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EXPLORATION AND PRODUCTION DIVISION

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GEOCHEMISTRY BRANCH

GEOCHEMICAL ANALYSIS OF SEDIMENTS FROM THE WELL 6507/10-1, HALTENBANKEN AREA, OFFSHORE NORWAY

By

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Memorandum

To Dr A. M. Spencer
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From Dr H.A. Bockmeulen
Geochemistry Branch, Sunbury

Our ref GCB/19/83 Date 15th February 1983

Your ref

Subject GEOCHEMICAL ANALYSIS OF SEDIMENTS FROM THE WELL 6507/10-1

Please find attached Helen Ward's and Rosemary Woodhouse's interpretation of the geochemical data.

We are still not satisfied with the quality and results of the core extraction work and have therefore decided not to include them in the report in order to get the sediment data to you. The problem is being sure whether or not the hydrocarbons extracted from the core represent migrated oil or not. We will forward our interpretation as soon as we can.

I hope this solution is acceptable to you.

Regards.

H. Bockmeulen

H.A. BOCKMEULEN
Ext 8249

JDD

DATA BANK SUMMARY SHEET

Coordinates of area and/or wells described.

65°13'10.78"N 7°14'01.01"E

Country/Area:

OFFSHORE NORWAY (NORTH OF 62°)

Basin(s):

HALTENBANKEN

Stratigraphic range covered:

JURASSIC - TERTIARY

Report does/[illegible] contain significant well data.

Keywords:

CONTENTS

	Page No.
1. **INTRODUCTION**	1
2. **RESULTS AND DISCUSSION**	2
a) Maturity	2
b) Source potential	
3. **CONCLUSIONS**	

TABLES 1-8

FIGURES 1-11

ENCLOSURE 1

1. INTRODUCTION

The well 6507/10-1 is situated offshore Norway (Haltenbanken area) at 65° 13' 10.78"N 7° 14' 01.01"E. The sediments penetrated range in age from Triassic to Tertiary (TD 3698m). They comprise mudstones and siltstones, which are interbedded with sandstones and coals within the Lower Jurassic interval.

Geochemical analyses were undertaken to determine the maturity and source potential of these sediments. Sidewall cores and 30m cuttings composites were analysed, with the depths quoted in the text representing the top of the interval.

2. RESULTS AND DISCUSSION

a) Maturity

Measurement of vitrinite reflectance shows an increase in maturity with depth in the well. Those values considered reliable were used for statistical correlation. The Oil Generation Threshold (R_o = 0.55%) is predicted in the depth range 3674 ± 341m which places it around T.D. in this well (fig.1). Spore colours observed under transmitted and ultraviolet light also suggest the succession penetrated is essentially immature.

Eleven samples of Jurassic age were selected for soluble extract studies. The generation indices in all instances strongly suggest no significant hydrocarbon generation has yet commenced. Although the variation in the CPI apparently indicates the Kimmeridge and Heather Fm sediments are more mature than the underlying Coal Unit, this is due to the greater contribution of terrestrial organic matter in the latter sediments which most strongly influences the CPI.

Similarly conflicting data were obtained from GC-MS studies. Data from Coal Unit sediments suggest these are mature for hydrocarbon generation but the sterane and triterpane interpretations were hampered by the co-elution of a component beneath the C_{29} sterane peak and the ratios calculated may not be reliable. It is possible that bitumen has been analysed within some of the shallower samples, which may account for the anomalously high maturity levels indicated (Table 8).

On the basis of the data obtained, it is concluded that the Oil Generation Threshold lies at the base of this well. The lower Coal Unit sediments may have just commenced generation but the rest of the section penetrated is still immature.

b) Source Potential

Rock-Eval pyrolysis data indicate insignificant source potential in the Cretaceous and Tertiary sediments (1620-2780m). Hydrocarbon yields range from 0-0.7kg/tonne (average = 0.3kg/tonne). Within the Kimmeridgian and ~~top Heather Formations~~ (2785-2825m) the potential yields are very high, five of the seven samples pyrolysed yielding 21.0 to 67.9kg/tonne of hydrocarbons. These sediments are extremely rich in organic material (TOC = 6.2 - 12.1%wt) which is shown to be essentially oil prone by visual kerogen descriptions and Pyrolysis Gas Chromatography (PGC).

Siltstones and shales picked from the Mid to Lower Jurassic intervals give variable pyrolysis yields, ranging from 0-35.8 kg/tonne. There are several apparently rich source intervals within this section which have moderate to good organic richness (TOC = 1.9 - 7.9 %wt) and are oil to oil/subordinate gas prone. These potential source horizons are of unknown thickness and lateral extent and may even represent cavings from the Kimmeridge Clay Formation.

As would be expected, the Jurassic Coal Unit has extremely good source potential (P_2 = 240 - 246 kg/tonne) and is highly rich in organic matter (TOC = 10.9 - 61.2 %wt). The kerogen is predominantly gas prone (GOGI = 0.34 - 0.55) although source potential to generate liquid hydrocarbons may be expected.

Examination of the organic material shows the environmental changes within the sediments of 6507/10-1; from the marine Cretaceous interval to the terrestrially derived Jurassic Coal Unit. The Lower to Middle Jurassic interbedded sandstone, siltstone and mudstone sequence reflects the alternating terrigenous and marine influxes which accompanied the regression. Carbon isotope values range from $\delta^{13}C$ = -29.8°/oo to -24.4°/oo, the variations again showing changes from terrestrial to marine environments of deposition.

The n-alkane distributions of the coal unit samples (fig.3) clearly show the terrestrial nature of the organic material and this is also evident from GCMS data (figs. 6-11).

The presence of triterpane X in sediments at 2810m and 3290m (figs 6 + 8) could be a good oil-source correlation factor in the future.

3. CONCLUSIONS

1. Maturity data for this well indicate the Oil Generation Threshold lies at the base of the drilled section.

2. The Kimmeridge and top Heather Formations have good to excellent oil source potential.

3. Several intervals within the lower to middle Jurassic sandstone-siltstone section show moderate to very good source potential for oil and oil/subordinate gas. The thickness and lateral extent of these intervals is unknown.

4. The Jurassic coal unit shows excellent source potential, predominantly for gas. Minor oil generation may have commenced at the base of the well.

5. The organic material in the sediments reflects the change in environment of deposition from marine (Cretaceous) to terrestrial (Jurassic Coal Unit)

TABLE 1

VITRINITE REFLECTANCE DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH (m)	REFLECTANCE VALUES(%Ro)	COMMENTS
1500	.37(22)	VL/MOD BS/VST+PAR SUB I - Y/O(SPORES)
1590	.43(12)	TR PHY/F BW+OCC VW+I PAR - Y/O(SPORES)
1650	.31(17)	LIGHT BS/VL PHY/PAR V - Y-LTO(SPORES)
1740	.32(20)	BS/TR V+I PAR+W - Y+YO(SPORES)
1830	.34(20)	L-MOD BS/VL PHY/V PAR+W PAR+TR I - Y+YO(SPORES)
2010	.22(3).41(8)	PL SML BW+LIGHT BS/TR I PAR+V PAR+W - Y/O(SPORES)
2040	.3(1)	BW+LIGHT BS/BAR TWO I PAR+ONE V - Y/O(SPORES)
2130	0(0)	NDP/GN BW+BS/TR PHY/SML GN PAR/I+RM - Y/O(SPORES)
2220	.42(20)	BW+BS/MOD PHY/I+R PAR/TR V PAR - Y-LTO(SPORES)
2310	.36(9)	BW+BS/MOD PHY/ALMOST WH PAR TR V PAR - Y+YO(SPORES
2400	.42(11)	LIGHT BS+W/MOD PHY/MAIN I+R PAR/TR V PAR -Y+YO)SPO
2550	.36(7).5(6)	BW+MOD BS/MOD PHY/I+R PAR/TR V PAR - Y+YO(SPORES)
2550	.64(1)	BW+MOD BS/MOD PHY/I+R PAR/TR V PAR - Y+YO(SPORES)
2610	.66(2).48(7)	L-MOD PHY/SML GN PAR I+RM/TR V PAR - Y+YO (SPORES)
2700	.6(13).47(6)	BW/MOD PHY/I+R PAR+SUB V PAR - Y+Y/O(SPORES)
2700	.7(1)	BW/MOD PHY/I+R PAR+SUB V PAR - Y+Y/O(SPORES)
2871	.44(20) Healer	MOD BS+BW/MOD PHY/R+I PAR/TR V PAR - Y/O+LTO(SPORE
2992	.44(7) Dross	TR PHY/F R+TRUE V PAR - Y/O(SPORES)
3037	.41(13).59(7)	OCC BW+BS/L-MOD PHY/R PAR+TR V PAR - Y-LTO(SPORES)
3149	.43(19).63(1)	BW+BS/L-MOD PHY/I+R PAR+TR V - Y/O+LTO(SPORES)
3250	.53(20) Cook	OCC BW/LOW PHY/I+R PAR+SUB VW+PAR - Y/O(SPORES)
3322	.55(20) cont	PL BW/BS/MOD PHY/LOT R PAR/I/TR V PAR-Y/YO+LTO(SPO
3450	.55(20)	BW/MOD PHY/VW+VST+LGN FR - LTO(SPORES)
3506	.53(20)	V+LIPTINITE S I - LTO(SPORES+CUTICLES)
3603	.57(3)	MOD PHY/I+R PAR/F V PAR - LTO(SPORES+HC SP)
3667	.55(20)	F BW/MOD CONT OF INCL COAL FR - LTO(SPORES+HC SP)

FIGURES IN PARENTHESES INDICATE NUMBER OF READINGS
SEE LIST OF ABBREVIATIONS OVERLEAF

TABLE 1A

VITRINITE TABLE ABBREVIATIONS

ANS - ANISOTROPIC
BS - BITUMEN STAINING
BAR - VIRTUALLY BARREN
CARB - CARBARGILITE
→CTGS - CUTTINGS
DMA - DRILLING MUD ADDITIVE
F - FEW
FR - FRAGMENTS
GN - GNARLED
I - INERTINITE
IGN - IGNEOUS TRACES
L - LOW ORGANIC CONTENT
LOW - LOWEST REFLECTANCES MEASURED
MOD - MODERATE ORGANIC CONTENT
NTV - NO TRUE VITRINITE
OCC - OCCASIONAL
P - POOR
PL - PLENTIFUL-PLENTY
R - REWORKED
RO - REFLECTANCE MEASUREMENT
RICH - RICH-HIGH ORGANIC CONTENT
SC - SCRUFFY
SLT - SILTSTONE
SP - SPECKS
STC - STRUCTURE
TB - TURBO-DRILLED
TEL - TELINITIC
VL - V.LOW ORGANIC CONTENT
VAR - VARIABLE (HIGH) RO
W - WISPS-WISPY
* - ALLOCTHONOUS
? - QUESTIONABLE
BL - BLEBS

