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LABORATOIRES

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BREAM 17/12-1x WELL (NORGE)

GEOCHEMICAL STUDY

BETWEEN 3 960' AND 14 100'

2035 n° 4/969 R
/mn

B. PHILIPPE
July 1974

REFERENCE : COMMANDE n° 031011

Cette étude a été réalisée au Centre de Recherche ELF-R. E. à BOUSSENS par le Dpt. G. C. - Laboratoire.

Les documents énoncés ci-dessous et concernant la même commande vous ont déjà été envoyés :

J. DUCAZEAUX - P. DURIF : Rapport n° 4/963 R : Well Brisling 17/12-2, Biostratiphical report on Jurassic and Permian (6 440 to 7 630').

B. PHILIPPE : Rapport n° 4/968 R : BRISLING 17/12-2 WELL (NORGE)
GEOCHEMICAL STUDY

I - GENERAL REMARKS

I-1 - OBJECT OF STUDY

- Initial aims :

. to give an inventory of organic matter ;

. to estimate, if possible, the nature and quality of this organic matter ;

. to compare with the oils from the two tests carried out.

- Study actually carried out :

In view of the small volume of material, contamination by gas-oil in mud, and state of preservation (samples relativly dry) :

. partial organic inventory (I.O.C.; E.O.M.; desorbed gases) ;

. geochemical characterization on a single sample ;

. supplementary data on oils from tests (*). Comparison with chloroformic extract from rock.

I-2 - ANALYSES

- On cuttings :

* Inventory :

. 64 measurements - systematic between 3 960' and 14 100' - of contents of organic carbon insoluble by chloroform (I.O.C.)

. 14 measurements of contents of organic matter extractable by chloroform (E.O.M.).

Along with I.O.C., they enable the bitumen ratio (B.R.) - which is the percentage of extractable components in organic matter - to be calculated.

(*) D. JONATHAN : Décembre 1972 "17/12-1x - Rapport d'analyses géochimiques de fluides de tests."

. measurements of desorbed gases between 7 930' and 14 090' (analyses slightly influenced by gas-oil contamination).

In view of the "dry" condition of the cuttings, the sample-interval selected is wide (19 measurements).

We also use :

. Examination of the palynofacies (*) : description of the insoluble organic matter (I.O.M.) in palynological preparations between 4 000' and 9 010' ;

. Study of Reflectance (**)

* Geochemical Characterization :

. 3 -G.P.C.- chromatographical analyses of vapors (obtained by heating to 250°c). They show contamination by gas-oil in the mud.

. 1 "Composition" analysis of extract by chloroform from rock ;

. 2 - G.P.C. - chromatographical analyses : saturated and aromatic oil fractions, separated by "Composition".

- On crude oils from the tests - D.S.T. 1 and D.S.T. 2

. 2 chromatographical analyses of the aromatic oil fractions.

(*) J. F. RAYNAUD - Mai 1973 "Sondage Bream 17/12-1. Etude palynologique sur le mesozoïque entre 4 000' et 9 010'".

(**) P. ROBERT - Novembre 1972 "Sondages Bream et Heimdall. Etude du pouvoir réflecteur des matières carbonées."

I-3 - PRESENTATION OF RESULTS

- Plates (loose-leaf) :

. Plate 1 : log I.O.C., E.O.M., B.R.

. Plate 2 : photographic reductions of chromatograms.

. Plate 3 : Inventory log of desorbed gases.

- Appendix :

. "A" : Results of analyses of desorbed gases.

. "B" : Analytical card of chloroformic extract from rock (7 150').

II - R E S U L T S

II-1 - INVENTORY

- The I.O.C. measurements (Plate 1) indicate 4 geochemical zones :

. Between 4 100' and 7 100' : slight to moderate contents : approximativly between 0.5 % and 3 %.

