

SNEA (P)
DIRECTION EXPLORATION
LABORATOIRE DE GEOLOGIE DE BOUSSENS

GEO/LAB Bss n° 0/1961 RP
/ca

30/6-1 WELL
(NORWAY)

ORGANIC MATTER STUDY
OF THE JURASSIC SERIES

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Boussens - August 1980

Reference : Order n° 031119

- J. DUCAZEAUX - Report n° 0/1883 RP -
"30/6-1 well (Norway) - Comparison of the stratigraphical interpretations of the Mesozoic as proposed by SNEA(P) and IKU".
- P. DURIF - E. GROSDIDIER - J. DUCAZEAUX - Report n° 0/1884 RP -
"Well 30/6-1 (Norway) - Biostratigraphical study of the Cretaceous and the Jurassic (interval 2203 - 3172 m)".
- R. CUSSEY - Report n° 0/1886 RP -
"30/6-1 well (Norway) - Sedimentological study of Jurassic deposits".

DISPATCHING LIST

RECIPIENTS :

- DIVISION PROGRAMME PARIS à l'intention de l'Expert Régional EXPLO. EUROPE	1
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A B S T R A C T

Geochemical and optical studies carried out on the organic matter from the Jurassic interval of 30/6-1 well show mainly :

- a low degree of catagenesis in the whole Lias (up to 0.6 eq Ro at T.D.)
- a humic organic matter with a low oil potential.

9 pages
2 tables
10 plates

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This report presents the geochemical and optical (reflected light and fluorescence) analyses carried out on the organic matter from the 30/6-1 well (location map on plate 1) in the Jurassic interval between 2242 and 3004 m. It takes into account the optical observations in transmitted light on palynological slides*. The main results are summarized on plate 5.

The analysis of condensates (DST 1 and DST 2) will be carried out later and discussed in a report about the condensate of block 30/6.

1 - CATAGENESIS DATA

1.1 - TRANSMITTED LIGHT STUDY*

The thermal alteration index is estimated at :

- 2.5 to 2.75 from 2253 to 2920 m (Kimmeridgian to Hettangian)
- 3. below 2952 m (Rhetian).

1.2 - REFLECTANCE AND FLUORESCENCE STUDY

8 samples have been studied from between 2316 and 2853 m in the Liassic Section : 5 sidewall core samples, 2 core samples (from cores nr 1 and 5) and 1 cutting.

All samples were analysed both on concentrates and on total rock polished in massive sections. The first enables us to obtain Vitrinite fragments for statistical measurements of Reflectance, the second gives the best observation of structured groundmasses and exinites.

The top of the Liassic section is well characterised by rank parameters : Vitrinite $R_o = 0.5 \%$ at 2316, yellow - green algae giving Reflectance equivalence of 0.5% in core 5 and at 2500 m ; the palynological TAI of 2.5 is consistent with these figures in this zone.

Inversely, the lower part of the section is not so well defined and provides neither good Vitrinite** histograms, nor fluorescent algae, nor a definite TAI. Only a tendency, based on sporinite fluorescence, appears for a very small increase of rank ; about equivalent to 0.6% R_o in the Sinemurian, i.e. to the very beginning of oil maturation, in such a humic facies.

.../...

* J. DUCAZEAUX - Biostratigraphical study of the Cretaceous and the Jurassic - n° 0/1884 RP.

** The large Reflectance histogram at 2795 corresponds to a population of very small grains among which true vitrinite is rare and difficult to distinguish from semi-fusinite and fusinite, and R_o average is clearly higher than it should be, compared to other rank data.

1.3 - GEOCHEMICAL DATA

- The pyrolysis temperatures increasing from 430°C to 442°C,
- The low X_z indices (nC7/dimethylcyclopentane) and the medium Pristane/nC17 and Phytane/nC18

suggest a low degree of catagenesis, just at the beginning of the main oil generation zone.

1.4 - CATAGENESIS CONCLUSIONS

These corroborative data show that the whole of the studied section is at the very beginning of the main oil generation zone (0.5 to 0.6 % eq Ro).

2 - ORGANIC MATTER CHARACTERISTICS - OIL POTENTIAL

2.1 - PALYNOFACIES*

2255 - 2283	mainly ligneous particles with 20 to 30 % of amorphous organic
2283 - 2450	ligneous particles (~ 30 %), amorphous O.M. (~ 10 %)
2474	40 % of amorphous O.M.
2544	~ 50 % of black ligneous debris
2700 - 2818	15 to 50 % of amorphous OM, opaque and clear ligneous material (2795 15 % amorphous OM + 75 % black ligneous debris)
2833.50	100 % black debris
2853	~ 40 % black debris ; and ligneous particles
2878 - 2905	~ 40 % amorphous O.M. ; and ligneous particles
2935	100 % black debris
2952	80 % clear and black debris
2971.5 - 3004	100 % opaque ligneous material.

So, in the whole section, the palynofacies is mainly made up of ligneous material, with some quantities of amorphous organic matter in Pliensbachian and Sinemurian.

.../...

* taken from biostratigraphical report already mentioned.

2.2 - ORGANIC FACIES IN FLUORESCENT LIGHT

Algae have been found at many levels, up to 10 - 20 in number from either marine (Tasmanaceae) or lagoonal - lacustrine (Botryococcus) origin. However the basic composition of most organic matter appears to be humic = brown-red groundmasses (shaly) associated to more or less frequent sporinites, cutinites and reflecting coal macerals.

The coal populations are abundant only in the 2 upper samples = 2316 includes pure homogeneous vitrinite without Inertinite, core 1 includes low fluorescent Vitrinite (with a lower than normal reflectance).

The fluorescence intensity is mostly determined by the diffuse matter within groundmasses, always present. However, one sample, in the Sinemurian consists mostly of spores in a "durite" facies = made up of spores and inertinite, vitrinite being very rare (less than 5 %); this facies could be the most favourable, in the studied section, for oil generation.

2.3 - GEOCHEMICAL DATA

Geochemical analyses were carried out on 17 samples (8 SWC, 4 cores, 5 cuttings).

2.3.1 - Organic matter content

The total organic content (TOC) is medium to high in the shaly samples : $1 < \text{TOC} < 5 \%$, low in the sandstony samples $\text{TOC} < 1 \%$.

2.3.2 - Characteristics of hydrocarbons

The amount of hydrocarbons extractible by heating (peak S1 of Rock Eval Analysis) is lower than 1500 ppm (except for the coal sample at 2795 m with 6670 ppm) and the hydrocarbon content in the C5 - C15 range (thermovaporized fraction) is lower than 850 ppm (except 2000 at 2795 m).

The chromatograms show two populations of hydrocarbons, one of syngenetical hydrocarbon around nC25 (type 2795 m) and one of migrated hydrocarbons around nC18 (type 2542 m). The syngenetical H.C. have a $A/B \approx 3$, characteristic of humic facies, while migrated ones have a A/B ratio lower than 1.5 (see chromatograms plate 6 to 10).

