TABLES 9/4-3

Table 11 CASINGS

Diameter	Depth below KB	
	m	ft
30"	148	487
20"	404	1325
13 3/8"	1073	3520

Table 12 HOLE DEVIATION

Depth below KB		Degrees
m	ft	
411	1350	0.5
675	2214	0.25
1085	3561	0.75
1716	5629	0.75
1775	5825	0.5
1907	6255	0.5
2048	6720	0.3
2185	7170	0.5
2242	7355	0.3

Table 13a MUD PROPERTIES

Depth below KB		Weight ppg	Funnel visc. sec	Filter loss cm^3	% oil	Remarks
m	ft					
155	510	8.8				Drilled 36" hole w/sea water, no returns
413	1355	9.9	60			Circ. and cond. hole
687	2255	11.1	75	8		
1085	3561	11.5	50	13		Circ. and cond. hole. Bridging at 1400'. Circ. and cond. Bridging at 1340'. Circ. and cond.
1141	3742	12	48	12		Formation broke down, lost 288 bbls mud to formation
1562	5125	12	43	9.5		
1851	6074	12.1	45	7.2		
1912	6274	12.3	45	6		
2121	6960	12.1	43	5		Drilling in sticky shale
2190	7185	12	48	6.3		Silt from formation caused increase in viscosity and PV.
2493	8180	11.5	42	3.5		
2621	8600	11.9	40	6.2		
2682	8800	11.9	45	6.4		

U-74

-3

ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES

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double

9/4-3 WELL (NORGE)

-

GEOCHEMICAL REPORT

DIRECTION EXPLORATION

LABORATOIRES

ELF R.E.
D. EXPLOR.
DEPARTEMENT GEOLOGIQUE CENTRAL
LABORATOIRES

-

double

9/4-3 WELL (NORGE)

-

GEOCHEMICAL REPORT

2035 n° 4/983 R

B. PHILIPPE

September 1974

Reference : Order No. 031009

This study was carried out by the Dpt.G.C. - Laboratory at the ELF R.E. Research Center of Boussens.

- B. PHILIPPE - Report No. 4/983 R :
9/4-3 Well, geochemical report.

I - GENERAL REMARKS

. The object of Geochemical study is to give an organic inventory and to estimate the petroleum potential of the Lower Cretaceous and Jurassic.

. The cuttings available were dried and unwashed.
All the analyses were carried out on cuttings washed with water and teepol.

. The organic inventory -between 6000' and 8600'- includes 25 measurements of insoluble organic matter (IOC) contents and 25 measurements of organic matter extractable by chloroform (EOM).

. Characterization : . 1 "minianalysis" - chromatography of the saturated hydrocarbon fraction, separated on alumina, of the extract by Hexane in a glass tube.
. 2 "compositions" of chloroformic extract, with chromatographical analyses of saturated and aromatic hydrocarbon fractions.

. Presentation of results.
- Plate (loose-leaf)
Plate 1 = results of organic and mineralogical inventories
Plate 2 = reductions of chromatograms
Plate 3 = card "Etude Matière Organique"

- Appendix
2 analytical cards of chloroformic extract from rock.

II- RESULTS AND INTERPRETATION

- Between 6000' and 7840' (Middle Cretaceous to upper Jurassic)

The simultaneous examination of contents in IOC and EOM shows an average of about 1 % in IOC of which the quantity of organic matter extractable by chloroform is rather low (<500 ppm)
The bitumen ratio (BR) is not very high. It reaches 7 % at 6410'. One "minianalysis" on this sample shows a distribution spectrum of normal -paraffins typical of gas-oil : contamination by fuel in mud.
This observation implies that the actual BR are lower than those measured.
The low bitumen ratios show the non-occurrence of epigenetical products in the studied zone.
The insoluble organic matter (kerogen) -from examination of the palynofacies (*) - is chiefly a mixture of angular black wastes and of ligneous material : facies with a very low petroleum potential

.../...

