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1/3 - 4 WELL

(NORWAY)

GEOCHEMICAL STUDY OF OIL SHOWS IN THE MUD

(1590 m AND 2820 m)

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Boussens - Février 1985

LISTE DE DIFFUSION

DESTINATAIRES HORS DEX :

EXPLORATION DIG EUROPE	1
EXPLORATION ELF AQUITAINE NORGE	8
S.I.D. BOUSSENS	2

A B S T R A C T

The main results of the geochemical analysis carried out on the oil fraction recovered in the mud from 1595 m (Mid. Miocene) and 2820 m (Danian) in the 1/3 - 4 well are as follows :

- the oil fractions are more or less altered by the kind of sampling,
- the origin is thought to be an Upper Jurassic formation and the degree of evolution to be higher than for Ekofisk products ; in addition, some differences are due to a longer migration from the source rock.

8 pages
1 tableau
5 figures

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TABLE

Table 1 : Geochemical data 1/3 - 4, 1/3 - 3 and Ekofisk B2.

FIGURES

Fig. 1 : Location map.

Fig. 2 : 1/3 - 4 - 1590 m - chromatograms.

Fig. 3 : 1/3 - 4 - 2820 m - chromatograms.

Fig. 4 : Pristane/n-C17 vs Phytane/n-C18 diagram.

Fig. 5 : 1/3 - 4 - 1590 m. Aromatic HC separation.