B - BITUMEN
BW - BITUMEN WISPS
CAV - CAVED
COR - CORRODED
DD - DIFFERENTIATION DIFFICULT
DOM - DOMINANT
FL - FLUORESCENCE
G - GOOD
GRAN - GRANULARITY
INST - INTERSTITIAL
IRON - IRON OXIDES
LGN - LIGNITE
M - MOSTLY
NDP - NO DETERMINATION POSSIBLE
OBS - OVERALL BITUMEN STAINING
OX - INDICATIONS OF OXIDATION
PAR - PARTICLES
POS - POSSIBLY
RM - REWORKED MATERIAL
RES - RESIN
S - SOME
SH - SHALE
SML - SMALL
SUB - SUBORDINATE
STR - STRONGLY
TR - TRACE
V - VITRINITE
VW - VITRINITE WISPS
VST - VITRINITE STRINGERS
WH - WHOLLY
= - EQUAL PROPORTIONS
PHY - PHYTOCLASTS (CONTENT)

(SPORE FLUORESCENCE COLOURS UNDER U.V. LIGHT)

G - GREEN
O - ORANGE
LT - LIGHT
D - DEEP

Y - YELLOW
R - RED
M - MID
P - PALE

TABLE 2

VISUAL KEROGEN DESCRIPTIONS

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH(m)	SPORE COLOUR	ESTIMATED SOURCE POTENTIAL
162^	2	MOD OIL
1770	2	MOD-GOOD OIL
2010	2-2/3	NONE
2220	2-2/3	NONE
2310	2/3	NONE
2550	2-2/3	POOR OIL/GAS
2700	3	NONE-POOR OIL/GAS
2730	3	NONE-POOR OIL/GAS
2900	n.d.	NONE
3016	3	MOD GAS
3149	3	GOOD OIL/SUB GAS
3250	3	NONE
3278	3	GOOD GAS
3279	3	GOOD GAS
3280	3-3/4	GOOD GAS

TABLE 2A

Category	Level	3280	3279	3278	3250	3149	3016	2900	2730	2700	2550	2310	2220	2010	1770	1620
SAMPLES		3280	3279	3278	3250	3149	3016	2900	2730	2700	2550	2310	2220	2010	1770	1620
Type		SWC	SWC	SWC	SWC	SWC	SWC	SWC	CTS	CTS	CTS	CTS	CTS	CTS	CTS	CTS
Amount of Organic Matter		Large	V. Large	Mod	V.S.	Mod	Small	V.S	Small	Small	Small	V.S	Small	V.S	Small	Small
MIOSPORES	1-2 Trace/present	O		O	O				O		O	O	O			
	3 Common					O				O				O	O	O
	4 Frequent		O				O									
	5 Abundant															
DINOFLAGELLATE CYSTS AND ACRITARCHS	1-2					O	O									O
	3													O	O	
	4								O	O	O	O	O			
	5															
TASMANITIDS AND LEIOSPHERES	1										O				O	
	2															
	3															
FORAM LININGS	1										O	O	O	O		
	2														O	O
	3															
MEGASPORES	1															
	2															
	3															
OTHER MICROFOSSILS 1	1						O			O	O				O	O
	2								O		O					
	3															
OTHER MICROFOSSILS 2, MISCELLANEOUS PHYTOCLASTS	1															
	2														O	
	3															
CUTICLES	1-2	O	O	O		O	O					O				
	3															
	4-5															
OTHER TISSUES	1-2	O		O	O	O	O		O	O	O	O	O	O		O
	3		O					O							O	
	4-5															
BROWN 'WOOD' HUMINITE + VITRINITE	1-2				O	O	O		O	O	O	O	O	O	O	O
	3		O													
	4-5	O		O												
BLACK 'WOOD' VITRINITE + INERTINITE	1-2					O		O						O	O	O
	3		O	O	O		O		O				O			
	4-5	O		O						O	O	O				
BLACK 'WOOD'; REWORKED VITRINITE & INERTINITE ONLY	1-2		O	O		O		O						O	O	O
	3				O				O		O	O	O			
	4-5									O						
FINELY DISSEMINATED PARTICLES	1-2	O		O	O			O	O	O	O	O	O	O		
	3								O	O	O					O
	4-5		O	O		O	O					O	O	O	O	
AMORPHOUS VASCULAR PLANT MATERIAL	1-2			O					O		O					
	3			O					O						O	
	4-5		O				O									
AMORPHOUS MATTER OF ALGAL ORIGIN; MARINE (M) NON MARINE (N)	1-2								O	O	O	O		O		
	3								m	m	m	m		m		
	4					O									O m	O
	5					m										m
PRESERVATION STATE	good		O	O									O	O		
	fair	O		O	O	O	O			O		O	O	O	O	O
	poor	O			O	O	O		O	O	O					
Reworking (1-5)																
ENVIRONMENT OF DEPOSITION	undiff. mar.															
	open mar.								O	O	O	O	O	O		
	restricted mar.					O									O	O
	nr. shore mar./strong terrig. infl.														O	O
	some mar. influence/brackish				O		O									
	non-mar./freshwater	O	O	O												
COLOUR/MATURATION	1							↑								
	2							ND			O	O	O	O	O	O
	3	O	O	O	O	O	O		O	O	O	O	O	O		
	4	O						↓								
	5															
	6															
	7															
SOURCE POTENTIAL FOR OIL (O) AND GAS (G)		GOOD GAS	GOOD GAS	GOOD G/AS.	NONE	GOOD/SUB G	MOD GAS	NONE	NONE. POOR O/G	NONE. POOR/G	POOR O/G	NONE	NONE	NONE	MOD-GOOD O	MOD O

TABLE 3

ROCK-EVAL AND PYROLYSIS DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH (m)	P1 KG/TONNE	P2 KG/TONNE	GOGI	TOC (%wt)	HYDROGEN INDEX	
1620	0	.1				
1680	0	.3				
1770	0	1				
1830	0	.7				
1890	0	.4				
1980	0	.1				
2010	0	.5				
2040	0	.5				
2130	0	0				
2220	0	.2				
2310	0	.2				
2400	0	.3				
2610	0	.5				
2700	0	.2				
2760	0	.3				
2775	0	.2				
2780	.1	.3				
2785 ×	2.1	67.7	.14	10.9	621	
2790 ×	.2	59.3	.22	8.6	689	
2797 ×	1.1	42.2	.28	8.5	496	
2803 ×	1	21.9	.19			Kimmeridge Clay
2808 ×	0	.1				
2810 ×	1.3	50.4	.25	9.6	525	
2831 ×	.1	1.4		1.9	73	
2837 ×	.2	1.3		2.5	52	
2840 ×	.1	.2		8.4	2	
2843 ×	.1	.3		.84	35	
2848 ×	.1	.4		1.2	33	Heather
2862 ×	.1	0				
2871 ×	0	0				
2877 ×	.1	.5		.96	52	
2990 ×	.5	23.8	.26	5.6	425	← silt at base Brent
2992 ×	0	0				
3016 ○	.1	.4		.8	50	
3020 ○	.7	32.9	.2	7.9	416	Drake
3037 ○	.1	1.8		1.9	94	
3120 ×	.2	5.7	.24			
3149 ×	.3	5.4	.21	2.1	257	
3200 ×	.1	0				
3225 ○	.3	2.7	.38	2.4	112	Cook
3250 ×	.2	.3		1	30	
3290 ○	1.2	35.8	.2	5	716	
3342 ○	0	0				
3374 ×	.2	1		1.4	71	
3400 ×	.3	3.1		3	103	Coal Unit
3462 ×	5.6	245	.55	65.8	372	
3472 ×	8.6	240	.38			
3499 ×	.8	30.2	.39	10.9	277	

TABLE 3 CTD

ROCK-EVAL AND PYROLYSIS DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH (m)	P1 KG/TONNE	P2 KG/TONNE	GOGI	TOC (%wt)	HYDROGEN INDEX
3506 - S coal	9.4	246	.34	61.2	403
3550 - S mud	0	0			
3598 - S sst	0	0			
3603.9 - S mud	0	0			

NOTE:- GOGI VALUE IS A NUMERICAL REPRESENTATION OF THE SOURCE POTENTIAL OF A SAMPLE AT ITS PRESENT MATURITY. INTERPRETATION WITHOUT REFERENCE TO PYROLYSATE DISTRIBUTION & MATURITY MAY BE MISLEADING !