2.3.3 - Genetic potential

The genetic potential of the rock samples is estimated by pyrolysis analysis (Rock-Eval). The pyrolysis results are given in table 1 ; the hydrogen indices (HI) and oxygen indices (OI) of the kerogens are plotted in a diagram on plate 3.

The amount of hydrocarbons produced by pyrolysis (peak S2) is low to medium in the whole Lias section and the related HI are low to medium (≤ 200 mg HC/g TOC).

2.4 - CONCLUSIONS REGARDING OIL POTENTIAL

In view of the humic facies of the organic matter and the rather low hydrogen indices, together with the low degree of catagenesis, the whole jurassic series are thought to have a low potential. This low potential doesn't exclude the possibility that the Jurassic interval, if it regionally had a higher degree of catagenesis, may be the source rock of wet gas (found near 2300 m). The results of the geochemical analysis of the condensates (which will be published in a report about the condensates from the block 30/6) will enable us to make a decision.

TABLE 1 AND 2

D	Cutting	
SWC	Sidewall core	
K	Core	
TOC	Total organic carbon (% of rock)	
IOC	Insoluble organic carbon (% of rock)	
S1	Hydrocarbons present in the rock) mg HC/g of rock
S2	Hydrocarbons produced by pyrolysis	
HI	Hydrogen index (mg HC/g TOC)	
OI	Oxygen index (mg CO ₂ /g TOC)	
T _m	Temperature at the top of S2	
X1	nC ₆ /methylcyclopentane	
X2	nC ₇ /dimethylcyclopentane	
Y1	nC ₇ /Toluene	
Pr	Pristane	
Ph	Phytane	
A, B	Pr/nC ₁₇ , Ph/nC ₁₈ .	

STRATL. UNITS	AGE	N°	Type of sample	DEPTH	TOC	IOC	S ₁	S ₂	HI	OI	T _m
BRENT FM.	Cretaceous	1	D	2242	0.90	0.7	—	0.16	20	115	432
	Kimmeridg.	2	D	2254		0.55	—	0.07	10*	175*	429
	Oxfordian	3	D	2284		1.57	—	1.84	115*	60*	432
	Early aalen. Late Toarc.	4	SWC	2316	2.15		1.39	1.91	90	30	431
		5	K1	2333.7	1.75		0.23	1.43	85	30	437
	Toarcian	6	K2	2343.6	5.01		1.53	9.96	200	10	430
		7	K4	2360.6	2.20		0.56	3.91	180	60	431
		8	K5	2372	1.25		0.30	1.57	125	75	433
		9	SWC	2400	0.65		0.30	0.19	30	110	436
		10	SWC	2450	1.0		0.55	1.68	170	40	432
DUNLIN FM.	Pliensbachian	11	SWC	2500	1.30						
		12	D	2542		0.96	—	0.87	90*	70*	438
		13	SWC	2625	1.35		0.10	0.97	70	90	442
STATFJORD FM.	Sinemurian	14	SWC	2795	26.1		6.67	47.35	180	15	438
		15	SWC	2853	0.1						
	Riétian	16	SWC	2952	1.15		0.34	0.99	85	20	439
		17	D	3004		0.39	—	—	—	210	—**

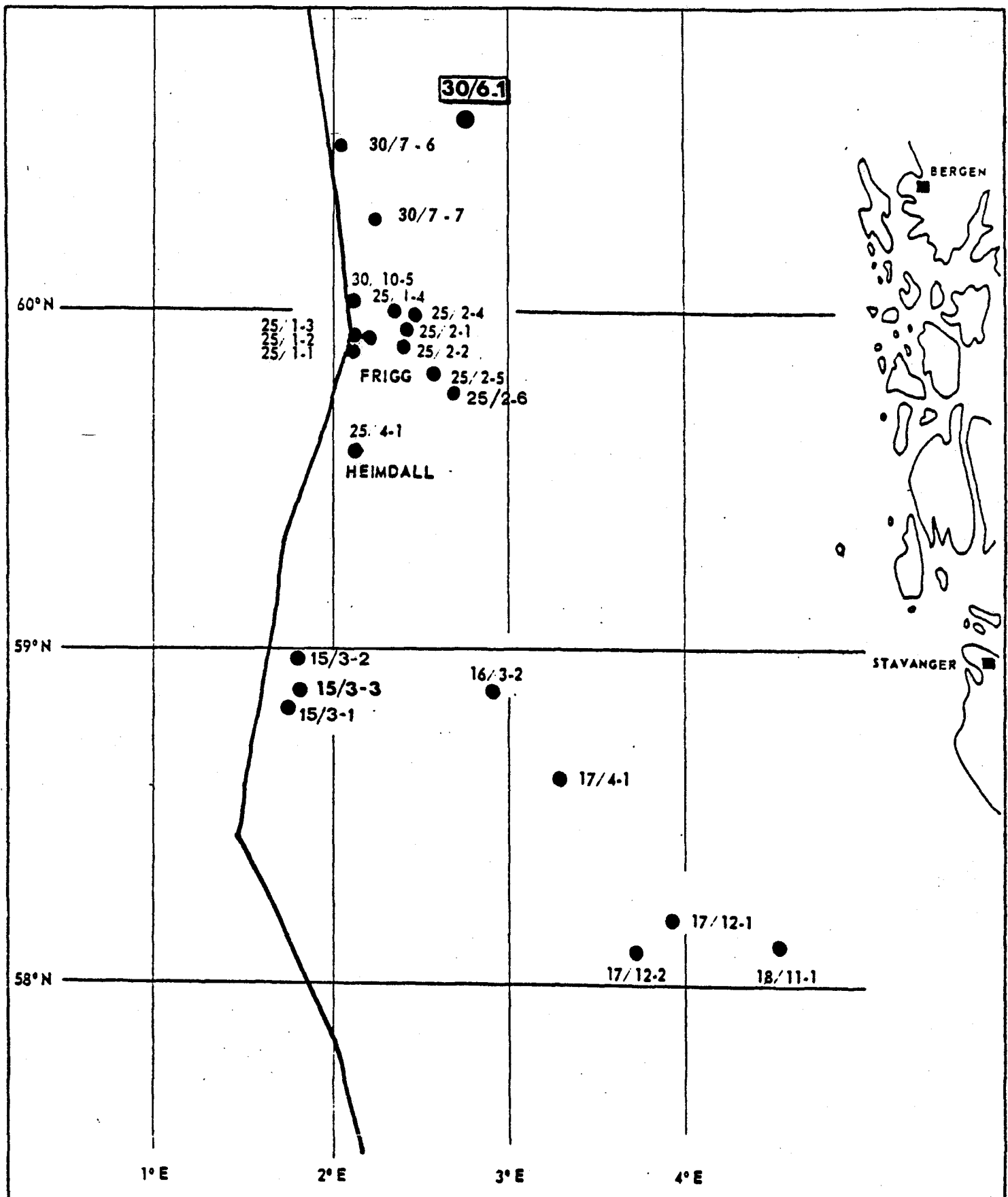
* HI and OI calculated with IOC

** S₂ too low for a T_m reading

TABLE 1 : 30/6-1 - GEOCHEMICAL RESULTS (Carbon, pyrolysis)