(*) J.F RAYNAUD, Octobre 73
"Sondage 9/4-3. Etude palynologique des déblais entre 6000' et 8610' "

- Between 7840' and 8000' Radioactive shales (Kimmeridgian)

The organic inventory of this homogeneous lithological zone is based on two samples : 7920' and 7970'.The IOC contents are high -4.7 and 5.6 %.
The low pereentages (< 4 %) of organic matter extractable by chloroform indicate an unfavorable organic material or low maturation.
The 7970' sample -higher content in extractable matter- was selected for study of the Composition of the chloroformic extract. The chromatogram of the saturated hydrocarbon fraction shows fairly numerous and well -distributed normal - alkanes, no regular decrease in n.alkane contents proportional to the increase in the number of carbons, a fairly clear imparity between n C19 and n C25, Pristane/n C17 and Phytane /n C18 ratios greater than 1 (Pristane/Phytane = 0.86), the development of cyclanes between n C25 and n C30.
The characteristics of this extract point out a good petroleum quality of the kerogen and low maturation.
Examination of the palynofacies shows very high-quality sapropelic shapeless matter.
The Radioactive shales of 9/4-3 well are source rock which has not yet squeezed out its hydrocarbons or has done so only to a limited extent.

- Between 8000' and 8600' (Dogger-Lias ? ; Lower Kimmeridgian to Oxfordian ?)

The sampling is made chiefly on the argillaceous beds. The results are of only punetual value because the lithology is not homogeneous : sandstones and shale beds. More examination of the palynological preparations shows some derived cuttings possibly from Kimmeridgian material.
The contents in IOC and EOM are variable.
The 8400' sample (IOC = 4 %, EOM = 4000 ppm, BR $\simeq$ 8 %) was selected for characterization of the extract by chloroform. The n.alkanes are well distributed but little developed (3.7 % of n. alkanes in the saturated hydrocarbon fraction), their development is irregular and shows a sharp prevalence, between n C21 and n C27, of the n.alkanes with an odd number of carbons.
The isoprenoids are fairly well developed. Pristane is very abundant (Pristane/Phytane = 2.47).
The palynofacies is composed of sapropelic shapeless organic matter and of "carbonized" ligneous wastes. A part of the shapeless matter is probably derived from the radioactive shales. (J.F RAYNAUD).

There is no correlation between the chromatograms of the saturated hydrocarbon fraction of this extract and that of the extract from Kimmeridgian radioactive shales - especially fairly clear disparity in the Pristane/Phytane ratio : the syngenetical organic material is different.
The chromatograms of the aromatic hydrocarbon fraction - 7970' sample in the radioactive shales and 8400' sample - also show different characteristics and corroborate the disparity between these two geochemical facies.
The aromatic hydrocarbon fraction from the 7970' sample is characterized by a fairly benzotiophenic development, a cyclanoaromatic development without peak of true aromatics. The aromatic hydrocarbon fraction from 8400' sample has not a benzothiophenic development, the graph increases only from the dibenzotiophens.

- Comparison between the two extracts -7970' and 8400' samples - from 9/4-3 and the extracts from some other wells in the Norvegian Sea.

. There is a good correlation between the chromatogram of the saturated hydrocarbon fraction from the 7970' sample and the chromatograms of almost all extracts by chloroform from radioactive shales (upper Jurassic) studied in the Norvegian zone - main source-rock -.

.../...

. There is no correlation between the extract from the 7970' sample (saturated and aromatic hydrocarbon fractions) and the crude oil from the Dogger - Lias in the Heimdall Well (25/4-1). The absence of correlation between the saturated fraction of crude oil from the Dogger - Lias in 25/4-1 and that of extracts of radioactive shales from other wells (*) is corroborated by the chromatogram of the aromatic fraction from the radioactive shales in 9/4-3.

. There is no correlation between the crude oil from Dogger -Lias in Heimdall and the 8400' extract from rock in 9/4-3. In these two samples Pristane is however much more developed than phytane.

. In bream 17/12-1 well (**) the saturated hydrocarbon fraction from the 7150' sample in the radioactive shales of the Kimmeridgian shows some particular characteristics (especially : Pristane more developed than Phytane, clear development of heavy molecules).
The data from the chromatograms of saturated and aromatic fractions point to a new geochemical facies : disparities between extracts from the Dogger - Lias in Heimdall, and the "classical" geochemical facies from the radioactive shales recognized in other Norvegian Sea Wells, for instance in 9/4-3.

III - MINERALOGICAL DATA (see plate 1)

The "graphs" of distribution of the main minerals and clay minerals show a clear break at the base of the chalk -6450'-. The chalk contains approximatively 80 % of calcite, 10 % of Quartz and 10 % of Montmorillonite. The mineralogical composition of the Lower Cretaceous and Jurassic is fairly homogeneous, between 6450' and well bottom. It shows however two variations :
- At the top of Jurassic : increase in the percentage of Montmorillonite.
- In the Kimmeridgian radioactive shales : disappearance of Montmorillonite, Kaolinite slightly more abundant.
The fairly constant mineralogical composition does not show an important break in sediment supplies, between 6450' and well bottom, nor in the notable evolution of the mineral diagenesis.