TABLE 3A

KEROGEN PYROLYSATE DATA

WELL: 6507/10-1

Sample Depth	%wt in P2						GOGI
	C1	C2-C5	C6-C9	C10-C13	C14-C22	C23-C36	C1→C5 / C6→C36
2785	7.8	4.5	21.2	17.2	30.9	18.4	.14
2790	15.1	2.7	15.6	17.8	30.1	18.1	.22
2797	20.3	1.3	12	15.6	31.4	19.4	.28
2803	9.8	6.4	16.2	18.3	31.4	17.9	.19
2810	17.7	2.4	12.6	14.9	30.6	21.8	.25
2990	18.4	2.5	17.3	18.5	28.6	14.7	.26
3020	11.4	5.3	16.2	16.8	30.4	19.9	.2
3120	13.1	6.3	15.1	18	31.1	16.4	.24
3149	13.2	4.1	17.4	18.6	30.7	10	.21
3225	20.9	6.6	17.1	18.1	25.8	11.5	.38
3290	10.2	6.7	16.5	17.2	29.8	19.6	.2

Clay
Kimm.
Drake
Cook

TABLE 3A

KEROGEN PYROLYSATE DATA

WELL: 6507/10-1

Sample Depth	%wt in P2						GOGI
	C1	C2-C5	C6-C9	C10-C13	C14-C22	C23-C36	
3462	32.8	2.6	8.5	12.7	24.5	18.9	.55
3472	23	4.7	13	14.1	27	18.2	.38
3499	18.7	9.4	14.6	13.9	25.7	17.7	.39
3506	21.3	4	16.7	14.6	26.6	16.8	.34

Coal Unit

TABLE 4

LITHOLOGY AND TOC DATA

WELL: 6507/10-1 ADDITIONAL DATA
LOCATION: OFFSHORE NORWAY

DEPTH(m)	AGE/FM	PICKED LITHOLOGY	%TOC	%CARBONATE
1620	TERT/HORDALAND	SHALE-C	0.82	.36
1680	TERT/HORDALAND	SHALE-C	0.48	3.6
1770	TERT/HORDALAND	SHALE-C	1.4	7.6
1830	TERT/HORDALAND	SHALE-C	0.89	.41
1860	TERT/HORDALAND	SHALE-C	0.71	5.8
1980	CRET/BALDER	SHALE-C	0.32	1.1
2010	CRET/BALDER	SHALE-C	0.75	.19
2040	CRET/BALDER	SHALE-C	0.88	1.9
2130	CRET/SHETLAND	SHALE-C	0.45	.5
2220	CRET/SHETLAND	SHALE-C	0.94	.08
2310	CRET/SHETLAND	SHALE-C	1	.29
2400	CRET/SHETLAND	SHALE-C	0.98	.09
2610	CRET/SHETLAND	SHALE-C	0.9	.19
2700	CRET/SHETLAND	SHALE-C	1	.06
2760	CRET/SHETLAND	SHALE-C	3.4	43.5
2775	CRET/SHETLAND	MDST-S	0.54	16.6
2780	CRET/SHETLAND	LST-S	0.73	57.8

SAMPLE TYPES :-
N-CORE SAMPLE
S-SIDEWALL CORE
O-OUTCROP
C-CUTTINGS

TABLE 4 CTD

LITHOLOGY AND TOC DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH(m)	AGE/FM	PICKED LITHOLOGY	%TOC	%CARBONATE	
2785	U.JUR/KIMM	MDST-S	10.9	10.4	
2790	U.JUR/KIMM	MDST-S	8.6	.09	
2797	U.JUR/KIMM	MDST-S	8.5	.47	
2801	U.JUR/KIMM	MDST-S	6.2	.35	
2808	U.JUR/KIMM	MDST-S	0.21	7.6	Kimm
2810	U.JUR/KIMM	MDST-S	9.6	.13	
2825	U.JUR/KIMM	MDST-S	12.1	2.8	
2828	U.JUR/KIMM	MDST-S	1.7	7.2	
2831	U.JUR/KIMM	MDST-S	1.9	1.3	
2837	U JUR/HEATHER	MDST-S	2.5	.17	
2840	U JUR/HEATHER	MDST-C	8.4	.24	
2843	U.JUR/HEATHER	SILTST-S	0.84	.86	
2848	U.JUR/HEATHER	CARB SILTST-S	1.2	1.2	Heather
2862	U.JUR/HEATHER	SILTST-S	0.5	16	
2871	U.JUR/HEATHER	SILTST-S	0.74	.25	
2877	M JUR SILTST FM	MDST-S	0.96	.43	
2990	M JUR SST FM	MDST-C	5.6	.18	
2992	M JUR SST FM	SILTST-S	0.17	.3	
3016	L JUR SILTST FM	SILTST-S	0.8	.53	Drake
3020	L JUR SILTST FM	MDST-C	7.9	5.9	
3037	L JUR SILTST FM	SILTST-S	1.9	.2	
3149	L JUR SST FM	SILTST-S	2.1	.17	
3200	L JUR SST FM	SILTST-S	0.1	.34	
3225	L JUR SST FM	SILTST/SST-S	2.4	2.1	Cook
3250	L JUR SST FM	SILTST/SST-S	1	.27	
3290	L JUR SST FM	SILTST-C	5	3.4	
3342	L JUR COAL UNIT	SST-S	0.13	.5	
3374	L JUR COAL UNIT	SST/COAL-S	1.4	.4	
3400	L JUR COAL UNIT	SST/CARB MDST-S	3	.46	
3462	L JUR COAL UNIT	COAL-S	65.8	16.3	
3499	L JUR COAL UNIT	MDST-S	10.9	.28	Coal Unit
3506	L JUR COAL UNIT	COAL-S	61.2	.96	
3550	L JUR COAL UNIT	MDST-S	0.62	1.9	
3598	L JUR COAL UNIT	SST-S	0.13	3.1	
3603	L JUR COAL UNIT	CARB MDST-S	1.1	6.6	

SAMPLE TYPES :-
N-CORE SAMPLE
S-SIDEWALL CORE
O-OUTCROP
C-CUTTINGS

TABLE 5

SEDIMENTS SOLUBLE EXTRACT DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH (m)	TOC %wt	TSE/TOC o/oo	SAC/TOC o/oo	CPI	ASPHALTENES %wt	
2785	10.9	46	4	1.11	28.9	
2797	8.5	40	3	1	35.2	Kimm
2810	9.6	26	2	1.01	36.1	
3020	7.9	36	3	1.12	35.5	
3037	.89	33	12	1.25	n.d.	Drake
3120	1.9	26	7	1.42	n.d.	
3149	2.1	2	5	1.43	n.d.	Cook
3290	5	36	6	1.18	n.d.	
3472	54.7	16	2	1.27	42.2	
3499	10.9	11	1	1.23	52.3	Cook Un
3506	61.2	2	1	1.28	48.4	

TABLE 6

SEDIMENTS SOLUBLE EXTRACT DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

DEPTH(m)	%SAC	%TSE	PRIST/PHYT	PRIST/C-17	PHYT/C-18	
2785	10.44	.51	1.66	2.59	1.7	
2797	9.54	.34	1.53	2.64	1.8	Kimm
2810	10.26	.25	2.52	4.31	1.62	
2880.5	30.9	.001	N.D.P.	N.D.P.	N.D.P.	Brent
3020	9.94	.29	1.74	3.34	2.05	
3037	37.29	.03	4.02	2.06	.56	Drake
3073	22.7	.002	1.22	.62	.57	
3120	29.92	.05	4.04	3.83	.92	
3149	24.31	.05	5.01	2.73	.67	Cook
3290	17.4	.18	1.84	2.78	1.74	
3472	15.05	.88	7.19	3.22	.38	
3499	13.8	.13	5.73	2.28	.32	Cook ?
3506	11.05	.18	6.95	5.93	.84	

TABLE 7

CARBON ISOTOPES DATA

WELL: 6507/10-1
LOCATION: OFFSHORE NORWAY

	DEPTH (m)	ISOTOPE RATIO PERMIL	SAMPLE TYPE	
SWC	2785	-29.8	KEROGEN	
SWC	2797	-28	KEROGEN	Krimm
SWC	2810	-25.4	KEROGEN	
C	2880.5	-27.8	CORE EXTRACT(TSE)	Brent
[illegible]	3020	-27.4	KEROGEN	
[illegible]	3037	-27	KEROGEN	Drake
C	3073	-26.8	CORE EXTRACT(TSE)	
SWC ?	3120	-26.5	KEROGEN	
SWC	3149	-26.5	KEROGEN	Cook
[illegible]	3210	-26.8	KEROGEN	
SWC ?	3472	-25.6	KEROGEN	
SWC	3499	-25.7	KEROGEN	Coal U
SWC	3506	-28.3	KEROGEN	

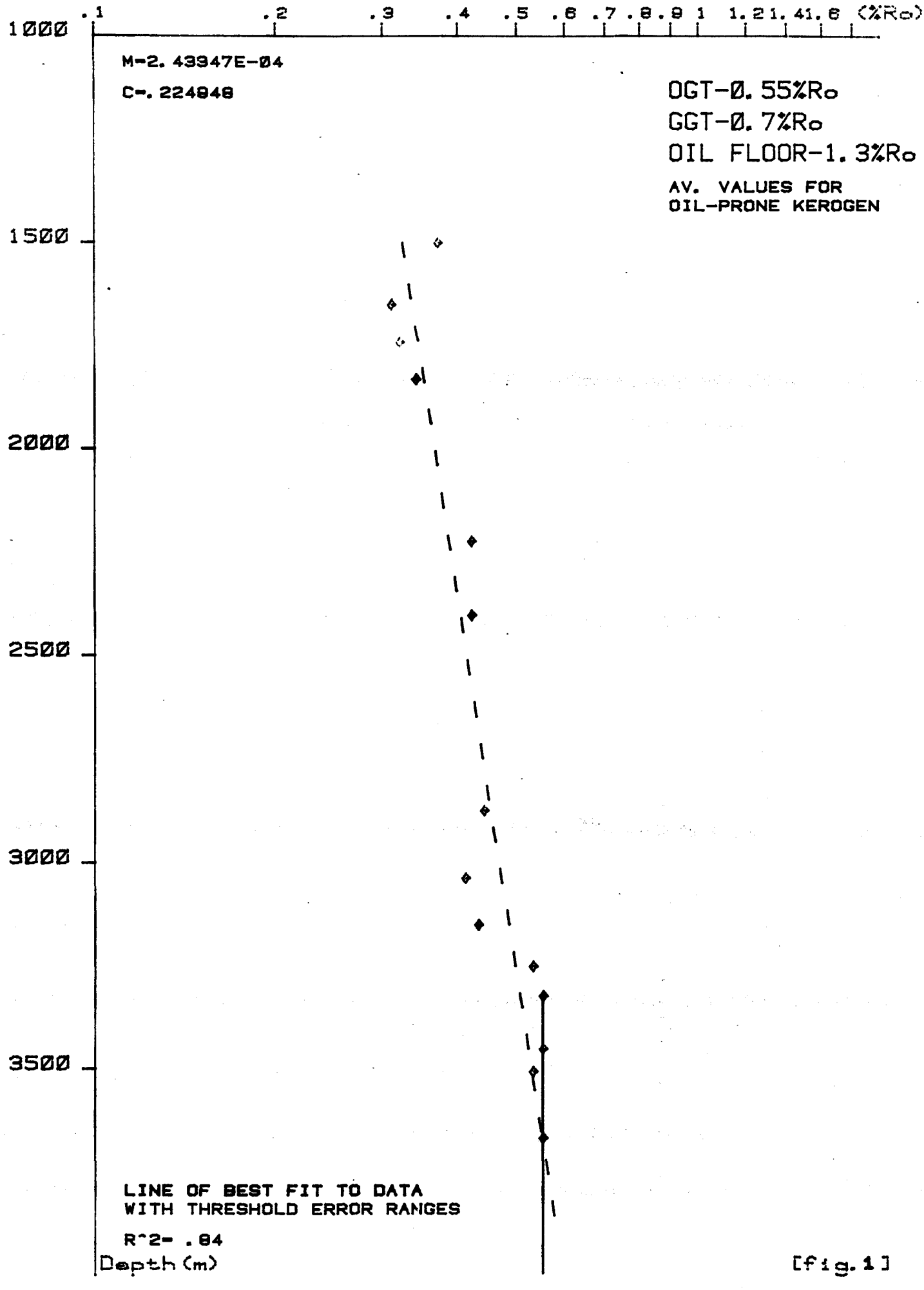
C-13/C-12 ISOTOPE RATIOS RELATIVE TO PDB STANDARD
SECONDARY STANDARD: NBS-22 AT -29.4 PERMIL