N°	DEPTH	TV ppm	nAlk % TV	X ₁	X ₂	Y ₁	nAlk ppm	Pr/nC17	Ph/nC18	A/B
4	2316	237	18	1.46	4.11	0.23	53	0.69	0.52	1.33
5	2333.7	248	15	1.39	3.94	0.26				
6	2343.6	844	18	1.45	3.88	0.28	31	0.50	0.39	1.29
7	2360.6	146	11	1.59	4.67	0.26				
8	2372	119	14	1.46	3.18	0.18				
10	2450	140	28	0.74	1.52	0.13	54	0.62	0.53	1.15
12	2542	27	29	0.88	1.6	0.30	27	0.46	0.40	1.15
13	2625	38	12	0.59	0.84	0.05				
14	2795	2010	9	1.15	2.51	0.14	46	1.38	0.49	2.81
15	2853						—	—	—	—
16	2952	66	15	2.54	5.22	0.21				

TABLE 2 : 30/6-1 - CHROMATOGRAPHICAL RESULTS



elf aquitaine

ELF NORGE
 Pays: **NORWAY**
 Permis ou concession: **053**

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


DIRECTION EXPLORATION
 Date: **JULY 1980**
 Auteur: **CAILLEAUX**
 N°Class: **A. 5412**




NORTH SEA
30/6-1 LOCATION

PL.1

REFLECTANCE
(measurements)

FLUORESCENCE
(global amount estimated)

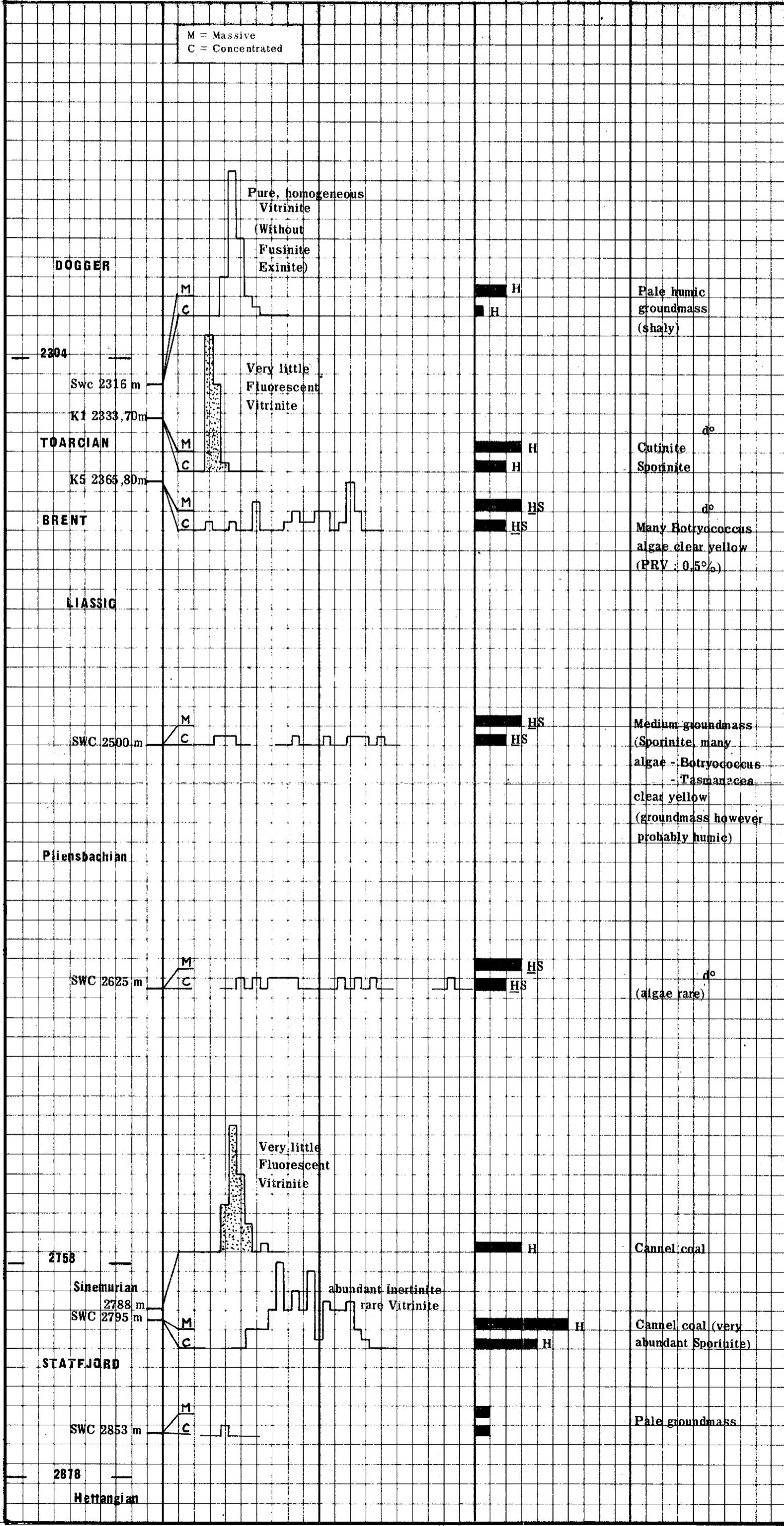
-  Vitrinite
-  Bitumens
-  Fluorescent vitrinit