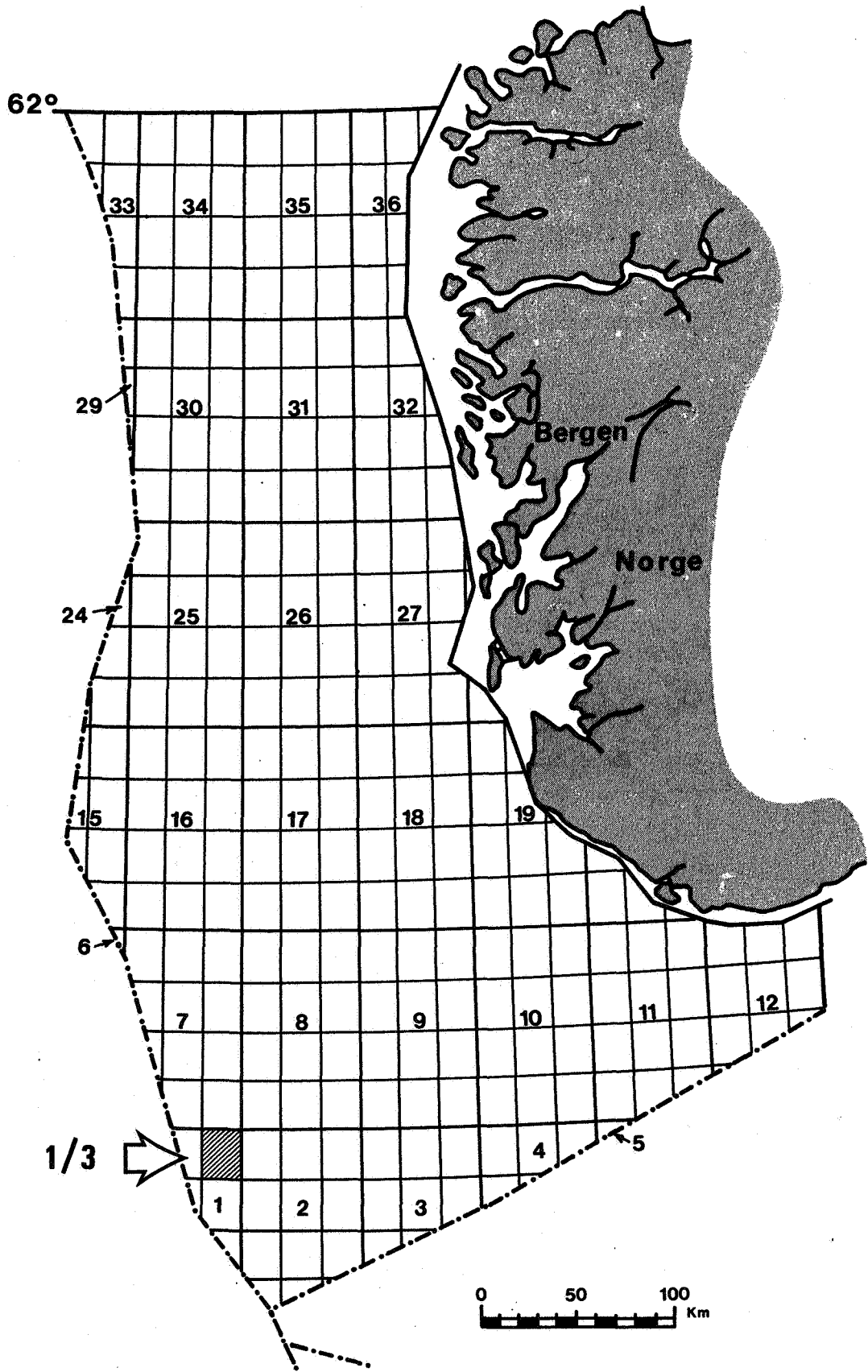


Fig. 1 - LOCATION MAP 1/3

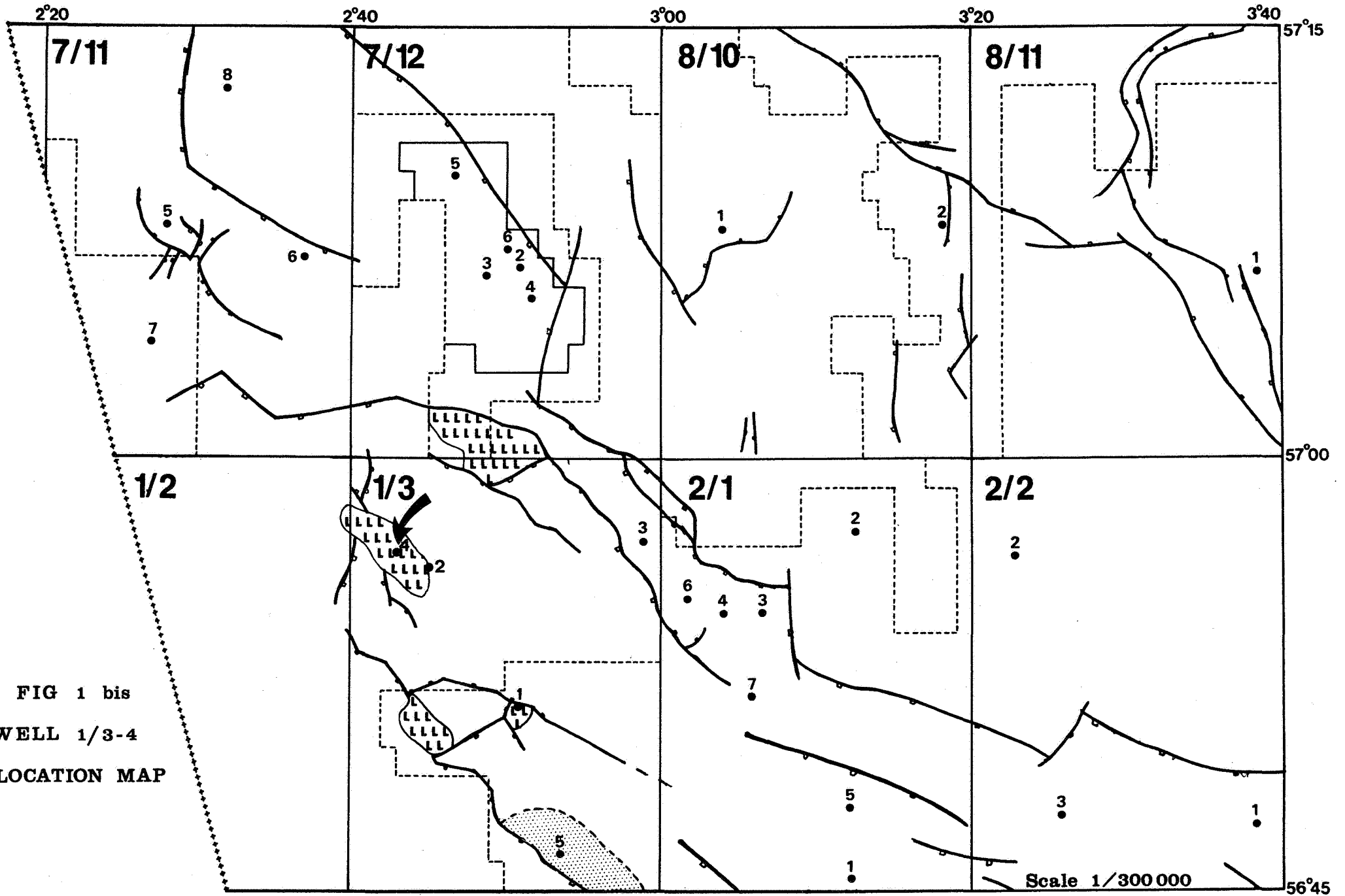


FIG 1 bis
WELL 1/3-4
LOCATION MAP

1 - INTRODUCTION - SAMPLING

This report presents the results of the geochemical analysis carried out on two oil-shows samples recovered with the mud during the 1/3 - 4 well drilling* :

- the first sample came from a siltstony level in the shaly Mid-Miocene at 1595 m ; the total yield was 100 l of unforeseen oil (34°API).
- the second sample came from the Danian (one of the main targets). This sample was recovered (after circulation at 2820 m) in the mud ditch before the vibrating screen. After decantation the oil fraction represented only around 2 % of the sample essentially made up of water and mud.