TABLE 8

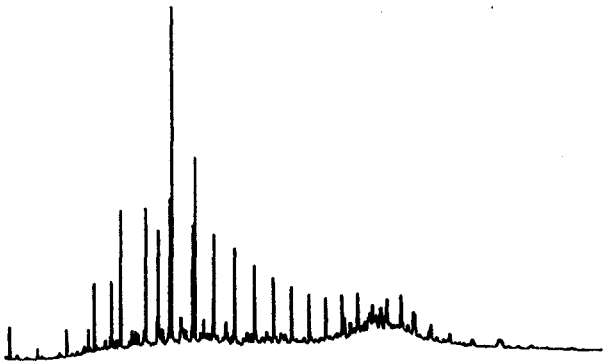
MOLECULAR PARAMETERS GC/MS ANALYSIS

PARAMETER CODE	2810m	3120m	3290m	3472m	3499m	3506m
H1	0.56	0.50	0.53	0.58	0.58	0.57
H2	0.53	0.54	0.55	0.57	0.57	0.68
H3	0.83	0.75	0.76	0.76	0.75	0.75
S1	0.46	0.24	0.27	0.48	0.48	0.54
S2	0.57	0.28	0.45	0.39	0.36	0.42
S3	-	23.4:12.9:63.7	30.6:28.4:40.9	6.6:14.3:79.1	8.1:19.7:72.2	12.9:17.1:69.9

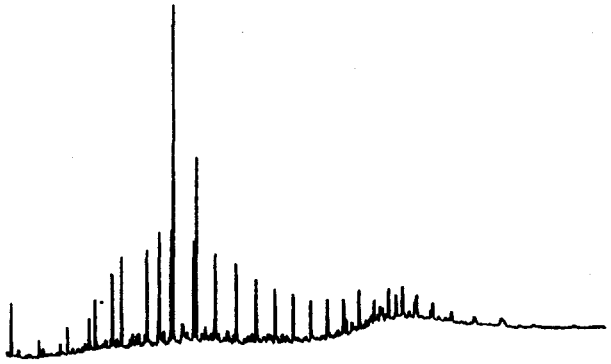
Vitrinite Reflectance Analysis
for well: 6507/10-1



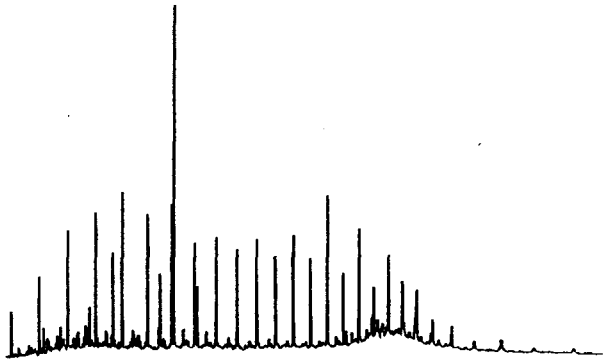
[fig.1]



