III.4 Fluids and Pressures

An amount of 64 RFTs and 4 FITs have been performed in both Brent and Statfjord formations. The recorded pressures of 19 in the Brent and of 25 in the Statfjord are valuable. The results for each zone are presented on plate 5.

Brent Formation

Samplings have been performed in four zones (3243,3 - 3257,8 - 3267,5 - and 3286 m). Four recovered only filtrate and mud, the only sample which snould be representative of the formation recovered (at 3286 m) 19 liters of filtrate and 56 liters of gas (with 12,5% C1, 0,4% C2, 0.1% C2, traces of C4). Due to the low gas/water ratio this recovered gas is representative of gas dissolved in water. The formation pressure gradient deduced from the recorded data is aobut 1.02.

According to these data the Brent formation is consequently assumed to be water bearing.

Statfjord Formation

Several samplings have been performed in some intervals, but mainly in the 3449 - 3471 m interval where electric logs showed hydrocarbon possibilities. Three samplings recovered oil, gas and emulsion.

Test No. 22 at 3563,1 m recovered after 30 minutes:

2 liters of oil d = 0.81 44,5 API
5,5 liters of gas
4,4 liters of emulsion

Test No. 28 at 3563 m recovered after 7 minutes:

2 liters of oil
7 liters of gas
1,5 liters of emulsion

Test No. 38 at 3568,3 m recovered:

0,35 liters of oil
110 liters of gas
2,65 liters of mud and filtrate

Other FITs were also attempted: At 3530,5 m only mud was sampled, at 3561,5 m 10 liters of emulsion of oil, filtrate and mud and 1,5 liters of gas were sampled confirming the hydrocarbon possibilities of the 3559 - 3571 m interval.

From these test results, the log analysis and computations and the fluorescences on some sidewall cores, the Statfjord formation can be devided in the following zones:

3504 - 3520 m: water bearing zone
3520 - 3559 m: residual hydrocarbon zone
3559 - 3571 m: oil bearing zone
3571 - 3684 m: water bearing zone

Only some oil analysis results from test 22 at 3563,1 m are actually available. They can be resumed as follows:

specific gravity (at 15.4° C)	0.8101
specific gravity (at 20.4° C)	0.8042
API gravity	44,5
viscosity at 20° C	2.79 C st
	2.24 C po
	1.20 degrees e
at 50° C	1.83 C st
	1.42 C po
	1.12 degrees e
pour point	- 34° C
total sulphur	0.079%
H_2S - no	not measurable

All other samples have been sent to the Elf Boussens laboratory.

The formation pressure gradient deduced from the recorded data is about 1.02.

SNEA (P)
D.G.P. - D. EXPLORATION
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GEO/LAB Bss n° 8/1733 RP
/ca

WELL 25/2-6
(NORWAY)

-

ORGANIC MATTER FROM THE JURASSIC SERIES
(KEROGEN AND OIL)
OPTICAL AND GEOCHEMICAL STUDIES

B. PHILIPPE - P. ROBERT

Boussens - December 1978

Reference : Order nº 031153

- J. DUCAZEAUX - Report nº 8/1629 RP -
  "25/2-6 well (Norway) - Palynological study on the Lower Tertiary and the Upper Cretaceous (upper part)".

- R. CUSSEY - Report nº 8/1680 RP -
  "25/2-6 well (Norway) - Sedimentological study of Jurassic deposits".

- P. DURIF, E. GROSDIDIER, J. DUCAZEAUX, J.F. RAYNAUD, P. de RENEVILLE -
  Report nº 8/1699 RP -
  "Well 25/2-6 (Norway) - Biostratigraphical study of the Mesozoïc -
  Micropalentology : 2620 to 3750 m
  Palynology : 3035 to 3750 m".

DISPATCHING LIST

RECIPIENTS :

EXPERT REGIONAL EXPLO. EUROPE	1
EXPLO. DIG EUROPE	1
ELF NORGE S/c. EXPLO. DIG EUROPE	12
D.R.A. BOUSSENS	1
S.I.D. BOUSSENS	2

A B S T R A C T

The Jurassic section studied (3080 - 3520 m) contains two main source-rock intervals :

- the first between 3080 and 3240 m (Portlandian to lower Kimmeridgian), which is immature or just at the beginning of the oil generation zone which has a very high hydrocarbon potential (generally about 50×10^3 T/Km2 $\times$ m); the genetical characteristics of its hydrocarbons vary : type 1 above 3150, type 2 below.

- the second, between 3317 and 3500 (Liassic), which is in the main oil generation zone and has a present hydrocarbon potential strongly reduced by the catagenesis ($< 10 \times 10^3$ T/Km2 $\times$ m) ; its hydrocarbons are classed in type 2.

The crude oil from 3563 m (RFT n°,22) is non-degraded and has the genetical characteristics of the type 2.

9 pages
1 table
19 plates

C O N T E N T S

PLATES

This report presents the analytical results of the optical (in reflected light) and geochemical studies of the organic matter from the Jurassic series* of 25/2-6 (location of this well on Plate 1). It takes into account the results of the optical study in transmitted light on palynological slides.

All these results are summarized on Plate 2 : "Organic Matter Study. Synthesis of results".

1 - OPTICAL STUDIES OF THE ORGANIC MATTER

1.1 - OPTICAL STUDY IN TRANSMITTED LIGHT

The analytical results are included in the biostratigraphical report** and are summarized on Plate 2.

1.1.1 - Palynofacies

The organic facies observed on the palynological slides are primarily made up of :

- amorphous matter between 3080 and 3150 ;
- amorphous matter (>50 %) and ligneous particles between 3150 and 3190 m;
- coaly-ligneous particles between 3190 and 3220 m ;
- amorphous matter between 3220 and 3240 m ;
- coaly and ligneous particles between 3240 m and the well bottom at 3750m.

1.1.2 - T.A.I.

The thermal alteration indices estimated are :

2.5	at 3100
3^-	at 3215
2.5^+-3	at 3350
3-3.5	at 3512
3.5-3.5^+	at 3750

.../...

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* apart from one sample of Cretaceous, in reflected light.

** previously cited.

1.2 - OPTICAL STUDY IN REFLECTED LIGHT

The optical analysis of organic matter was performed between 2550 m and 3518,30 m (Upper Cretaceous to Sinemurian) on 16 samples.

Among the 14 core or SWC samples, 11 have been polished in full rock sections, without concentration, and 3 have been concentrated by means of a gravity method. Only 2 cutting samples, from the Toarcian, have been used, after concentration.

The analytical results are given on Plate 3 and summarized on Plate 2.

1.2.1 - Nature of organic matter

Cretaceous

Only 1 sample studied, at 2550 m, consists of coaly particles and reddish fluorescent associated rock (only humic).

Jurassic

- At ≠ 3100 m (Upper Kimmeridgian) sapropelic rock, highly fluorescent (global index 3 in a scale from 0 to 5) with abundant marine algae, containing frequent bitumen inclusions and bituminous organisms.

  Completely devoid of coaly (humic) material.

- The rest of the section is essentially made up of humic (terrestrial) material with rare algae (mostly lacustrine botryococcus).

  Sporinite - rich rock, with a humic fluorescent facies appears from 3159.9 - 3164.10 - 3195 (Malm), 3256 to 3284 (Dogger). Bitumen and/or gelinite inclusions are abundant in the Dogger - Lias.

  Pure massive coal has been observed at 3284 m and fragments in the Toarcian concentrates.

  Oil veinlets are frequent in the whole section and frequent exsudatinite confirms oil generation by main macerals.

1.2.2 - Reflectance

Dürley R.-Date

Fair reliable vitrinite is not very frequent in the studied section.

In the Dogger zone, bitumen and gelinite reflectance is continuous with 0.55 % values : the fluorescence coulours of algae suggest slightly higher values such as 0.60 to 0.65 %. This under-estimation, common with bitumen, may be due, for vitrinite, to its high oil content or to its nature of vitrinite "B" or "desmocollinite" (ICCP lexicon).

Taking into account the isolated, but probably reliable result in the Cretaceous, the vitrinite reflectance increase - or equivalent - can be summarized in the whole section as follows,

Age	Depth	Ro
U. Cretaceous	2550 m	0.5 %
U. Kimmeridgian	3100 m	0.5 % (eq. algae)
Dogger	3250 m 3280	0.6 - 0.65 (partly d°)
Toarcian	3350	0.75 %
Sinemurian	3515	0.9 - 0.95 % ?

.../...

2 - GEOCHEMICAL STUDY

2.1 - SHALY AND COALY ROCK SAMPLES

All the analyses were carried out on core or sidewall core samples between 3093 and 3518 m. The analytical results of the organic inventory are given in table 1 and summarized on Plate 2. For the pyrolyses, the hydrogen index (IH) and the oxygen index (IO), which give data on the present petroleum quality, are plotted on a diagram (Plate 4).

The constitutions of the organic matter extracted by chloroform and the chromatographies of the thermovaporised and saturated fractions were carried out on a few selected samples (see the samples analysed on table 1) ; these chromatograms and the constitutions are given on plates 6 to 17. The Pristane/nC17 and Phytane/nC18 ratios, measured on the chromatograms of the saturated fractions, are plotted on a diagram (Plate 5).

The main results are presented below for each gross lithological interval and/or formation.

- Shale interval between 3080 m and 3240 m (Portlandian to Callovo-Oxfordian)

The total organic carbon contents are high : generally between 5 and 7 %, apart from one sample (3.3 at 3195 m) the pyrolysis results show that the petroleum quality of the kerogen is very good (IH* $>$ 400 ; IO $\leqslant$ 15) for 5 samples between 3105 and 3185 m, and so probably in the whole Portlandian to lower Kimmeridgian section, i.e. between about 3080 and 3190 m ; the petroleum quality of the kerogen is mediocre (IH $\simeq$ 135 ; IO $\simeq$ 15) at 3195 m. The petroleum quality of the kerogen from the 3220 - 3240 m has not been studied.

The average present hydrocarbon potential of the 3080 - 3190 m interval is high, about 50×10^3 T/Km2 $\times$ m ; that of the 3190 - 3220 m interval is low, about 10×10^3 T/Km2 $\times$ m. According to the high total organic carbon contents and in view of the palynofacies the average present hydrocarbon potential of the 3220 - 3240 m interval is presumably high.

The genetical characteristics of the hydrocarbons vary, in particular the pristane/phytane ratio (see Plate 5) and the distribution of the n-alkanes. Above 3150 m (Portlandian to upper Kimmeridgian) in two samples the phytane prevails over the pristane and the even-numbered n-alkanes prevail over the odd-numbered n-alkanes (type 1) ; below 3150 m, lower Kimmeridgian to Callovo-Oxfordian, in three samples it is the opposite (type 2).

The catagenetical chracteristics of these hydrocarbons, in particular the pristane/nC17 and phytane/nC18 ratios and the n-alkane distributions indicate a low maturation.

.../...

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* IH = Hydrogen index (mg HC/gC) ; see Plate 4

IO = Oxygen index (mg CO2/gC) ; see Plate 4

- Brent Sands formation, between 3240 and 3317 m (Dogger)

This sandstony formation contains a few shaly beds, rich in organic matter, and coal beds.
The petroleum quality of the kerogen from the shaly and coaly beds is rather good to good ($240 < IH < 420$). The average present hydrocarbon potential of the shales and of the coals is very high, about 100 and 500×10^3.Tons/Km2 × m respectively, but their thickness is very weak. The genetical characteristics of the hydrocarbons from the shales and the coals are quite close ; their main characteristics are the very high predominance of the pristane over the phytane, the abundance of the n-alkanes having a high molecular weight and the predominance of the odd-numbered n-alkanes. The catagenetical characteristics of these hydrocarbons indicate a low maturation (at a maximum at the beginning of the oil generation zone).

- Dunlin Shale formation, between 3317 and 3504 m (Lias)

The total organic carbon contents are relatively high to medium : 1.3 to 2.5 above about 3420, and about 0.9 below this depth.
The present petroleum quality of the kerogen is mediocre to relatively good ($50 < IH < 240$; $35 < IO < 50$). The average present hydrocarbon potential is low, lower than 10×10^3 Tons/Km2 × m between 3317 and 3420 m, and lower than 5×10^3 T/Km2 × m between 3420 and 3504 m.

The genetical characteristics of the hydrocarbons from two samples of this formation are quite close and make it possible to class then in type 2. Their catagenetical characteristics show a slightly higher maturation than above (beginning of the main oil generation zone ?).