-  Fluorescent macerals
-  Hydrocarbon traces in reservoirs
-  Mud products

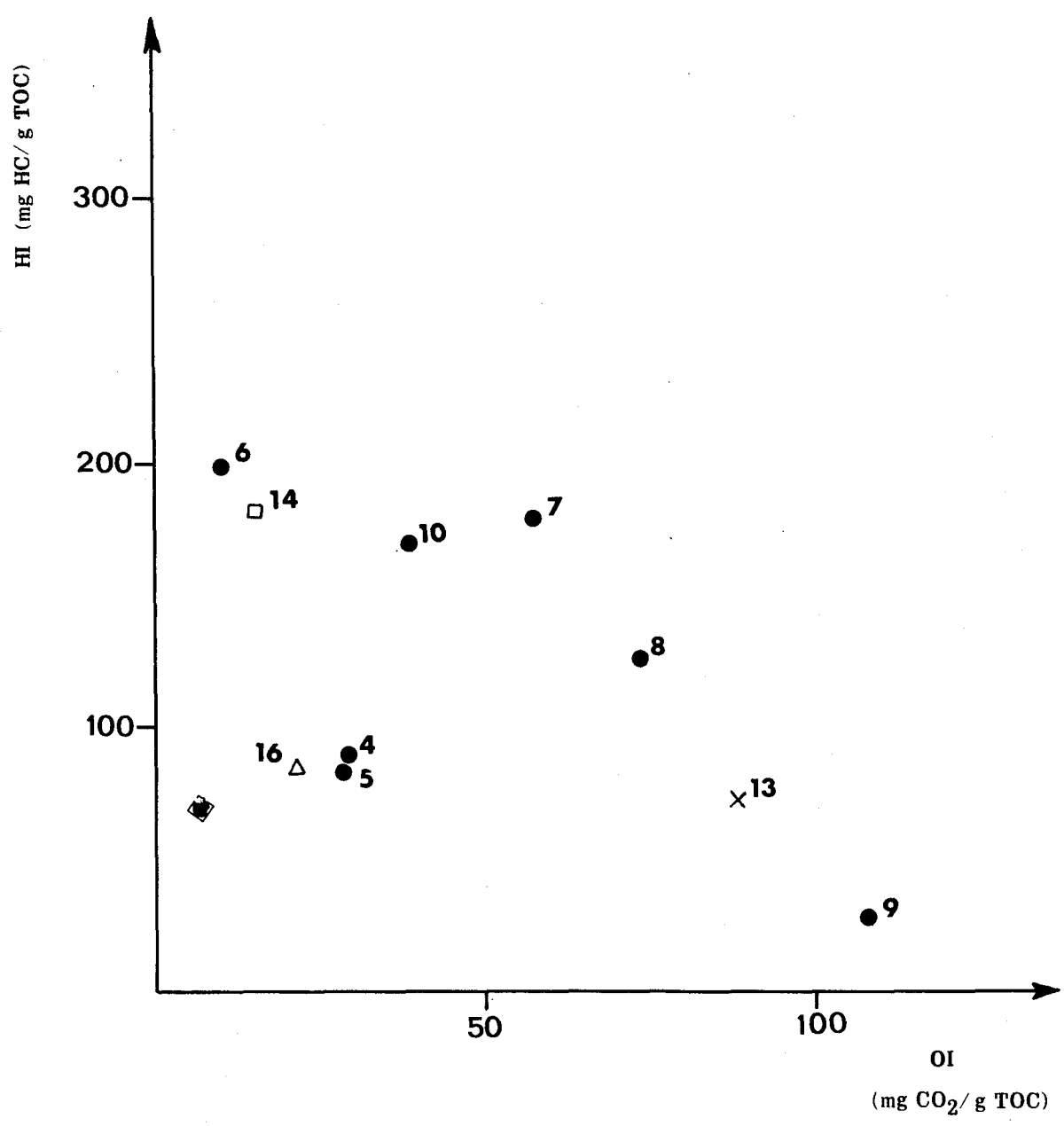
PL. 2

REFLECTANCE		FLUORESCENCE				
VITRINITE BITUMEN		GLOBAL ESTIMATED		ORGANIC MATTER NATURE		
0	1	2%	1	2	3	4

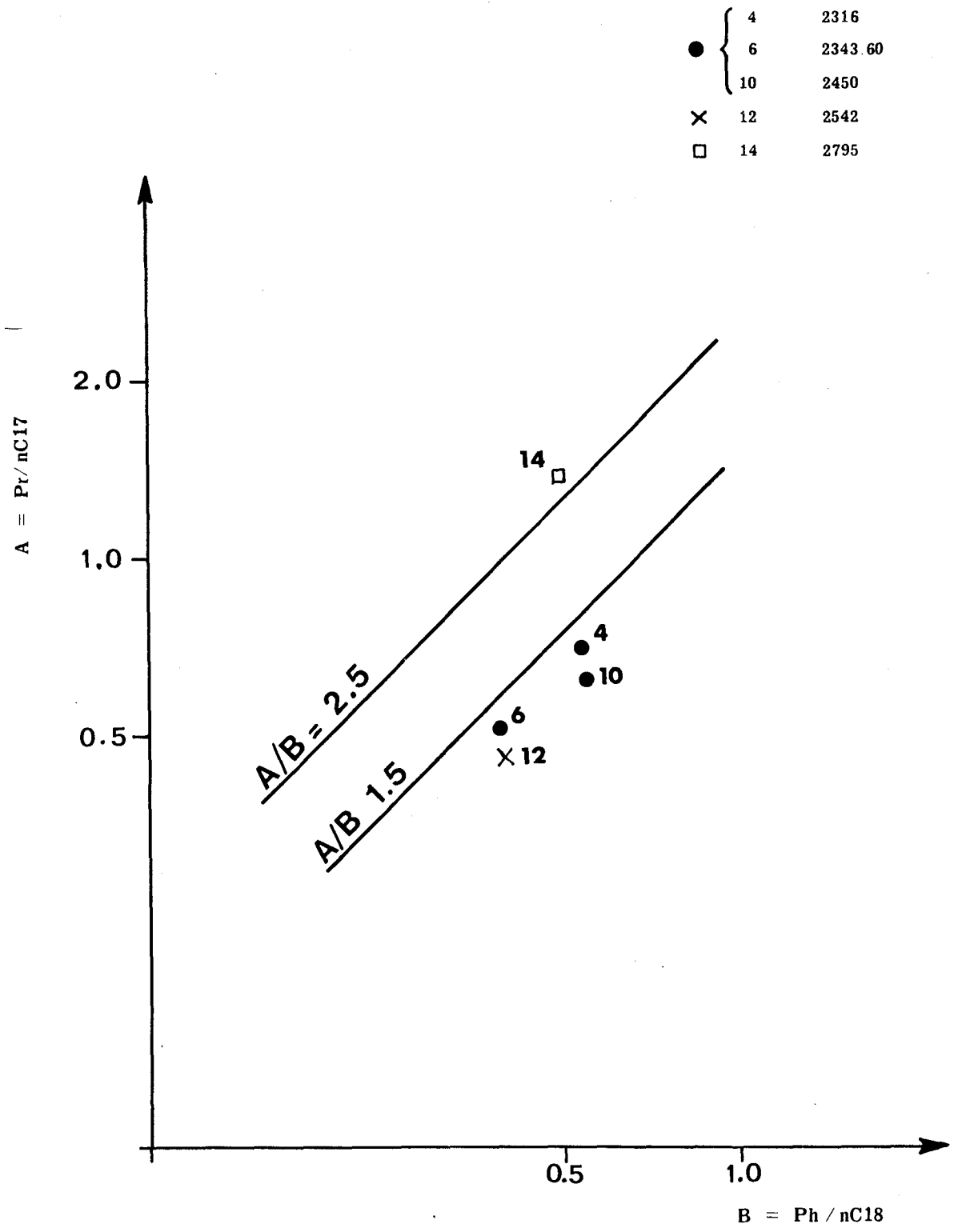
M = Massive
C = Concentrated



Toarcian	●	4	2316 m
		5	2333,70
		6	2343.60
		7	2360.60
		8	2372
		9	2400
		10	2450
Pliensbachian	×	13	2625
Sinemurian	□	14	2795
Rhetian	△	16	2952