. Between 7 100' and 7 300' : fairly high contents, above 3.5 % (maximum 7 %)

. Between 7 300 and 8 000' : probable progressive decrease in contents. The high values of I.O.C. for cuttings between 7 600' and 7 900' seem to be derived cuttings from the radioactive shales above (7 100' to 7 200') : the diagraphical logs show coarse detrital sediments.

. Between 8 000' and 14 100' : very low contents of organic carbon (0.1 to 0.3 %). The contents are slightly higher between 13 500' and 14 100', but lower than 1 %.

- The E.O.M. measurements (Plate 1) carried out show contents lower than 1 000 ppm between 4 000' and 7 000'. One measurement, in the radioactive shales (7 150'), reaches 2 800 ppm.

These values are in excess in view of the contamination by gas-oil (cf. II-2), although the samples were washed with water and teepol. In these circumstances, the bitumen ratios (B.R.) give values in excess.

- Desorbed gases between 7 930' and 14 090' (Plate 3 and Appendix "A")

The I.O.C. content is very low : there is no source-rock.

The lithology being chiefly of sandstone, it is indispensable to see whether there are any epigenetic hydrocarbons.

. The quantity of desorbed gases is low, or even very low.

The "graph" shows 2 zones which have different relative percentages of gas (break about 11 000').

. The samples studied being rather "dry", a partial loss of light hyrocarbons is likely. This apparently negative result is perhaps not significant.

The small volume of the samples and the extensive contamination prevent us from verifying by the usual methodology, whether or not heavier, less volatile hydrocarbons occur.

- Optical study of kerogen :

- The palynofacies examination shows 2 main types of insoluble organic matter (I. O. M.) :

* between 4 000' and 7 075 : ligneous type which is rather unfavorable to the generation of liquid hydrocarbons ;

* between 7 075 and 9 010' : "sapropelic-shapeless" type, with ligneous waste. The thermal alteration index (T. A. I.) is low.

- Mean Reflectance in the Jurassic is approximativly 0.5 % : Beginning of "chief phase of oil-generation".

CONCLUSION

The most favorable geochemical zone is located in the radioactive shales of the Kimmeridgian between 7 100' and 7 200' (high I.O.C. and sapropelic matter, favorable ; medium E.O.M. and low B.R. (< 3 %) (0.55 %) : in conformity with moderated diagenesis shown by Reflectance and low T.A.I.).

2164 - 7194

II-2 - GEOCHEMICAL CHARACTERIZATION

. The 3 analyses of vapors - 4 580', 6 475', 13 710' - show a typical gas-oil spectrum : contamination.

. 7 150' sample - radioactive shales - (Plate 2 and Appendix "B").

The percentage of oil components is low - 23 % -. The chromatogram of saturated oils shows the loss of light elements and the development of heavy molecules - ramified or cyclic - containing more than

25 atoms of carbon. The distribution of normal-paraffins is irregular and shows the predominance of nC.19. The isoprenoids are fairly well-developed (the Pristane peak is higher than the Phytane one).

Conclusion (Radioactive shales) :

These characteristics indicate rather low maturation of the organic matter and some disparities with radioactive shale extracts in other wells.

II - 3 - COMPARISON BETWEEN ROCK-EXTRACT (7 150') and CRUDE OILS FROM TESTS (Plate 2)

In order to compare the rock-extract with the test-oils, 2 chromatographical analyses of aromatic hydrocarbons were carried out on the crude oils. The identity of these two chromatograms confirms their common origin - see D. JONATHAN report -.

Comparison with the rock-extract chromatogram - 7 150' sample - shows :

. an enrichment in light diaromatics and a loss of cyclanoaromatics with high durations of retention : probable result of migration ;

. the disappearance of the true aromatics, particularly the triaromatics - Phenanthrene family - : probable result of "washing" in the formation.

III - C O N C L U S I O N S

The radioactive shales (7 100 to 7 200') have a virtual petroleum potential.

The single extract analysis carried out does not show the typical distribution of n-paraffins from radioactive shales - source-rocks - recognized in other wells in the Norvegian zone (chemical composition of the kerogen probably different).