The gross composition of the oil samples, and calculated indices are given in the table 1, the chromatograms of the thermovaporized, saturated and aromatic fractions are given in figure 2 and 3.

Owing to the kind of sampling the two oil samples are affected : a loss of very light hydrocarbons is observed up to n-C8 (fig. 2 and 3, TV fractions).

2 - 1595 m SAMPLES

(table 1, figure 2)

2.1 - ORIGIN

The (Pristane/n-C17) / (Phytane/n-C18) ratio = 1.45 suggest an Upper Jurassic source rock as for the Ekofisk crudes (ratios = 1 - 1.5, see fig. 4).

.../...

* For each sample, "flash" analyses were performed and the results were given by two successive telex (see annex 1 and 2).

2.2 - MATURATION

Owing to the loss of hydrocarbons the usual indices like $X1 = n-C6/\text{methylcyclopentane}$ and $X2 = n-C7/\text{dimethylcyclopentane}$ are unserviceable. The predominance of the n-alkanes over the isoprenoids ($\text{Pristane}/n-C17 = 0.38$; $\text{Phytane}/n-C18 = 0.26$; $n-C10/\text{DMN} = 9.8$) suggest an higher degree of evolution than for Ekofisk crudes (0.49 - 0.36 and 4.01 respectively).

2.3 - MIGRATION

The saturated HC/aromatic HC ratio is higher than in Ekofisk : 3.5 vs 2.2.

The separation of the aromatic fraction into mono-di-and polyaromatic (fig. 5) shows the large predominance of the monoaromatic HC by comparison with Ekofisk B2 : more monoaromatic HC, less di-and polyaromatic. This discrepancy is probably due to migration and perhaps to a slight degradation of di-and polyaromatic HC into monoaromatic HC and water soluble compounds.

Therefore the 1595 m oil; very similar to Ekofisk, would have undergone a longer migration from an Upper Jurassic source rock, slightly more mature than for Ekofisk.

3 - 2820 m SAMPLES

(table 1, figure 3)

This sample is very affected by the sampling : the oil fraction represents only around 2 % of the sample (oil + mud + water), and the thermovaporized fraction (C5 - C15) is only 1 % of this oil fraction.

Nevertheless the n-alkanes represents the same percentage of the TV fraction than in the 1595 m sample (45 and 41 % respectively).

3.1 - ORIGIN

As the 1595 m oil samples, this oil was sourced by an Upper Jurassic source rock ; $(\text{Pristane}/n-C17) / (\text{Phytane}/n-C18)$ ratio = 1.36.

.../...

3.2 - MATURATION

The 2820 m oil sample has reached the same degree of evolution than the 1595 m samples, according to the predominance of the n-alkanes over the isoprenoids and the distribution of the alkanes. It is also more mature than the Ekofisk crudes.

3.3 - MIGRATION

As for the Miocene sample (1595 m), the Danian sample exhibits a saturated HC/aromatic HC ratio higher than in Ekofisk : 3.7 vs 2.2. So the Danian oil, which is, in many respects similar to Miocene oil is thought to have also undergone a longer migration than the Ekofisk crudes.

4 - CONCLUSION

These two oil sample were sourced by an Upper Jurassic source rock, which has undergone an higher degree of maturation than for Ekofisk crudes. They have undergone a longer migration from the source rock than the Ekofisk crudes did.

T A B L E 1

GEOCHEMICAL DATA

OIL COMPOSITION AND CALCULATED INDICES

WELL	1/3 - 4		1/3 - 3	EKO FISK B2
RESERVOIR	MIOCENE 1595 m	DANIAN 2820 m	Up. Jurassic DST 3B 4211 - 4214 m	DANIAN
R.D. %	82,3	no dist.	64.3	77.7
R.D. Composition :				
% Polar Compounds	7.3	6.0	5.0	11.3
% saturated HC = S	72.0	74.0	72.8	60.7
% Aromatic HC = A	20.7	20.0	22.2	28.0
S/A	3.47	3.70	3.28	2.16
X1 = n-C6/MCP	—	—	1.76	1.74
X2 = n-C7/DMCP			6.69	6.46
Y1 = n-C7/TOL	8.58	—	1.74	1.37
Z1 = n-C10/DMN	9.79	12.1	7.57	4.01
TV % T.P.	15	1	28	47
n-Alk. % TV	41	45	35	16
n-Alk. % Sat.	10	13	15	14
Pr/n-C17 = A	0.38	0.41	0.48	0.49
Ph/n-C18 = B	0.26	0.30	0.35	0.36
A/B	1.44	1.36	1.38	1.34
Pr/Ph	1.45	1.47	1.44	1.39

