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SUMMARY

The organic geochemical data obtained from samples from well 30/3-4 allow the following conclusions to be reached:

1. Rocks from the Tertiary, Cretaceous and Viking group contain a poor to fair richness of immature, strongly degraded kerogen and have no significant hydrocarbon generation potential.
2. The claystones of the Brent group contain a good to excellent richness of marginally to moderately mature, terrestrial kerogen which could generate waxy hydrocarbons, condensate or gas at optimum thermal maturity.
3. A thermal maturity consistent with the main phase of oil generation may have been reached in the Dunlin group.
4. The two oils from DST No. 1 and DST No. 4 are thermally mature, light oils of similar origin.
5. Core samples from the Brent group and the Intra-Dunlin sand mostly contain residual hydrocarbons derived from the same source material as the oils.

CONTENTS

	Page
1. INTRODUCTION	6
2. EXPERIMENTAL	11
INTERPRETATION LEVELS	17
3. RESULTS AND DISCUSSION	
3.1 Source rock evaluation of cuttings samples	20
3.2 Source rock evaluation of sidewall core samples	36
3.3 Comparison of convention core hydrocarbons and DST oils	38
4. CONCLUSIONS	42

TABLES

Table 1. Lithostratigraphic formation top data for 30/3-4	9
Table 2. Well drilling data	9
<u>Cuttings</u>	
Table 3a. Concentration of C ₁ -C ₅ + hydrocarbons in headspace: cuttings	44
Table 3b. Concentration of C ₁ -C ₅ + hydrocarbons in occluded: cuttings	49
Table 3c. Concentration of C ₁ -C ₅ + hydrocarbons summation	54
Table 4. Lithology and total organic carbon measurements: cuttings	59
Table 5. Rock-eval pyrolysis: cuttings and sidewall cores	80
Table 6. Visual kerogen analysis: cuttings	85
Table 7. Vitrinite reflectance data: cuttings	91
Table 8a. Concentration of EOM and chromatographic fractions: cuttings	94
Table 8b. Weight of EOM and chromatographic fractions: cuttings	95
Table 8c. Concentration of EOM and chromatographic fractions: cuttings	96
Table 8d. Composition in percent of material extracted from the rock: cuttings	97
Table 8e. Content of asphaltenes: cuttings	98
Table 9. Tabulation of data from the gas chromatograms: cuttings	99

CONTENTS continued	Page
Table 9b. Methyl-phenanthrene Index (MPI) ratios calculated from aromatic gas chromatograms: cuttings	99a
Table 10. Molecular ratios calculated from peak heights in mass chromatograms. Maturity parameters	100
Table 11. Molecular ratios calculated from peak heights in mass chromatograms. Maturity and source characteristic parameters	101
Table 12. $\delta^{13}\text{C}$ isotope data	102
Table 13. Semiquantitative data from pyrolysis-GC	103
 <u>Oils and cores</u>	
Table 14. API gravity data	105
Table 15. Content of $\text{C}_2\text{-C}_8$ hydrocarbons in oil samples	106
Table 16a. Concentration of EOM and chromatographic fractions: cores and oils	109
Table 16b. Weight of EOM and chromatographic fractions: cores and oils	110
Table 16c. Concentration of EOM and chromatographic fractions: cores and oils	111
Table 16d. Composition in percent of material extracted from the rock: cores and oils	112
Table 16e. Content of asphaltenes: cores and oils	113
Table 17. Tabulation of data from the gas chromatograms: cores and oils	114
Table 17b Methyl-phenanthrene Index (MPI) ratios calculated from aromatic gas chromatograms: Cores + DST samples	114a
Table 18. Molecular ratios calculated from peak heights in mass chromatograms. Maturity parameters	115
Table 19. Molecular ratios calculated from peak heights in mass chromatograms. Maturity and source characteristic parameters	116
Table 20. $\delta^{13}\text{C}$ isotope data for oils and core samples	117

CONTENTS	Page
FIGURES	
<u>Cuttings and sidewall cores</u>	
Figure 1. Vitrinite reflectance histograms	119
Figure 2. Saturated hydrocarbon gas chromatograms	150
Figure 3. Aromatic hydrocarbon gas chromatograms	160
Figure 4a. Mass chromatograms representing terpanes (m/z 191)	170
Figure 4b. Mass chromatograms representing steranes (m/z 217 and 218)	176
Figure 5. Pyrolysis GC of cuttings	187
<u>Oils and cores</u>	
Figure 6. C2-C8 hydrocarbon gas chromatograms	189
Figure 7. Saturated hydrocarbon gas chromatograms	193
Figure 8. Aromatic hydrocarbon gas chromatograms	206
Figure 9a. Mass chromatograms representing terpanes (m/z 191)	219
Figure 9b. Mass chromatograms representing steranes (m/z 217 and 218)	226
APPENDICES	
Appendix I. Molecular ratios from terpane and sterane mass chromatograms applied as maturity and source characteristic parameters	240
Appendix II. Background data from GC analysis of saturated hydrocarbons. Cuttings samples.	242
Appendix III. Background data from GC analysis of saturated hydrocarbons. Oils and core samples.	252
Appendix IV. Discussion of the $\delta^{13}\text{C}$ isotope data for selected cuttings samples	265
Appendix V. Discussions of pyrolysis-gas chromatography data	267

1. INTRODUCTION

One hundred and three canned cuttings samples and twelve sidewall cores were submitted from well 30/3-4 for routine geochemical evaluation. An additional ten conventional core samples and two drill stem test (DST) oil samples were also supplied with a view to investigating possible variations in the liquid hydrocarbons from two zones in the Brent group and an intra-Dunlin sand. The analyses and reporting are carried out under IKU number 22.1793, according to Statoil order T-4533, Job 12.

The following analyses were carried out on the cuttings samples:

- C ₁ -C ₇ light hydrocarbon analysis of headspace and occluded cuttings gas	103 samples
- Preparation, washing, lithological description (Type A) and hand picking:	103 samples
- Total organic carbon (TOC) determination:	105 samples
- Rock-Eval pyrolysis:	76 samples
- Kerogen description and thermal alteration index (TAI):	29 samples
- Vitrinite reflectance determination:	33 samples
- Extraction and MPLC separation:	9 samples
- Gas chromatography of saturated and aromatic hydrocarbons:	9 samples
- GC-MS of saturated hydrocarbons:	9 samples
- Pyrolysis GC of kerogens:	9 samples
- $\delta^{13}\text{C}$ isotope analysis of saturated and aromatic hydrocarbons and kerogens	9 samples

The twelve sidewall core samples were only analysed for TOC content and Rock-Eval pyrolysis characteristics at Statoil's request.

The ten conventional core were analysed by:

- Extraction, MPLC separation
- Gas chromatography of saturated and aromatic hydrocarbons
- GC-MS of saturated hydrocarbons
- $\delta^{13}\text{C}$ isotope ratio of saturated and aromatic hydrocarbons

The two DST oil samples were analysed by:

- API gravity
- $\text{C}_2\text{-C}_8$ gas chromatography
- MPLC separation of $>210^\circ\text{C}$ fraction
- Gas chromatography of saturated and aromatic hydrocarbons
- GC-MS of saturated hydrocarbons
- $\delta^{13}\text{C}$ isotope ratio of saturated and aromatic hydrocarbons

Turbo-drilling caused problems with the samples between 2792m and 3285m (TD). The Viking group in this well may be affected by caved Cretaceous material, although this is difficult to evaluate fully. The cuttings samples from the lower Brent group (2855-2945m), the unturbo-drilled part of the Dunlin group (2945-2960m) and the Statfjord formation (3225-3285m) show visible evidence of hydrocarbon staining. Caved material is present throughout the turbo-drilled interval. The use of lignosulphonate mud below 2800m does not appear to have seriously affected sample quality. Generally, the quality of kerogen in most of the samples is quite poor and tends to restrict the analyses to the Brent group and part of the Dunlin group.

One draft copy of this report will be sent to Statoil for approval. On approval, ten copies of the final report will be sent to Statoil and ten copies will be stored at IKU. A geochemical data tape with $\text{C}_1\text{-C}_7$ gas composition of headspace and occluded gas, TOC and Rock-Eval,

Extraction data, gas chromatographic data, vitrinite and kerogen data has been sent to Statoil.

Due to technical difficulties the pyrolysis-GC data were not included in the draft report. These results are reported in this final report together with the $\delta^{13}\text{C}$ isotope data for the cuttings samples. Low recoveries of the hydrocarbon fractions made it impossible to split the samples to allow GC and isotope analysis to be done simultaneously. Thus the GC analysis was done before the sample material was sent to IFE. This was also the case for the kerogen concentrates, i.e. pyrolysis-GC was done before any material was sent for isotope analysis.