V - CONCLUSIONS

Specific to the 9/4-3 Well

- There is no show of migrated hydrocarbons, nor of source-rock between 6000' and 7840'.

.../...

(*) J. Du ROUCHET July 1973 "Well Heimdall 25/4-1 organic Geochemical report" and J. Du ROUCHET July 1974 "Complementary analyses on Heimdall 25/4-1"

(**) B. PHILIPPE June 1974 "Bream 17/12-IX Well Geochemical study between 3960' and 14100' "

- The Kimmeridgian radioactive shales are a potential source-rock of low maturity and with a good petroleum quality (Geochemistry and palynofacies)
- The older (age ?) argillaceous beds, which are not radioactive, have probable petroleum potential, of uncertain commercial interest in 9/4-3 (low percentage of n.alkanes, heavy compounds ; low cumulated thickness of shale beds)
  The Geochemical facies is different from that of the Kimmeridgian radioactive shales. The kerogen is less favorable than that of the radioactive shales.

In the Geochemical context of the North Sea Wells.

- The main source-rock recognized in the North Sea is the radioactive black shale Formation of the Upper Jurassic.
- The Geochemical facies can vary in these shales (for instance : 17/12-1)
- The older argillaceous beds, as in Heimdall, can, locally, be source-rock.
  . It is possible that the shales lower than the Kimmeridgian in 9/4-3 are a potential or effective source-rock in more subsident zone, where the argillaceous facies must be thicker and more deeply buried.

Supplementary geochemical analyses of other crude oils and rock samples will be necessary to determine the location and evolution of the geochemical facies of source-rocks in the North Sea.
These data are to be integrated into the broader geological context.

A P P E N D I X

7644

ANALYSE ~~D'HUILE~~ D'EXTRAIT CHLOROFORMIQUE DE ROCHE (sur 109,7 mg) SONDAGE : 914-3 7970'

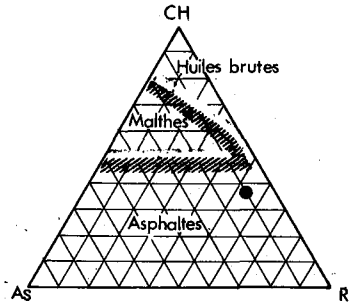
ECHANTILLON : Extrait CHC/3. Désulfuré Soufre : 6,1% COT = 5,6 MOE totale 2580 ppm MOE désulfurée 2420 ppm Age ou Formation :

CONSTITUTION :

Asphaltènes As = 10,6 %
Résines R = 52,7 %
Constituants huileux CH = 36,2 %
Pertes + Résidus: 100 -(A+R+CH) = 0,5 %

Asphaltènes Insolubles/CCl4 C = 1,1%

CH Saturés = 20,6% CH Aromatiques = 15,6% ; S/A = 1,3



ANALYSE DES HYDROCARBURES SATURES PAR CPG (Poids de la prise d'essai = 21 mg.)