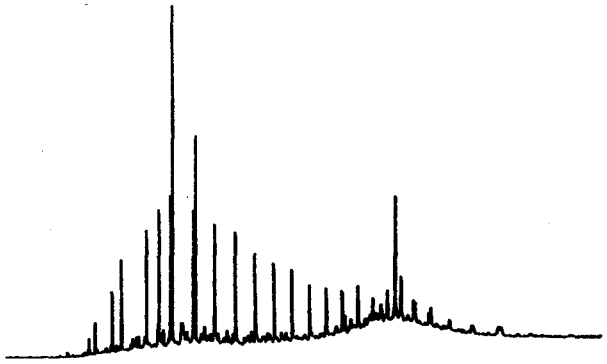
SAMPLE: 2705m



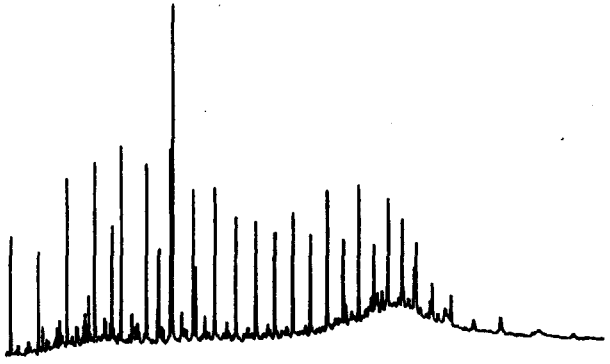
SAMPLE: 9020m



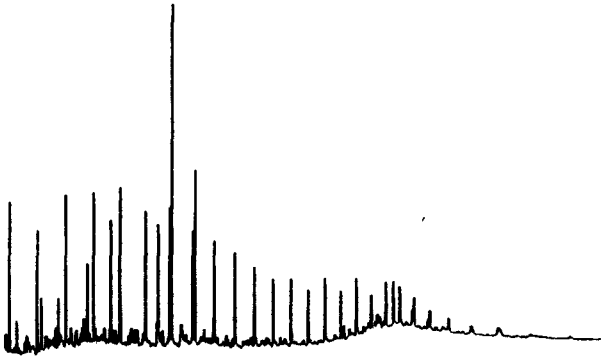
SAMPLE: 9140m



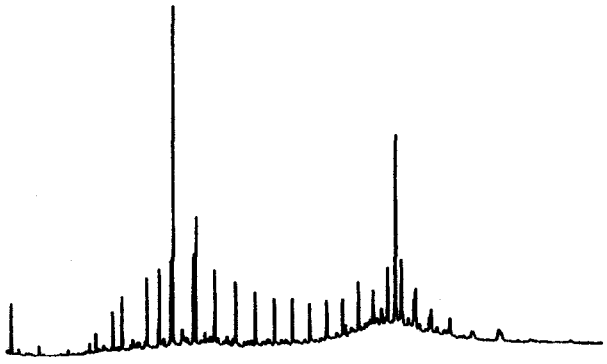
SAMPLE: 2707m



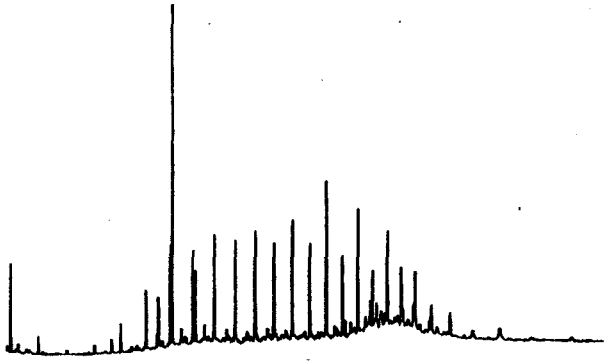
SAMPLE: 9097m



SAMPLE: 9280m



SAMPLE: 2810m

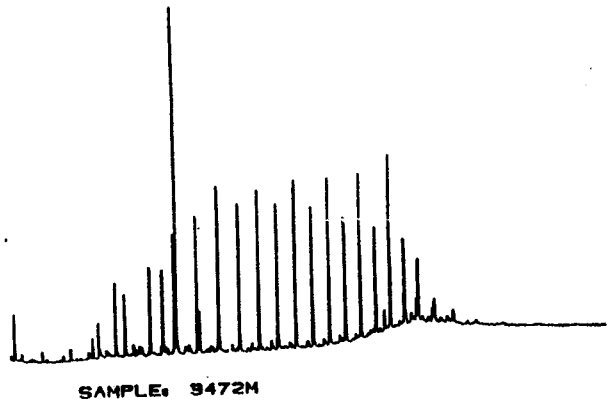


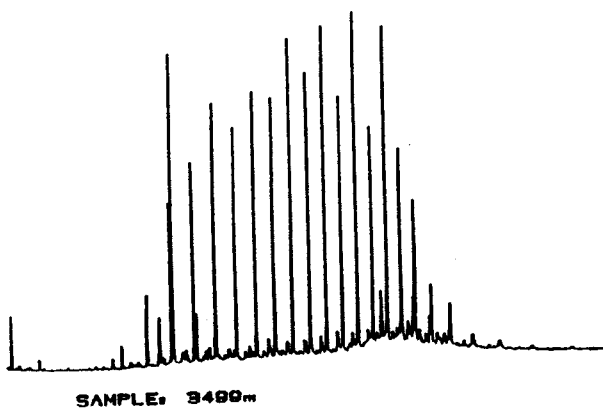
SAMPLE: 9120m

GEOCHEMISTRY BRANCH, BP SUNBURY

SAC FRACTION GAS CHROMATOGRAMS

Fig. 2





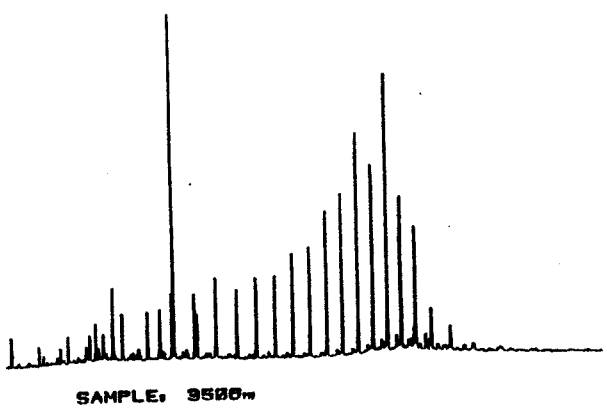
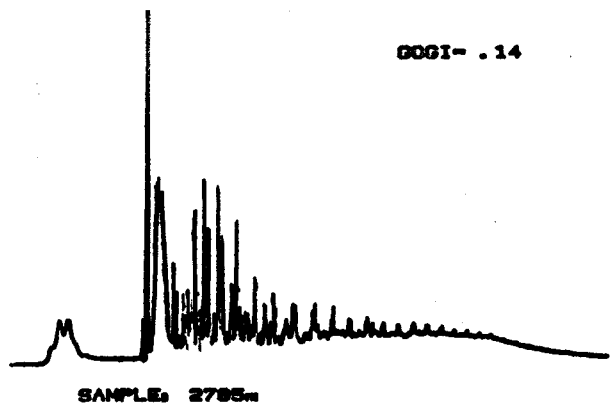
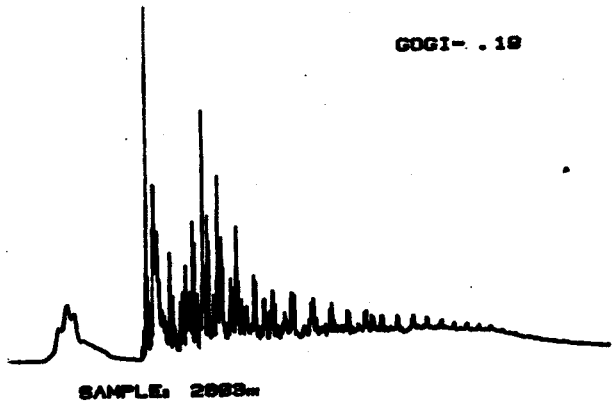


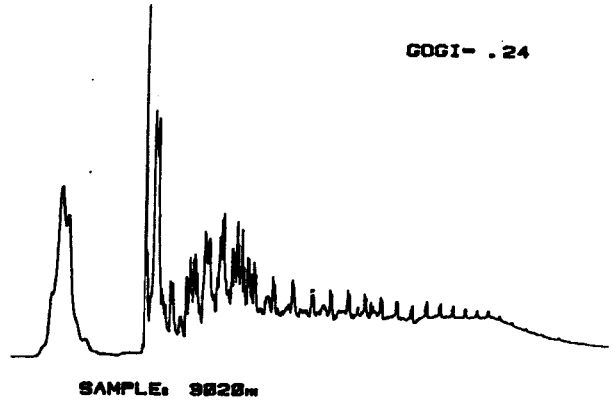
Fig. 2

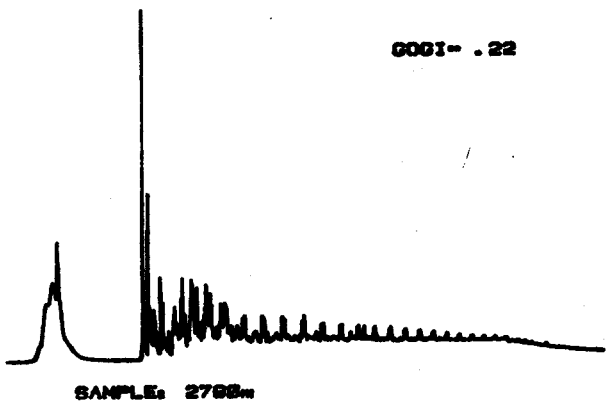
GEOCHEMISTRY BRANCH, BP SUNBURY

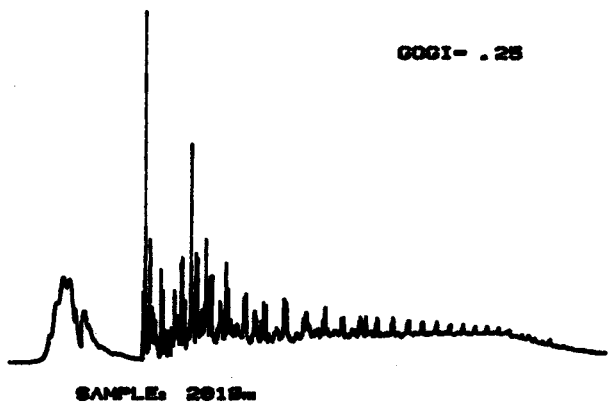
SAC FRACTION GAS CHROMATOGRAMS

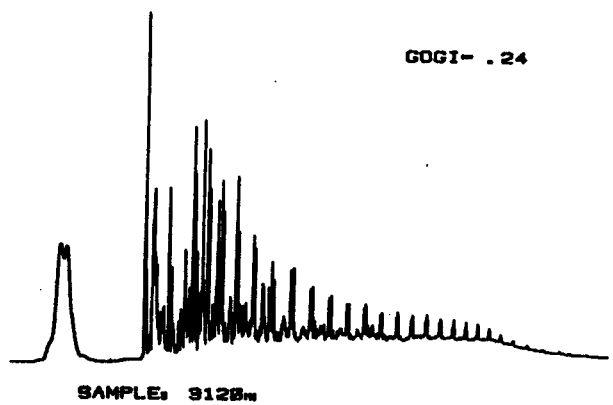


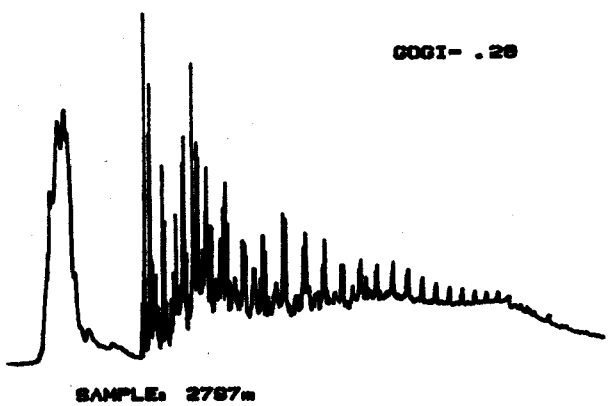


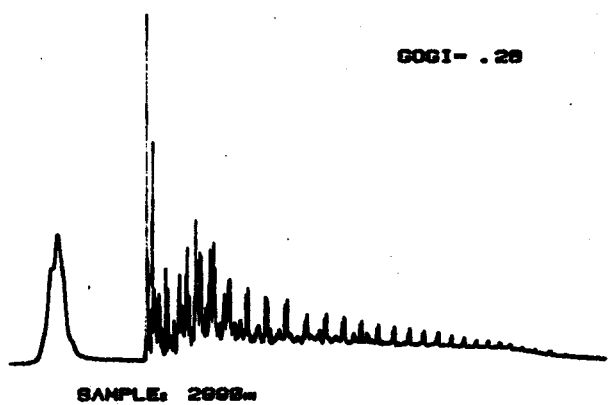








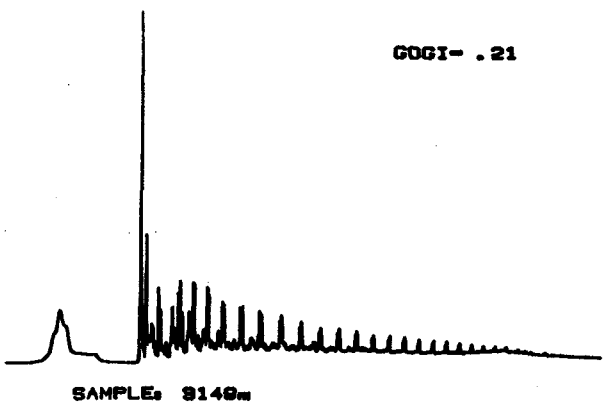


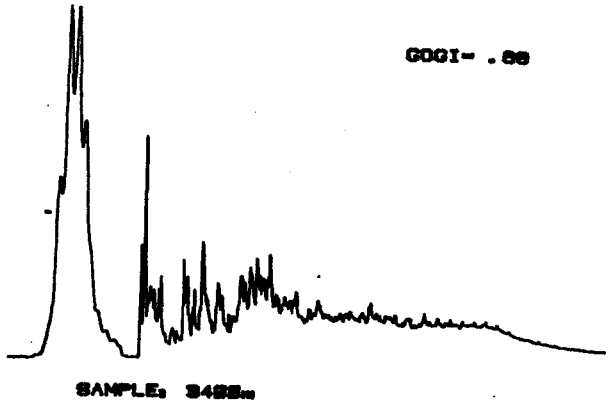


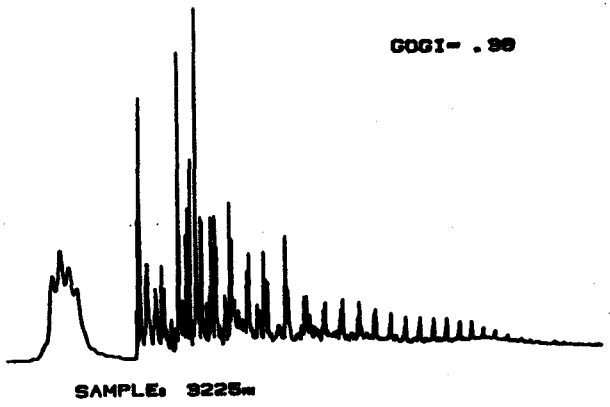
GEOCHEMISTRY BRANCH, BP SUNBURY

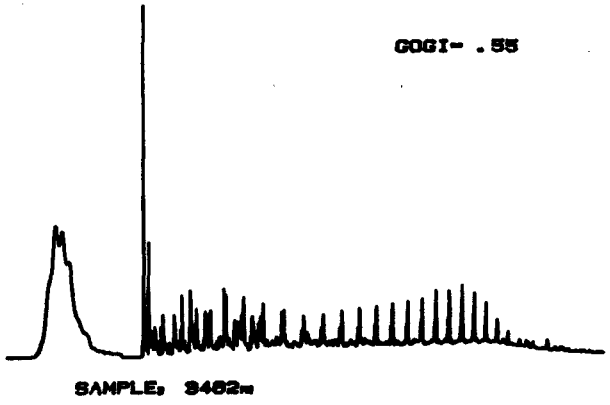
KEROGEN PYROLYSATES (P2)