Table 1. Lithostratigraphic formation tops for 30/3-4

Balder Formation	2027m
Cretaceous	2265m
Viking Group	2780m
Brent Group	2796m
Etive Formation	2894m
Dunlin Group	~2950m
intra-Dunlin Sand	3077.5m
Statfjord Formation	3233m
Total Depth (TD)	3287m

Table 2: Well drilling data

a) Drill stem test (DST) intervals:

DST No. 1 =	3079-3096m (RKB)
DST No. 4 =	2866-2882m (RKB)

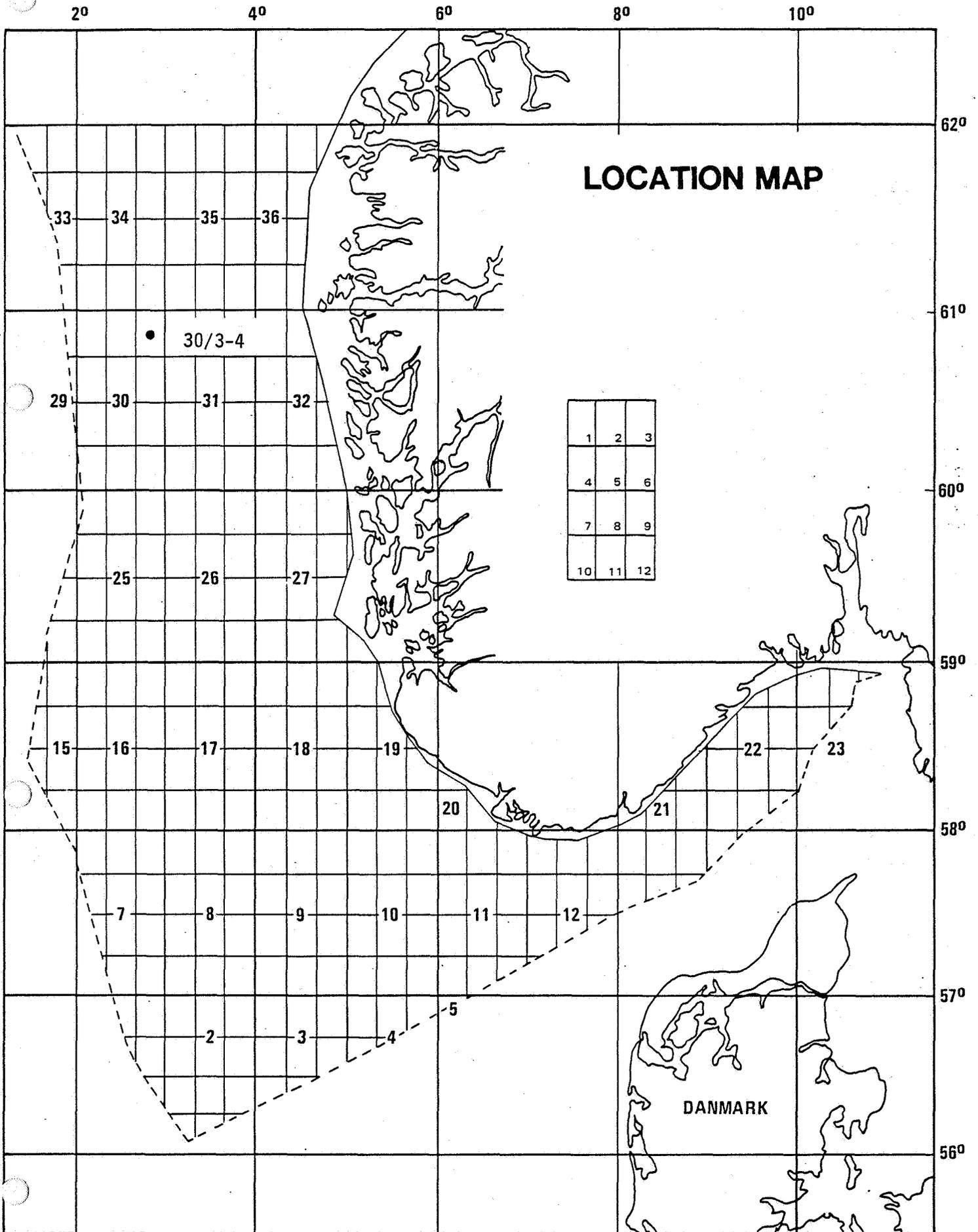
b) Turbo-drilled interval: 2972-3287m (RKB)
 (excluding cored intervals)

c) Casing points:

Casing	=	30"	at	248m
		20"	at	600m
		13 3/8"	at	1858m
		9 5/8"	at	2796m

d) Mud additives:

Lignosulphonate used below 2800m.



2. EXPERIMENTAL METHODS AND DESCRIPTION OF INTERPRETATION LEVELS

2.1 Gas analyses

A septum was attached to the can, a sample of the headspace gas was taken and analysed for C_1 , C_2 , C_3 , $i-C_4$, nC_4 and C_5^+ (conditions: see below). If any C_5^+ was detected a second sample was taken and analysed for C_4-C_{10} compounds (conditions: see below).

The can was opened, headspace volume, water volume and sample weight were measured. The canned samples were washed with tempered water on 4, 2 and 0.125 mm sieves to remove drilling mud and thereafter dried at $35^{\circ}C$.

For occluded gas analysis an aliquot of the 2-4 mm fraction of each sample before drying was crushed in water using an airtight ball mill. The evolved gas was analysed as described for headspace gas.

GC conditions:

$C_1-C_5^+$ analysis

This analysis was performed on Carlo Erba Fractovap 2150 and 2350 gas chromatographs equipped with 2m x 1/8" stainless steel columns filled with Porapak Q on Chromosorb using nitrogen as carrier gas. The oven temperature was $150^{\circ}C$. After elution of n-butane the column was back-flushed and C_5^+ was recorded. A standard gas containing methane, ethane, propane, n-butane, n-pentane and n-hexane was used for quantitation.

2.2 Lithological descriptions

Lithological examinations are normally carried out using a binocular microscope (maximum 50x magnification). Colour descriptions are in accordance with "Rock Colour Chart" published in 1979 by the Geology Society of America. Boulder, Colorado. The clients have a choice of three different levels of description from a simple identification of the lithologies to a full examination of the sample. Handpicking of the cuttings for organic geochemical analyses is based on these descriptions.

2.3 Total Organic Carbon

Bulk samples were crushed in a mortar. Aliquots of the samples were then weighed into Leco crucibles and treated three times with hot 10% HCl to remove carbonate, and washed 4 times with distilled water to remove traces of HCl. The crucibles were then placed on a hot plate and dried for 24 hours. The total organic carbon (TOC) content of the dried samples was determined using a Leco CR12 carbon analyser.

2.4 Rock-Eval pyrolysis

Crushed sample (100mg) was weighed into a platinum crucible the base and cover of which are made of sintered steel, and analysed on a Rock-Eval pyrolyser.

2.5 Preparation of kerogen concentrates

Finely crushed preextracted material is treated with concentrated HCl (200ml) and 40% HF (100ml). The acids are removed by adding water to the mixture and decanting. These steps are done several times. After the acid treatment the sample is washed with hot water (2 hours), 10% ammonium carbonate solution (> 2 hours) and cold water (2x2 hours).

The kerogen is further purified by extraction with methanol, methanol/DCM (1:1) and DCM. The dried kerogen sample is then analysed for its TOC content.

2.6 Extractable Organic Matter

Powdered rock was extracted by a flowblending for 3 minutes using dichloromethane (DCM) with 1% methanol as solvent. The DCM used was of organic geochemical grade and blank analyses showed the occurrence of negligible amounts of contaminating hydrocarbons.

Activated copper fillings were used to remove any free sulphur from the samples.

After extraction the solvent was removed on a Buchi Rotavapor and the amount of extractable organic matter (EOM) was determined.

2.7 Evaporation of the light components in fluid samples

Prior to chromatographic separation of oil/condensate samples, the fractions boiling below 210°C were removed by heating the samples until constant weight at 210°C is obtained. The heating is performed at atmospheric pressure.

The fraction of light components is determined as the weight difference between the original sample and the amount that is left after the heating.

2.8 Chromatographic separation

The extractable organic matter (EOM) was separated into saturated fraction, aromatic fraction and non hydrocarbon fraction using a MPLC system with hexane as eluant (Radke et al., Anal. Chem., 1980). The various fractions were evaporated on a Buchi Rotavapor and transferred to glass vials and dried in a stream of nitrogen.

The same separation procedure was applied to the fractions of oil/condensate samples boiling above 210°C.

2.9 Pyrolysis Gas Chromatography (Py-GC Programmed)

Thermal extraction (S1)

20-30 mg of whole rock sample was placed in a boat shaped sample probe and thermoextracted in a stream of helium at 350°C for 5 minutes.

Pyrolysis-Gas Chromatography (S2)

20-30 mg of solvent- and thermoextracted whole rock sample was programmed pyrolysed in helium (350°C to 550°C at 35°C/min.) in a furnace type pyrolyzer. The outlet of the pyrolyzer was directly connected to a splitter (30:1) and a fused silica capillary column. The pyrolysis product was trapped in a cooled (liq. Nitrogen) U-shaped section at the front of the column.

