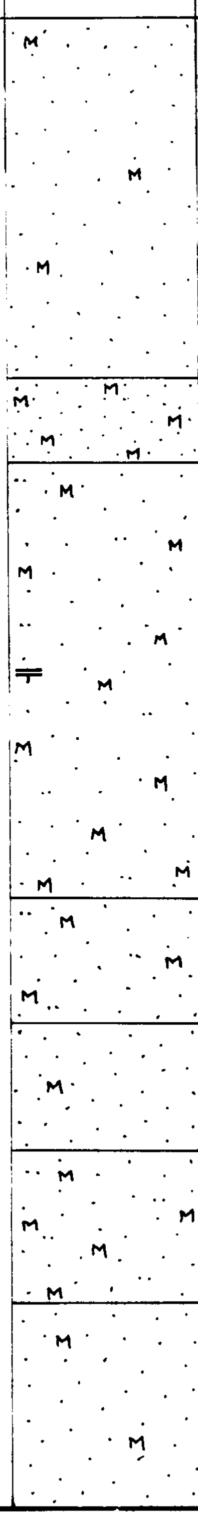
GEOLOGIST: DATE:

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS (m)	LITHOLOGICAL DESCRIPTIONS	SHOWS
1776				Sd, a.a.	a.a.
1777			1776·5	Mica Sltst a.a.	No shows
1778			1777.0	Sd, unconsol lt brn (oil saturated) mostly m-crs scat Musc poor-mod srtd.	As in Sd above
1779					
1780			1780·2		

WELL NO. 30/7-2	**NORSK HYDRO a.s** PETROLEUM DIVISION CORE REPORT	CORE NO'S 3 SHEET ※1

AREA: Norwegian North Sea
WELL RKB: 22,9 m
INTERVAL: 1780,2m - 1792,4m CUT: 12,2 m RECOVERY: 100%
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: FELLOWES, LEIVESTAD, RYDBERG
DATE: 29.9.75

Depth scale: 1781, 1782, 1783, 1784, 1785, 1786, 1787, 1788, 1789, 1790



DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
1780,2	Sd, uncons, clr qtz, dk yelsh brn (oil-stained), m grnd grdg into f, subrnd, fairly well srtd, tr musc, tr hd blk mineral. V sl increase in grainsize downwards.	Uniform, strong, whsh yel fluo yelding an instant streaming, strong yelsh wh fluo cut. Uniform heavy tan oil staining w/ amber vis cut. Saturated w/ oil. Fluo a/a but patchy.
1782,6	Sd, mainly a/a but loc vf grnd and more mic.	Patchy, fair, whsh yel fluo yelding an instant, streaming, strong yelsh wh fluo cut.
1783,15	Sd, uncons, clr qtz, olv gry, m grnd grdg into f w/ tr Slt, m-poorly srtd, v muscovitic, tr hd blk min. V sl tr Sh, dk gry.	No fluo - no stain. No fluo - no stain. Patchy, fair, yel fluo yelding an instant, strong/fair yelsh wh fluo cut. No vis stain or vis cut.
1786,0	Sd, a/a w/ tr biotite.	Only v locally sl tr of yel fluo.
1786,8	Sd, uncons, clr qtz, dk yelsh brn (oil-stnd), m-f grnd, ang-subrnd, fairly well srtd, tr musc, tr hd blk min.	Patchy, fair, yel fluo yelding an instant, strong yelsh wh fluo cut. Patchy tan oil stn w/ pale straw vis cut
1787,7	Sd, w/ tr of Slt as in intval 1783,15-1786,0 m.	Only v locally patchy yel fluo yelding an instant fair yelsh wh fluo cut. No vis cut or vis stain.
1788,7	Sd, uncons, clr qtz, dk yelsh brn (oil-stained), m-f, loc vf grnd, subrnd-subang, fairly well srtd, sl tr mica, sl tr dk hd min.	Uniform, strong, yel fluo yelding an instant, strong wh/yelsh wh fluo cut. Uniform tan oil staining w/ dk amber vis cut. Saturated w/ oil.