R.D. : Distillation résidue
 TV : Thermovaporized fraction
 (C5 - C15)
 T.P. : total product

MCP : methylcyclopentane
 DMCP : dimethylcyclopentane
 TOL : toluene
 DMN : dimethylnonane (isoprenoid)

Pr., Ph. : Pristane, Phytane

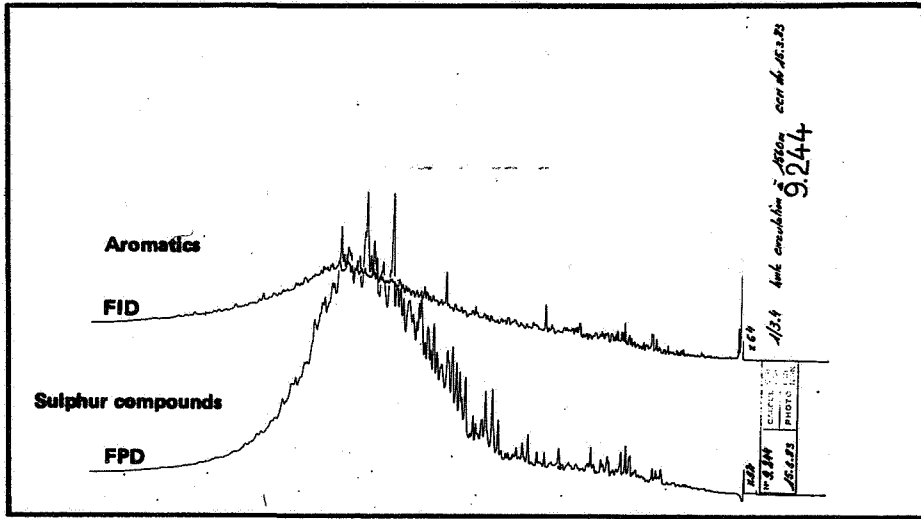
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PAYS : **NORWAY**
Country
SONDAGE : **1 / 3 - 4**
Well

Huile | **Cote** | **1590 - 1595 m**
Oil | **Depth**
Identification | **Recovered after circulation**
Identification
Formation
Formation
Age | **Mid - Miocène (sandstones)**
Age