The outlet of the splitter was directly connected to a FID detector and the course of the pyrolysis could be followed by the detector response of the bulk pyrolysis product (30:1) which was recorded as a broad peak. At the end of the pyrolysis the pyrolysis product was

injected on to the capillary column at ambient temperature (by removing the nitrogen bath) and analysed under the GC conditions given below.

GC-conditions

Column: 25m OV-1, I.D. 0.25 mm, fused silica capillary column.

Carrier gas: Helium with inlet pressure 8 psi. Flow; ca. 1.5. ml/min.

Oven programme: 30⁰ - 280⁰C at 4⁰C/min.

2.10 Vitrinite reflectance

Vitrinite reflectance measurements of 4 of the samples, were done. The samples were mounted in Bakelite resin blocks; care being taken during the setting of the plastic to avoid temperatures in excess of 100⁰C. The samples were then ground, initially on a diamond lap followed by two grades of corundum paper. All grinding and subsequent polishing stages in the preparation were carried out using isopropyl alcohol as lubricant, since water leads to the swelling and disintegration of the clay fraction of the samples.

Polishing of the samples was performed on Selvyt cloths using three grades of alumina, 5/20, 3/50 and Gamma, followed by careful cleaning of the surface.

Reflectance determinations were carried out on a Leitz M.P.V. microphotometer under oil immersion, R.I. 1.518 at a wavelength of 546 nm. The surface of the polished block was searched by the operator for suitable areas of vitrinitic material in the sediment. The reflectance of the organic particle was determined relative to optical glass standards of known reflectance. Where possible, a minimum of twenty individual particles of vitrinite was measured.

The samples were also analysed in UV light, and the colour of the fluorescing material determined.

2.11 Processing of samples and evaluation of visual kerogen

Crushed rock samples were treated with hydrochloric and hydrofluoric acids to remove the minerals. A series of microscopic slides contain strew mounts of the residue:

T-slide represents the total acid insoluble residue.

N-slide represents a screened residue (15 μ mesh).

O-slide contains palynodebris remaining after flotation (ZnBr₂) to remove heavy minerals.

X-slides contain oxidized residues, (oxidizing may be required to remove sapropel which embeds palynomorphs, or where high coalification prevents the identification of the various groups).

T and/or O slides are necessary to evaluate kerogen composition/-palynofacies which is closely related to sample lithology.

Screened or oxidized residues are normally required to concentrate the larger fragments, and to study palynomorphs (pollen, spores and dinoflagellates) and cuticles for paleodating and colour evaluation.

So far visual evaluation of kerogen has been undertaken from residues mounted in glycerine jelly, and studied by Leitz Dialux in normal light (halogene) using x10 and x63 objectives. By x63 magnification it is possible to distinguish single particles of diameters about 2 μ and, if required, to make a more refined classification of the screened residues (particles >15 μ).

The colour evaluation is based on colour tones of spores and pollen (preferably) with supporting evidence from colour tones of other types of kerogen (woody material, cuticles and sapropel). These colours are dependant upon the maturity, but are also influenced by the paleo-environment (lithology of the rock, oxidation and decay processes). The colours and the estimated colour index of an individual sample may therefore differ from those of the neighbouring samples. The techniques in visual kerogen studies are adopted from Staplin (1969) and Burgess (1974).

2.12 Gas chromatographic analysis

The C₂-C₈ hydrocarbon fraction was determined on a Carlo Erba Fractovap GC. The column used was a 30m fused silica capillary column coated with SE-54. The temperature program applied was 50^oC (2min.) to 180^oC at 4^oC/min.

The saturated hydrocarbon fractions were each diluted with n-hexane and analysed on a HP 5730A GC. The GC is equipped with a 15m DB-1 fused

silica column and hydrogen (ca. 2.5 ml/min.) is used as carrier gas. Injections are performed in split mode (split ratio 1:10). The temperature program applied is 80°C (2 min.) to 280°C at 4°C/min.

The total aromatic fractions were, after dilution with n-hexane, analysed on a HP 5730 A GC. The GC is equipped with a 30m DB-5 fused silica column, and hydrogen (2.5 ml/min.) is used as carrier gas. The temperature program applied is 80°C (2 min.) to 280°C at 4°C/min. on both systems. Injections are performed in split mode (split ratio 1:10).

The data processing for all the GC analyses was performed on a VG Multichrom lab data system.

2.13 Gas chromatography - mass spectrometry (GC-MS)

GC-MS analyses were performed on a VG Micromass 70-70H GC-MS-DS system. The Varian Series 3700 GC was fitted with a fused silica OV-1 capillary column (30m x 0.3mm i.d.). Helium (0.7kg/cm²) was used as carrier gas and the injections were performed in split mode (1.5µl, split ratio 1:15). The GC oven was programmed from 120°C to 280°C at 4°C/min. after an initial isothermal period of 2 minutes.

The saturated hydrocarbons were analysed in multiple ion mode (MID) at a scan cycle time of approximately 2 secs. The mass spectrometer operated at 70eV electron energy and an ion source temperature of 200°C. Data acquisition was done by VG data systems.

Peak identification was performed applying knowledge of elution patterns in certain mass chromatograms. Calculation of peak ratios was done from peak height in the appropriate mass chromatograms.

2.14 δ¹³C isotope analysis

The δ¹³C isotope analysis was performed by mass spectrometry at Institute for Energy Technology (IFE) in Oslo according to their method. Their reference value for the standard NBS-22 is -29.8.

INTERPRETATION LEVELS

1. TOTAL ORGANIC CARBON (TOC)

%TOC

<0.5%	Poor Source Rock
0-5-1%	Fair Source Rock
1-2%	Good Source Rock
>2%	Rich Source Rock

2. ROCK-EVAL PYROLYSIS

 a) Data Supplied

S1	Free hydrocarbons in mgs per gram of rock.
S2	Potential or pyrolysable hydrocarbons of kerogen in mgs per gram of rock.
S3	Oxygen content of kerogen in mgs CO ₂ per gram of rock.
Hydrogen Index	S2/TOC x 100 i.e. mgs hydrocarbons per gram TOC.
Oxygen Index	S3/TOC x 100 i.e. mgs CO ₂ per gram TOC.
Petroleum Potential	S1+S2
Production Index	S1/S1+S2
T _{max}	Temperature at which the S2 peak is a maximum.

 b) Interpretation

<u>Kerogen type</u>	<u>Hydrogen Index</u>
Type I	650+
Type II	400-650
Type II/III	200-400
Type III	50-200
Type IV	<50 and up to 100 where oxygen index is very high.

N.B. Hydrogen and particularly oxygen indices are affected by organic carbon contents. Thus decreasing TOC contents, where the same organic matter type is present, can result in reduced hydrogen and increased oxygen indices (Katz, 1983). Hence oxygen indices have not been used.

Interpretation of Petroleum Potentials.*

	<u>S1+S2</u>
Poor	<1
Fair	1-5
Good	5-10
Rich	>10

S1 and S2 values can be raised by the presence of migrated bitumens.

Interpretation of Production Indices S1/S1+S2*

Primary bitumen	<0.1
Generated or Migrated hydrocarbons	0.1-0.5
Predominantly migrated hydrocarbons or stain	>0.5

* Only approximate guidelines not intended to indicate absolute limits.

Rock-Eval T_{max}

Variations in values can be due to maturity, type, migrated bitumens or to low S2 peaks. The following maturity boundaries are therefore only approximate.

Tmax	Type II	Equivalent reflectance in coals kerogens
425	Immature	0.5%
435	Oil generation zone	0.7%
450		1.0%
>450+	Gas zone →	

3. VITRINITE REFLECTANCE

Comparison of Vitrinite Reflectance (V.R.), Thermal Alteration Index (TAI) and Spore Fluorescence (S.F.) equivalent.

VR % Ro in oil	TAI	S.F. number and colour
0.3		3 yellow
0.4	1+	4 yellow orange
0.5		5 light orange
0.6	2	6 mid-orange
0.7		
0.8		7 dark orange
0.9	2+	
1.0	3-	8 orange-red
1.1		9 orange-red
1.2		no fluorescence
1.3	3+	

Detailed scale comparing the vitrinite reflectance measurements and the fluorescence measurements as follows:

VITRINITE REFLECTANCE R.AVER. 546 NM	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90	1.00	1.10
% CARBON CONTENT DAF.	57	62	70	73	76	79	80.5	82.5	84	85.5
LIPTINITE FLUOR NM	725	750	790	820	840	860	890	940		
EXC. 400 nm BAR. 530 nm										
colour	G	G/Y	Y	Y/O	L.O	M.O.	D.O.	O/R	R	
zone	1	2	3	4	5	6	7	8	9	

NOTE: Liptinite NM = Numerical measurements of overall spore colour and not peak fluorescence wavelength.

Relationship between liptinite fluorescence colour, vitrinite reflectance and carbon content is variable with depositional environment and catagenic history. The above is only a guide. Liptinite will often appear to process to deep orange colour and then fade rather than develop or O/R red shade. Termination of fluorescence is also variable.