In the research project on the kerogen by pyrolysis, it will be possible to envisage a study on I. O. M. which will probably enable :

. the quality and petroleum yield of this organic matter to be estimated.

. the organic matter to be compared with kerogen from the jurassic source-rocks in other Norvegian wells.

ANNEXE "A"

1555

17-12-1X 19 ECHANTILLONS 04-02-74

IDENT.	C1	C2	C3	IC4	NC4	IC5	NC5	C6+	SOMME C1..C5
7930.0	591.5	49.6	15.0	9.4	11.8	7.2	3.9	84.8	688.7
8300.0	496.5	34.6	8.2	1.4	2.6	0.6	0.0	66.0	544.3
8690.0	1333.6	285.0	78.1	5.2	29.9	8.7	10.5	201.0	1750.3
9100.0	275.9	35.5	8.6	0.6	2.3	0.0	0.0	99.6	323.1
9510.0	358.1	41.2	9.0	1.2	2.1	0.4	0.9	28.6	412.4
9900.0	304.6	28.6	7.0	0.8	1.7	0.0	0.0	72.2	343.0
10100.0	734.4	66.2	38.9	6.7	9.1	3.9	1.6	149.8	861.0
10300.0	979.1	95.3	24.7	4.4	7.5	2.0	1.1	97.2	1114.3
10700.0	245.7	19.1	4.9	0.6	0.8	0.0	0.0	13.0	271.4
11090.0	461.0	107.6	22.9	2.6	8.2	1.6	2.2	91.5	606.4
11500.0	183.7	35.5	8.9	0.9	3.3	0.7	0.7	139.4	234.1
11900.0	162.0	36.8	8.4	0.6	3.1	0.2	0.6	142.6	212.1
12300.0	97.7	16.0	7.8	0.3	1.5	0.0	0.0	73.4	123.4
12700.0	95.9	22.8	4.7	0.3	1.7	0.3	0.0	74.2	125.9
13100.0	139.1	24.9	5.2	0.3	1.6	0.0	0.0	57.4	171.4
13310.0	70.1	23.1	5.8	0.4	1.5	0.3	0.4	72.2	101.7
13720.0	916.3	221.9	12.3	1.6	7.9	0.1	1.4	68.3	1161.7
13910.0	182.8	31.8	6.7	0.7	2.0	0.1	0.4	64.0	224.9
14090.0	193.0	14.6	3.2	0.5	1.0	0.0	0.0	44.9	212.5

APPENDIX "A" DESORBED GASES

ANNEXE "B"

Appendix "B" analitical card of 7150' sample rock extract

ANALYSE D'HUILE OU D'EXTRAIT CHLOROFORMIQUE DE ROCHE (sur 0,02219.) mg)

SONDAGE : BREAM 17/12-1 x

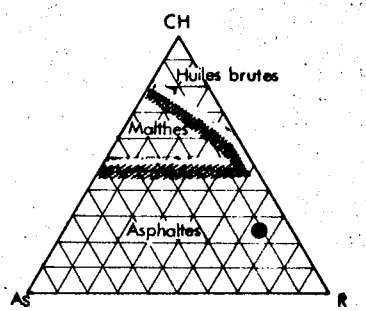
ECHANTILLON : 7150'. Extrait $CHCl_3$ - Désulfuré

COT = MOE totale 2830 ppm
MOE desulfuree 2700 ppm

Age ou Formation :

CONSTITUTION :

Asphaltènes	As = 11,3 %	Asphaltènes Insoluubles CCl4 C = 2,3 %
Résines	R = 59,7	
Constituants huileux	CH = 28,1	CH Saturés = 14 %; CH Aromatiques = 9,1 %; S/A = 1,5
Pertes + Résidus: 100 - (A+R+CH) = 5,9		



ANALYSE DES HYDROCARBURES SATURES PAR CPG (Poids de la prise d'essai = 2,93mg)