Pl.3 : 30/6-1 HI - OI DIAGRAM

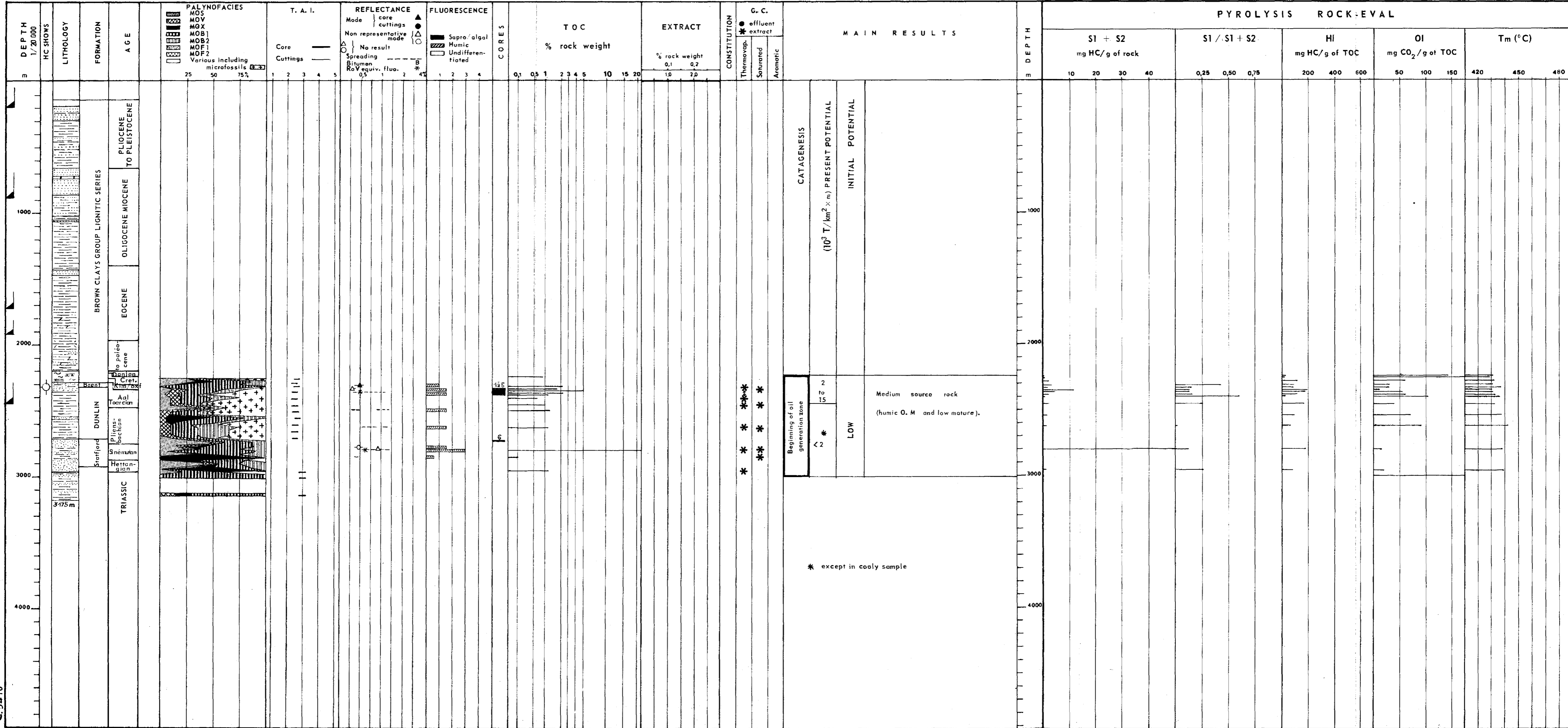


Pl.4 : 30/6-1 Pristane - Phytane diagram

ORGANIC MATTER STUDY
 SYNTHESIS OF RESULTS

WELL : 30/6-1
 COUNTRY : NORWAY

Plate: 5
 Date : MARCH 80



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PAYS
Country

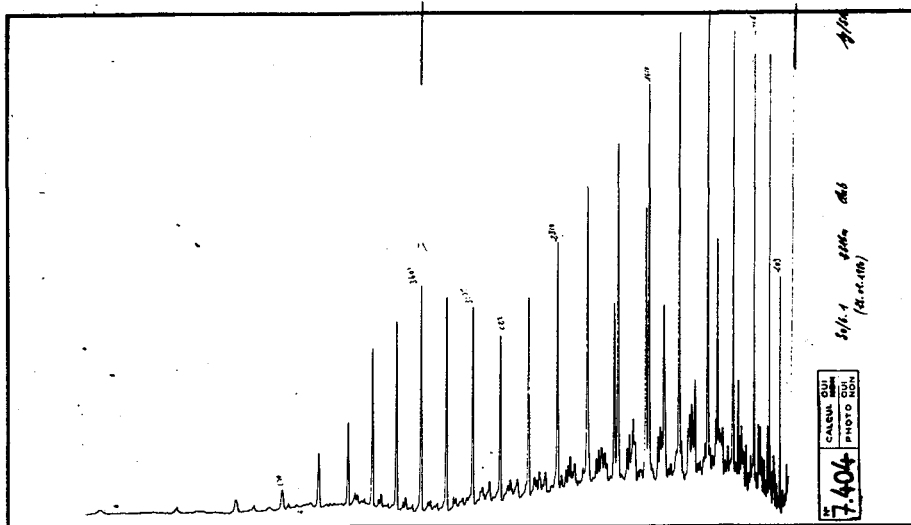
NORWAY

SONDAGE
Well

30/6-1

HC AROMATIQUES

AROMATIC HC



HC SATURES

SATURATED HC

2316 m

Pl.6

Cote
 Depth
 Identification
 Identification
 Roche
 Rock
 Formation
 Formation
 Age
 Age