4. EXTRACTABLE ORGANIC MATTER (OR SOLUBLE BITUMEN)

a) Data Supplied

EOM ppm. Extractable Organic Matter in parts per million (or ugs/gram of rock).

Hydrocarbon Extractability (sometimes called transformation ratio in the literature) milligrams of hydrocarbons (saturated and aromatic hydrocarbons) per gram of TOC.

% Saturates Saturated hydrocarbons/EOM. x 100

% Aromatics Aromatic hydrocarbons/EOM. x 100

SAT/ARO Saturates/Aromatics x 100*

* In table is multiplied by 100 as calculated by computer. In the discussion the ratio only is used.

b) Interpretation of source rock richness based on hydrocarbon contents*.

Hydrocarbons
 HC ppm.

Poor <100
 Fair 100-250
 Good 250-500
 Rich >500

* This is dependent on maturity, total organic carbon content and kerogen type as well as being influenced by migrated hydrocarbons and values should be treated as a rough guide only.

In the saturated hydrocarbon gas chromatograms the following peaks are identified.

nC₁₅, nC₂₀, nC₂₅, nC₃₀ normal alkane compounds of that carbon number.
 pristane

phytane

* = Acyclic Isoprenoids

3. RESULTS AND DISCUSSION

3.1 Source-rock evaluation

In this part of the report, the results from routine geochemical analysis of the cuttings samples will be discussed with reference to lithostratigraphic and well data supplied by Statoil (Tables 1 and 2).

Post-Palaeocene (950-2027m): A total of twenty-two canned cuttings samples were evaluated from this interval. The light hydrocarbon (C_1-C_7) composition of the samples is characterised by a very poor abundance, or absence, of the C_2+ components (Table 3). The four samples between 1900m and 2030m are an exception with a sharply increased abundance of C_5+ components. Methane is the most abundant component in the samples, except in the interval at 1900-2030m, and decreases rapidly from a high abundance of 42724 μ l/kg at 950-1000m to a minimum of 235 μ l/kg at 2015-2030m. Gas wetness values are variable, but rarely exceed 20%, with the exception of the 2015-2030m interval where a gas wetness value of 55.72% is recorded. These data suggest that the organic matter in the rocks is too immature to generate hydrocarbons, although migrated hydrocarbons may be present below 1900m, and are certainly present at the base of the interval.

The cuttings samples are dominated by various claystone lithologies (Table 4). Between 950m and 1650m, grey to greyish brown or brownish grey claystones are generally dominant. Above 1200m, these lithologies contain spicules and foram. fragments. Total organic carbon (TOC) contents are fairly similar in these samples, varying from 1.13 wt% to 1.62 wt%, with a mean value of 1.37 wt%, and indicate good organic richness. A coarse to medium grained sand is the dominant lithology between 1450m and 1550m. At 1650m, a grey to greenish grey claystone lithology becomes dominant, changing to a grey or olive grey claystone below 1950m. These lithologies have TOC contents varying from 0.36 wt% to 1.02 wt% with a mean value of 0.62 wt%, indicating poor to fair organic richness. An organic-lean, reddish-brown claystone lithology (TOC = 0.04 wt%) occurs at 1950-2000m. The change from a greenish grey claystone to an olive grey claystone lithology and the appearance of the reddish-brown claystone appears to correlate with the appearance of C_5+ light hydrocarbon components.

Rock-Eval pyrolysis data were obtained on thirteen samples from this interval (Table 5). Production indices for the samples at 1850-1900m, 1900-1950m and 2000-2015m suggest the presence of free hydrocarbons in these samples, thereby reducing the reliability on the data from these samples. The hydrogen indices of the samples vary from 52mg/g to 161mg/g and are typical of type III kerogen. The variation in hydrogen index does not appear to be related to variations in lithology or TOC content. Petroleum potential values vary from 0.82mg/g to 2.80mg/g indicating poor to fair hydrocarbon generation potential, although Tmax values of between 413^oC and 434^oC suggest that the type III kerogen is thermally immature at this time.

The kerogen examined in nine samples (Table 6) is mostly fluffy aggregates and amorphous degraded material embedding small degraded woody particles with bacterial and fungal debris. Woody material generally accounts for 5-10% of the kerogen and abundant cysts were observed at 2000-2015m. The appearance of the kerogen and the hydrogen index values suggest that the kerogen has been variably degraded by either biogenic factors or oxidising conditions. Such material is unlikely to produce significant amounts of hydrocarbons at optimum thermal maturity. Spore colour values vary from 1/1+ to 1+2- and suggest that the kerogen is thermally immature.

Vitrinite reflectance data were obtained for ten cuttings samples (Table 7). The most representative reflectance values vary from 0.30% at 1130-1200m to 0.44% at 2000-2015m and are generally consistent with both Tmax and spore colour data in indicating thermal immaturity. Particles of vitrinite are mostly quite scarce in these samples and are often very small. The organic matter content of the samples varies from poor in most of the samples, to fair at 1160-1200m, 1300-1350m, 1500-1530m and 1650-1700m. Brown wisps of liptinitic material with occasional palynomorphs account for a greater part of the organic matter. Good samples for vitrinite reflectance measurements are indicated in table 7. In ultra-violet light, the amount of fluorescent liptinites is poor, possibly reflecting the degradation indicated in the visual kerogen data (Table 6). Fluorescence colours are predominantly greenish to greenish-yellow or yellow indicating thermal immaturity. Heavy bitumen staining and green matrix fluorescence at 2000-2015m and 2015-2030m may reflect the presence of the liquid hydrocarbons indicated by the C₁-C₇ hydrocarbon data and the Rock-Eval data.

Two cuttings samples at 1650-1700m and 2015-2030m were extracted to examine the extractable organic matter present in the samples (Table 8). Both samples yielded poor EOM concentrations of 213ppm (1650-1700m) and 384ppm (2015-2030m). A greater proportion of the EOM at 1650-1700m (52.4%) represents hydrocarbons, relative to the EOM at 2015-2030m (23.9%). In both samples, saturated hydrocarbons are nearly twice as abundant as aromatic hydrocarbons.

The saturated hydrocarbon gas chromatograms are shown in figure 2. The gas chromatogram of the 1650-1700m extract is slightly bimodal with a predominance of C_{20}^+ hydrocarbons and a prominent hump of unresolved compounds. The predominance of higher molecular weight compounds suggests that the bitumen is probably of low thermal maturity, possibly with an input of terrestrially-derived material. A high pristane/phytane ratio of 2.2 and a carbon preference index (CPI) of 2.3 would tend to support this. The gas chromatogram of 2015-2030m extract is also slightly bimodal with a well developed assemblage of n-alkanes decreasing from a maximum at nC_{16} and a group of unidentified peaks about nC_{29} which could represent contaminants or which may suggest that the extract is immature. The latter suggestion is contradicted by the mature appearance of the n-alkane distribution and suggests a non-indigenous origin. The greater thermal maturity of the 2015-2030m extract is indicated by a CPI of 1.4. A pristane/phytane ratio of 2.6 is similar to that of the preceding sample and may indicate a similar origin.

The aromatic hydrocarbon gas chromatograms of the 1650-1700m and 2015-2030m samples are shown in figure 3. Phenanthrene, the alkyl phenanthrenes and aromatised steranes and terpanes are the most prominent peaks in the 1650-1700m gas chromatograms. The alkyl naphthalenes, with the exception of the methyl naphthalenes are also reasonably developed. The phenanthrene and alkyl phenanthrene peaks dominate the 2015-2030m gas chromatogram with poorly developed alkyl naphthalenes and aromatic steranes and terpanes. Both samples appear to yield immature aromatic hydrocarbon distributions, suggestive of slightly different hydrogen-poor (e.g. type III) kerogen types.

The mass chromatograms representing the terpanes (m/z 191) and the steranes (m/z 217,218) are shown in figure 4, and the tabulated data are given in tables 10 and 11.

The two samples from this interval at 1650-1700m and 2015-2030m, show very different mass chromatograms for both the steranes and the terpanes. The shallower sample has mass chromatograms dominated by unidentified compounds. This makes it difficult to determine the molecular parameters with any accuracy, and therefore the high values of the maturity ratios may be erroneous. Another explanation is that this sample contains migrated bitumen. The sample at 2015-2030m shows mass chromatograms typical of immature hydrocarbons and corresponding to approximately 0.3% vitrinite reflectance. A very high abundance of the 28,30-bisnorhopane (Z/E in m/z 191) is present.

The geochemical data suggest that the upper part of the post-Palaeocene section contains rocks of good organic richness. However, the kerogen is almost certainly degraded and of reduced petroleum generation potential at peak thermal maturity. The kerogen is currently thermally immature. Non-indigenous hydrocarbons occur at the base of this interval.