Proportion des n.alcanes dans les Satures = 7,74 %

Proportion : du Farnesane = 0,10 % du Pristane = 0,41 % du Phytane = 0,49 %

Rapports: Pristane/Phytane = Pristane/n.C17 = 0,74 Phytane/n.C18 = 0,49

Recherche de dominance paire ou impaire par calcul du Carbon Preference Index (CPI) :

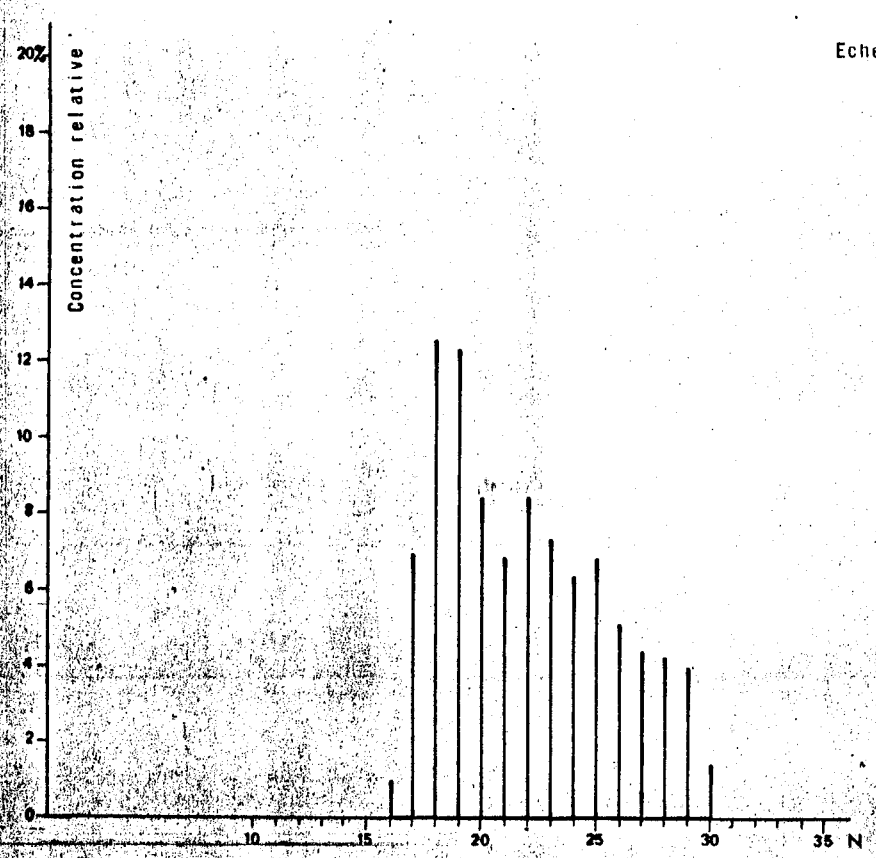
CPI entre la n.alcane C17 et la n.alcane : C29 CPI = 1,053

Distribution relative des n.alcanes :