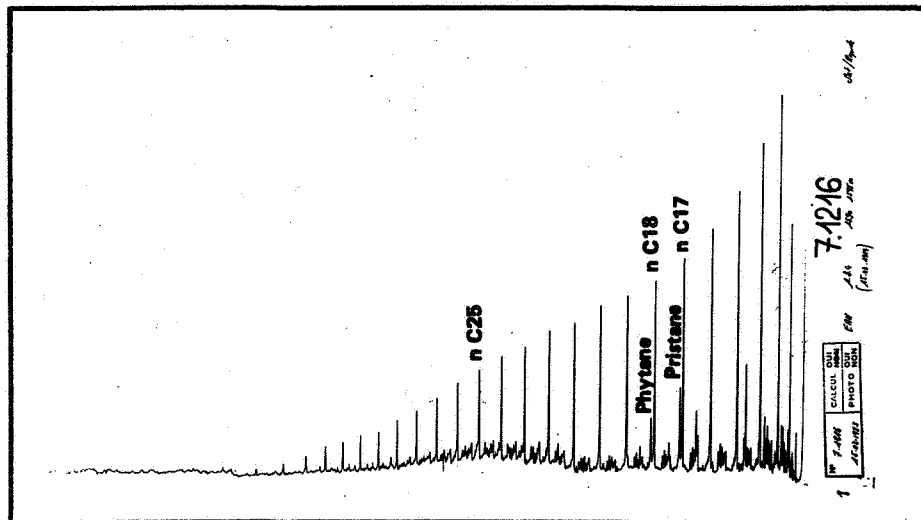
Fig. 2



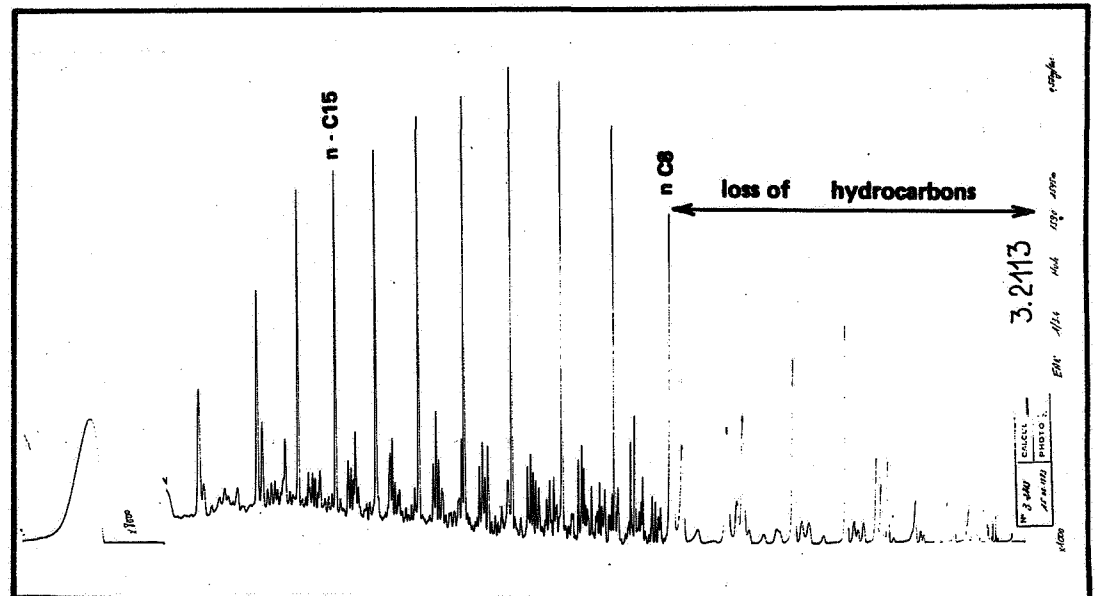
HC AROMATIQUES AROMATIC HC.

Composition du produit total (%)
Composition of total product

Asphaltènes <i>Asphaltenes</i>	As :	} 6,0	$\frac{S}{A} = 3,47$
Résines <i>Resins</i>	R :		
HC saturés <i>Saturated HC</i>	S :	59,3	
HC aromatiques <i>Aromatic HC</i>	A :	17,0	
Distillat <i>Distillate</i>	D :	17,7	



HC SATURES SATURATED HC.



HC THERMOVAPORISES THERMOVAPORIZED HC.

SNEA (P)

DIVISION RECHERCHES ET APPLICATIONS EN GEOLOGIE

PAYS : NORWAY

Country

SONDAGE : 1/3-4

Well

Fig. 3

**Huile
Oil**

**Cote
Depth**

2820 m

**Identification
Identification**

Oil in mud emulsion (recovered in the mud ditch)