Balder Formation (2027-2265m)

Fifteen canned cuttings samples were examined from the Palaeocene Balder formation. The light hydrocarbon (C_1 - C_7) composition of the samples shows a continuation of the trend observed at the base of the preceding interval. The abundance of C_5+ compounds increases to a maximum of 5965 μ l/kg at 2105-2120m, dropping rapidly to zero below 2210m. The abundance of C_1 - C_4 compounds also shows a slight increase, although C_4 compounds become significantly reduced below 2120m. The light hydrocarbon data suggest that there are minor amounts of non-indigenous hydrocarbons between 1900 and 2210m. Low C_1 - C_4 abundances with a dominance of methane are reflected by gas wetness values of between 6.00% and 31.68% (excluding the very high value of 65.29% at 2030-2045m) and suggest that the rocks are probably thermally immature and have no significant hydrocarbon generation potential at this time.

The beginning of the Balder formation coincides with the appearance of significant amounts of a tuff lithology in the samples (2030-2105), after which the tuffaceous material becomes a minor constituent of the samples. The tuff-dominated interval correlates with the highest abundance of C_5+ hydrocarbons. The grey or olive grey claystone lithology observed at the base of the preceding interval continues through most of the Balder formation, being the dominant lithology at 2030-2045m and

at 2105-2225m. This lithology is mostly organic poor, with TOC values of between 0.83 wt% and 0.29 wt% and a mean TOC of 0.45 wt%. Below 2225m, a more organic-rich, dark grey to grey, silty claystone appears and is the dominant lithology at 2240-2270m, (average TOC = 0.70 wt%). Minor light grey or red to reddish brown claystone lithologies also occur throughout the Balder formation.

Rock-Eval data were obtained on twelve cutting samples from this formation. All of the samples, regardless of lithological variation, are characterised by hydrogen indices typical of type IV or hydrogen-poor type III kerogen. Production indices for the samples vary from 0.11mg/g at 2030-2045m to 0.80mg/g at 2135-2150m and mostly suggest the presence of non-indigenous hydrocarbons through the formation. Tmax values vary widely and are largely unreliable due to poor S₂ peaks and the presence of hydrocarbon contamination.

The kerogen in three samples at 2060-2075m, 2165-2180m and 2210-2225m consists mostly of fluffy aggregates and degraded amorphous material embedding degraded woody material, and fungal/bacterial/algal debris. Woody material and structured debris is a minor component of the samples, accounting for 5-10% of the kerogen. The Rock-Eval data suggest that this kerogen is severely degraded and has no hydrocarbon generation potential. Spore colour values vary from 1+ to 1+/2- and suggest that the kerogen is thermally immature.

The three samples at 2060-2075m, 2165-2180m and 2210-2225m were also measured for vitrinite reflectance. The samples are very poor in particulate organic matter, which consists mostly of brown liptinite wisps. The most reliable vitrinite reflectance value obtained was 0.39% at 2210-2225m, which is consistent with the spore colour data. Trace amounts of greenish-yellow or yellow liptinite fragments are visible in ultra-violet light. A green matrix-fluorescence in most of the samples suggests the presence of bitumen staining.

No samples were extracted from the Balder formation.

The rocks of the Balder formation have a poor to marginally fair richness of severely degraded, thermally immature kerogen and are unlikely to be capable of hydrocarbon generation. Minor amounts of non-indigenous hydrocarbons appear to be present, especially between 2030m and 2210m.

Cretaceous (2265-2780m)

A total of thirty-three canned cuttings samples was analysed from the Cretaceous interval in this well. Light hydrocarbon (C_1 - C_7) data show a gradual increase in the C_2 - C_4 components down to 2660m relative to the abundance of methane which increases from 232 μ l/kg at 2270-2285m to 11950 μ l/kg at 2375-2390m and decreases below this. This change is reflected by an increase in gas wetness values down the interval. At 2660-2675m, C_5 + components appear and remain at a fairly constant abundance to the base of the Cretaceous. The appearance of the C_5 + components coincides with a marked increase in gas wetness values to around 70%, and a rapid decrease in iC_4/nC_4 ratio from 0.90 to 0.44 at the Cretaceous/Jurassic boundary. Overall, the light hydrocarbon data suggest that the organic matter in the Cretaceous sediments is thermally immature and that, between 2660m and 2780m, minor amounts of non-indigenous material may be present.

The cuttings lithologies in the Cretaceous interval are mostly a combination of dark grey to grey claystone and grey to olive grey claystone with a more organic-rich medium dark grey to grey claystone replacing the former lithology below 2585m, and becoming dominant between 2690 and 2780m. The upper two claystone lithologies are divided into the more organic-rich dark grey claystone with an average TOC of 0.71 wt%, and the less organic-rich olive grey claystone with an average TOC of 0.37 wt%. Below 2585m, the olive grey claystone lithology continues with an average TOC of 0.45 wt%, together with the medium dark grey claystone lithology which has an average TOC of 0.92 wt%. Minor amounts of a white limestone lithology occur down to 2360m, with traces still observed at 2525m. The dark grey or medium dark claystones have fair organic richness, while the olive grey claystones have poor organic richness.

Rock-Eval pyrolysis data were obtained on twenty-nine cuttings samples. The results are similar to those observed in the overlying Balder formation. The samples between 2270m and 2540m have production indices of between 0.24mg/g and 0.61mg/g which suggest the presence of non-indigenous hydrocarbons. Tmax data over this interval are quite variable and cannot be considered reliable due to poorly developed S_2 peaks and the possibilities of contamination. Hydrogen indices are very low, with an average value of 35mg/g and suggest the presence of hydrogen-poor

type IV kerogen. The presence of hydrocarbon contamination may have raised these values. With the exception of samples at 2555-2570m, 2570-2585m, 2705-2720m and 2720-2735m, the Rock-Eval data for the samples below 2540m suggest that hydrocarbon contamination is not a serious problem. Hydrogen indices over the interval 2540-2780m vary from 54mg/g to 89mg/g with an average value of 64mg/g, which is typical of hydrogen-poor type III kerogen. The four samples which may be affected by contaminants have hydrogen and oxygen indices typical of type IV kerogen. Tmax values over this interval vary from 421°C to 440°C and suggest that the rocks are probably immature to marginally mature.

Seven samples at 2300-2315m, 2360-2375m, 2435-2450m, 2520-2535m, 2600-2615m, 2660-2675m and 2735-2750m were evaluated for kerogen composition. The first two samples have similar kerogen to that described from the Balder formation which indicates that severe degradation may have occurred and which agrees with the Rock-Eval data. The remaining five samples contain kerogen which is mostly grey amorphous debris enclosing particles of woody material. Woody material is slightly more abundant in these five samples. The palynomorphs in the samples appear etched, pale and thin-walled. Evidence of caved material was observed at 2735-2750m. The spore colour values vary from 1+ to 1+/2-, 2+/2 and 2 suggesting that the kerogen is immature to marginally mature in agreement with the Rock-Eval data.

Vitrinite reflectance data were obtained on seven samples from the Cretaceous interval. The reflectance values vary from 0.40% to 0.47% and suggest immaturity to marginal maturity in agreement with the other maturity indicators. With the exception of the three samples at 2300-2315m, 2525-2540m and 2600-2615m, the samples were poorly suited to vitrinite reflectance measurement being characterised by poor organic matter dominated by brown wisps of liptinite and less common particles of reworked vitrinite and inertinite. Obvious bitumen staining was observed at 2525-2540m and 2600-2615m. In ultra-violet light, only traces of fluorescent liptinite are present in the samples, varying from a greenish-yellow colour at 2300-2315m and 2360-2375m, to greenish-yellow and yellow at 2435-2450m and 2525-2540m to a yellow yellow-orange colour in the remaining samples.

Two samples at 2525-2540m and 2750-2765m were extracted to evaluate and characterise any EOM present. The sample at 2525-2540m yielded a good EOM concentration of 1322ppm, of which 397ppm represents hydrocarbons.

However, relative to the TOC, an EOM concentration of 117mg/g TOC suggests that the EOM is not indigenous. The second sample at 2750-2765m yielded a poor EOM concentration of 378ppm of which 130ppm represents hydrocarbons. The ratio of hydrocarbons to non-hydrocarbons in these samples is higher than might be expected from early generation products and suggest that the EOM in both samples is non-indigenous.

The gas chromatograms of the saturated hydrocarbons are shown in figure 2. The gas chromatogram of the 2525-2540m sample show a bimodal n-alkane distribution with maxima at nC_{19} and nC_{29} . A large unidentified peak occurs near the nC_{27} peak. The pristane/phytane ratio of 1.2 is significantly different from those reported in the post-Palaeocene interval. The CPI of 1.3 is not consistent with the thermal maturity of the kerogen in the enclosing rocks. The gas chromatogram of the 2750-2765m sample is significantly different from that of the previous sample, showing reasonably mature, unimodal n-alkane distribution with a maxima at nC_{16} . The n-alkane distribution of this sample and the pristane/phytane ratio of 2.5 is similar to that of the non-indigenous material at 2015-2030m. A CPI of 1.1 suggests thermal maturity and is inconsistent with the measured kerogen maturity.