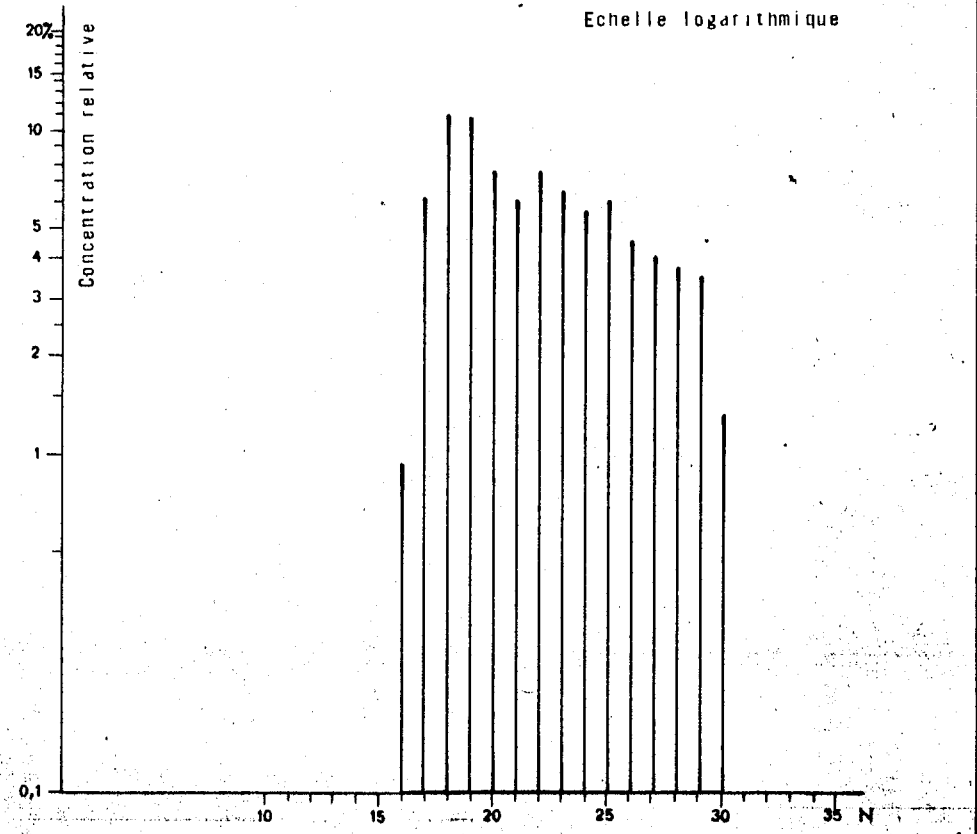
n.C15	n.C16	n.C17	n.C18	n.C19	n.C20	n.C21	n.C22	n.C23	n.C24	n.C25	n.C26	n.C27	n.C28	n.C29	n.C30	n.C31	n.C32	n.C33
% 1,07	% 7,19	% 13,00	% 12,75	% 8,74	% 7,10	% 8,13	% 7,58	% 6,59	% 7,08	% 5,31	% 4,78	% 4,41	% 4,14	%	%	%	%	%

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

Echelle arithmetique



Echelle logarithmique



I O M
20 40 60 80 %

CLAY MINERALS
20 40 60 80 %

FORMATION TESTS

STRATI-GRAPHY

LOG 1/5.000

DEPTH SAMPLES

ANALYSES OF CHARACTERIZATION

I O C
1 2 3%

E O M
1000 4000 ppm

BITUMEN RATIO
2 4 6 8%
20 40 60 80%

4000'

LIGNEOUS TYPE

"SAPROPELIC" TYPE

7075'

9010'

IM
K
I
M
M + CM
C
K'

DST. 2
DST. 1
9"5/8

UPPER CRETACEOUS

LOWER JURASSIC

TRIAS

ZECHSTEIN

4000'
5000'
6000'
7000'
8000'
9000'
10000'
11000'
12000'
13000'
14000'
2500
3000
4000
5500

Radioactive shales

Derived cuttings?

7.47
4,10
5,48
6,17

5640

ANALYSES OF HYDROCARBON CHARACTERIZATIONS

→ Analysis of desorbed gases
+ Composition of chloroformic extract from rock
× Analysis of vapors
△ Analysis of saturated fraction
○ Analysis of aromatic fraction

elf

Secteur MER DU NORD
Operateur
Permis ou Concession Zone Norvegienne

elf NORGE A/S

BREAM 17/12 - Ix WELL

ORGANIC INVENTORY

1/500

elf ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES
DIRECTION EXPLORATION
LABORATOIRE