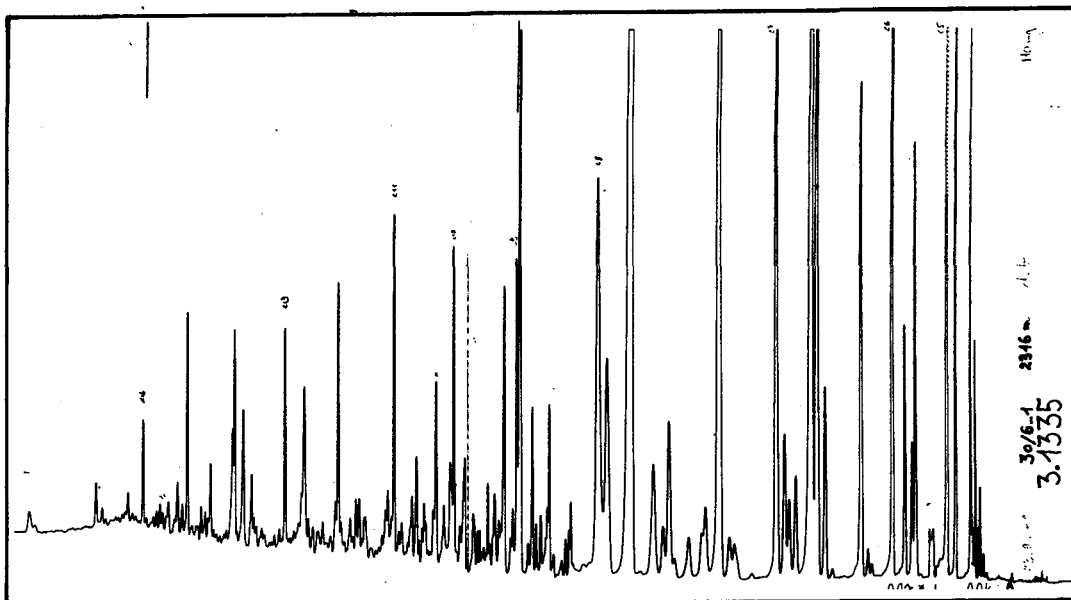
Swc

Brent Equivalent

EARLY TOARCIAN / LATE TOARCIAN

Composition du produit total (%)
 Composition of total product

Asphaltènes <i>Asphaltenes</i>	As	:	
Résines <i>Resins</i>	R	:	
HC saturés <i>Saturated HC</i>	S	:	$\frac{S}{A} =$
HC aromatiques <i>Aromatic HC</i>	A	:	
Distillat <i>Distillate</i>	D	:	



HC THERMOVAPORISES

THERMOVAPORIZED HC

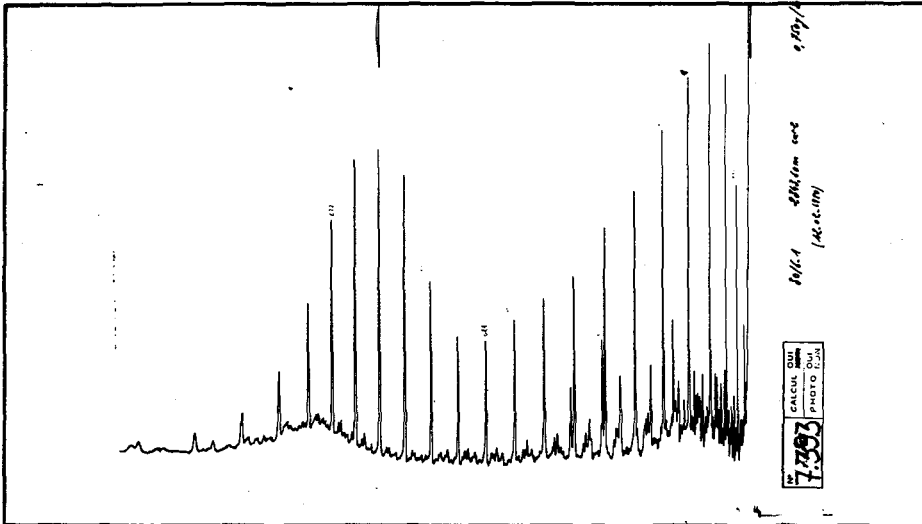
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Country

SONDAGE : 30/6-1
Well

HC AROMATIQUES AROMATIC HC

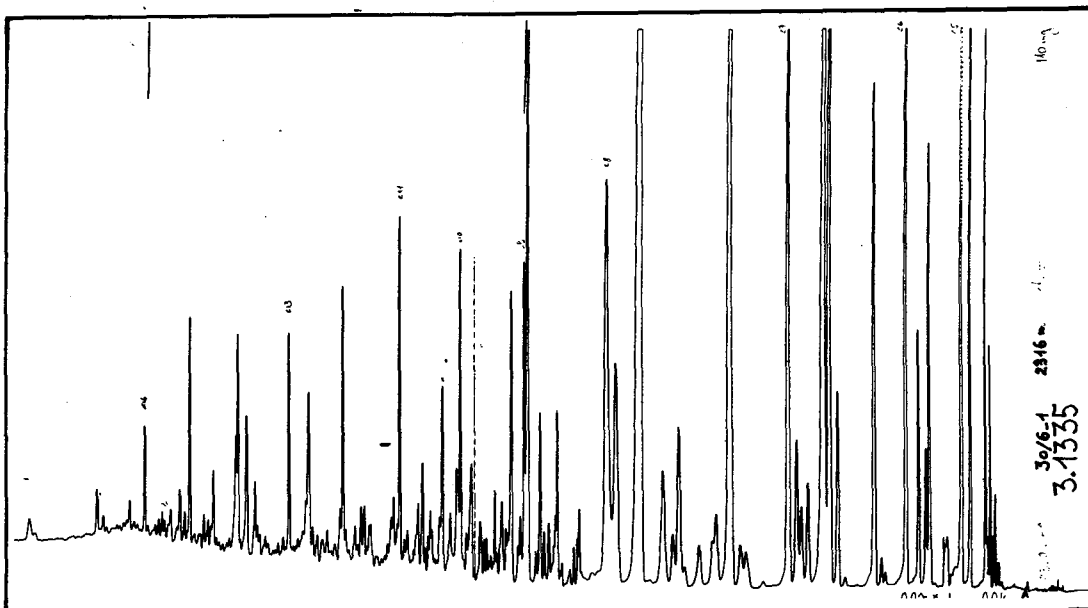


HC SATURES SATURATED HC

Cote Depth	2343,60 m
Identification Identification	Core n° 2
Roche Rock	Brent Equivalent
Formation Formation	TOARCIAN
Age Age	

Composition du produit total (%)
Composition of total product

Asphaltènes <i>Asphaltenes</i>	As	:	
Résines <i>Resins</i>	R	:	
HC saturés <i>Saturated HC</i>	S	:	$\frac{S}{A} =$
HC aromatiques <i>Aromatic HC</i>	A	:	
Distillat <i>Distillate</i>	D	:	