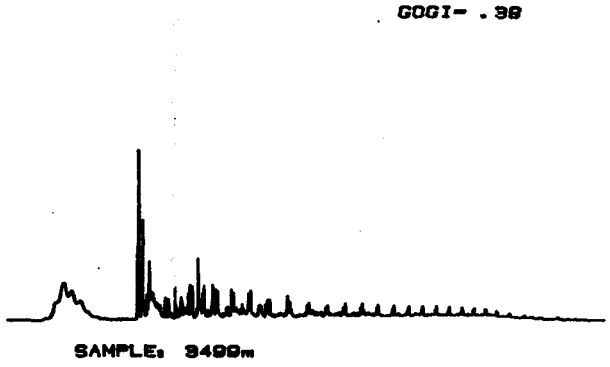
Fig. 4

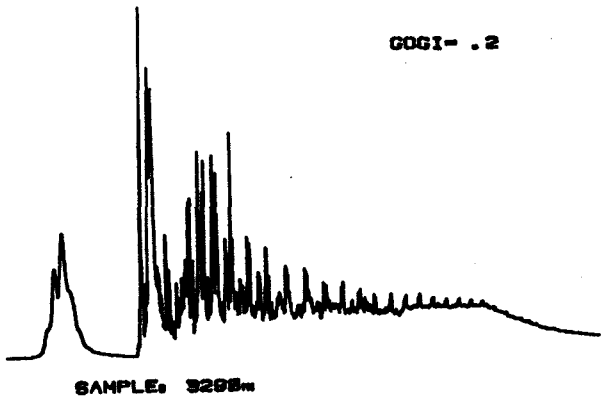


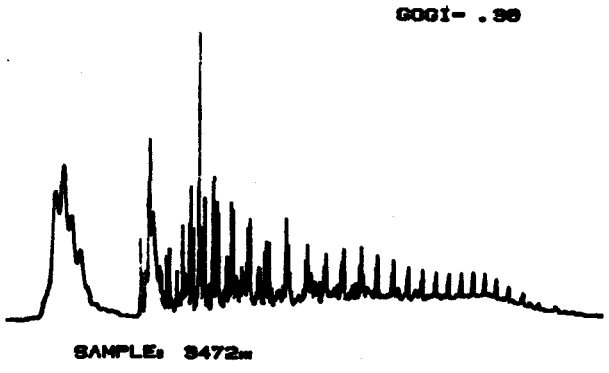












GEOCHEMISTRY BRANCH, BP SUNBURY

KEROGEN PYROLYSATES (P2)