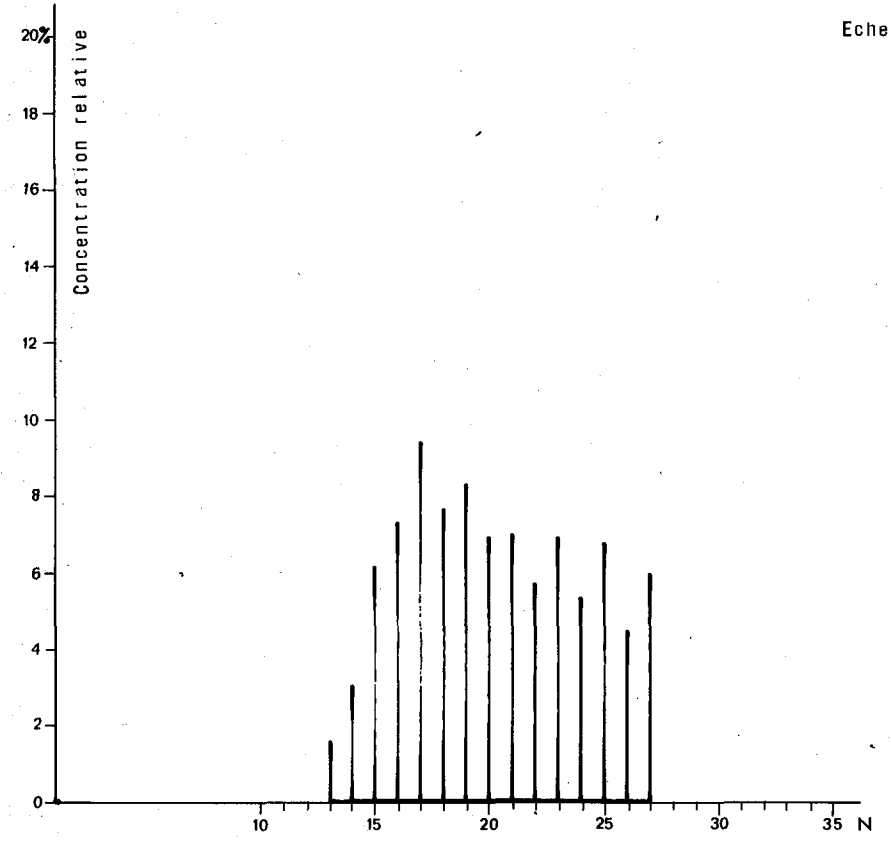
Proportion des n.alcanes dans les Saturés = 7%
Proportion : du Farnesane = 0,37 du Pristane = 0,91 du Phytane = 1,07
Rapports: Pristane/Phytane = 0,86 Pristane/n.C17 = 1,29 Phytane/n.C18 = 1,85

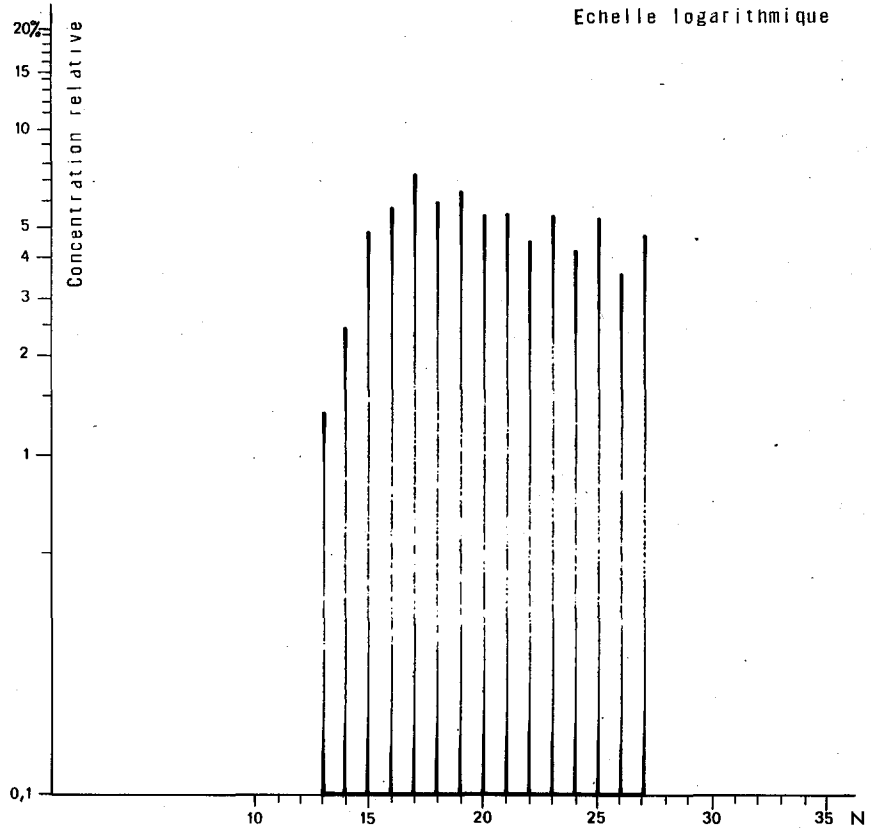
Recherche de dominance paire ou impaire par calcul du Carbon Preference Index (CPI) :
CPI entre la n.alcane 18 et la n.alcane : 26 CPI = 1,216