The aromatic hydrocarbon gas chromatograms for the two samples at 2525-2540m and 2750-2765m are shown in figure 3. The gas chromatogram of the upper sample shows an absence of any recognisable peaks. The reason for this is uncertain. The gas chromatogram for the remaining sample shows a fairly mature distribution of aromatic hydrocarbons with very prominent alkyl naphthalenes, phenanthrene and alkyl phenanthrene peaks. This is inconsistent with the measured thermal maturity of this interval and suggests that the bitumen may not be indigenous.

The mass fragmentograms for the two samples at 2528-2540m and 2750-2765m show terpane and sterane distributions typical of moderately mature sediments. Differences in the T_m/T_s ratio and in the abundance of bisnorhopane (Z/E) may indicate differences in the organic matter which produced the hydrocarbons in these two samples.

The Cretaceous sequence appears to consist largely of a sequence of claystones with a poor to fair richness of strongly degraded kerogen of low thermal maturity. This kerogen is not capable of significant hydrocarbon generation. The presence of minor amounts of non-indigenous kerogen is indicated.

Viking Group (2780-2795m): One canned cutting samples was examined from this poor development of the upper Jurassic Viking Group. The light hydrocarbon data for this sample is similar to that observed at the base of the Cretaceous sequence. A high gas wetness value of 71.2% and a very low iC_4/nC_4 ratio of 0.39 suggest that this interval may contain minor amounts of free hydrocarbons.

The sample is dominantly a medium dark grey to grey claystone lithology similar to that observed in the lowermost Cretaceous rocks. This suggests that either there is no break in sedimentation between the Cretaceous and Jurassic intervals, or that the sample is badly affected by caved Cretaceous material. The TOC value of 0.80 wt% is similar to that of the lowermost Cretaceous rocks and indicates fair organic richness. Casing was set at 2796m.

The Rock-Eval data for this sample is also similar to that of the Cretaceous samples. A production index of 0.24mg/g suggests the possibility of minor hydrocarbon contamination. A poor hydrogen index of 35 mg/g is more typical of type IV kerogen and the low S_2 peak means that the T_{max} of 445⁰C is probably not reliable.

The kerogen from this sample is very similar to that described from the lower part of the Cretaceous and indicates that the kerogen is strongly degraded. Spore colour values vary from 1+ to 2 and suggest that the kerogen is immature to marginally mature.

The sample at 2780-2795m is a poor sample for vitrinite reflectance, and a tentative reflectance value of 0.45% was obtained. This is consistent with the trend observed in the lowermost Cretaceous and may be fairly representative. The sample has a poor organic matter content dominated by brown wisps of liptinite and bitumen, and reworked material. A fair amount of fluorescent liptinite is present in ultra-violet light consisting of greenish-yellow wisps and yellow to yellow-orange debris.

The Viking group appears to be broadly similar to the lower part of the Cretaceous interval, although the possibility of caving contamination must be considered. The claystone contains a fair amount of strongly degraded, marginally mature kerogen of insignificant hydrocarbon generation potential.

Brent Group (2795-2950m): Nine canned cuttings samples were examined from the Brent group. The light hydrocarbon (C_1-C_7) data show a significant change from the overlying Viking group. There is a large increase in the abundance of all the measured components by one order of magnitude, or greater. Gas wetness values in the Brent group vary from 58.54% at 2795-2810m to 88.85% at 2810-2825m. The high gas wetness values, an average C_2-C_4 abundance of 45562 μ l/kg and an average C_5+ abundance of 15274 μ l/kg suggest the presence of significant amounts of free hydrocarbons in this unit. iC_4/nC_4 ratios of 0.18 to 0.38 suggest that these hydrocarbons are thermally mature.

The cuttings samples consist predominantly of a mixture of coal, fine to coarse sand and variable proportions of a greyish black to brownish black claystone which is the dominant lithology at 2795-2810m, 2870-2885m and 2900-2915m. This claystone is organic-rich, with TOC values varying from 1.90 wt% to 5.28 wt% and a mean TOC of 4.22 wt% indicating generally excellent organic richness. The coaly lithology has relatively low TOC contents of 12.15 wt% (2810-2825m) and 10.25 wt% (2825-2840m) which may indicate a high clay content. Between 2855m and 2945m, the cuttings samples show visible evidence of bitumen staining.

Rock-Eval pyrolysis data was obtained on six cuttings sample lithologies. The hydrogen indices of the samples are typical of hydrogen-rich type III kerogen. Only the sample at 2915-2930m shows any evidence of significant hydrocarbon contamination. T_{max} values vary from 433 $^{\circ}$ C to 438 $^{\circ}$ C and suggests that the kerogen is moderately mature. High S_2 peaks and petroleum potential values suggest a generally good hydrocarbon generation potential at optimum thermal maturity, assuming that hydrocarbon contamination has not seriously affected the results.

The kerogen in four samples at 2810-2825m, 2826-2840m, 2860-2875m and 2915-2930m was evaluated. The kerogen in all of these samples consists of 50-80% woody fragments and leaf cuticles which agrees with the Rock-Eval data. Grey amorphous aggregates were recorded at 2860-2875m, and the coaly material may be caved in this sample. Spores tend to be more abundant than palynomorphs. The kerogen in these samples tends to suggest that the hydrocarbons generated at optimum maturity will be gaseous or waxy in nature. Spore colour values vary from 1+ to 2 and are broadly consistent with the T_{max} data.

Five samples at 2795-2810m, 2810-2825m, 2825-2840m, 2870-2885m and 2885-2900m were evaluated for vitrinite reflectance. Reliable reflectance values of between 0.46% and 0.51% were obtained from the samples, with the exception of the first and last samples which yielded unreliable results due to the presence of reworked material. These reflectance values are in good agreement with the Tmax and kerogen data. The first sample at 2795-2810m has a good organic matter content dominated by bitumen and liptinite with few particles of indigenous vitrinite. The three middle samples consisted of coal or carbonaceous claystone with abundant vitrinite, some of which may be reworked and liptinite. Sandstone fragments in these samples showed heavy bitumen staining. The last sample at 2885-2900m had a poor organic matter content consisting mostly of corroded particles of reworked vitrinite and bitumen staining. With the exception of the last sample, the samples contain an abundance of fluorescent liptinites with a yellow to yellow-orange or light orange colour. Greenish-yellow material was also observed in some samples.

Two samples at 2810-2825m and 2870-2885m were extracted in order to evaluate the EOM present. Both samples yielded excellent concentrations of EOM of 2447ppm (2810-2825m) and 5982ppm (2870-2885m), with hydrocarbon concentrations of 1881ppm and 2143ppm respectively. In the latter case, difficulties in picking the lithologies means that a bulk claystone-coal lithology was extracted. The 2810-2825m extract consists mostly of saturated hydrocarbons (74.0%) while the other extract at 2870-2885m contains only 17.9% saturates. This suggests that the two extracts are derived from very different sources.

The gas chromatogram of the saturated hydrocarbons at 2810-2825m shows a unimodal n-alkane distribution with a maxima at nC₂₉. This is consistent with coal derived material and is probably of indigenous origin. The CPI ratio of 1.9 would also be consistent with the marginal to moderate thermal maturity of the coal. The pristane/phytane ratio is probably unreliable. The gas chromatograms of the saturated hydrocarbons at 2870-2885m is also unimodal with a maxima around nC₂₅-nC₂₉. This would be consistent with generation from terrestrial kerogen, although the rapid loss of compounds below nC₁₈ may indicate loss of the more volatile components during handling. If the latter has occurred, then the pristane/phytane ratio of 3.4 may not be wholly reliable. The CPI ratio of 1.3 is not inconsistent with the thermal maturity of the

kerogen, but the visible evidence of bitumen staining on the samples means that caution must be exercised.

The aromatic hydrocarbon gas chromatograms for the intervals at 2810-2825m and 2870-2885m are shown in figure 3. The gas chromatograms of the upper sample shows a prominence of phenanthrenes and alkyl phenanthrenes together with aromatised steranes and terpanes. This might be expected in hydrocarbons produced by a marginally to moderately mature type III kerogen such as exists at this interval. The only recognisable peaks in the gas chromatogram of the remaining sample are phenanthrene and alkyl phenanthrenes. A large "hump" of unresolved compounds is also present. This aromatic hydrocarbon composition is not inconsistent with a terrestrial source kerogen of moderate thermal maturity.

The mass chromatograms obtained from the two samples at 2810-2825m and 2870-2885m are shown in figure 4. The upper sample has a sterane and terpene composition which suggests a lower thermal maturity than that suggested for the Cretaceous samples. This might be compatible with an indigenous source. The lower sample has a sterane and terpene composition which suggests a equivalent vitrinite reflectance of 0.5-0.6%. The very high T_m/T_s value in the upper sample is difficult to explain.

The Brent group consists of a series of interbedded sandstones, coals and very organic-rich claystones. The kerogen in the coals and claystones is largely terrestrial in origin and of moderate thermal maturity. Hydrocarbon staining was observed in the samples, but the possibility of indigenously-derived early generation products cannot be ruled out.