Oil : 2 % of the sample

**Formation
Formation**

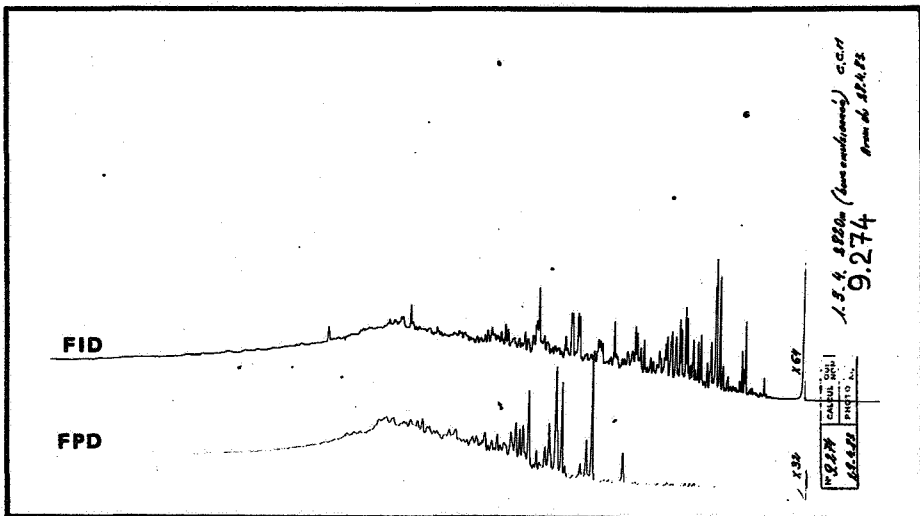
Ekofisk formation

**Age
Age**

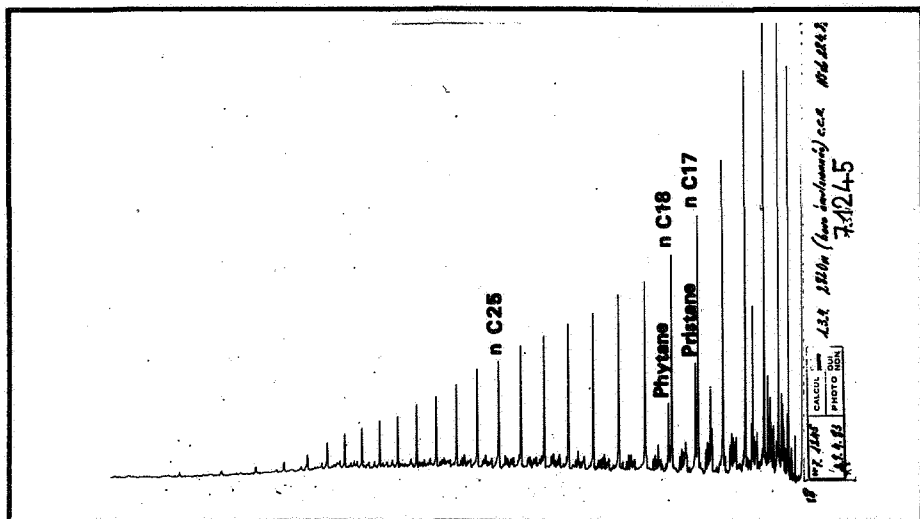
Danian

**Composition du produit total (%)
Composition of total product**

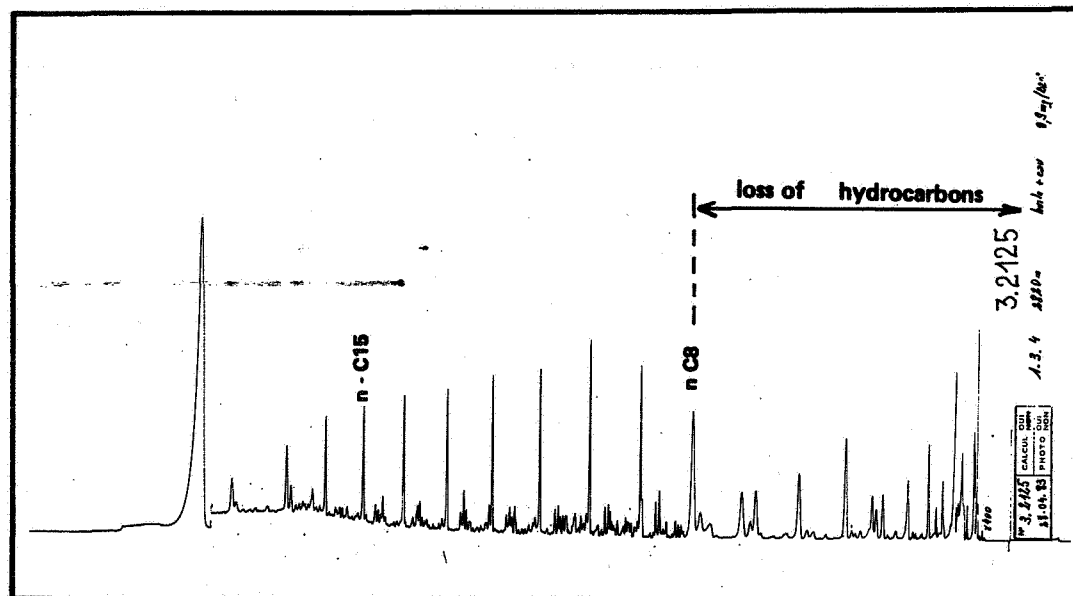
Asphaltènes Asphaltenes	As	:	}	6	$\frac{S}{A} = 3,70$
Résines Resins	R	:			
HC saturés Saturated HC	S	:	74		
HC aromatiques Aromatic HC	A	:	20		
Distillat Distillate	D	:	No distillation		