Distribution relative des n.alcanes :

nC 14	n.C15	n.C16	n.C17	n.C18	n.C19	n.C20	n.C21	n.C22	n.C23	n.C24	n.C25	n.C26	n.C27	n.C28	n.C29	n.C30	n.C31	n.C32	n.C33
3,26%	6,59 %	7,82 %	10,07 %	8,21 %	8,89 %	7,42 %	7,50 %	6,13 %	7,41 %	5,73 %	7,26 %	4,82 %	6,41 %	%	%	%	%	%	%

HISTOGRAMMES DE LA DISTRIBUTION RELATIVE DES n.ALCANES EN FONCTION DU NOMBRE N DE CARBONES





7644

ANALYSE ~~D'HUILE DE~~ D'EXTRAIT CHLOROFORMIQUE DE ROCHE (sur 168,9 mg)

SONDAGE : 914-3 8400'

ECHANTILLON : Extrait CHC/3. Désulfuré Soufre: 2,5%

COT = 4,0 MOE totale 4030 ppm MOE désulfurée 3930 ppm

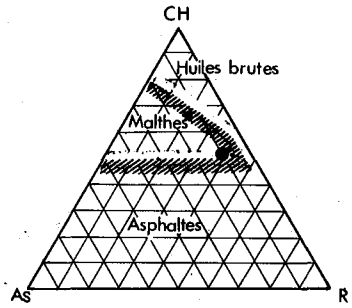
Age ou Formation :

CONSTITUTION :

Asphaltènes As = 12,8 %
Résines R = 31,3 %
Constituants huileux CH = 50,1 %
Pertes + Résidus: 100 -(A+R+CH) =

Asphaltènes Insolubles/CCl4 C = 3,5 %

CH Saturés = 26,9% CH Aromatiques = 23,2%; S/A = 1,2



ANALYSE DES HYDROCARBURES SATURES PAR CPG (Poids de la prise d'essai = 40 mg.)

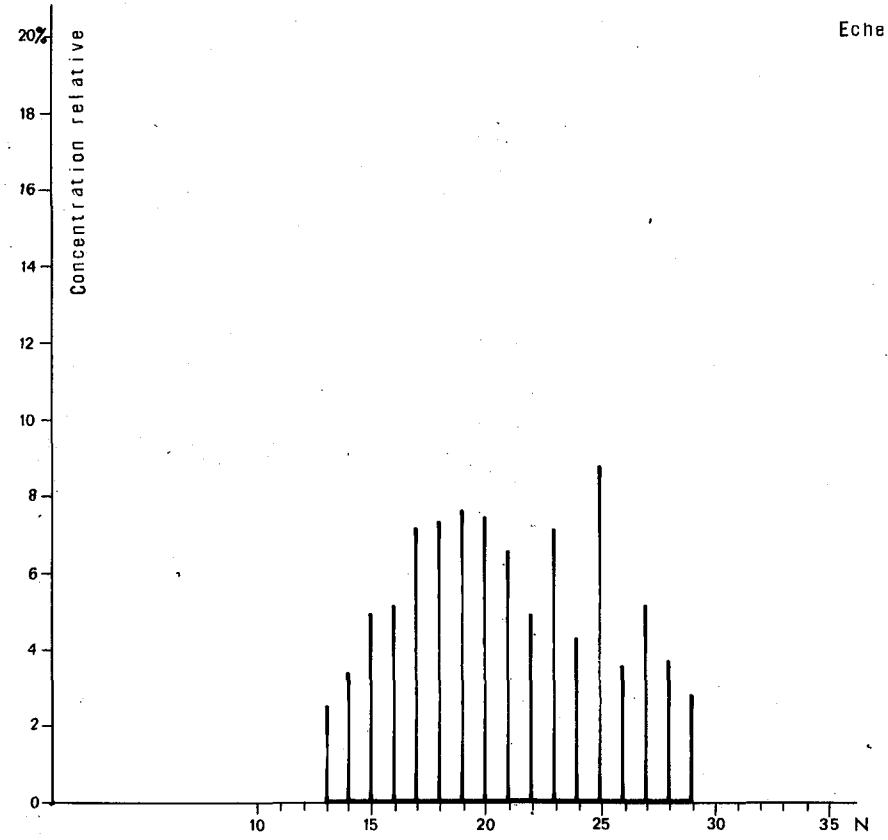
Proportion des n.alcanes dans les Saturés = 3,7%
Proportion : du Farnesane = 0,14 du Pristane = 0,50 du Phytane = 0,20
Rapports: Pristane/Phytane = 2,47 Pristane/n.C17 = 1,77 Phytane/n.C18 = 0,70