WELL 30/7-2	CORE REPORT	CORE NO'S 3 SHEET ※1

WELL NO. 30/7-2

NORSK HYDRO a.s
PETROLEUM DIVISION
CORE REPORT

CORE NO'S 3
SHEET ※ 2

AREA: CONTINUED FROM SHEET ※1
WELL RKB:
INTERVAL: CUT: RECOVERY:
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: DATE:

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
1791		M		A/a	A/a
1792		M	1792,4		

WELL NO	NORSK HYDRO a.s	CORE NO'S
30/7-2	PETROLEUM DIVISION	4 SHEET * 1

CORE REPORT

AREA: Norwegian North Sea
WELL RKB 22,9
INTERVAL 1792,4-1802,5   CUT: 1792,4-1800,6 (8,2m)   RECOVERY: 81,5 %
SCALE 1:50 (1cm = 0,5m)
GEOLOGIST: FELLOWES, LEIVESTAD, RYDBERG   DATE 30.9.75

DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
1792,4	Sd, uncons, dk yelsh brn (oil stained), m grnd loc grdg into f grnd, subang-subrnd, micaceous (musc), well srtd, tr hd blk min (hornblend ?).	Uniform/patchy, strong, whsh yel fluo yelding an instant streaming wh/blsh wh cut fluo. Uniform/patchy tan oil staining w/ dk amber vis cut.
1793,5	Sd, a/a but m gry. Poss v sl increase in grainsize.	No stain - no fluo.
1793,8	Sd, as 1792,4-1793,5m but locally sl more fine grained.	Show as 1792,4-1793,5m. Patchy, fair yel fluo yelding an instant wh cut fluo. Patchy tan oil stain w/ pale straw cut.
1795,4	Sd, as 1793,5-1793,8m.	Only v sl tr of yel patchy fluo.
1796,6	Sd, as 1792,4-1793,5m.	Patchy, fair yel fluo yelding an instant wh cut fluo. Tan stain
1796,8	Sd, as 1793,5-1793,8m.	No stain - no fluo.
1797,75	Sd as 1793,5-1793,8m w/ laminae of Sh, dk gry, fiss, well ind, tr pyr.	No stain - no fluo.
1798,0	Sd, as 1792,4-1793,5m.	Show as 1792,4-1793,5 but straw vis cut.
1798,25	Sd, as 1793,5-1793,8m interlaminated w/ Sh, dk gry, subfiss, m well ind, v slty, v mic	No stain - No fluo.
1799,25	Sd, as 1793,5 - 1793,8m.	No stain - no fluo.
1800,6	No Recovery	

Depth scale: 1793, 1794, 1795, 1796, 1797, 1798, 1799, 1800, 1801, 1802

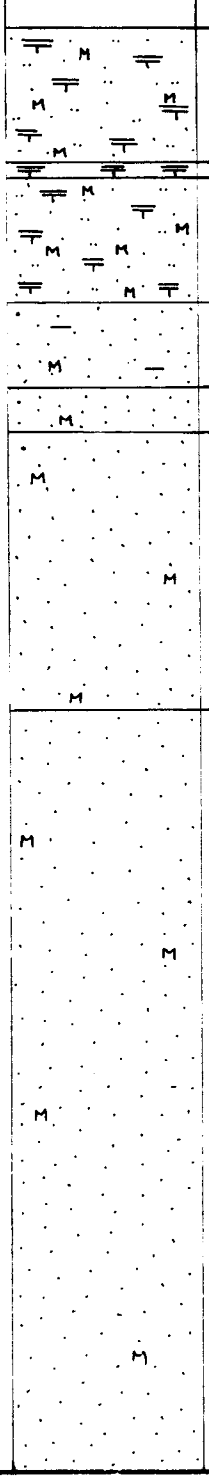
WELL NO 30/7-2	NORSK HYDRO a.s PETROLEUM DIVISION CORE REPORT	CORE NO'S 4 SHEET * 2

AREA: CONTINUED FROM SHEET 1
WELL RKB:
INTERVAL: CUT: RECOVERY:
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: DATE:

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
1802		No Recovery	1802,5		

WELL NO 30/7-2	NORSK HYDRO a.s PETROLEUM DIVISION CORE REPORT	CORE NO'S 5 SHEET # 1

AREA Norwegian North Sea
WELL RKB 22,9 m
INTERVAL 1802,5 - 1816,2 m. CUT : 1802,5 - 1814,1 RECOVERY : 84,4 % (11,6 m)
SCALE 1:50 (1cm = 0,5m)
GEOLOGIST FELLOWES, LEIVESTAD, RYDBERG DATE