- Statfjord Sand formation, between 3500 and 3700 m(Liassic)

This formation contains a few shaly beds ; only three shaly samples from core 4 (between 3510.5 and 3518.5 m) were analysed.
The total organic carbon contents are between 0.85 and 3.1 %. The present petroleum quality of the kerogen is mediocre to relatively good
($40 < IH < 200$; $35 > IO > 10$).
The genetical characteristics of one sample are quite close to those of the samples from the Dunlin shale formation (type 2). Its catagenetical characteristics suggest a maturation compatible with the main oil generation zone ; according to this fact, the initial hydrocarbon potential was higher.

According to the knowledge of the geochemical-sedimentological setting of this region, it is presumable that the thicker shaly beds (not studied) had at a minimum the same initial hydrocarbon potential as the Dunlin shale Formation.

2.2 - CRUDE OIL

The crude oil analysed corresponds to the RFT n° 22 from 3563.1 m, in Statfjord Sand formation. Its gross composition and chromatograms are on plate 18 ; its gross composition is plotted on a triangular diagram (Pl. 19) with the composition of the crude oils from Norwegian Sea, previously studied. This oil is non degraded. It correlates with the crude oils from this region, especially the oils from 25/2-5 and 25/2-4 ; it is also classed in type 2.

.../...

3 - CONCLUSIONS

The state of maturation of the organic matter is low just at the beginning of the oil generation zone, in the upper part of the Jurassic section. It reaches the main oil generation zone in the Liassic. $R_o < 0.75\%$

The shales of the Portlandian to Callovo-Oxfordian, between 3080 and 3240 m, are rich in kerogen (COT $\simeq$ 5-7 %) of a very good petroleum quality, at least above 3190 m. The present, almost initial, hydrocarbon potential is about 50×10^3 Tons/Km2 × m above 3190 m and between 10 and 50×10^3 Tons/Km2 × m below this depth. Their hydrocarbons are classed in type 1 above 3150 and in type 2 below.

The kerogen of the shaly and coaly beds of the Brent Sand formation, Dogger (between 3240 and 3317 m) is of a good petroleum quality ; the present, almost initial, hydrocarbon potentials of these very thin beds are about 100 and 500×10^3 Tons/Km2 × m respectively. Their hydrocarbons are classed in type 2.

The shales of the Dunlin Shale formation, Liassic (between 3317 - 3500 m), and the shaly beds of the upper part of Statfjord Sand formation, are relatively rich in kerogen (COT $\simeq$ 1 - 3 %) of a mediocre petroleum quality ; their present hydrocarbon potential, lower than the initial potential, is lower than 10×10^3 Tons/Km2 × m. Their hydrocarbons are classed in type 2.

The crude oil from the Statfjord Sand Formation (RFT n° 22 at 3563 m) is non degraded and correlates with the other crude oils from this region ; it has the genetical characteristics of the type 2.

25/2-6. Tilpasning av varmefluks og β.

Forsøk 2 velger: Varmefluks = konst = 60 mW/m²

$\beta_{165} = 1.4$

to riftfaser

Begynner på T. Brent-gr.

$\beta_{60} = 1.15$ (56?)

Bathon ? bekk
156 MA - 156

Voldsom heforning i midt-kritt. Sjekk om input-dataene er riktige. Får OK

Sammenlikning av modning for 60 mW/m² (forsøk II og III) med reel modning

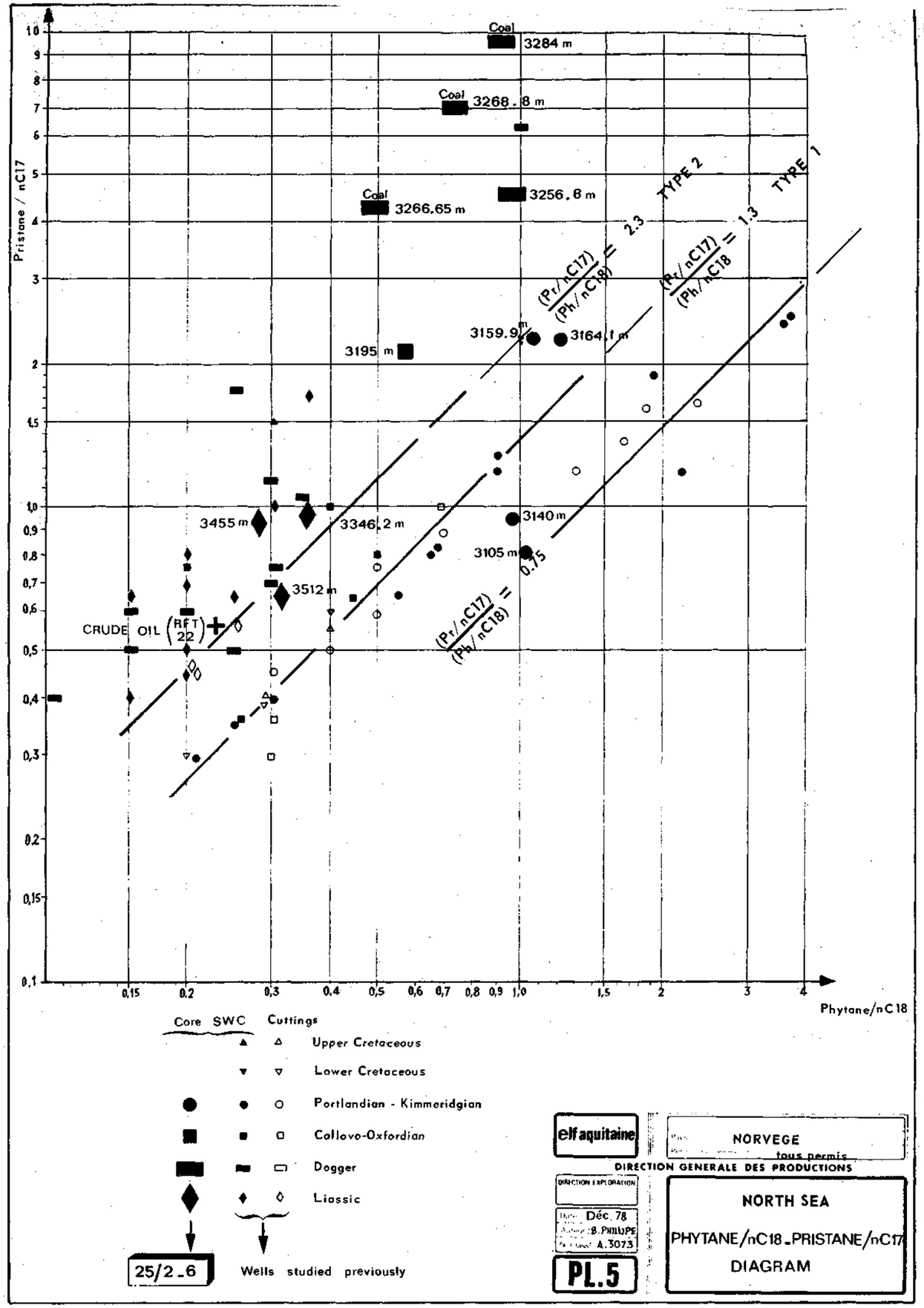
~~Tarom~~ = VR

Portland $\overset{\text{Kim}}{=}$ Rel bra tilpasning. noe for høy

Brent-gr.: Bra tilpasning, noe for lav?

Valg av strekningsfaktorer ok unntatt for midtkritt og øvre tertiær (må velge større β her)

5 h



elf aquitaine

NORVEGE

tous permis

DIRECTION GENERALE DES PRODUCTIONS

DIRECTION EXPLORATION

Déc. 78

B. PHILIPPE

A.3073

PL.5

NORTH SEA

PHYTANE/nC18 - PRISTANE/nC17

DIAGRAM

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3105 m

Identification *Identification* SWC

Formation *Formation*

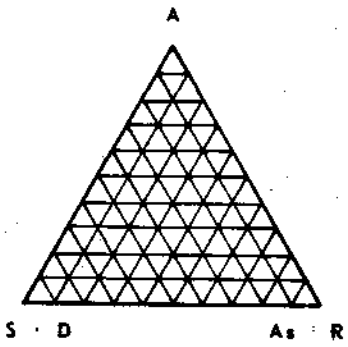
Age *Age* PORTLANDIAN - KIMMERIDGIAN

TOC : 6.9 %

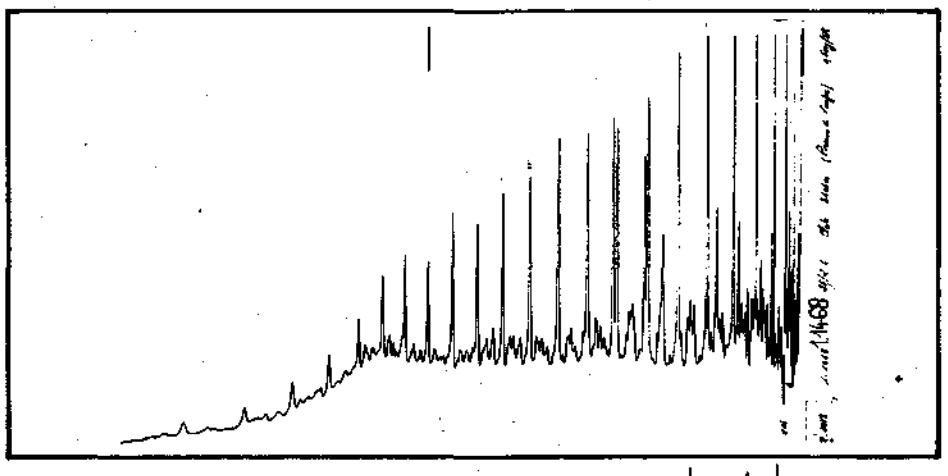
Composition du produit total (%)
Composition of total product

Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC satures + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:

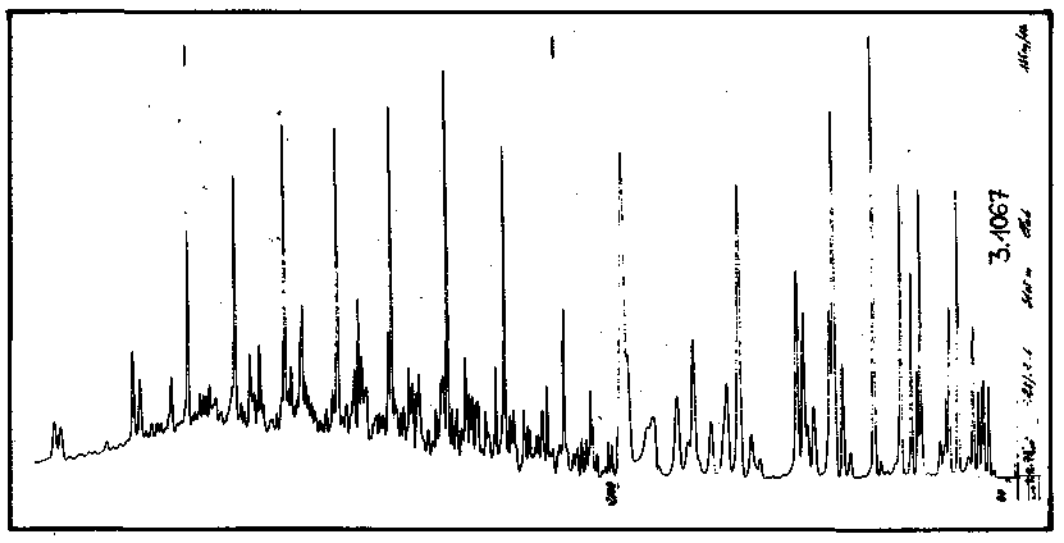
$\frac{S}{A}$ =



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC* modèl



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3140 m

Identification *Identification* SWC

Formation *Formation*

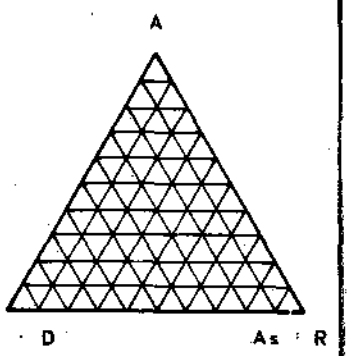
Age *Age* PORTLANDIAN - KIMMERIDGIAN

TOC = 5.4

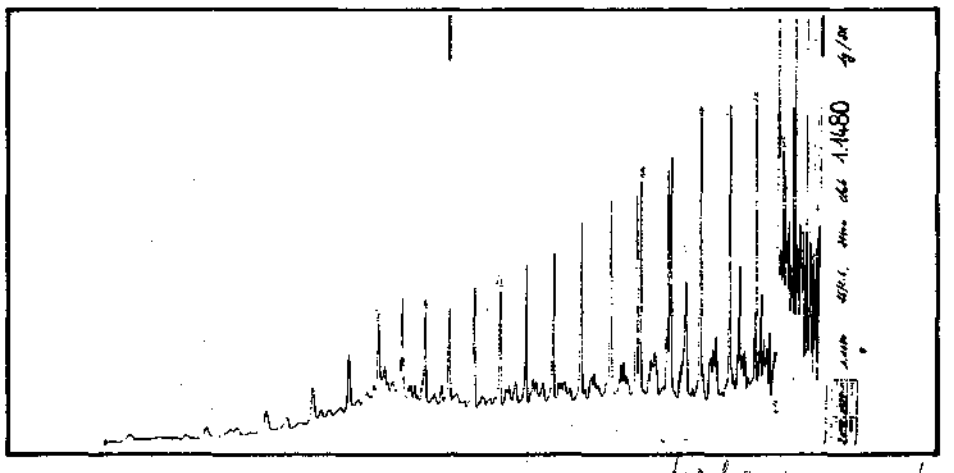
Composition du produit total (%)
Composition of total product

Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC satures · distillat *Saturated HC · distillate*	S · D	:
HC aromatiques *Aromatic HC*	A	:

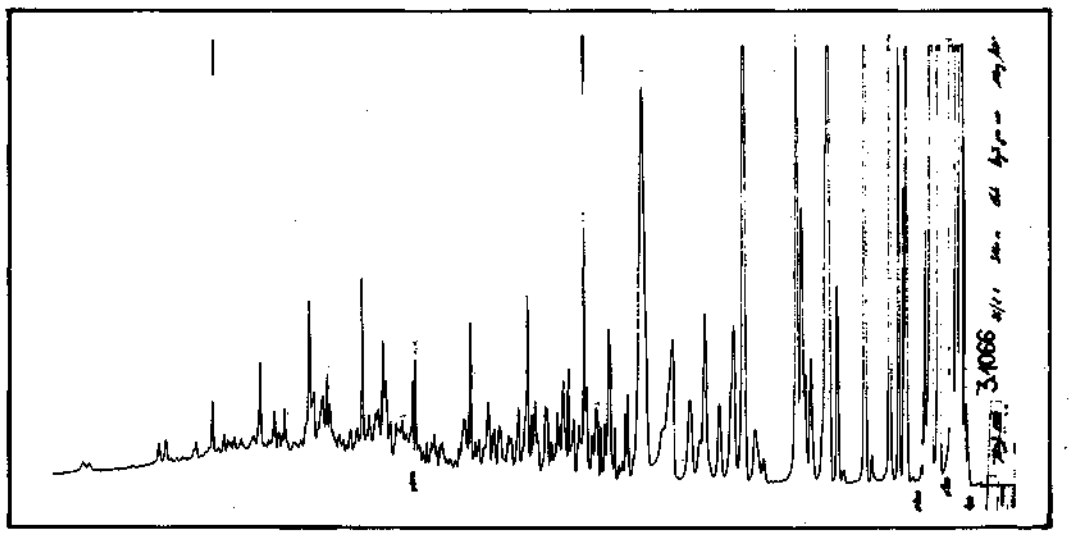
$\frac{S}{A}$ =



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3159.90 m

Identification *Identification* Core 1

Formation *Formation*

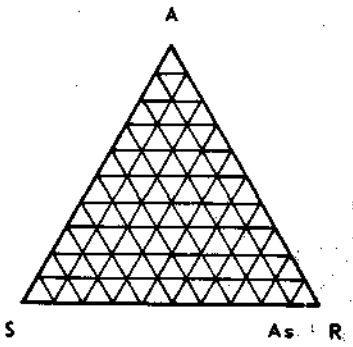
Age *Age* KIMMERIDGIAN

TOC 5 7

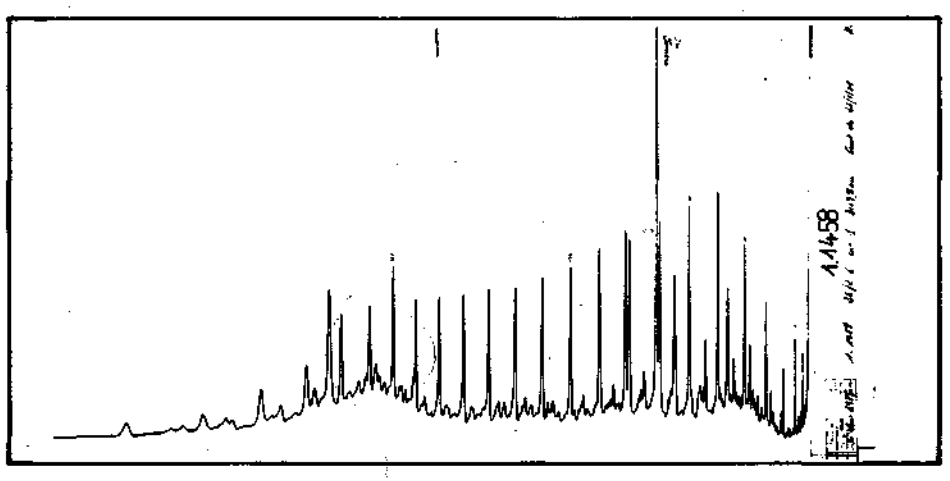
Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	17.5
Résines *Resins*	R	:	30
HC saturés *Saturated HC*	S	:	19
HC aromatiques *Aromatic HC*	A	:	33.5

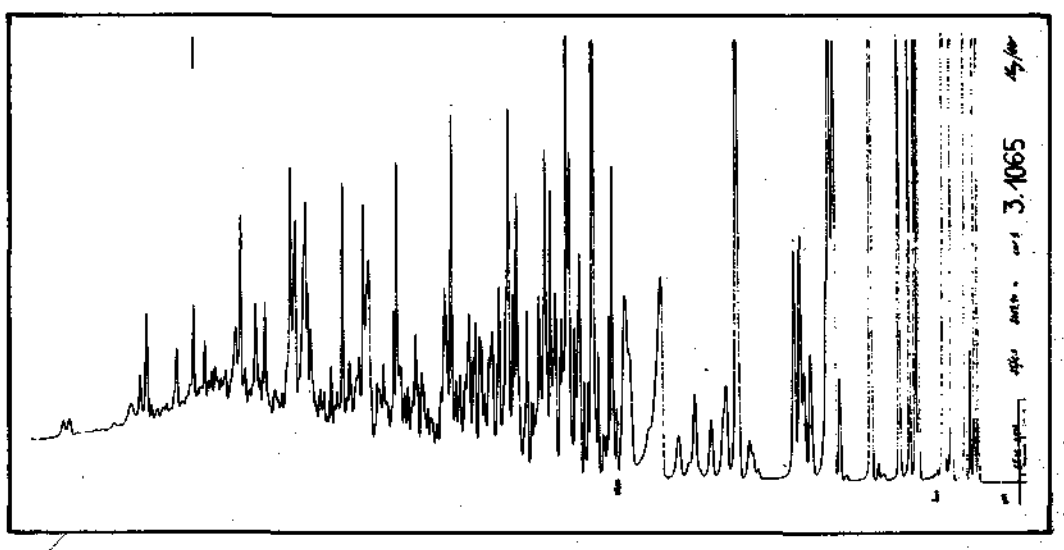
$\frac{S}{A} = 0{,}55$



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC* marginal model - mobil



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3164 10 m

Identification *Identification* Core 1

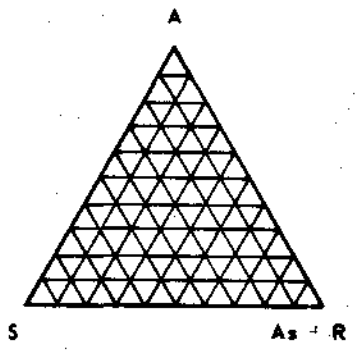
Formation *Formation*

Age *Age* KIMMERIDGIAN

TOC = 7.1

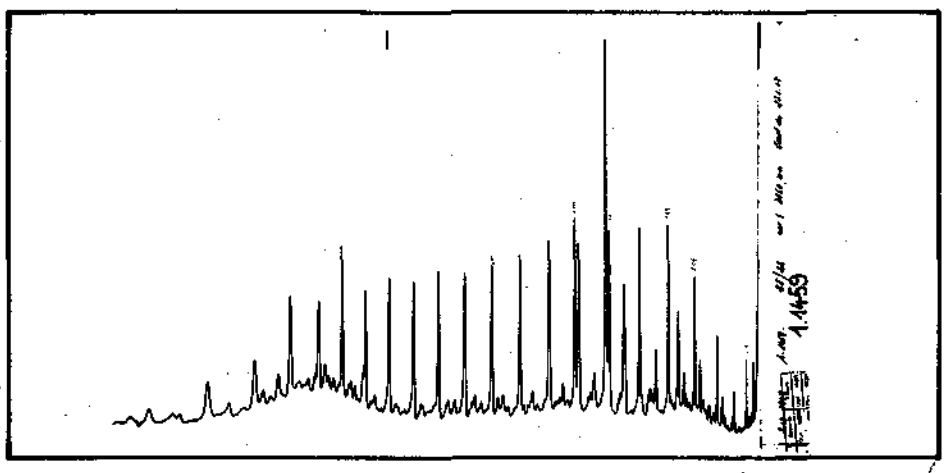
Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	15
Résines *Resins*	R	:	24,5
HC satures *Saturated HC*	S	:	24,5
HC aromatiques *Aromatic HC*	A	:	36