Fig. 5

ANALYSIS NAME: DM00:[300,301]M714.MIS;1 V04.0 WINDOW: 1

TITLE: 2810 SATS DNZ NORWAY

OPERATOR: C MAILE DATE: 10-JAN-83 11:25:37

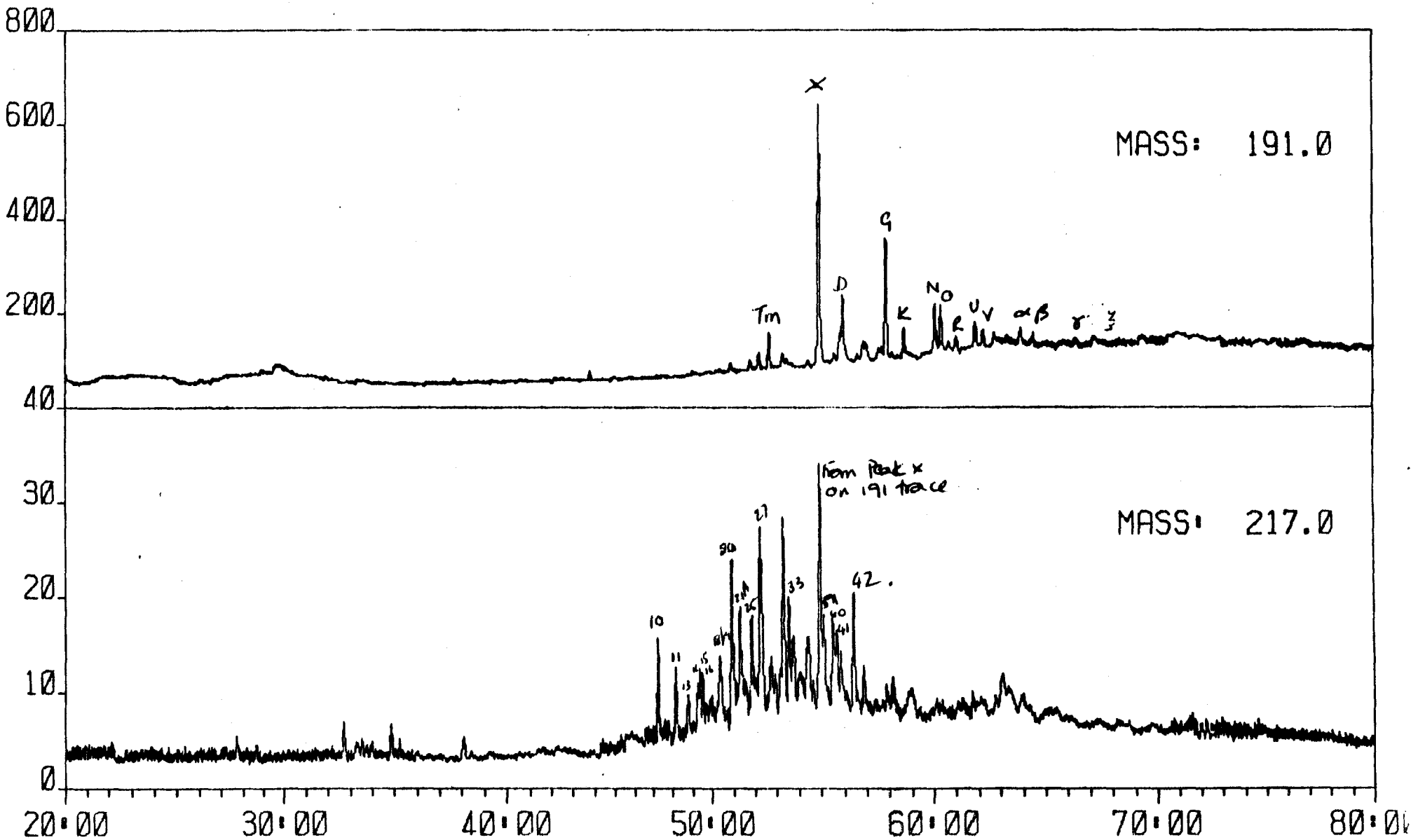


Fig. 6

ANALYSIS NAME: DM00:[300,301]M715.MIS;1 V04.0 WINDOW: 1

TITLE: 3120 SATS DNZ NORWAY

OPERATOR: C MAILE DATE: 11-JAN-83 09:56:05

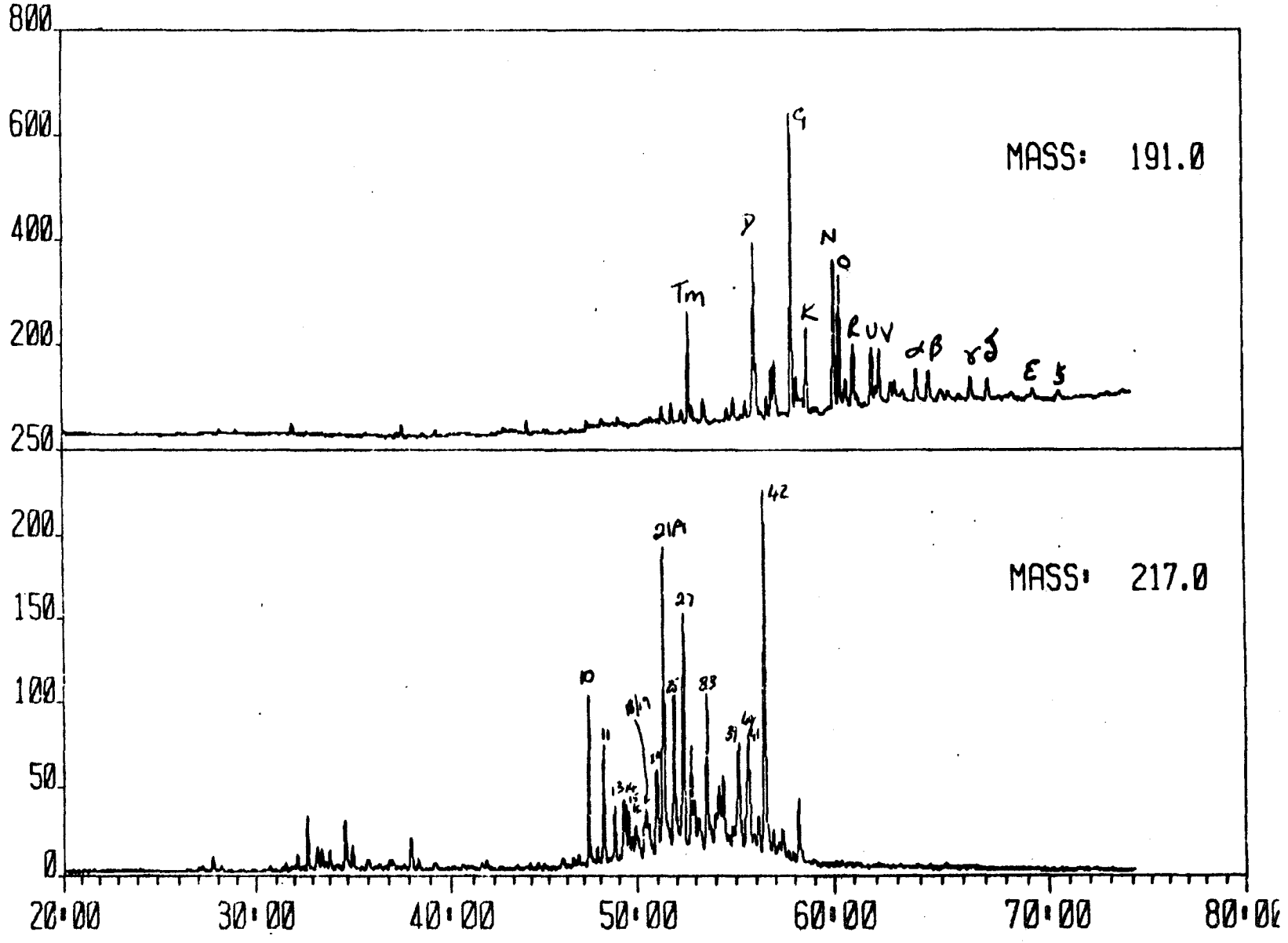


Fig. 7

ANALYSIS NAME: DM00:[300,301]M716.MIS;1 V04.0 WINDOW: 1

TITLE: 3290 SATS DNZ NORWAY

OPERATOR: C MAILE DATE: 11-JAN-83 11:15:51

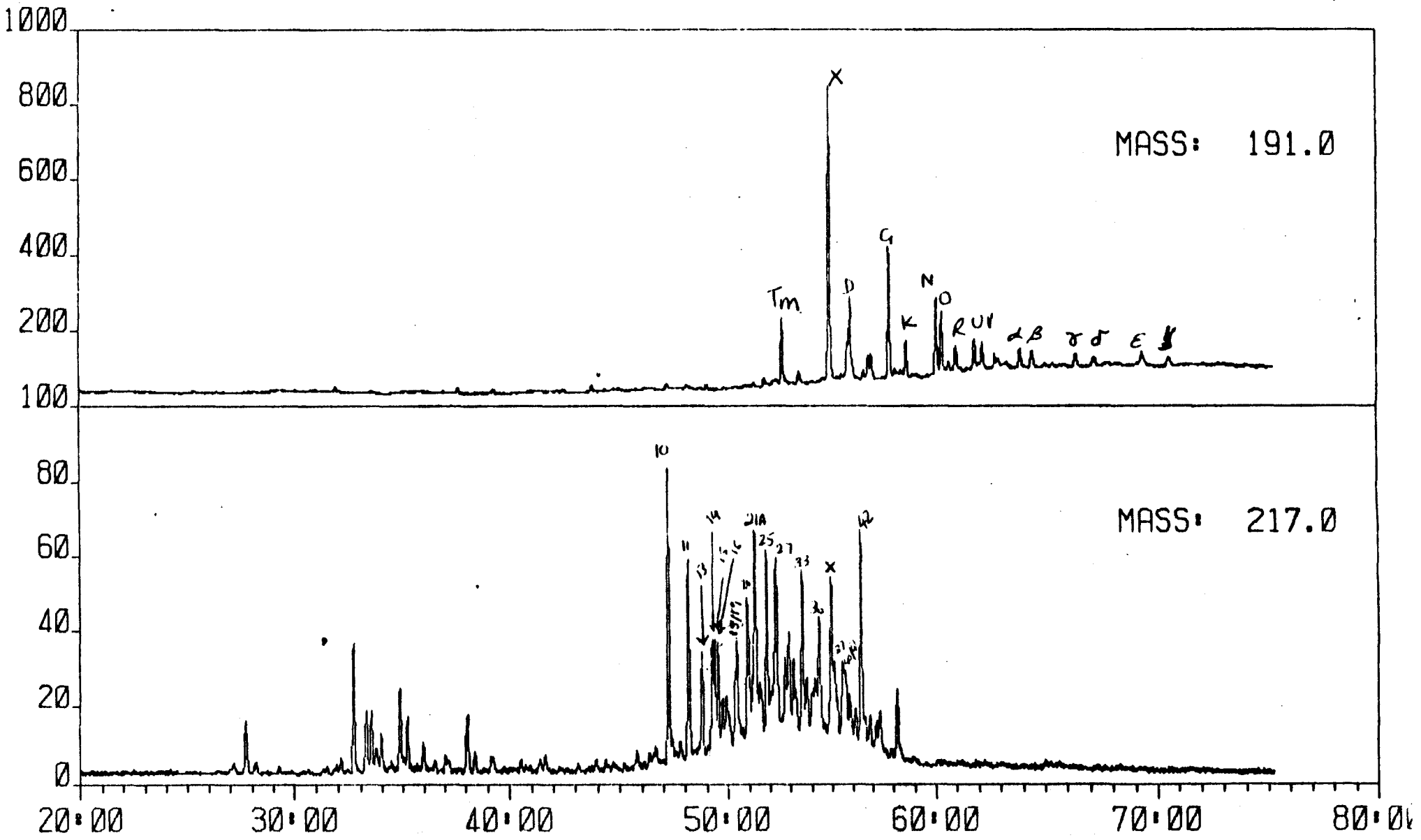


Fig. 8

ANALYSIS NAME: DM00:[300,301]M717.MIS;1 V04.0 WINDOW: 1

TITLE: 3472 SATS DNZ NORWAY

OPERATOR: C MAILE DATE: 11-JAN-83 12:35:07

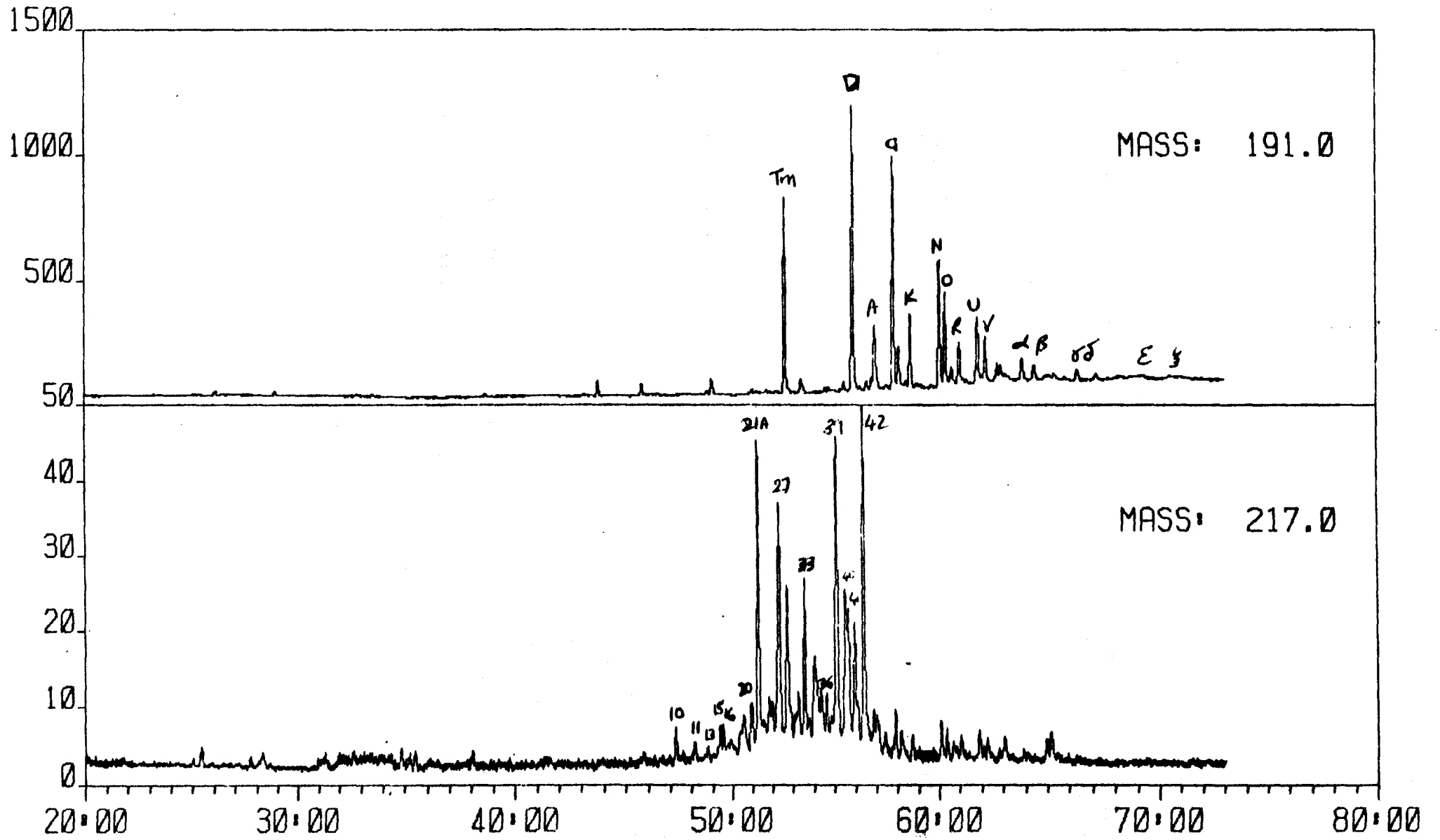


Fig. 4

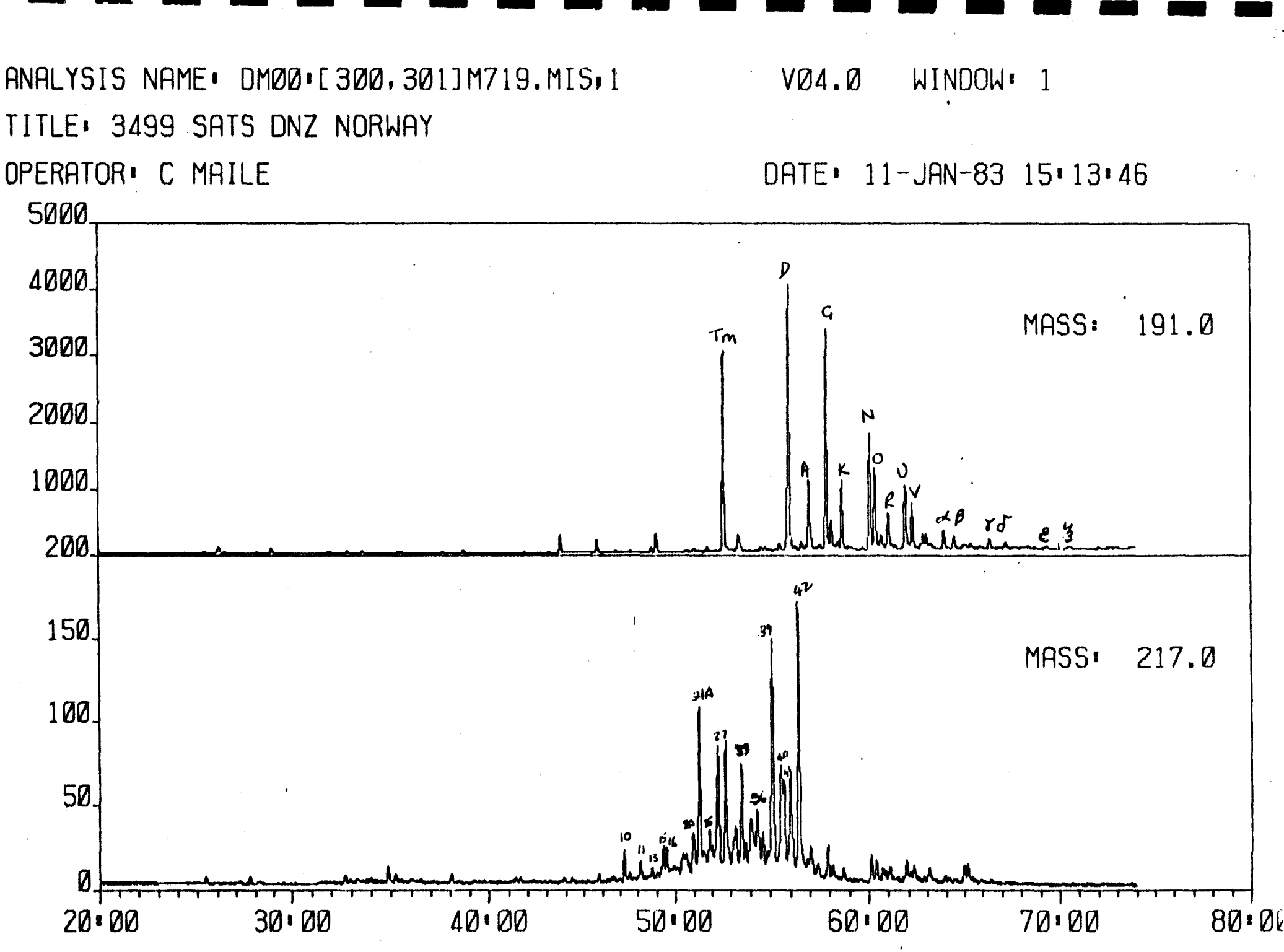

ANALYSIS NAME: DM00:[300,301]M719.MIS;1
V04.0 WINDOW: 1
TITLE: 3499 SATS DNZ NORWAY
OPERATOR: C MAILE
DATE: 11-JAN-83 15:13:46
MASS: 191.0
MASS: 217.0
5000
4000
3000
2000
1000
200
150
100
50
0
20:00
30:00
40:00
50:00
60:00
70:00
80:00
Tm
D
C
A
K
N
O
R
U
V
αβ
γδ
ε
ζ
31A
39
42

Fig. 10

ANALYSIS NAME: DM00:[300,301]M718.MIS;1 V04.0 WINDOW: 1

TITLE: 3506 SATS DNZ NORWAY

OPERATOR: C MAILE DATE: 11-JAN-83 13:55:09

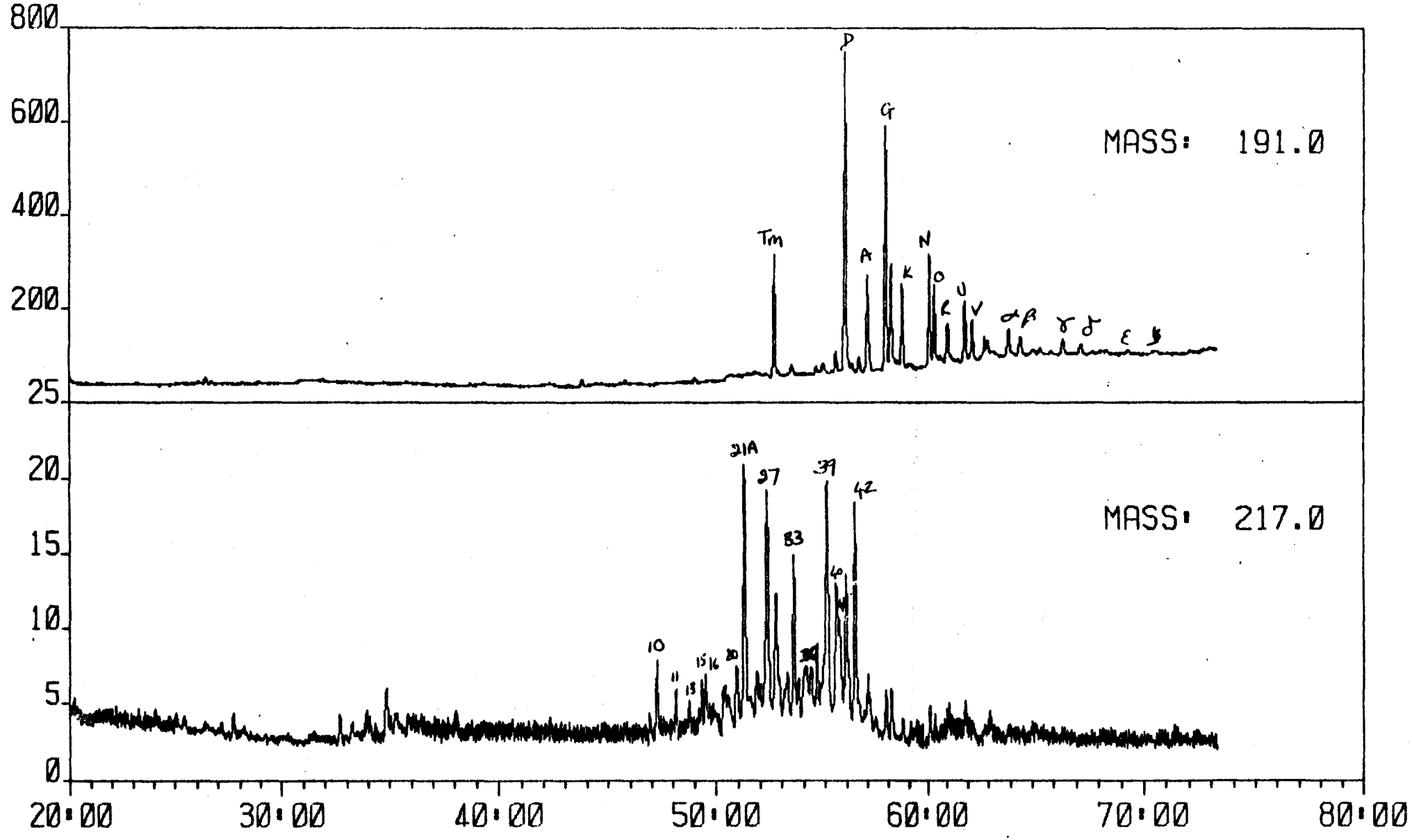


Fig. 11

WELL : 6507 / 10-1

LOCATION: OFFSHORE NORWAY

OPERATOR:

Date Spudded : 10-7-82

Date Completed : 18-10-82

TD : 3698 m

BP RESEARCH CENTRE, SUNBURY. OPERATIONAL SERVICES GROUP

PETROLEUM GEOCHEMICAL LOG

SCALE = 1 : 10,000

MATURITY INDICATORS

SPORE COLOUR: IMMATURE | THRESHOLD * | MATURE — 1 2 3 4 5 6 7

VITRINITE REFLECTANCE %: IMMATURE | THRESHOLD * | PEAK OIL | OIL FLOOR — 0.2 | 0.55 | 0.8 | 1.3

GENERATION INDICES. °/₀₀: TSE / TOC ■ — 100; SAC / TOC □ — 30; THRESHOLD *

CARBON PREFERENCE INDEX: 2.0 | 1.0

GEOLOGICAL AND WELL DATA

Sample No. | STRATIGRAPHY | Depth Drilled ft & m | Graphic Log | Picked Log