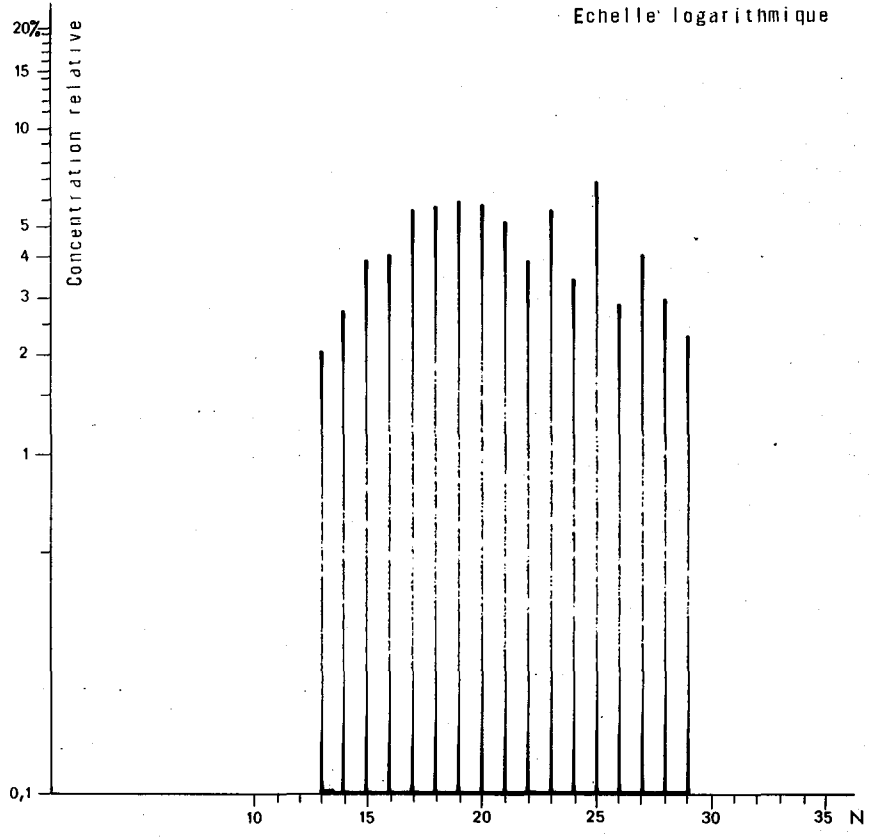
Recherche de dominance paire ou impaire par calcul du Carbon Preference Index (CPI) :
CPI entre la n.alcane 18 et la n.alcane : 28 CPI = 1,289

Distribution relative des n.alcanes :

nC14	n.C15	n.C16	n.C17	n.C18	n.C19	n.C20	n.C21	n.C22	n.C23	n.C24	n.C25	n.C26	n.C27	n.C28	n.C29	n.C30	n.C31	n.C32	n.C33
3,63%	5,28 %	5,51 %	7,68 %	7,87 %	8,16 %	7,98 %	7,04 %	5,24 %	7,65 %	4,58 %	9,91 %	3,81 %	5,52 %	3,96 %	3,00 %	%	%	%	%

HISTOGRAMMES DE LA DISTRIBUTION RELATIVE DES n.ALCANES EN FONCTION DU NOMBRE N DE CARBONES





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TEL. (045) 41 011 TELEX 33174

WELL: 9/4-3

LETTER OF TRANSMITTAL

to: OLJEDIREKTORATET

Ref. GEOCHEM. INVESTIGATIONS attention: MR. S. EGGEN

LOGS	SCALE 1:200						SCALE 1:500						REMARKS PRINT	REMARKS SEPIA	REMARKS INTERVAL
	1	2	3	4	5	6	1	2	3	4	5	6			
BHC GR															
IES PS															
ISF / sonic															
DLL															
DIL															
MLMLL															
Micro SFL															
FDC / CNL															
FDC															
SNP															
CCL + PR															
CBL															
Temp. log															
F.I.T															
C.P.I															
HDT / high resolution															
" / arrow plot															
" / polar plot															
Company logs															
composite log															
mud log															
litho log / log hecto															

OTHER DOCUMENTS: GEOCHEMICAL REPORT.