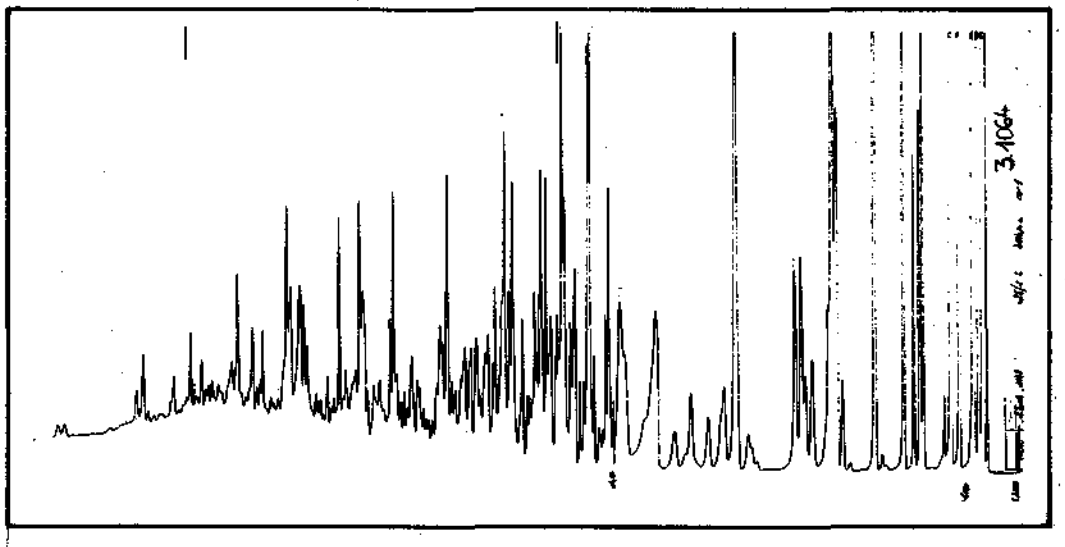


$\frac{S}{A} = 0,7$

HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

Pl.10

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3195 m

Identification *Identification* SWC

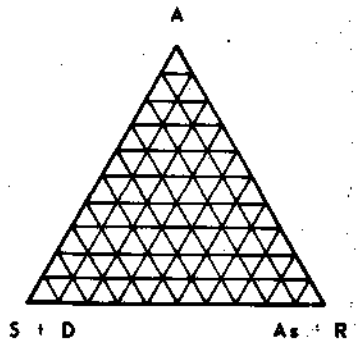
Formation *Formation*

Age *Age* OXFORDIAN

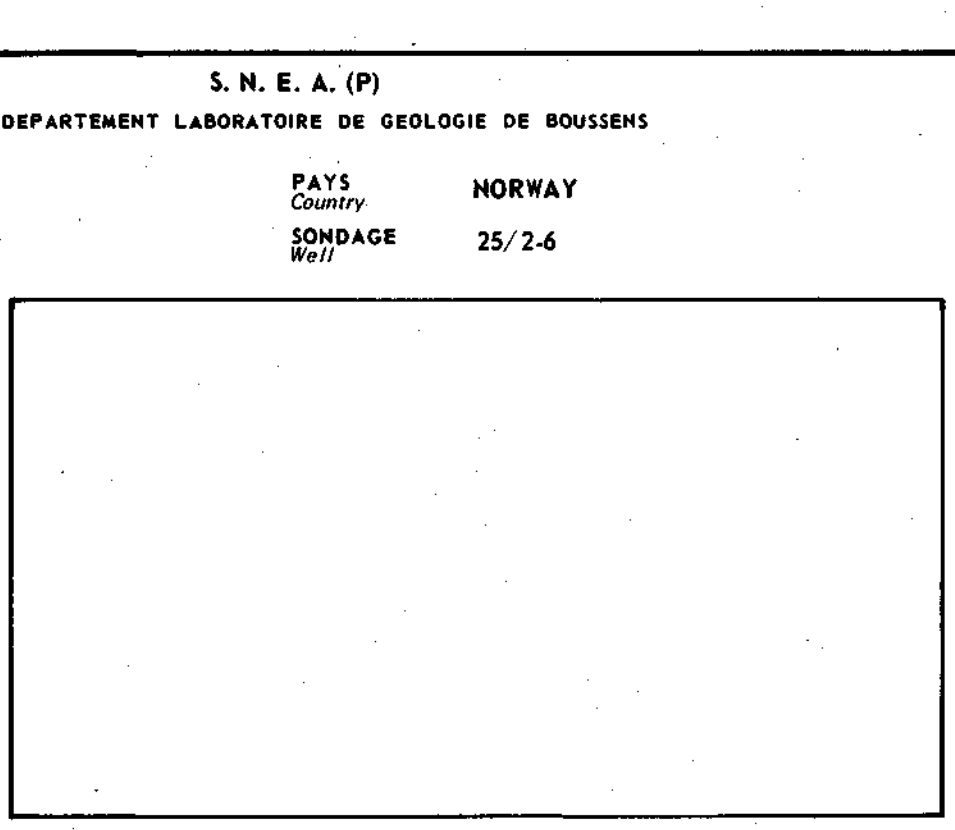
TOC = 3.3

Composition du produit total (%)
Composition of total product

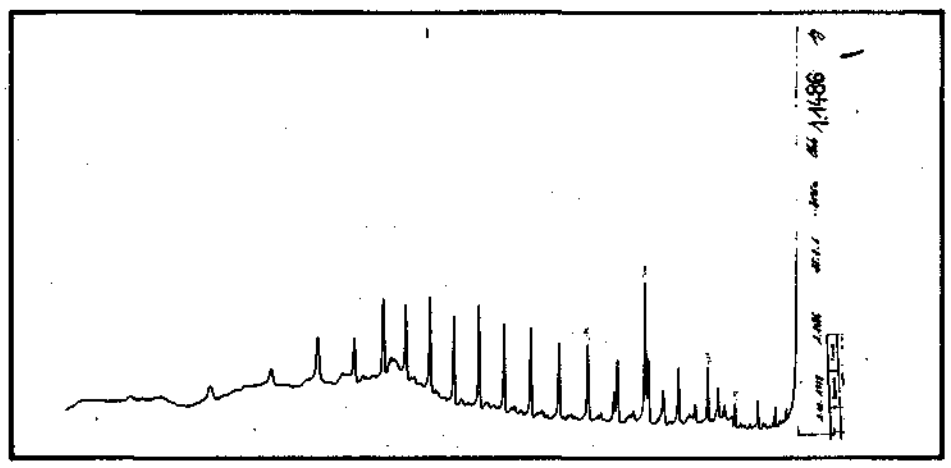
Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC saturés + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:



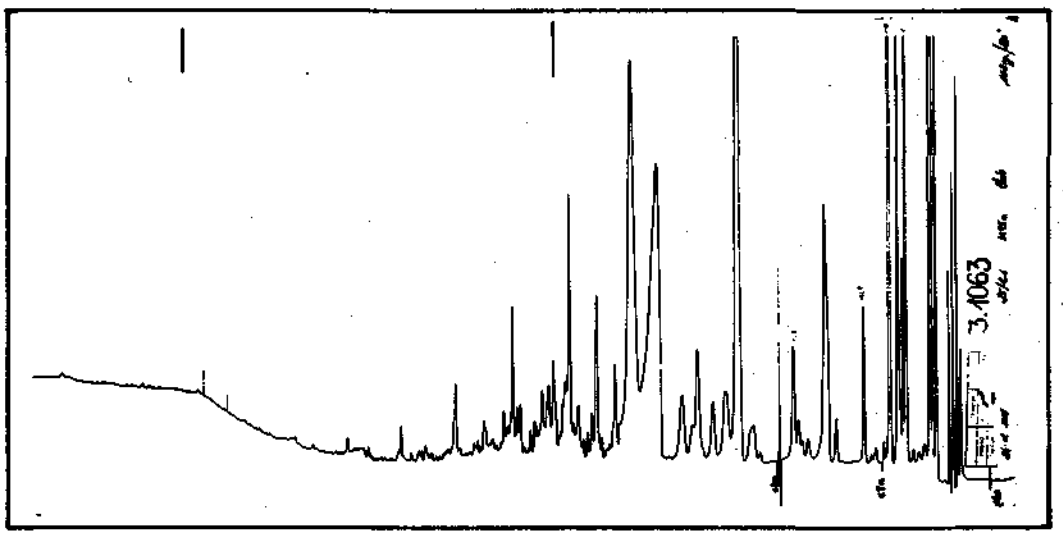
$\frac{S}{A}$ =



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A-3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

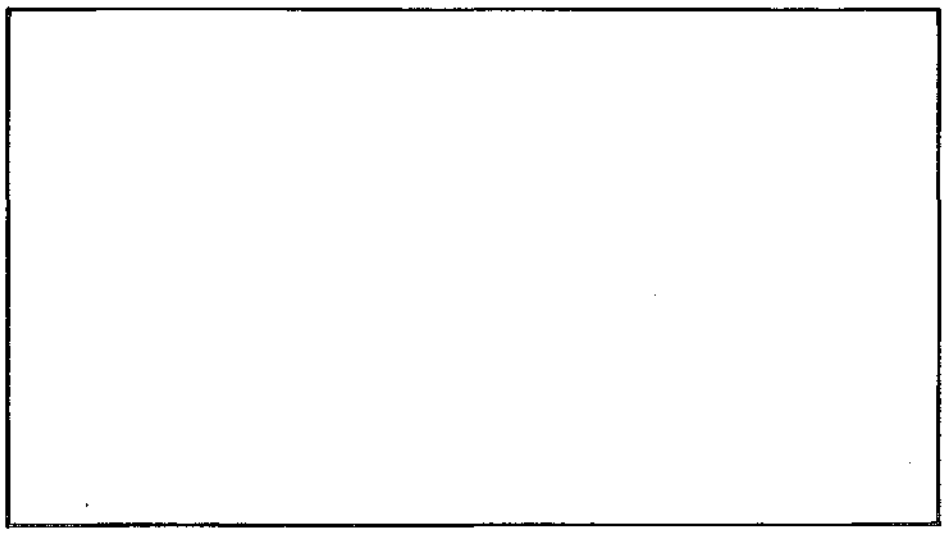
Cote *Depth* 3256.8

Identification *Identification* Core 2

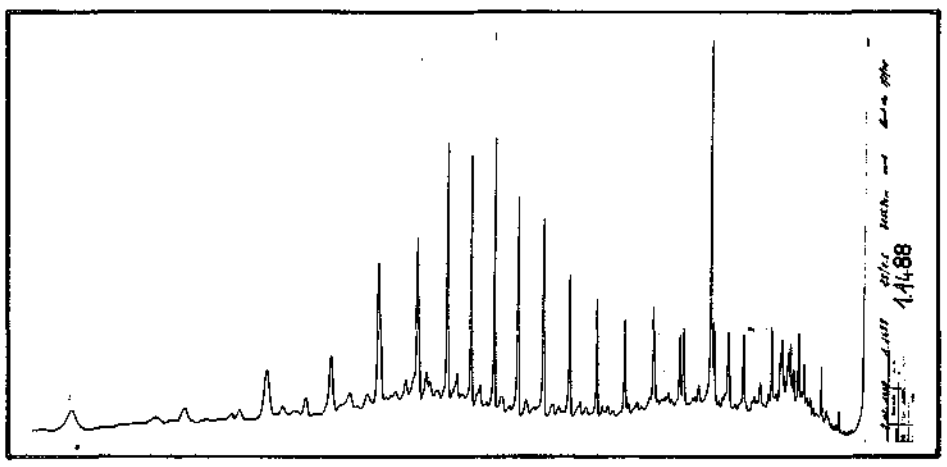
Formation *Formation* Brent

Age *Age* DOGGER

TOC = 11.5



HC AROMATIQUES *AROMATIC HC*

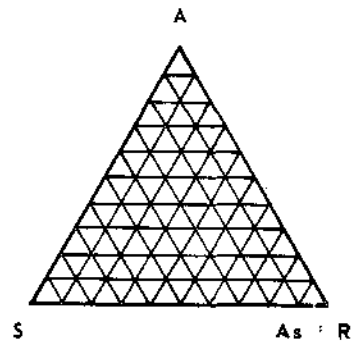


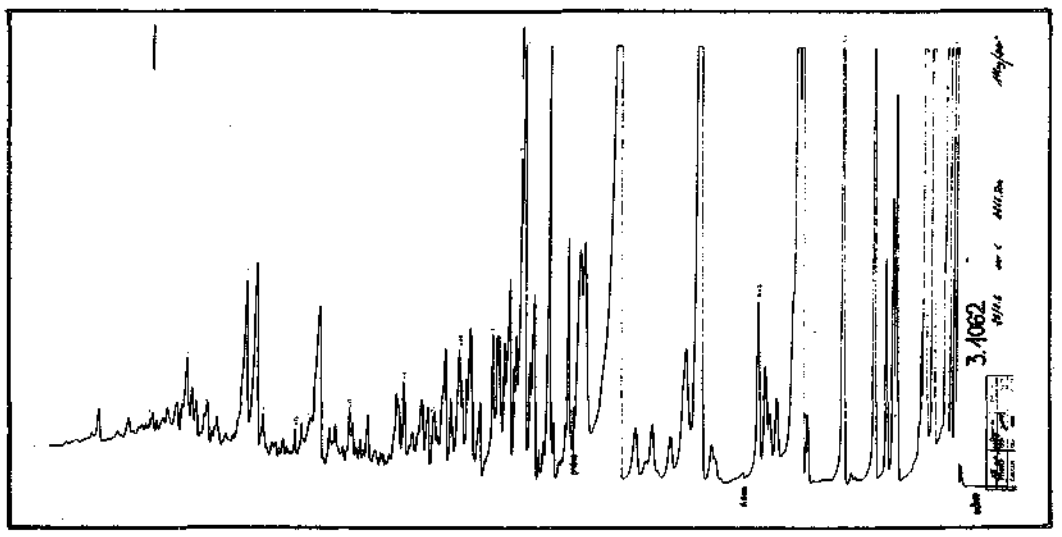
HC SATURES *SATURATED HC*

Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	32
Résines *Resins*	R	:	25.5
HC satures *Saturated HC*	S	:	9.5
HC aromatiques *Aromatic HC*	A	:	33