TERTIARY

CRETACEOUS — SHETLAND GROUP — CR KNOLL — KIMM. — HEATHER — MID. JUR. SST. — L. JUR. SILTST. — L. JURASSIC SST.

JURASSIC — COAL UNIT

RHAETIAN

Depth Drilled ft & m: 250 | 1000 | 500 | 2000 | 750 | 3000 | 1000 | 4000 | 1250 | 1500 | 5000 | 1750 | 6000 | 2000 | 7000 | 2250 | 8000 | 2500 | 9000 | 2750 | 3000 | 10000 | 3250 | 11000 | 3500 | 12000 | 3750 | 13000 | 4000 | 4250 | 14000 | 4450

G

SOURCE ROCK QUALITY

TOTAL ORGANIC CARBON %: CUTTINGS / SWC — POOR | MODERATE | GOOD — 0.5 | 1.5 | 3.0

VISUAL KEROGEN: INERT | GAS PRONE | OIL PRONE

PYROLYSIS DATA

SOURCE TYPE: GOGI RATIO — OIL | MIXED OIL/GAS | GAS — 0.2 | 0.5

ROCK - EVAL: MAX YIELD kg/t — P_1 — — — — P_2 ——— — 1.5 | 5 | 10 | 15

PRODUCTS: OIL YIELD kg/t — 1.5 | 5 | 10; GAS YIELD kg/t — 1.5 | 5 | 10 | 15

COMMENTS

(22) (12) (17) (20) (20) (3) (1) (8) (20) (9) (11) (7) (4) (1) (7) (2) 13 (6) (1) (20) (7) (15) (7) (19) (1) (20) (20) (20) (3) (20)

68 59 42 22 50 24 33 36 245 240 30·2 247 65·8 54·7 10·9

KEY

▲ PROBABLE ● AUTOCHTHONOUS

△ POSSIBLE ○ ALLOCHTHONOUS

\+ BITUMEN STAINING AND / OR WISPS.

NOTES

* Average Generation Threshold for Oil Prone Kerogens.

TSE - Total Soluble Extract.

TOC - Total Organic Carbon.

SAC - Saturates Content.

Note

1. GOGI = Gas/Oil Generation Index (PGC): P_1 = Hydrocarbon Yield at 250°C, (Rock-Eval). P_2 = Pyrolysed Hydrocarbon Yield from 250-550°C (Oil plus Gas), (Rock-Eval).
2. Source Rock Potential Ratings for PGC and Rock Eval (P_2 only) Yields are :- < 0.5, Insig : < 1.5, Poor : > 1.5-5, Moderate : > 5-15, Good : > 15, Very Good.
3. Values represent Maximum Theoretical Yields in kg/tonne. Amount of Hydrocarbons actually reaching the reservoir may be only 1 % of this Value.
4. Samples with Oil Yields of < 1.5 kg/tonne or TOC'S of < 0.5 % are unlikely to generate sufficient Oil to commence migration.