PL. 1

Date Juillet 74
B PHILIPPE
N°classt 7552

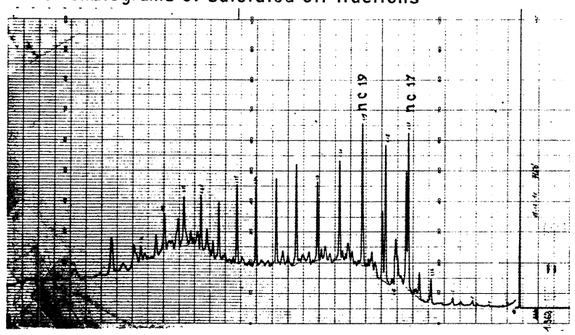
elf	Secteur MER DU NORD Opérateur Permis ou Concession Zone Norvegienne	elf NORGE A/S

BREAM 17/12-1x WELL

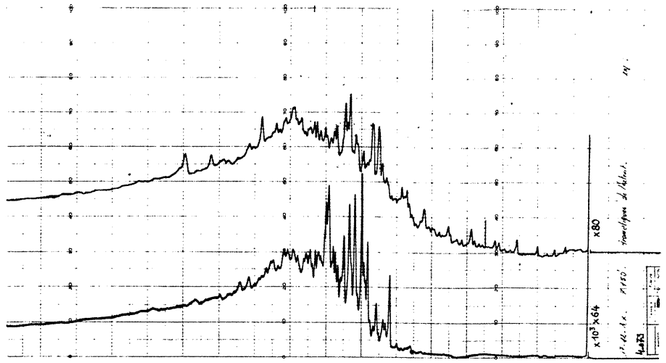
Echelle : 1/ 0000000

elf ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES DIRECTION EXPLORATION LABORATOIRE	PL.2	Date Juillet 74 B PHILIPPE N°classt 7553