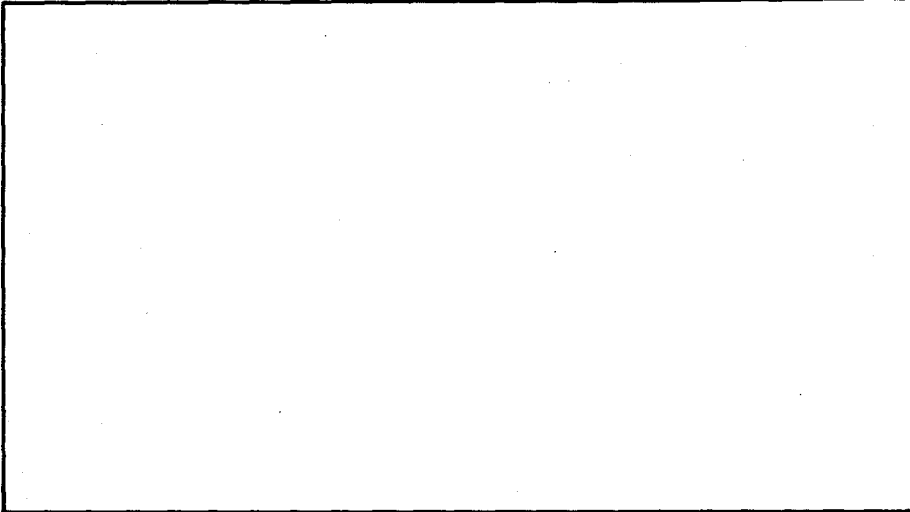


HC THERMOVAPORISES THERMOVAPORIZED HC

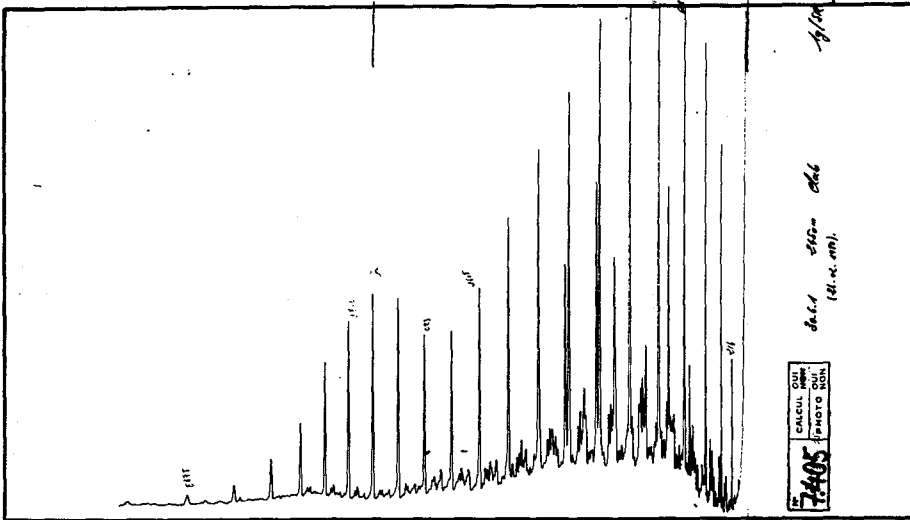
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SONDAGE : 30/6-1
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HC AROMATIQUES AROMATIC HC

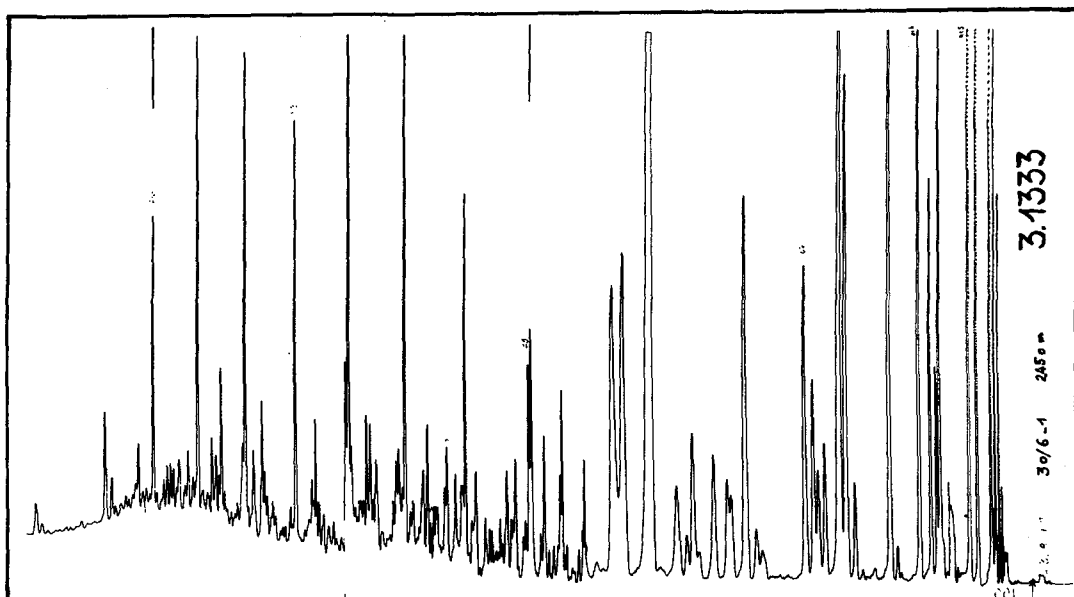


HC SATURES SATURATED HC

Huile Oil	Cote Depth	2450 m
Condensat Condensate	Identification Identification	Swc
Roche Rock	Formation Formation	
	Age Age	TOARCIA

Composition du produit total (%)
Composition of total product

Asphaltènes Asphaltenes	As	:	
Résines Resins	R	:	
HC saturés Saturated HC	S	:	$\frac{S}{A} =$
HC aromatiques Aromatic HC	A	:	A
Distillat Distillate	D	:	



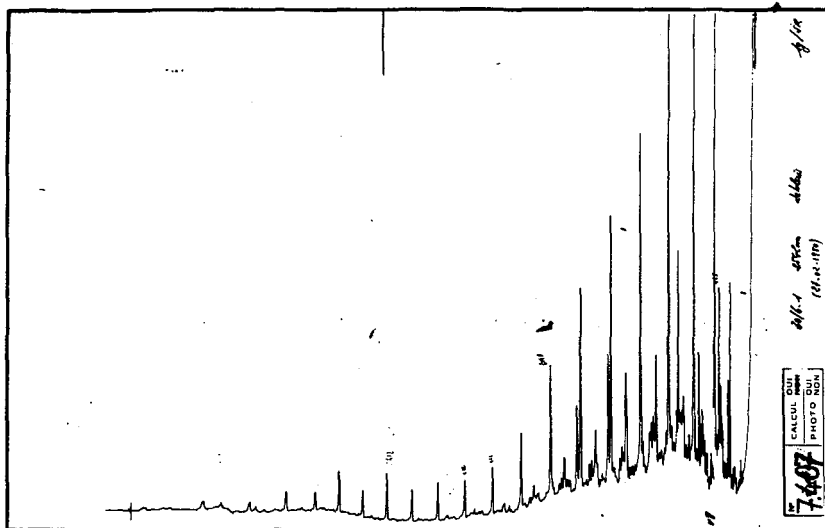
HC THERMOVAPORISES THERMOVAPORIZED HC.