$\frac{S}{A} = 0,3$





HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3266.65

Identification *Identification* Core 3

Formation *Formation* Brent

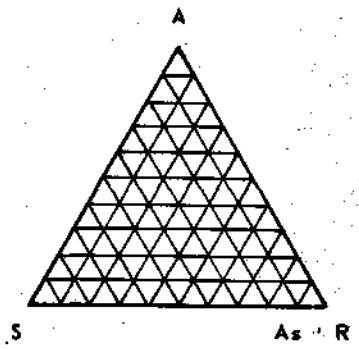
Age *Age* DOGGER

TOC = 27.9

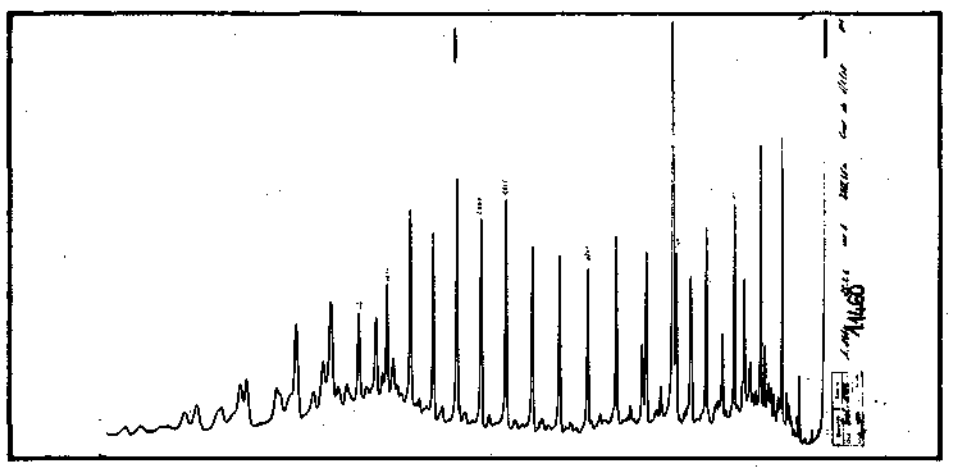
Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	34.5
Résines *Resins*	R	:	35.5
HC saturés *Saturated HC*	S	:	7.5
HC aromatiques *Aromatic HC*	A	:	22.5

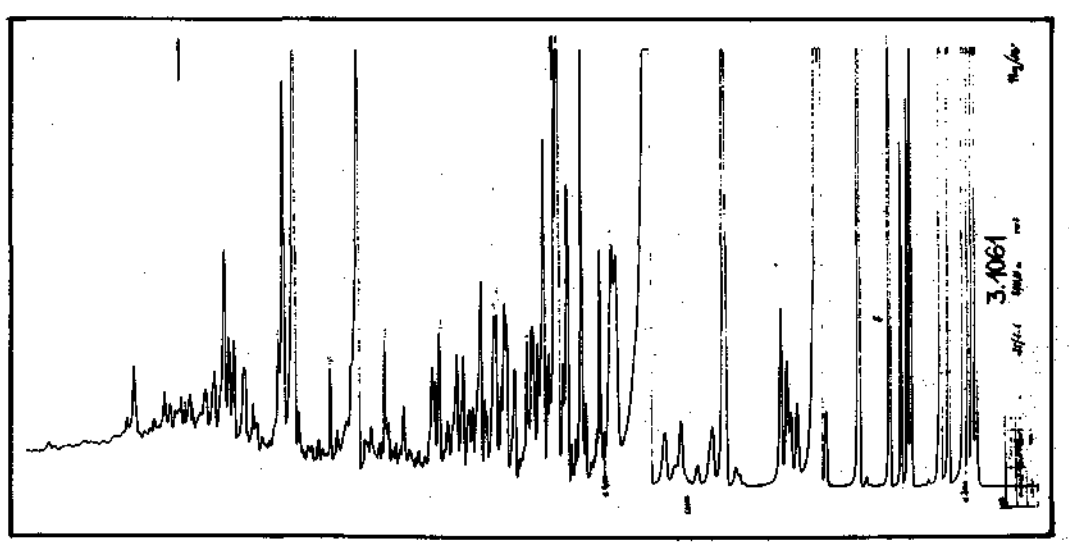
$\frac{S}{A}$ = 0.35



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3268.8

Identification *Identification* Core 3

Formation *Formation* Brent

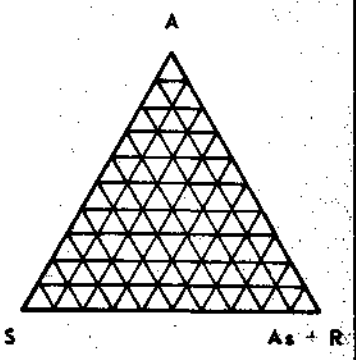
Age *Age* DOGGER

TOC = 73

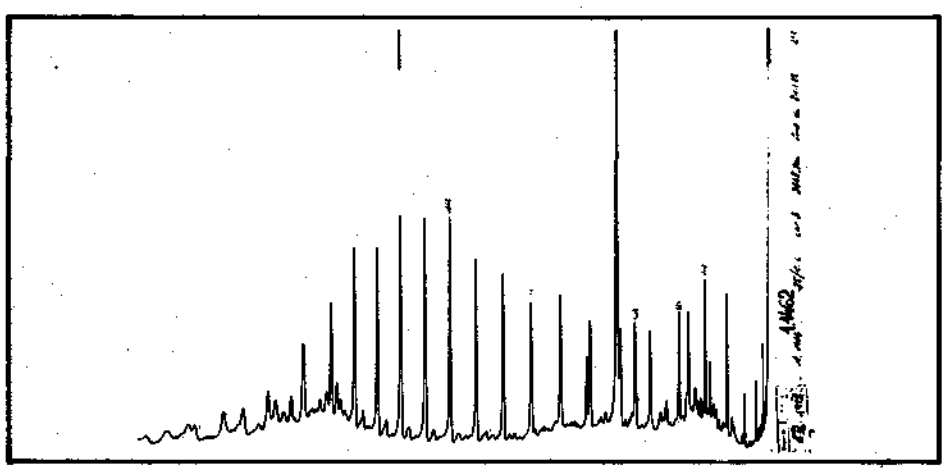
Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	20
Résines *Resins*	R	:	30
HC saturés *Saturated HC*	S	:	12
HC aromatiques *Aromatic HC*	A	:	38

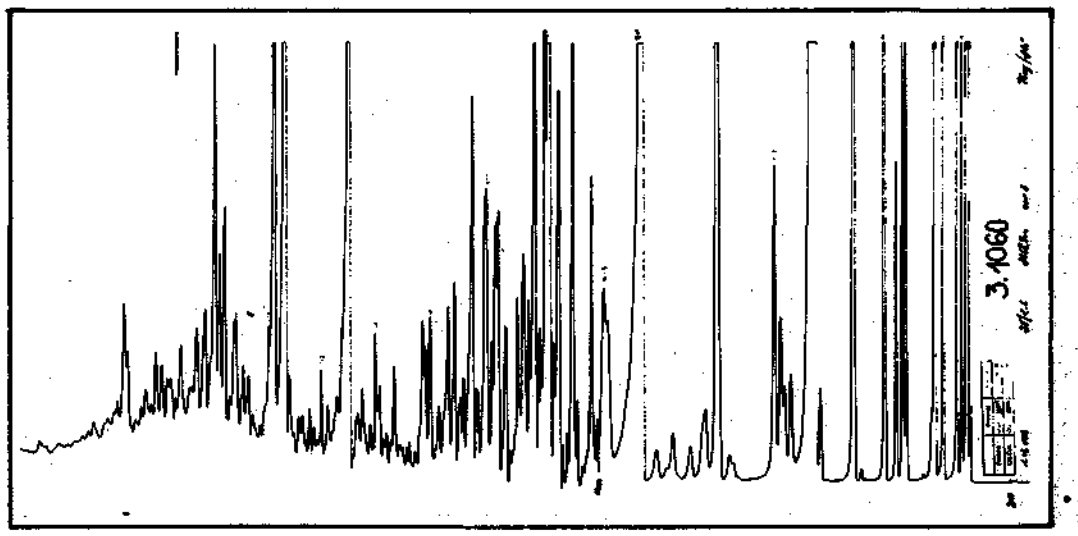
$\frac{S}{A} = 0.3$



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

4.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3284 m

Identification *Identification* SWC

Formation *Formation* Brent

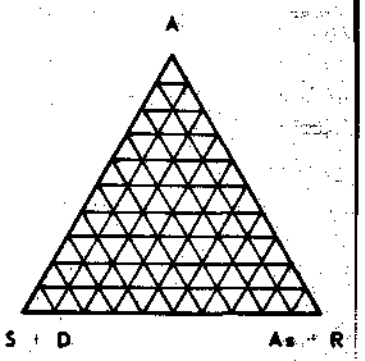
Age *Age* DOGGER

TOC = 70

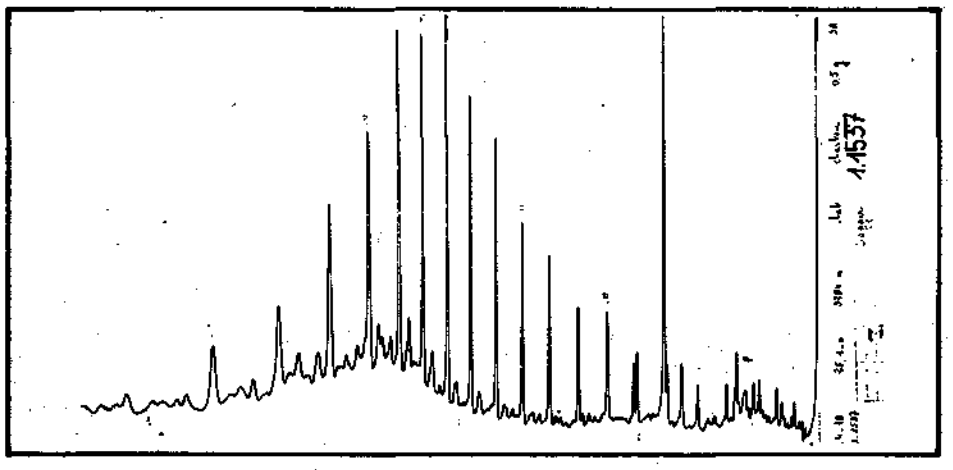
Composition du produit total (%)
Composition of total product

Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC saturés + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:

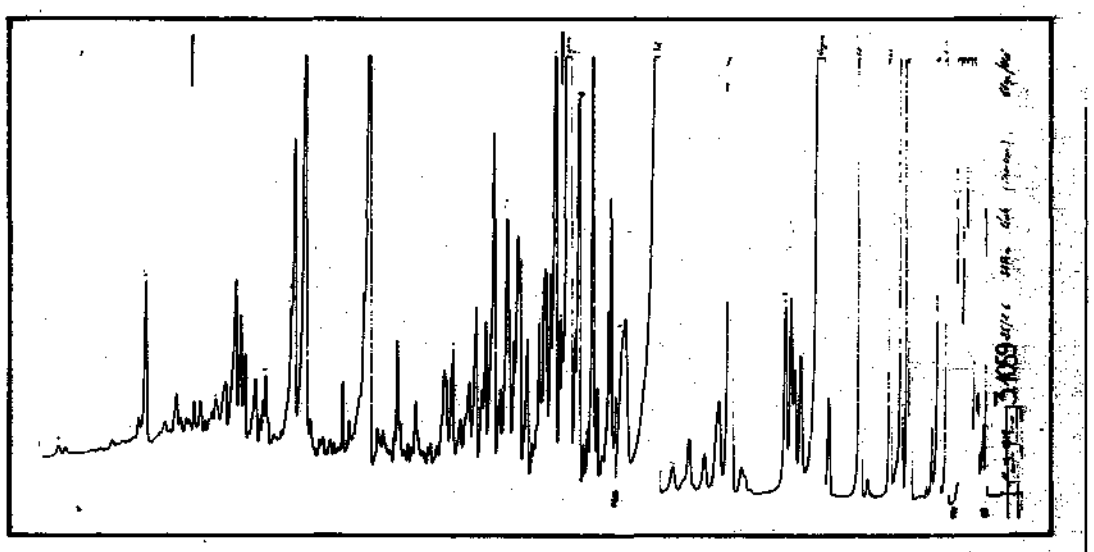
$\frac{S}{A}$ =



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A. 3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3346.2