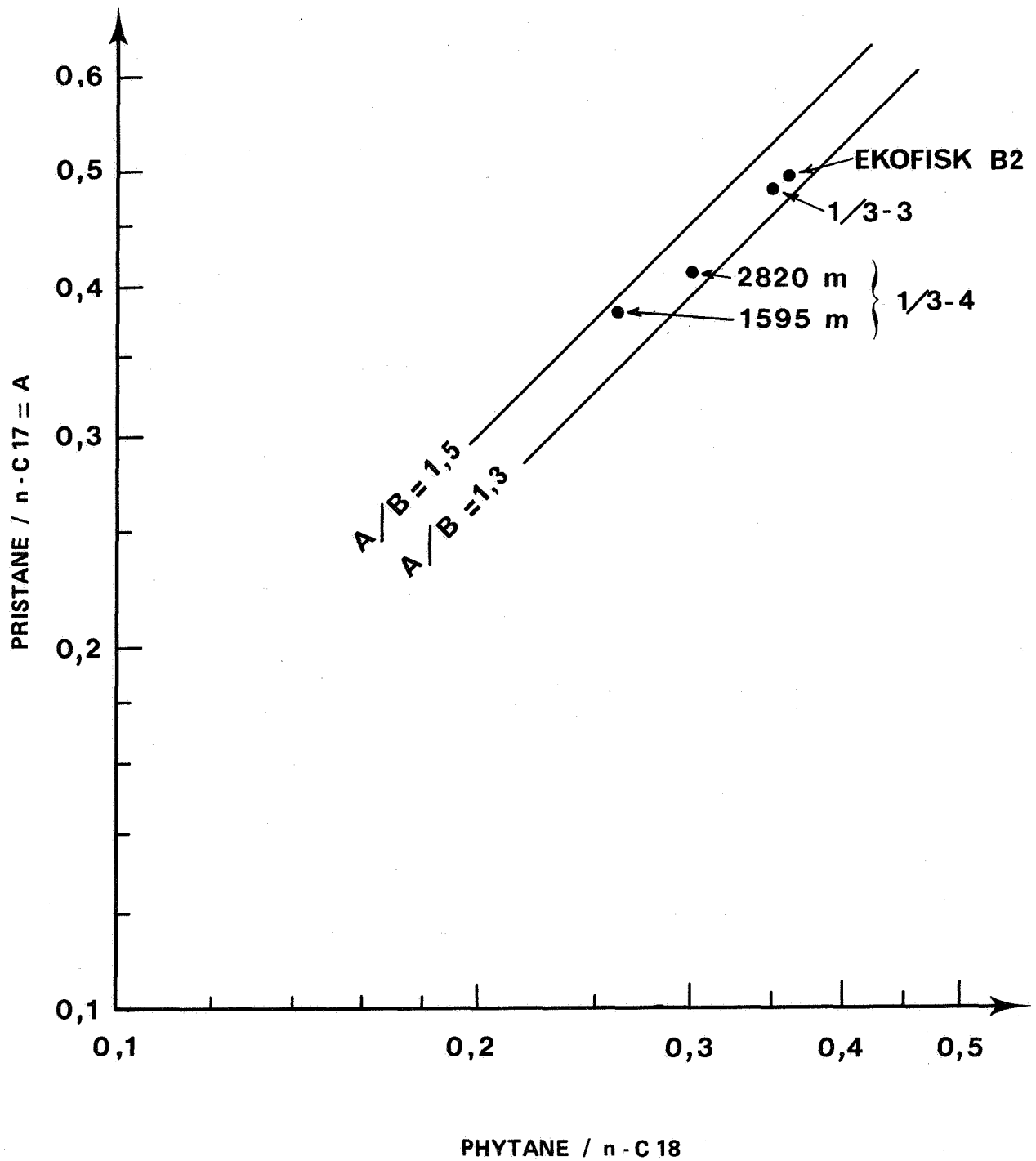
HC AROMATIQUES AROMATIC HC.



HC SATURES SATURATED HC.



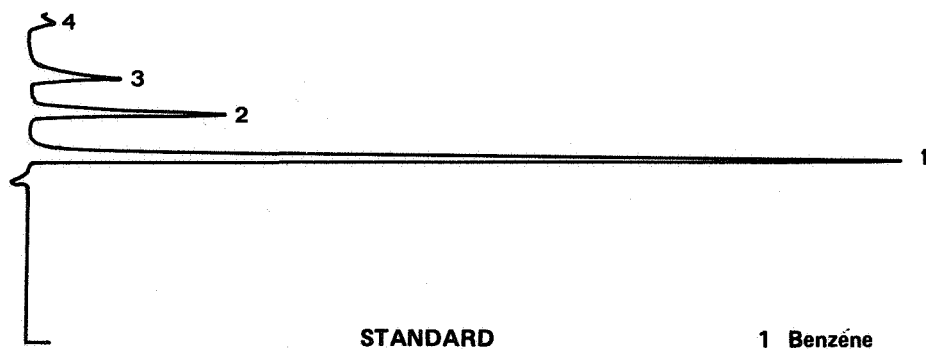
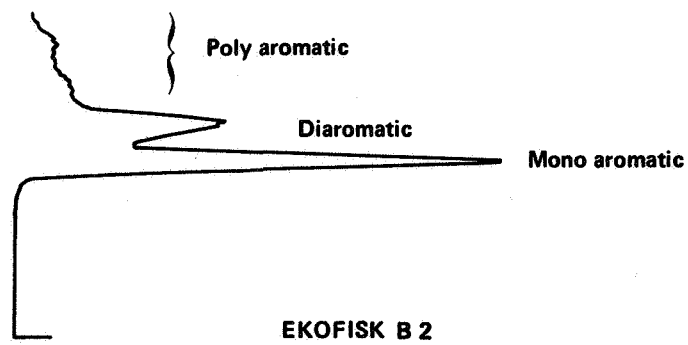
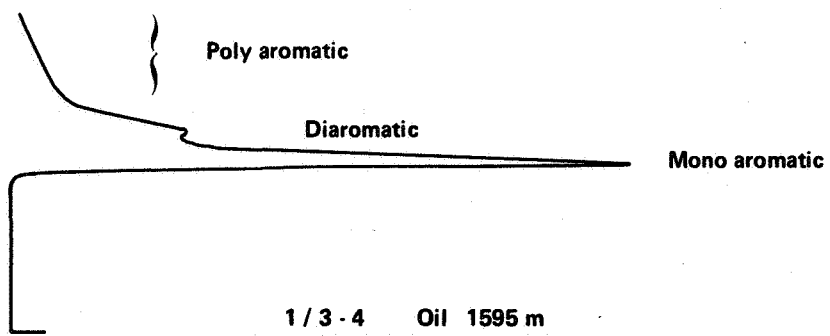
HC THERMOVAPORISES THERMOVAPORIZED HC.