Dunlin Group (~2950-3233m): A total of eighteen canned cuttings samples was evaluated from the Dunlin group. It is documented that turbo-drilling was carried out below 2972m and this should be borne in mind when considering the data. The light hydrocarbon (C_1-C_7) data for the first two samples at 2945-2960m and 2960-2975m are broadly similar to those described from the Brent group. Below 2975m, however, there is a relative increase in methane content accompanied by a decrease in the C_2+ components. This is reflected in gas wetness values which drop from 73.82% at 2960-2975m to 17.71% at 3035-3050m and remaining at this level to the base of the Dunlin group. This decrease correlates with

the onset of turbo-drilling and may represent the effects of rapid heating on the free hydrocarbons. The iC_4/nC_4 ratio of the samples is similar to those seen in the Brent group.

The upper two samples at 2945-2960m and 2960-2975m consist of a mixture of organic-rich greyish black or dark grey claystones (av. TOC = 4.58 wt%), medium to coarse sand and coal. Traces of turbo-drill affected claystone are seen in the lower sample. Below 2975m, the samples consist of greyish black, turbo-drill affected claystone, medium to coarse sand and coal. The claystone is generally the dominant lithology, except at 3075-3120m, where the sand is dominant. This interval equates with the intra-Dunlin sand at 3077.5m. The claystone is of variable organic richness, and in some samples coal may have contaminated the TOC samples. High TOC values of between 13.51% and 4.35% occur above 3035m and could also have been affected by caved material from the Brent group. Below 3035m, the TOC values of the claystones are fairly constant with a mean value of 0.86 wt%.

Rock-Eval data were obtained on thirteen cuttings lithologies. In the upper two samples, hydrogen indices of 102 mg/g and 125 mg/g are typical of the type III kerogen seen in the Brent group. The T_{max} values of 436°C are also consistent with data from the overlying interval. Below 2975m, high hydrogen indices in association with high TOC values at scattered intervals in the turbo-drilled interval suggest that the measured lithology may be contaminated with caved coaly material or claystones. Data from these samples will be disregarded because of this uncertainty. The remaining samples in the turbo-drilled zone clearly show the effects of turbo-drilling in very low S_2 peaks and hydrogen indices with anomalous T_{max} values. It is suggested that Rock-Eval data from the sidewall cores (chapter 3.2) are used to evaluate the Dunlin Group.

Five samples at 2960-2975m, 2975-2990m, 3035-3050m, 3120-3135m and 3210-3225m were evaluated for kerogen quality. The lower four samples show the typical grey amorphous aggregates seen in turbo-drilled samples. No primary structures are preserved. The samples at 2975-2990m and 3120-3135m contain possibly caved coaly material. No spore colour values could be determined. The top sample at 2960-2975m was similar in appearance to samples from the Brent group containing a high proportion of woody material and leaf cuticle debris. Spore colour values of

between 1+ and 2 suggest that the kerogen in this sample is marginally to moderately mature.

Six samples were measured for vitrinite reflectance. All of the samples contained fragments of turbo-drill affected claystone. Vitrinite reflectance values of between 0.66% and 0.56% were obtained, mostly on fragments of probably caved material, but are felt to be unreliable as indicators of the thermal maturity of the samples. Three samples at 3035-3050m, 3195-3210m and 3210-3225 were found to be barren of organic matter except for rare, very small inertinite particles. In the remaining particles, the turbo-drilled fragments were barren and measurements were taken on fragments of coal and claystone/carbonaceous claystone. With the exception of the caved fragments which contained good amounts of yellow to yellow-orange or light orange liptinite in ultra-violet light, the samples were largely barren. Traces of a dull orange fluorescing material were seen in the sample at 3090-3105m. It is not possible to obtain an idea of the thermal maturity of the rocks from these data.

Three samples at 2960-2975m, 2975-2990m and 3020-3035m were extracted to evaluate any EOM present in the samples. All three samples yielded good EOM concentrations of between 1714ppm and 1193ppm of which between 38.3% and 45.8% represent hydrocarbons. The 2960-2975m sample has the highest percentage of saturated hydrocarbon at 33.3%, while the lower two samples have similar saturated hydrocarbon percentages of about 19%. The percentage of aromatic hydrocarbons in the samples shows less variation, varying from 12.5% to 20.8%.

The saturated hydrocarbon gas chromatogram of the 2960-2975m extract is similar to that described from 2870-2885m in the Brent group, being unimodal with a maxima about nC_{25} - nC_{27} and a hump of unresolved compounds around nC_{30} . The pristane/phytane ratio of 1.6 may be unreliable due to the rapid drop-off below nC_{19} . The sample at 2975-2990m has a bimodal n-alkane distribution which is intermediate between the two previous samples. The pristane/phytane ratios are not dissimilar, ranging between 1.6 at 2960-2975m and 2.1 at 3020-3035m. It may be speculated that the three extracts are derived from similar types of source material, but are at different levels of maturity due to the effects of the turbo-drilling. The sources of the extracts are difficult to determine.

The aromatic hydrocarbon gas chromatograms are shown in figure 3. The gas chromatogram of the 2960-2975m interval shows only a large "hump" of unresolved compounds, with no recognisable peaks. The gas chromatogram of the turbo-drilled interval at 2975-2990m shows a mature, oil-like distribution with prominent alkyl naphthalenes, phenanthrene and the alkyl phenanthrenes. It is not known if this is due to hydrocarbon contamination or to turbo-drilling effects, although the former seems more likely. The gas chromatogram of the remaining turbo-drilled interval at 3020-3035m is somewhat similar to those samples described from the Brent group and the Cretaceous section with a near-absence of alkyl naphthalenes, and prominent phenanthrene and alkyl phenanthrene peaks. Similar distributions are seen in residual oils in hydrocarbon reservoirs. Turbo-drilling is unlikely to have caused this distribution.

The three samples at 2960-2975m, 2975-2990m and 3020-3035m were analysed by GC-MS. The sterane and terpane distributions in the mass fragmentograms of the three samples suggest roughly similar levels of thermal maturity in each sample, and are similar to those seen towards the bottom of the Brent group. There is a slight increase in thermal maturity with increasing depth, which is also reflected in the source dependent parameters. There appears to be no significant difference in the source type of organic matter.

Turbo-drilling has obscured the true geochemical character of the rocks of the Dunlin group and it is difficult to reach any conclusions about this interval. It is suggested that the Rock-Eval data obtained on sidewall core samples be used for evaluation of the turbo-drilled interval.

Statfjord formation (3233-3285m, TD): Four canned cuttings samples were evaluated from the Statfjord formation. The light hydrocarbon (C_1-C_7) composition of the samples is essentially similar to that observed in the overlying Dunlin group. There is a minor decrease in the abundance of the C_1-C_4 components down the section which is mirrored by a slight increase in gas wetness values from 11.60% at 3225-3240m to 24.10% at 3270-3285m. The abundance of C_5+ compounds remains largely unchanged, but is slightly increased relative to the Dunlin group. The turbo-drilling of this section makes it difficult to reach any conclusions regarding these data.

A medium to very coarse sand/sandstone becomes the dominant cuttings lithology below 3240m. Minor amounts of coal, light grey and greyish black, turbo-drilled claystone lithologies also occur in the samples. Based on TOC contents of 0.84 wt% and 0.70 wt%, the two claystones have fair organic richness, although due to the turbo-drilling, these values are not wholly representative of the original rock.

Rock-Eval data for the two claystone lithologies clearly show the effects of turbo-drilling in very low S_2 peaks, low hydrogen indices and highly variable T_{max} values. These data merely indicate that the organic matter has largely been destroyed by the turbo-drilling.

One sample at 3270-3285m was evaluated for vitrinite reflectance. The reflectance measurements were taken on coaly fragments in the sample since the turbo-drilled lithology is barren of organic matter.

Due to the turbo-drilling, it is not possible to make any conclusions regarding the organic geochemistry of the Statfjord formation.

3.2 Sidewall cores

A total of twelve sidewall core samples from the Brent and Dunlin Group were analysed for TOC content and Rock-Eval pyrolysis characteristics. Nine of the samples are from the Brent group and the remaining three samples are from the Dunlin group.

Brent Group (2796-2950m): The nine sidewall core samples consist of medium to dark grey claystones with TOC values which vary from 1.67 wt% at 2823m to 6.74 wt% at 2806m, with a mean value of 3.57 wt%. These values are comparable to those observed in cuttings samples from this group and would indicate good to excellent organic richness.

With the exception of the hydrogen indices for the samples at 2815m and 2820.50m, which would indicate a more hydrogen-rich type II/III kerogen, hydrogen index values of between 120mg/g and 191mg/g are similar to those observed in the cuttings samples and are typical of type III kerogen. Tmax values of between 430°C and 440°C suggest marginal to moderate thermal maturity, while petroleum potential values of between 2.97mg/g and 14.60mg/g suggest that the kerogen does have potential for hydrocarbon generation.