Identification *Identification* SWC

Formation *Formation* Dunlin

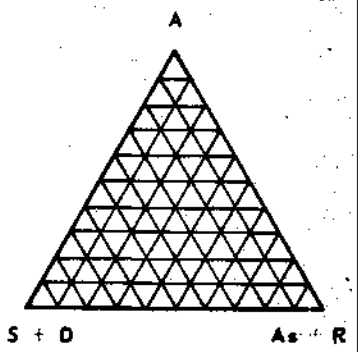
Age *Age* LIAS

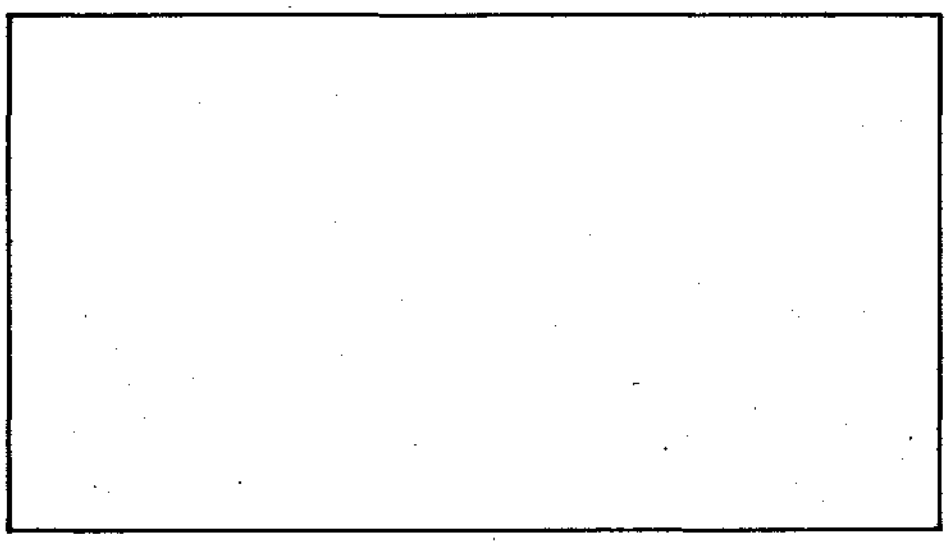
TOC = 1.65

Composition du produit total (%)
Composition of total product

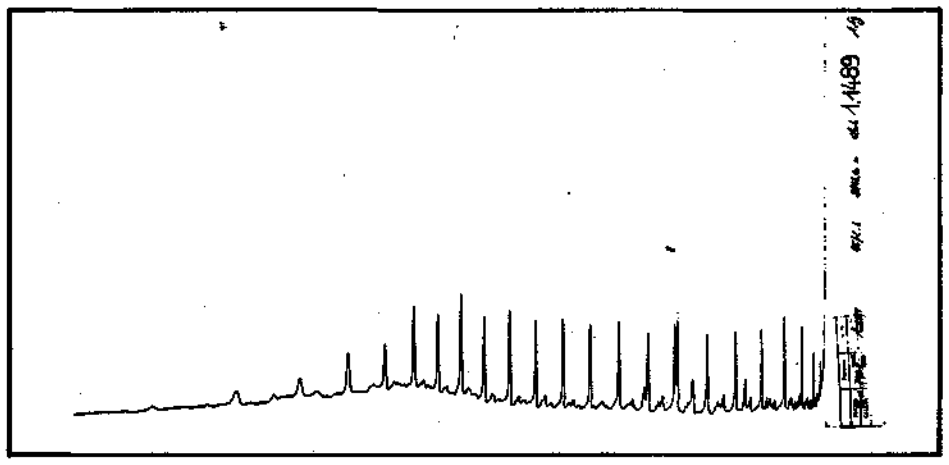
Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC saturés + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:

$\frac{S}{A}$ =

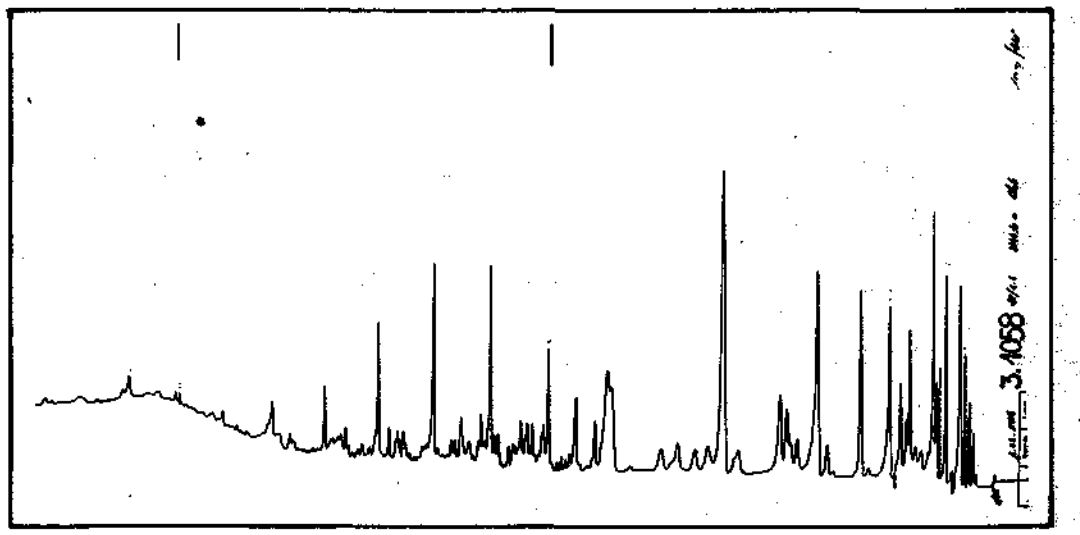




HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

Cote *Depth* 3455 m

Identification *Identification* SWC

Formation *Formation* Dunlin

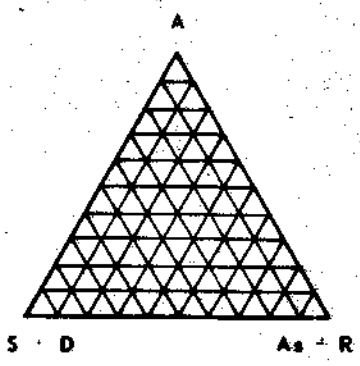
Age *Age* LIAS

TOC = 0.9

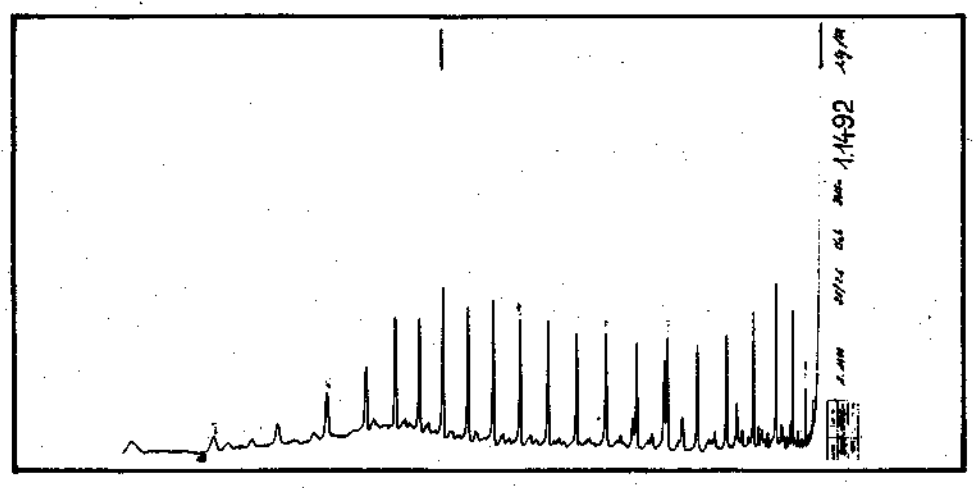
Composition du produit total (%)
Composition of total product

Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC saturés + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:

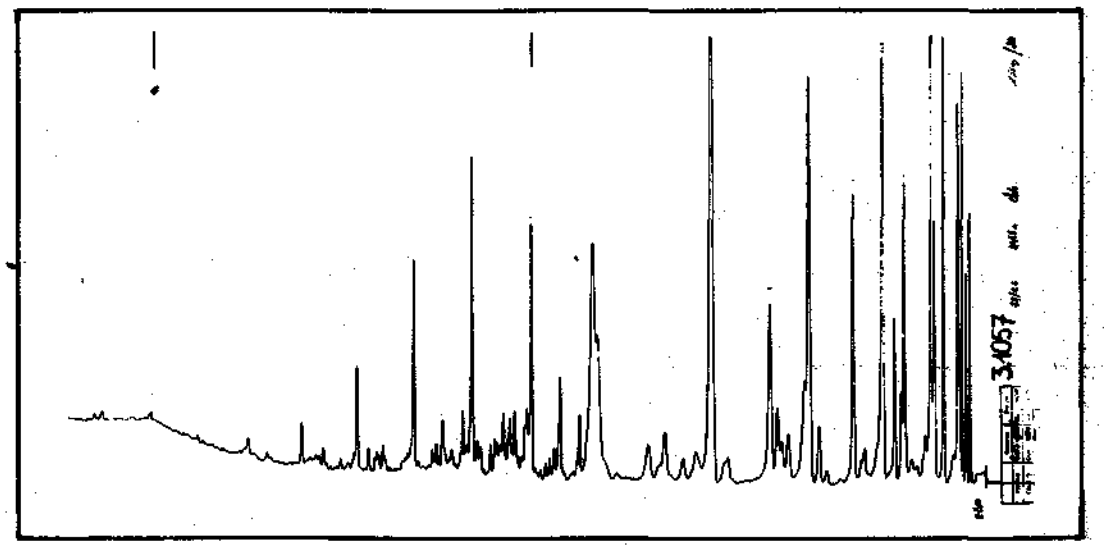
$\frac{S}{A}$ =



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

A. 3074

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

PI.17

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Roche *Rock*

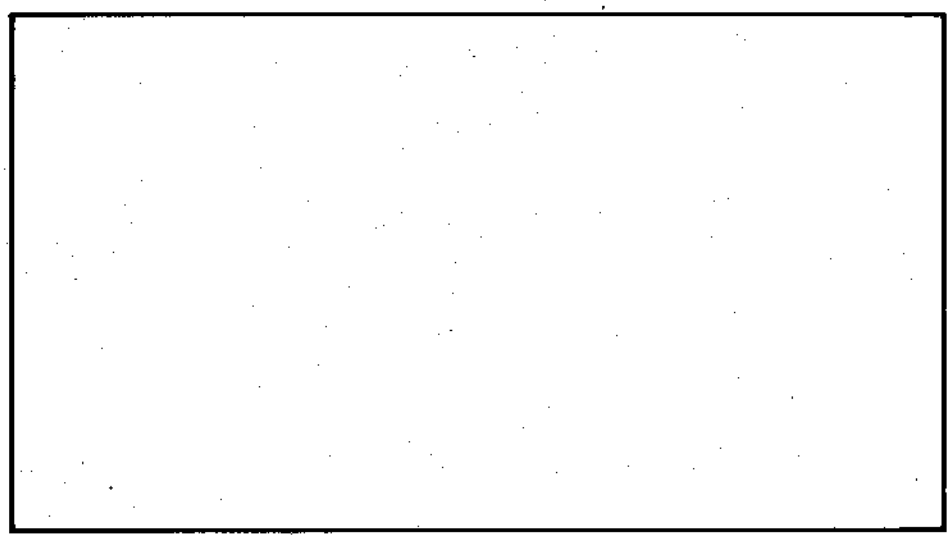
Cote *Depth* 3512 m

Identification *Identification* Core n° 4

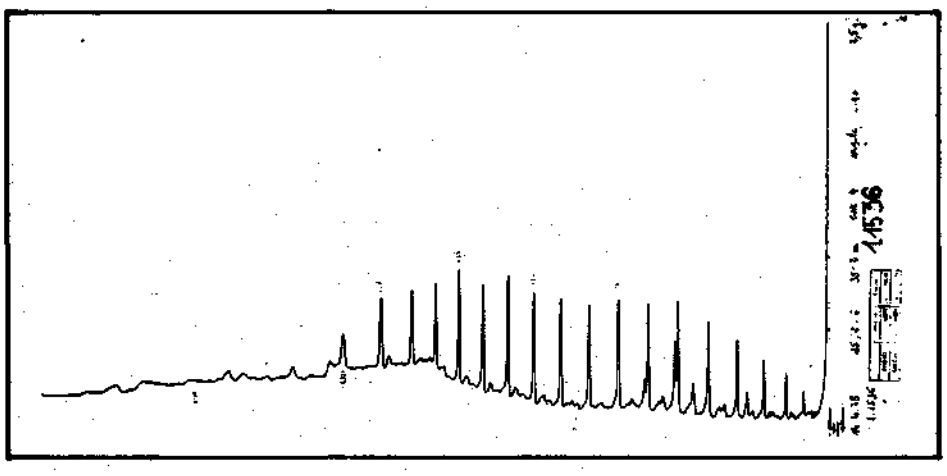
Formation *Formation* Statfjord

Age *Age* LIAS

TOC = 1



HC AROMATIQUES *AROMATIC HC*

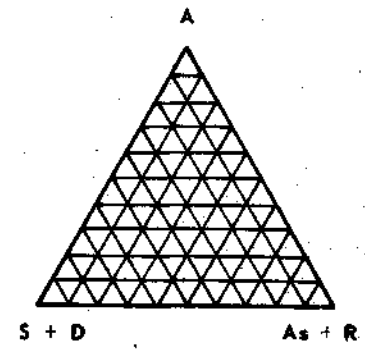


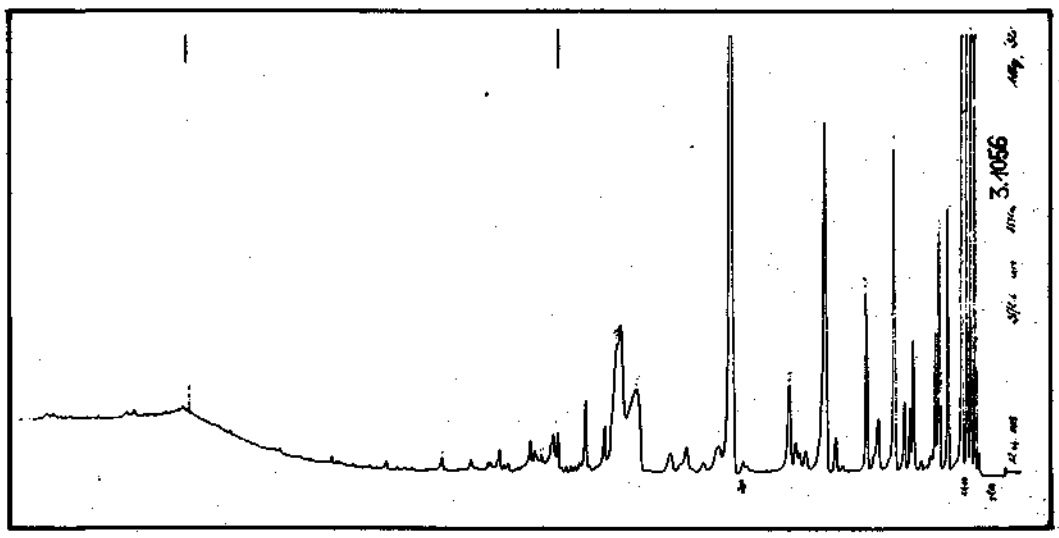
HC SATURES *SATURATED HC*

Composition du produit total (%)
Composition of total product

Asphaltènes *Asphaltenes*	As	:
Résines *Resins*	R	:
HC saturés + distillat *Saturated HC + distillate*	S + D	:
HC aromatiques *Aromatic HC*	A	:

$\frac{S}{A}$ =





HC THERMOVAPORISES *THERMOVAPORIZED HC*

A.3074

25/2-6 Huile

S. N. E. A. (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE DE BOUSSENS

Pl.18

PAYS *Country* NORWAY

SONDAGE *Well* 25/2-6

Huile *Oil*

Cote *Depth* 3563.10 m

Identification *Identification* RFT n° 22

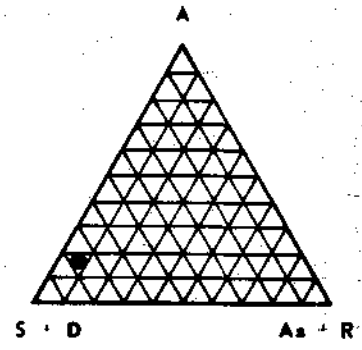
Formation *Formation* Statfjord Sands

Age *Age* LIASSIC

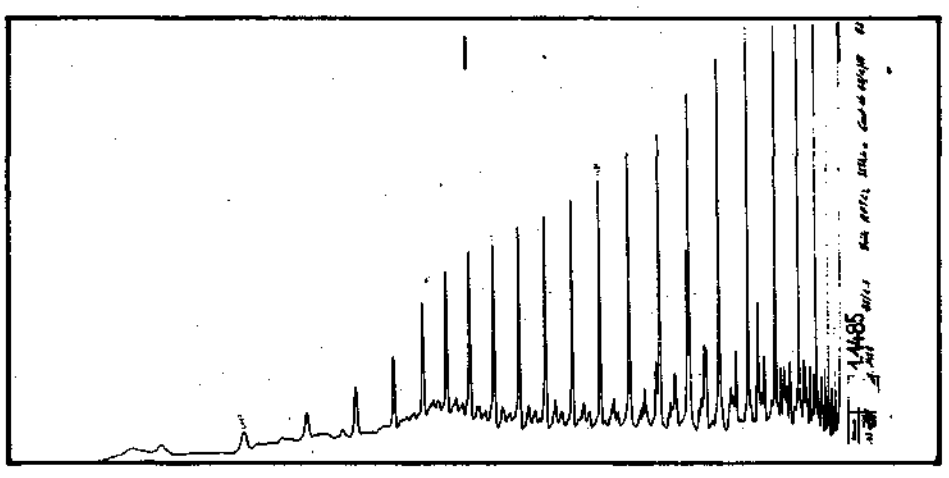
Composition de l'extrait *Composition of extract* (%)

Asphaltènes *Asphaltenes*	As	:	0.5
Résines *Resins*	R	:	7.0
HC saturés + distillat *Saturated HC + distillate*	S + D	:	77.5
HC aromatiques *Aromatic HC*	A	:	15.0

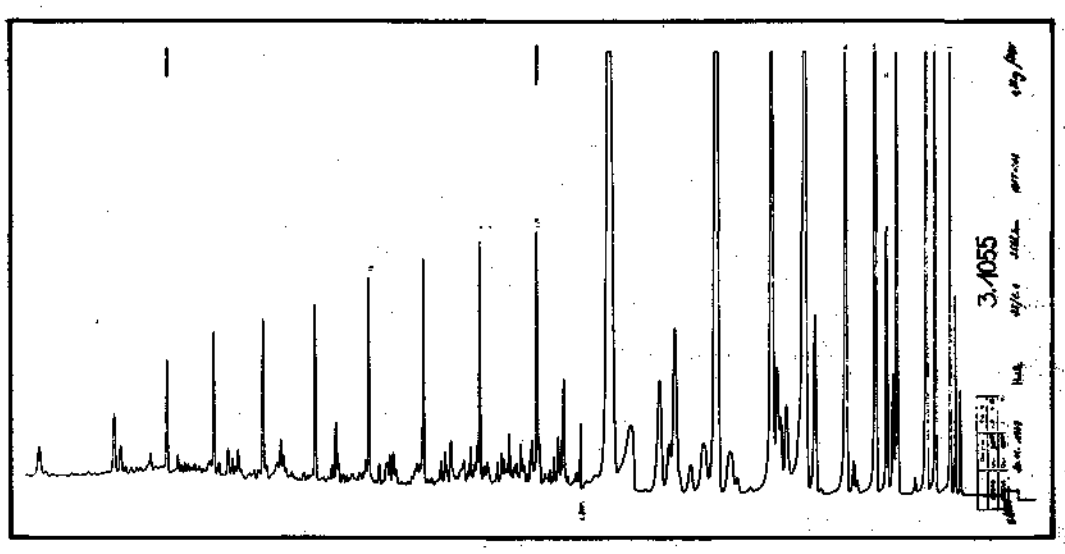
$\frac{S}{A} = 2.7$



HC AROMATIQUES *AROMATIC HC*



HC SATURES *SATURATED HC*



HC THERMOVAPORISES *THERMOVAPORIZED HC*

II (voc ther. évaporisés)

A. 3074

TABLE 1 - 25/2-6 WELL

ORGANIC INVENTORY

SAMPLE IDENTIFICATION	TOC mgC / 100 mgR	IOC mgC / 100 mgR	EOM mgHC / 100 mgR	EOM/TOC mgHC / 100 mgC	ROCK - EVAL S1 mg HC / g Rock	S2 mg HC / g Rock	S2 mgHC / g TOC	S3 $mgCO_2$ / gTOC	Tm (°C)	S1 / (S1 + S2)	CONSTITUTION	THERMO-VAPORIZAT.	G.C. OF SATURATES
3093 m SWC	6.2												
3105 m d°	6.9				10.	29	420	15	427	0.26		+	+
3122 m d°	6.65												
3128 m d°	6.8												
3140 m d°	5.4				5.	22	405	10	427	0.19		+	+
3159.90 C1	(5.7)	5.35	0.41	7.2	4.	31	540	10	?	0.12	+	+	+
3164.10 C1	(7.1)	6.8	0.35	5	3.	29	410	5	429	0.10	+	+	+
3185 m SWC	5.4				1.5	22	415	10	431	0.07			
3195 m d°	3.3				0.5	4	135	20	434	0.08		+	+
3225 m d°	6.3												
3232.50 d°	5.2												
3256.80 C2	11.5	9.5	0.19	2	3.	27	240	20	438	0.10	+	+	+
3266.65 C3	27.9	27.5	0.57	2	6.5	86	310	5	439	0.07	+	+	+
(3268.80 * C3)	(73.0)	69.7			42	247	340	≤ 5	390	0.15		+	+
3284 m SWC	70.0				24.5	295	420	5	410 à 435	0.07		+	+
3325 m SWC	1.35												
3346.2 d°	1.65				1.	4	240	35	441	0.18		+	+
3405 m d°	1.3				0.5	<1	60	50	?	0.36			
3415 m d°	2.5				1	3	120	40	438	0.23			
3445 m d°	0.95												
3455 m d°	0.9				0.5	<1	70	35	444	0.33		+	+
3465 m d°	0.9				0.5	<1	70	40	?	0.40			
3510.50 C4	0.85				≤0.5	<1	40	35	449	0.40			
3512 m C4	1.0				≤0.5	<1	55	30	449	0.24		+	+
3518.30 C4	3.1				0.5	6	180	10	440	0.07			

Brent gr

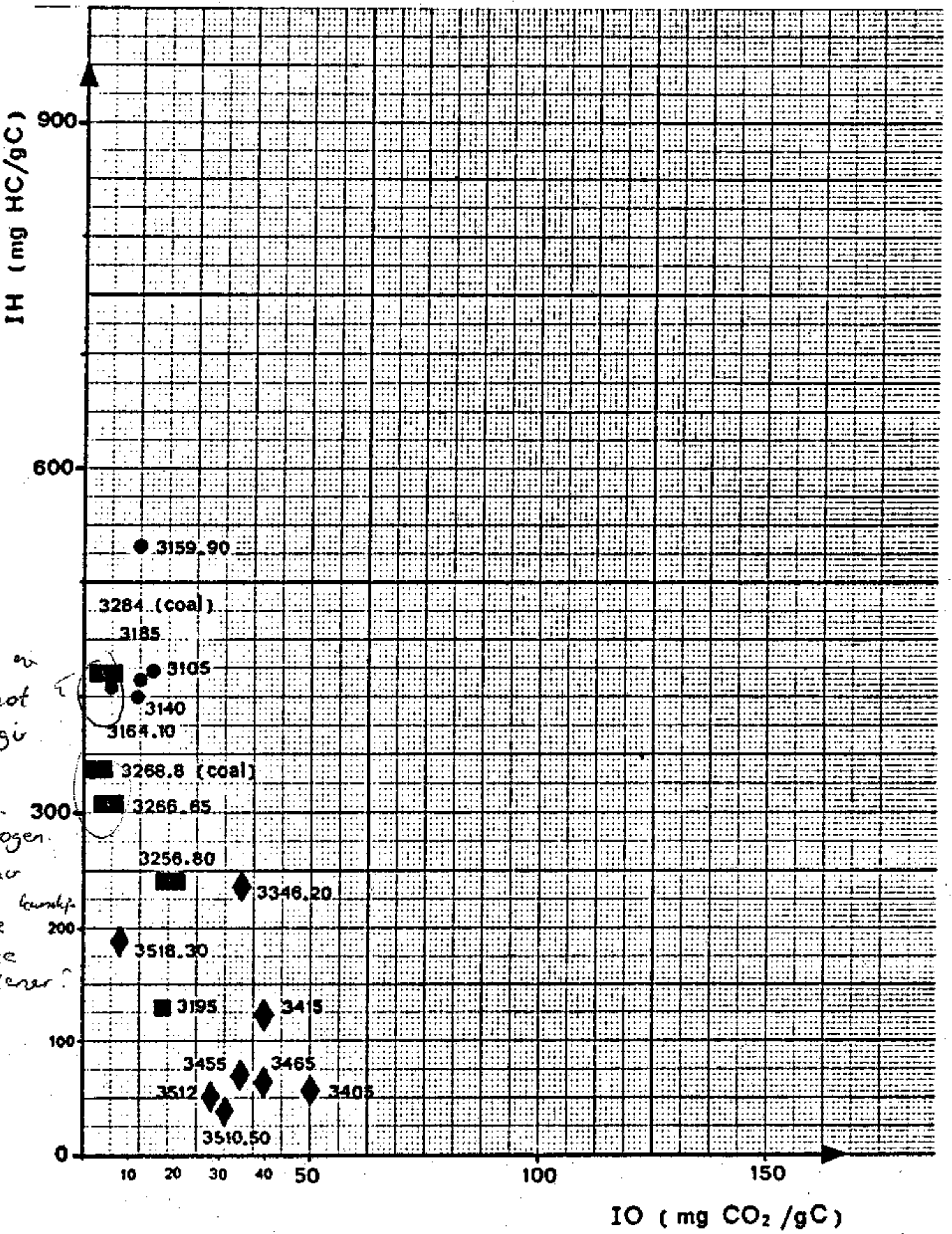
Dunlin gr Drake-Burton

Statfj. Fm

* 3268.80 m C3 : sample mainly made of bitumen and/or gelinite veinlets (cf. Pl.3) ; note its very low S3 and relatively low Tm

TOC = Total Organic Carbon ; the values in brackets are calculated
IOC = Organic Carbon, insoluble in chloroform
EOM = Organic Matter, extracted by chloroform
HC = Hydrocarbons
Tm = Temperature at top of S2
\+ = Constitutions and gas chromatographies carried out

A.3076



Plotting av H.I. mot Tmax gir ikke type I-kerogen.