Chromatograms of saturated oil fractions

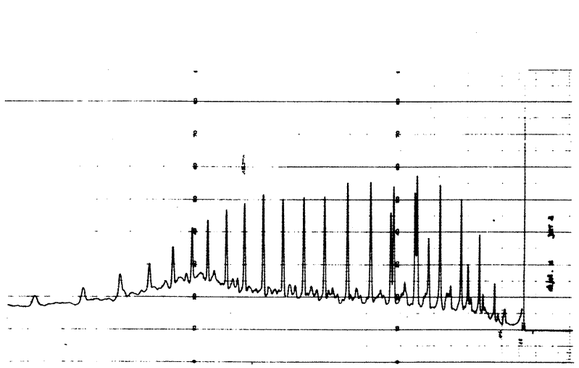


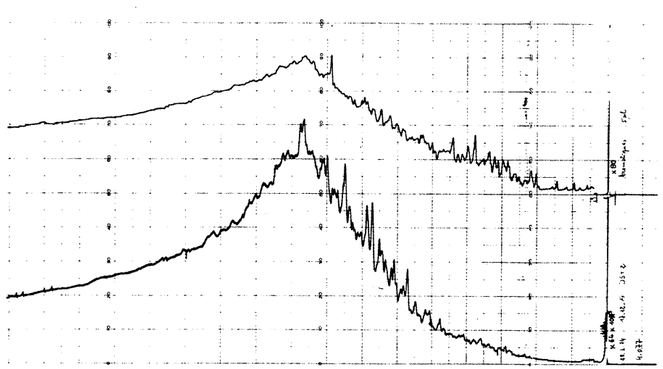
Chromatograms of aromatic oil fractions

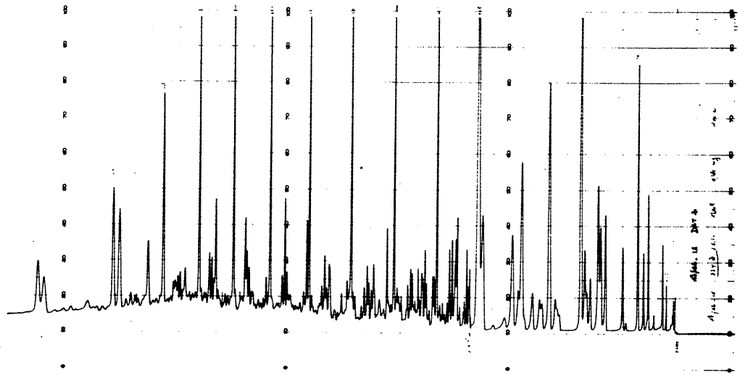


Chromatograms of vapors

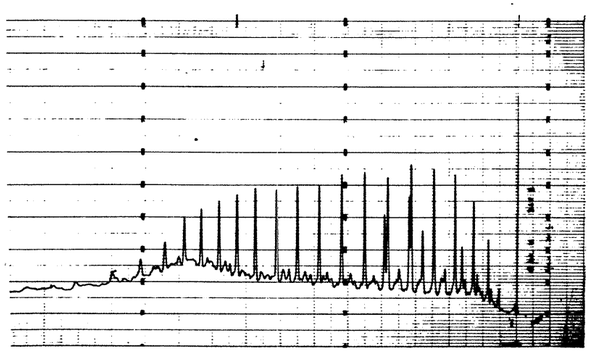
7150' sample
Radioactive shales

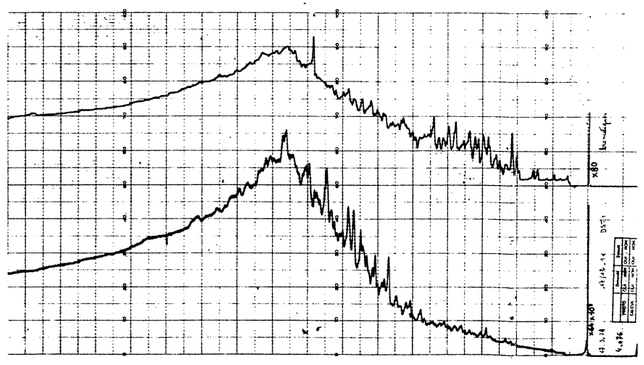


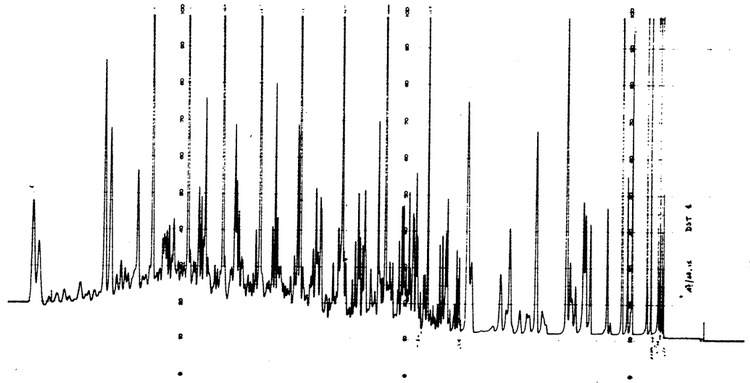




DST. 2







DST. 1

TUNEURS EN GAZ ACIDIFIABLE

400 1000 10000 200000

COTES

POURCENTAGES

IC4/NC4

IC5/NC5

C3/C4

C1 _____

Somme C1 C5 _____

C1 _____

C2 _____

C3 + + + + +

C4 x x x x x

C5 _____

COMPOSITION OF DESORBED GASES

10000

1000

100

10

1

C1 C2 C3 IC4 NC4 IC5 NC5 C6+

elf	Secteur MER DU NORD Opérateur Permis ou Concession Zone Norvegienne	elf NORGE A/S
	BREAM 17/12 - 1x WELL DESORBED GASES	échelle : 1/ 0000000
SNEA ENTREPRISE DE RECHERCHES ET D'ACTIVITES PETROLIERES DIRECTION EXPLORATION LABORATOIRE	PL 3	Date Juillet 74 B PHILIPPE N° dossier 7554