Date 14/12-78

Received by B. G. Melving

Please sign and return the pink copy

Date 13/12-78

Per Spilund

elf aquitaine norge a/s

MAIN MINERALS 20 40 60 80%

CLAY MINERALS 20 40 60 80%

STRATI. (FROM DIV.II)

LOG 1cm = 100'

DEPTH

SAMPLES

CHROMATOGRAPHICAL ANALYSES: *

IOC 1 2 3%

EOM 1000 3000

BITUMEN RATIO 2 4 6 8%

6000'

*6410'

6500'

7000'

7500'

*7970'

8000'

*8400'

8500'

LOWER CRETACEOUS

JURAS. TOP

Radioact. clay

DOGGER-LIAS

?

TRIAS

C

M

AND

IM

K

I

Sid

Ba

Dol

P

Q

O

4,7

5,6

4,5

4,0

Secteur NORVEGE

Opérateur

Permis ou Concession Zone Norvégienne

elf NORGE A/S

9/4-3 WELL

ORGANIC AND MINERALOGICAL INVENTORIES

elf ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES

DIRECTION EXPLORATION

LABORATOIRE

PL. 1

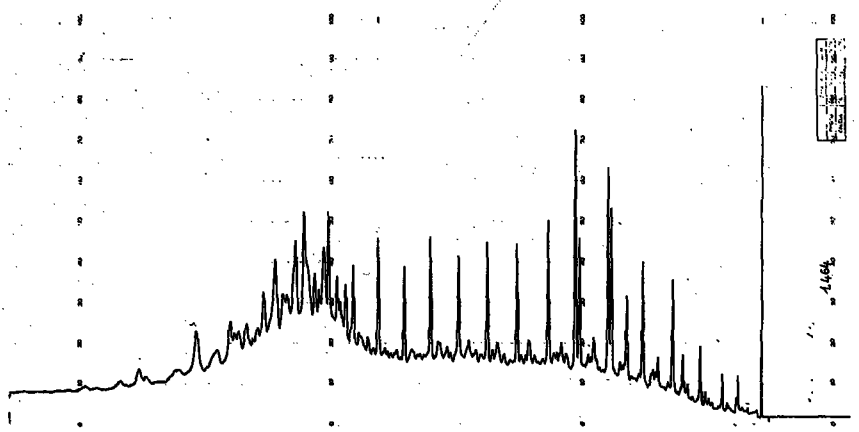
Date Août 74

B.PHILIPPE

N°classt 7641

9/4-3 WELL

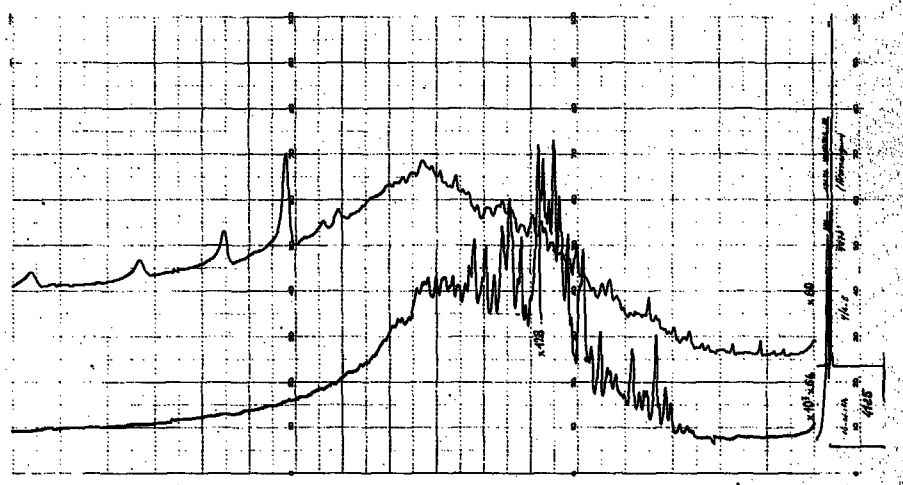
Saturated hydrocarbon fraction

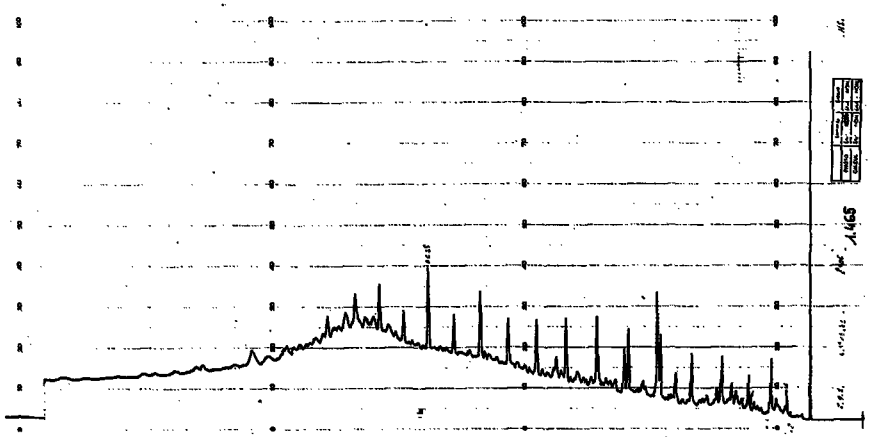


7970'

Radioactive Shales

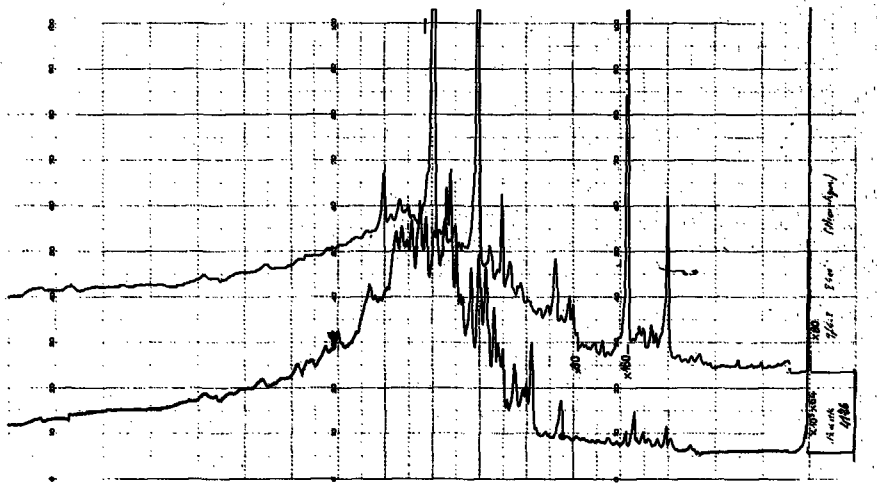
Aromatic hydrocarbon fraction





8400'

Shales



elf-r.e.
CENTRE DE RECHERCHES DE BOUSSENS
elf DEPARTEMENT GEOLOGIQUE CENTRAL LABORATOIRE

ETUDE MATIERE ORGANIQUE