A 9586

Fig. 4 - 1/3-4 - PRISTANE / n - C17 VS PHYTANE / n - C18 DIAGRAM

Fig. 5 - 1 / 3 - 4 - AROMATIC HC SEPARATION



- 1 Benzène
- 2 Naphtaléne
- 3 Fluoréne
- 4 Anthracéne

SNEA-P DRAG LABORATOIRE BOUSSENS

A:

ELF NORGE EXPLORATION

ATTENTION J. CHIALVO

GEOCHEMICAL ANALYSIS OF 1/3-4 OIL SAMPLE (1595 M.)

OIL SAMPLE RECEIVED IN BOUSSENS LAB. ON 15.03.83 (9 AM)

ITS GROSS COMPOSITION IS :

DISTILLATE : 17,7 %
 SATURATED HC : 59,3 %)
 AROMATIC HC : 17,0 %) S/A : 3,47

RESINS + ASPHALTENES : 6,0 %

A SLIGHT LOSS OF VERY LIGHT HYDROCARBONS IS OBSERVED (INFERIOR CB), DUE TO THE KIND OF SAMPLING. THE THERMOVAPORIZATION SPECTRUM (C5-C18) IS RATHER SIMILAR TO THESE OF THE EKOFISK CRUDES (DANIAN AND MAASTRICHTIAN) BUT WITH A LOWER AMOUNT OF LIGHT AROMATIC HYDROCARBONS (BENZENE, TOLUENE, XYLENES).

ORIGIN : (PRISTANE/NC 17) / (PHYTANE/ NC18) : 1,44 SUGGEST AN UPPER JURASSIC SOURCE ROCK, AS FOR EKOFISK CRUDES (1-1,5).

MATURATION : THE PREDOMINANCE OF THE N. ALKANES OVER THE CYCLANES (X2 = NC7 / DIMETHYLCYCLOPENTANE : 9,6) AND OVER THE ISOPRENOIDS (PRISTANE/ NC17 : 0,38 AND PHYTANE /NC18 : 0,26) SUGGEST AN HIGHER DEGREE OF EVOLUTION THAN IN EKOFISK CRUDES (5-7, 0,45 -0,50, 0,4 RESPECTIVELY).

MIGRATION - THE SATURATED HC/AROMATIC HC RATIO IS HIGHER THAN IN EKOFISK : 3,47 VS 2-2,8

THE SEPARATION OF THE AROMATIC FRACTION INTO MONO-, DI- AND POLYAROMATIC HYDROCARBONS SHOWS THE LARGE PREDOMINANCE OF THE MONO AROMATIC HC BY COMPARISON WITH EKOFISK : MORE MONO-, LESS DI-, LESS POLYAROMATIC HC, DISCREPANCY PROBABLY DUE TO MIGRATION (AND, PERHAPS, TO A SLIGHT BIODEGRADATION OF DI- AND POLYAROMATIC HC INTO MONOAROMATIC HC AND WATER SOLUBLE COMPOUNDS).

SO THE 1/3-4 OIL, VERY SIMILAR TO EKOFISK, WOULD HAVE UNDERGONE A LONGER MIGRATION FROM AN UPPER JURASSIC SOURCE ROCK, SLIGHTLY MORE MATURE THAN FOR EKOFISK.

END - P CAILLEAUX

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ELF NORGE EXPLORATION : ATT. J. CHIALVO - K. KIRKEMO

BIOCHEMICAL ANALYSES OF 1/3-4 OIL SAMPLE (2820 M)

- SAMPLE RECEIVED IN BOUSSENS LAB. ON 28-04-83 (K. KIRKEMO)
- OIL FRACTION REPRESENTS AROUND 2 % OF THE SAMPLE ONLY
(ESSENTIALY WATER AND MUD)
- THE GROSS COMPOSITION OF THE OIL FRACTION IS :
 - SATURATED HYDROCARBONS = 74 %) S/A = 3,53
 - AROMATIC HYDROCARBONS = 21 %)
 - POLAR COMPOUNDS = 6%
- THE LIGHT HYDROCARBONS ARE AFFECTED BY THE KIND OF SAMPLING
- AS FOR THE MID-MIOCENE OIL (1597 M) AN UPPER JURASSIC ORIGIN
IS SUGGESTED BY THE PRISTANE/PHYTANE RATIO = 1.5
THE TWO OIL SAMPLES FROM 1/3-4 HAVE THE SAME DEGREE OF
EVOLUTION, HIGHER THAN FOR EKOFISK CRUDES.

P. CAILLEAUX

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