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PAYS : NORWAY
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HC AROMATIQUES AROMATIC HC

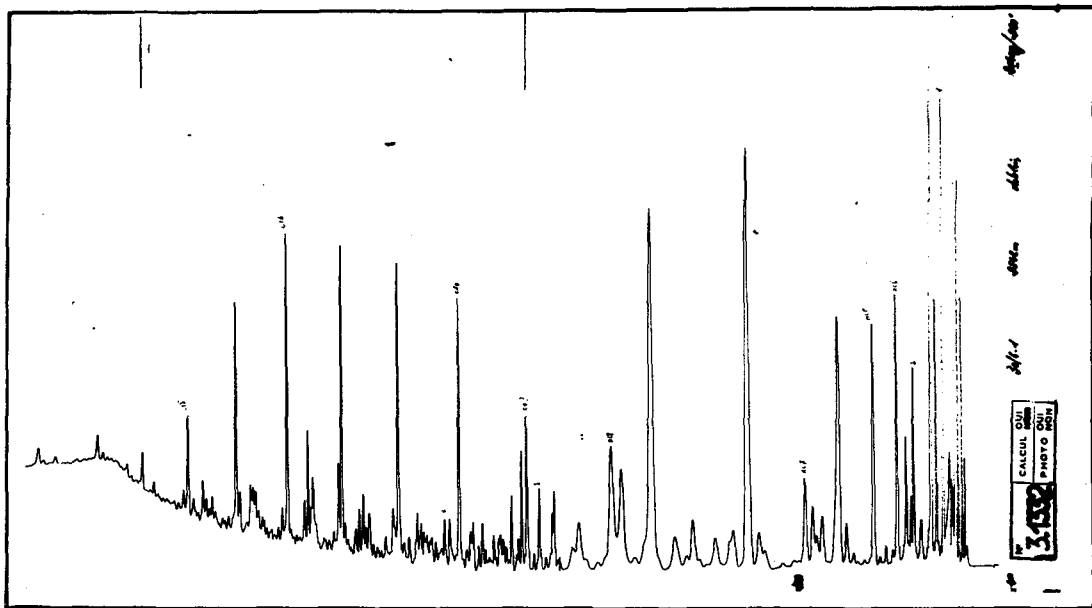


HC SATURES SATURATED HC

Huile Oil	Cote Depth	2542 m
Condensat Condensate	Identification Identification	Cuttings
Roche Rock	Formation Formation	Dunlin Equivalent
	Age Age	PLIENSBACHIAN

Composition du produit total (%)
Composition of total product

Asphaltènes Asphaltenes	As	:	
Résines Resins	R	:	
HC saturés Saturated HC	S	:	$\frac{S}{A} =$
HC aromatiques Aromatic HC	A	:	
Distillat Distillate	D	:	



HC THERMOVAPORISES THERMOVAPORIZED HC

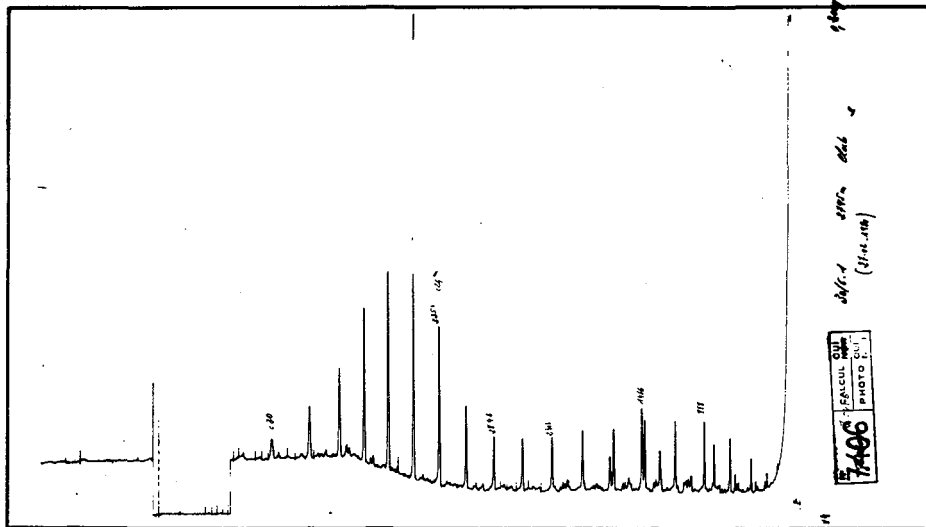
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HC AROMATIQUES AROMATIC HC

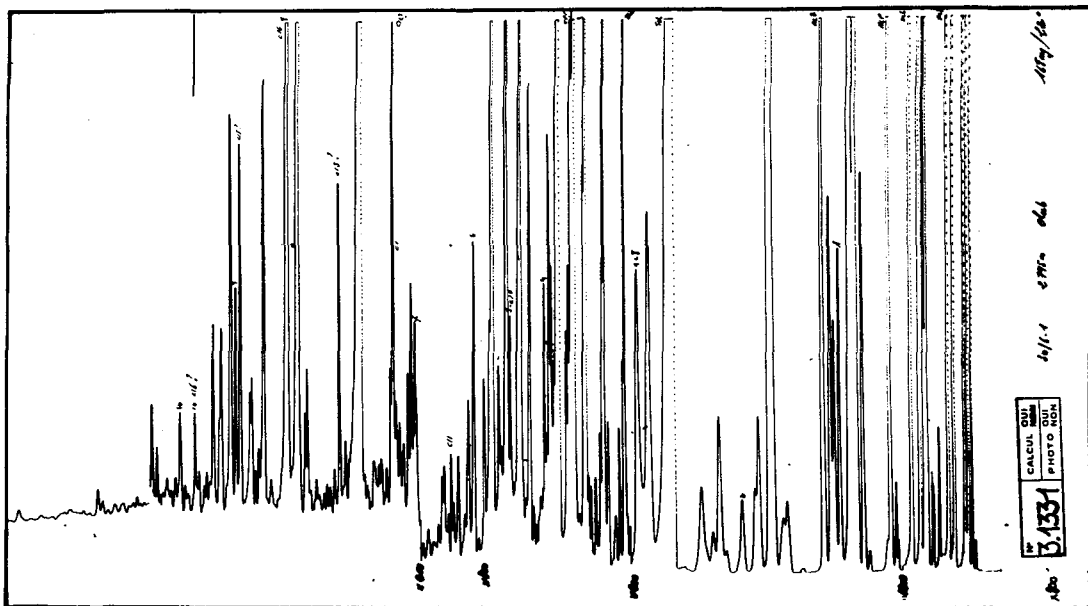


HC SATURES SATURATED HC

Huile Oil	Cote Depth	2795 m
Condensat Condensate	Identification Identification	Swc
Roche Rock	Formation Formation	Statfjord Equivalent
	Age Age	SINEMURIAN

Composition du produit total (%)
Composition of total product

Asphaltènes Asphaltenes	As	:	
Résines Resins	R	:	
HC saturés Saturated HC	S	:	$\frac{S}{A} =$
HC aromatiques Aromatic HC	A	:	
Distillat Distillate	D	:	



HC THERMOVAPORISES THERMOVAPORIZED HC