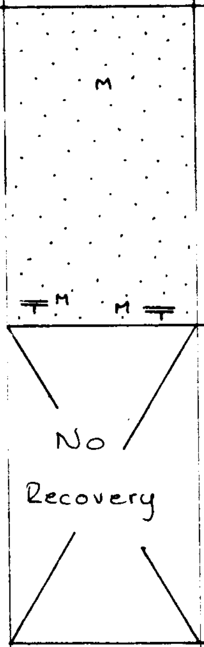


DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
			1802,5	Interlaminated Sst, gry, f-vf grdg into Sltst, m hd, ang-subrnd, and Sh, gry-dk gry, smooth, mica, slty.	
1803			1803,4	Sh, clean, dk gry, smooth, mica.	
			1803,5	As 1802,5-1803,4 m.	
1804			1804,3	Sst, clr qtz, v frbl, f-vf, m srtd, sl arg, v poorly cons.	Patchy yel strong fluo yelding an instant streaming blsh wh cut fluo. Patchy stain
1805			1804,9	Sd, clr qtz, dk yelsh brn (oil stained), f-m, rnd-subrnd, w srtd, (mic)	Uniform, yel, fair fluo. Uniform tan stain. Saturated.
			1805,2	Sst, clr qtz, dk yelsh brn (oil stained), f-m, rnd-subrnd, well sorted, sl mic, v poorly consolidated.	Uniform yel, fair fluo yelding an instant, strong streaming blsh wh cut fluo. Uniform tan oil staining. Amber-dk amber vis cut. Saturated.
1806					
1807			1807,0	Sd, uncons, clr qtz, dk yelsh brn (oil-stain), f-m, rnd-subang, well sorted, (mic).	Show a/a
1808					A/a
1809					A/a
				A/a	
1810					A/a
					A/a
1811					A/a
1812				A/a	

WELL NO. 30/7-2	**NORSK HYDRO a.s** PETROLEUM DIVISION CORE REPORT	CORE NO'S 5 SHEET #2

AREA: CONTINUED FROM SHEET #1.
WELL RKB
INTERVAL CUT: RECOVERY:
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: DATE

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
				A/a	A/a
					A/a
1813				A/a	A/a
					A/a
1814			1814,1	Tr Sh, dk gry, mic.	
1815					
1816			1816,2		



WELL 30/7-2	CORE REPORT	CORE NO'S 5 SHEET #2

WELL NO 30/7-2

NORSK HYDRO a.s
PETROLEUM DIVISION
CORE REPORT

CORE NO'S 5
SHEET #3

AREA: Norwegian North Sea
WELL RKB: 22.9 m
INTERVAL: 1814.1 - 1816.2 m CUT: 2.1 m RECOVERY: 100%
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: Rydleeny Kihle
DATE: 1.10.75

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
1814.5			1814.1	Cly, grnsh gy, sticky.	No fluo
1815			1814.6	Sd, uncons, clr, qtz, dk yelsh brn (oil stnd), m-f, w srtd, subang-subrnd, (mica)	Uniform fair/gd fluo, yelding an instant wh streaming cut fluo. Uniform oil stain. Lt amber vis cut.
			1815.25		
			1815.4	Cly, A/a	No stain
1816			1816.2	Sd, A/a.	Show a/a
1817					

Remarks:
When coring co.no. 6 the unrecovered part of co.no 5 was picked up in the core-barrel.
The recovery of the whole core no 5 is thus 100%.

WELL NO 30/7-2

NORSK HYDRO a.s
PETROLEUM DIVISION
CORE REPORT

CORE NO'S 6
SHEET # 1

AREA: Norwegian North Sea.
WELL RKB: 22.9 m
INTERVAL: 1819 - 1821.7 m CUT: 2.7 m RECOVERY: 100%
SCALE: 1:50 (1cm = 0,5m)
GEOLOGIST: Rydberg, Kihle
DATE: 1.10.75

DEPTH SCALE	RE-COVERY	LITHOLOGICAL COLUMN	DEPTHS	LITHOLOGICAL DESCRIPTIONS	SHOWS
			1819.1	Sd, uncons, dk yelsh brn (oil stained), m-f, w srtd, subang - subrnd, (mica).	Uniform, fair yel fluo, yelding an instant wh streaming cut fluo. Uniform oil staining w/light amber vis cut.
1820				Sd, uncons, clr. qtz, m gy, m-f, w srtd, subang - subrnd, v sl mica.	No stain - no fluo.
1821					
			1821.7		
1822					

Remarks
A depth correction of 2.8m was made before this core was cut.

List of References

1) Reservoir fluid study for Norsk Hydro a.s
Oil well No. 30/7-2A SINTEF 16/12-75

2) Water analysis, well 30/7-2. NTNF's kontinentalsokkel-kontor 7/11-75

3) Grain size distribution analysis of 36 selected samples from cores 1-6. Norsk Hydro well 30/7-2 NTNF's kontinental-sokkelkontor 7/11-75

4) Lithologic description, porosity/permeability, residual liquid saturation, grain density, calci/dolomaty and fluorescence. Well 30/7-2 interval 1970,0-1989,17 (cores 1-8) Scanwell data 27/10-75

5) R.S.M. DE WIEST, ed. Flow through porous media, Academic press, New York, 1969,79

6) Wayhan, D.A. et al: Estimating Waterflood Recovery in Sandstone Reservoirs, Drilling and Production practice, 1970, API, Dallas

7) Muskat, Physical Principles of oil production, McGrawhill book company, inc. New York, 1949

8) Stiff, H.A: Trans AIME 192 (1951), 376