Tableau synoptique des résultats

Secteur NORVEGE
Sondage 9/4-3
Coupe
Mise à jour le

COUPE TECHNIQUE PROFONDEUR Echelle 1/20000 | CAROTTES | HYDROCARBUR. | LITHOLOGIE | STRATIGR. INTERPRET. | BILAN D'ANALYSE (inventaire organique) | COT 1 2 3 % / 10 20 30 | MOE (ppm) | RAPPORT BITUMINOLOG 2 4 6 8 % / 20 40 60 80

1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
11000
12000
13000
14000
15000

LOWER CRETAC.
JURAS. TOP
RADIOACT. CLAY
DOGGER LIAS
TRIAS

Very low syngenetical O.M. content

Rather low syngenetical organic matter content.
Low EOM and BR

High O.M. content. Low BR

[High O.M. content]
(but may be derived)

5,6
4,5

FACIES ORGANIQUES (lames palyno.)
M.O.amorphe
M.O.amor. pulv.
M.O.pulv. noire
Déb. ang. noirs
M.O. ligneuse
Débris végét.
20 40 60 80 %

POUVOIR REFLECTEUR
Mode dominant (car.) ▲ (déb.) ●
Absence de charbon ou population non representat. △ ○
Etalement
0 % 0,5 1 2 4 6 %

I.A.T.
Carotte *
Déblais +
1 2 3 4 5

GEOCH. ORGANIQUE: Extraits | Huiles

POTENTIEL PETROLIGENE

6000
7000
8000
9000

?

*
*
*

Organic matter chiefly ligneous. Low IAT and PR

Very low petroleum potential

Hydrocarbon source rock. Low maturity

[May be source-rock] but no evidence

n° 7485