Portlandian - Kimmeridgian ●

Callovo - Oxfordian ■

Dogger ▬

Liassic ◆

(core or sidewal core samples)

elf aquitaine

NORVEGE

DIRECTION GENERALE DES PRODUCTIONS

Date : DEC. 1978

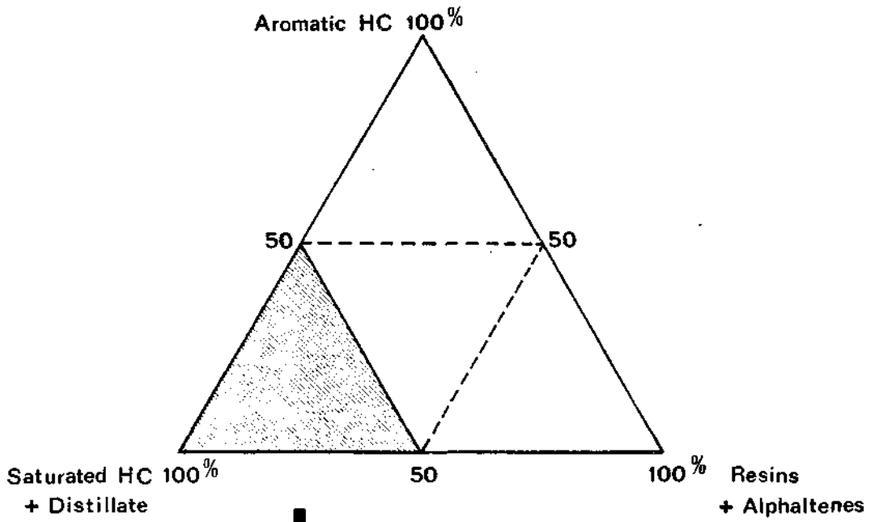
Auteur : A. PHILIPPE

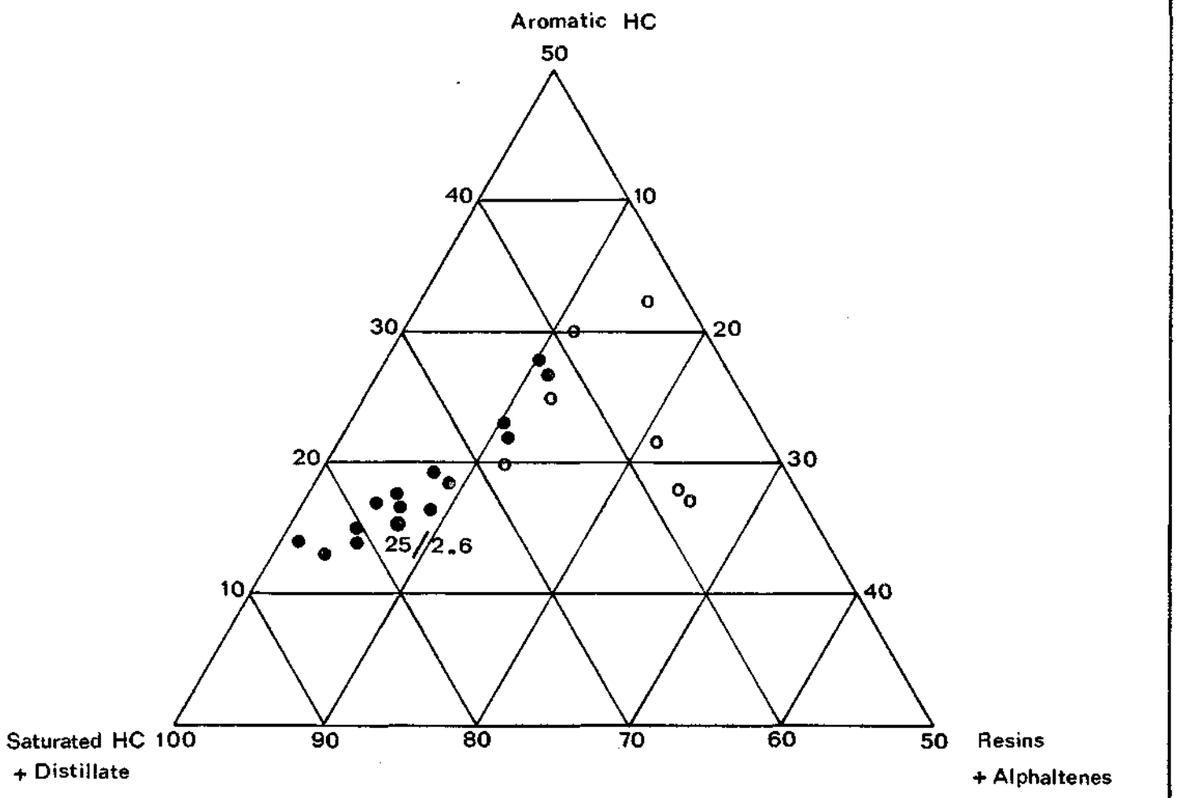
A. 3072

PL.4

NORTH SEA - 25/2.6

Hydrogen Index - Oxygen Index Diagram





● Non degraded oils

o Degraded oils

elf aquitaine

Pays : NORVEGE

Permis ou concession

DIRECTION GENERALE DES PRODUCTIONS

DIRECTION EXPLORATION

Date : DEC. 78

Auteur PHILIPPE

N°Classt A. 3075

PL.19

NORTH SEA - 25/2.6

Crude oil. Gross composition

Comparison with crude oils

previously studied

SNEA (P)

DEPARTEMENT LABORATOIRE DE GEOLOGIE
DE BOUSSENS

ORGANIC MATTER STUDY

SYNTHESIS OF RESULTS

WELL : 25/2 - 6

COUNTRY : NORWAY

Plate 2

Date AUGUST 78

DEPTH 1/2000 m

HYDROCARBONS

LITHOLOGY

FORMATION

AGE

PALYNOFACIES
1 MOS
2 MOV
3 MOX
4 MOB1
5 MOB2
6 MOF1
7 MOF2
8 Various including microfossils
25 50 75%

T. A. I.
Core
Cuttings
1 2 3 4 5

REFLECTANCE
Mode { core / cuttings
Non representative mode
No result
Spreading
Bitumen B
RoV equiv. fluo.
0,5 1 2 4%

FLUORESCENCE
Sapro/algal
Humic
Undifferentiated
1 2 3 4

CORES

TOC
S2 Pyrolyse
% rock weight
1 2 3 4

S1
% rock weight
0,1 0,2
1,0 2,0

CONSTITUTION
G. C.
effluent
extract
Thermovap.
Saturated
Aromatic

MAIN RESULTS

CATA-GENESIS

PRESENT HYDROCARBON POTENTIAL
$X10^3$ Tons / km^2 x m

GENETICAL CHARACTERISTICS OF THE SYNGENETICAL HC

CRUDE OIL

DEPTH m

DEPTH m	FORMATION	AGE
30"		
190	LIGNITIC SERIES	MIOCENE TO PLEISTOCENE
20"		
740		
1000		
	BROWN CLAYS GROUP	OLIGOCENE
2000		EOCENE
	Upper	
	LOWER SD SH GROUP	PALEOCENE
		DANIAN
13"3/8		
2824		UPPER CRETACEOUS
3000		
9"5/8		
3126	PORT. KIM.	
	OXF.	
	BRENT	DOG.
	DUNLIN	LIASSIC
	STATFJORD	
4000		

TYPE 1 : Pr / Ph < 1.3 ; even n-alkanes > odd n-alkanes
TYPE 2 : Pr / Ph > 2 ; even n-alkanes < odd n-alkanes

OIL WINDOW

50
10 to 50 *
< 10

T1
T2

← NON DEGRADED TYPE 2

(average on 3 samples)

For precise results and location of the detailed analyses see the table 1 in report

* Reaches 100 to 500 in shaly and coaly very thin levels

B. 3070

Brønn 25/2-6. Sammendrag av resultatene fra organisk geokjemisk analyse.

"Hot Shale" (Portland - M. Kim); 3083 - 3241 m RKB:
Kerogen type II (III) Noe mer terrestrisk enn gjennomsnitt!
Marginalt modent - ~~kat~~ katagenetisk modent
Ennå tendens til ~~bi~~ bimodal distribusjon på GC av mettet fraksjon. Type II fra termofordampede HC
~~ikke~~ Ikke representative ~~p~~ verdier for R_o. Ennå ikke nådd oljevindu (start i. R_o = 0.7 - 0.75

Brent-gr. (Bajoc - Aalenian ?)
Kerogen type III til III/II. "Normale" Brent kull (Ganske høg H.I. for kull type III)
Katagenetisk modning, noe mindre modent enn oljevindu (ennå bimodal distr. på GC av mettet HC)

Dunlin sh (toarc - ~~hettang~~ sinemur), 3317,50 - 3504 m RKB):
~~Type~~ kerogen type III - III/II.
katagenetisk modning, tangerer oljevindu; men noe mindre modent enn maks. oljegenerering for type III - kerogen.

Statfjord - fm (Sinemur - Rhaet) 3504 m - 3705 m RKB:
Problemer med asfaltene i kerogen type III - IV. Fallig. Svakt bimodal mettet HC-distribusjon på GC. Høg nC_{17}/pr
Antagelig ved maks oljedannelse for type III men oksydasjon fører til ~~for~~ høge T_{max}, neppe representativt, men muligens tidlig kondensatdannelse. TOC-verdiene neppe representative (lav S_1) Migrasjon?

Brønn 25/2-6. Tilpasning av varmefluks-verdier.

Forsøk 1: Konstant varmefluks lik 57 mW/m²
$\beta_{100Ma} = 1.2$
For lav β og varmefluks

Resultat Hotshale:
$R_{o,average} = 0.52$ %.

Resultat Brent-gr:
$R_{o,average} = 0,53$ %.

Resultat Dunlin-gr sh:
$R_{o,average} = 0,55$ %.

Resultat Statfj.-fm:
$R_{o,average} = 0.62$
$R_{o,max} = 0.68$ (V_M)

Konklusjon på forsøk 1:
Bra tilpasning, kanskje noe for høg varmefluks i øvre jura
Bra tilpasning i midt jura, kanskje noe for høg valgt varmefluks.
~~Noe for Bra tilpasning i undre jura~~ Må velge noe høgere varmefluks for en bedre tilpasning i undre jura
For lav heat-flow i statfj.-fm

Diagram 2

TYPE I

Labo-Fina Rock Eval

TYPE II

TYPE III

H.I. (mg. H.C/g. C org.)

Hydrogen index (mg HC/g C)

T°C at maximum S_2 peak

T_{max} °C

(●) Dogger jura (Portland ■ Brent-gr. (▲) Dunlin Sh. ▼ Statfj fm