These data broadly support the conclusions reached on the basis of the cuttings data, ie. that claystones in the Brent group contain a good to excellent richness of type III kerogen with fair to good hydrocarbon generation potential. Currently the kerogen has marginal to moderate thermal maturity.

Dunlin Group (2950-3233m): Three sidewall core samples were evaluated for TOC and Rock-Eval characteristics in the turbo-drilled interval (2972-3285m). The claystone and siltstone samples have good TOC values of 1.81 wt% and 1.35 wt%, respectively. The marly lithology has a poor organic richness based on a TOC value of 0.37 wt%.

The Rock-Eval data from the calcareous lithology at 3231.5m due to both the nature of the rock and to the possible presence of contaminating hydrocarbons as suggested by a production index of 0.41. In the remaining two samples, hydrogen indices of 125mg/g and 99mg/g are typical of type III kerogen. Tmax values of 440°C and 444°C suggest that the kerogen in the Dunlin formation is thermally mature, although it is not known how far turbo-drilling effects penetrate the wall of the well.

Conclusions about the Dunlin group based on these data must be tentative, but suggest a thermally mature type III kerogen which may be similar to that seen in the claystones of the Brent group.

3.3 Comparison of core samples with crude oil samples

Drill stem test (DST) samples

a) API gravity

The two oil samples from DST No. 1 at 3079-3096m and DST No. 4 at 2866-2882m gave API gravities of 39.5° (0.8273g/cc) and 38.1° (0.8341g/cc) which suggests that the oils are both thermally mature assemblages of hydrocarbons (Table 14).

b) C_2-C_8 hydrocarbons

The C_2-C_8 hydrocarbon composition of the two oil samples is shown in figure 6 and table 15. The gas chromatograms of the C_2-C_8 hydrocarbons are very similar, and suggest that the oil samples from both DST's are derived from similar sources. A predominance of the n-alkane peaks over the cyclic and aromatic compounds suggests that both oils are thermally mature. This is supported by iC_4/nC_4 ratios of 0.17 (DST No. 4) and 0.25 (DST No. 1), and the DST No. 4 oil appears to be slightly more thermally evolved than the DST No. 1 oil. This is slightly anomalous as the DST No. 1 oil is the deeper of the two samples.

c) Liquid chromatography

The liquid chromatography data are shown in table 16, and show that hydrocarbons account for between 64.9% (DST No. 4) and 77.3% (DST No. 1) of the oils. Saturated hydrocarbons account for between 45.9% (DST No. 4) and 57.2% (DST No. 1). These data indicate that the deeper DST No. 1 sample is the more thermally evolved oil. Such high contents of saturated hydrocarbons are often associated with very mature crude oils of almost condensate affinity.

d) Gas chromatography

The saturated hydrocarbon gas chromatograms of the DST oil (Figure 7) have nearly identical unimodal n-alkane distributions with maxima at nC_{13} and dropping rapidly such that no peaks above nC_{28} are resolvable. Similar n-alkane distributions are seen in very mature crude oils/-condensates. CPI ratios for these samples are extremely unreliable due

to the poor development of $nC_{25}+$ alkanes. Similar n-alkane profiles and identical pristane/phytane ratios of 1.9 (table 17) suggest that both oils share a common source material which was possibly deposited under mildly oxidising conditions.

The aromatic hydrocarbon gas chromatograms are also very similar (Figure 8) with a predominance of peaks representing alkyl-naphthalene compounds. Such distributions are typical of mature crude oils and especially condensates.

e) Gas chromatography-mass spectrometry (GC-MS)

Mass chromatograms representing the terpanes (m/z 191) and steranes (m/z 217,219) are shown in figure 9, and the tabulated data are given in tables 18 and 19.

The mass chromatograms of the oil samples contain the commonly-occurring terpene and sterane peaks which are typical of thermally mature hydrocarbon accumulations. The maturity-dependant ratios in tables 18 and 19 have equilibrium values which suggests that the oils have a thermal maturity corresponding to minimum of 0.70% vitrinite reflectance. 28,30-bisnorhopane is recognised in the oils and is typical of oils sourced by Upper Jurassic source horizons.

f) $\delta^{13}C$ isotope ratios

The two oils have similar $\delta^{13}C$ ratios for both the saturated hydrocarbons (DST No. 4 = -29.60/00 and DST No. 1 = -29.10/00) and the aromatic hydrocarbons (DST No. 4 = -28.40/00 and DST No. 1 = -27.8 0/00). These data indicate that the two oils are derived from similar sources.

g) Conclusions

The crude oils obtained from DST No. 4 and DST No. 1 are thermally mature, light oils which probably share a common source.

Conventional core samples

A total of eight core samples from the Brent group and two samples from the Dunlin group were extracted in order to evaluate and characterise any EOM present. The cores are mainly sandstones with an oily smell and bracket the intervals over which DST No. 1 and DST No. 4 were taken.

The extractability of the core samples varies from 10254ppm and 10278ppm at 2832.55m and 2833.40m, respectively, to a minimum of 1918ppm in the lowermost sample from the Brent group. Extractabilities of 7055ppm and 6673ppm were observed in the two samples from the intra-Dunlin sand. The EOM from all of these samples is non-indigenous material based on the lithology of the samples and EOM concentrations in excess of 1000mg/g TOC.

The composition of the EOM in the core samples is remarkably similar with a very small variation in the percentages of the different components. With the exception of the sample at 2934.50m which has a high percentage of saturated hydrocarbons at 64.9%, the percentage of saturated hydrocarbons in the remaining nine samples varies from 50.5% to 57.0%, and the percentage of aromatic hydrocarbons varies from 11.5% to 19.6% with an average of 17.6%. The similarity of the data from the different core samples tends to suggest that there is little difference in the character of the EOM in the Brent group and in the intra-Dunlin sand. This would be consistent with the close similarity observed in the oil samples.

The saturated hydrocarbon gas chromatograms of the EOM are shown in figure 7, and with the exception of the two samples at 2934.50m and 3086.45m, all show similar distributions of n-alkanes. The majority of the samples have a unimodal-n-alkane distribution with a maximum at nC_{14} - nC_{15} , with a reasonably gradual decrease in peak height down to nC_{40} . All of these samples have similar pristane/phytane ratios of between 1.4 and 1.5, which is lower than that observed in the oil samples. CPI ratios of around 1.0 suggest that the EOM is thermally mature. The remaining two samples at 2934.50m and 3086.45m have n-alkane distributions which are very similar to those of the DST oils with a maximum at nC_{13} - nC_{14} and a rapid drop in peak height down to nC_{28} , below which no reasonable peaks occur. Both of these samples have a pristane/phytane ratio of 1.7 which is more similar to that of the oils.

The aromatic hydrocarbon gas chromatograms are shown in figure 8, and are all essentially similar. Alkyl naphthalene compounds tend to be the most prominent peaks, followed by phenanthrene and the alkyl phenanthrene. Septum contamination accounts for the anomalous "hump" beyond the phenanthrene at 2927.65m, 2930.50m and 2934.50m. The distribution of aromatic compounds is more typical of mature crude oils and suggests that there are no major source differences for the EOM in the samples, regardless of variation in the saturated hydrocarbons.

$\delta^{13}\text{C}$ ratios for the saturated hydrocarbons vary from -29.2 o/oo to -29.9 o/oo, with a mean of -29.6 o/oo. The aromatic hydrocarbon fraction has $\delta^{13}\text{C}$ values of between -28.0 o/oo and -28.9 o/oo, with a mean value of -28.5 o/oo. The relatively small degree of variation suggests that the EOM in the samples is derived from an essentially common source, which is not dissimilar to that of the two DST oils.

The GC-MS data are shown in figure 9 and in tables 18 and 19. The mass chromatograms of the core extracts are largely similar to each other, and to the two DST oils. Sterane and terpane compounds occur which are typical of well mature hydrocarbon assemblages. Maturity ratios based on these compounds suggest that chemical equilibrium exists, indicating an equivalent vitrinite reflectance maturity of at least 0.7%.

Variations with source characteristic peaks and ratios are minor, suggesting that the hydrocarbons in the cores and the DST oils are very similar and probably share a common source interval. The presence of 28,30-bisnorhopane is typical of hydrocarbons sourced by Upper Jurassic shales.

All of the data strongly suggest that the core hydrocarbons and the DST oils share a common origin. It is possible that the broad range of hydrocarbons in most of the cores represent a less mobile residue which is coating the pore walls. It is notable that in these samples, the n-alkane peaks drop off below nC_{15} , while the oils have maximum peak heights at nC_{13} and nC_{14} . The two core samples at 2934m.50m and 3086.45m with oil-like n-alkane distributions are difficult to explain given the other data. It is possible that these hydrocarbons represent more volatile components which have migrated into cleaner sandstones at a late stage in the history of the hydrocarbon-bearing sequence. This is only speculation and a more satisfactory answer is not possible given the available data.

4. CONCLUSIONS

The most organic-rich rocks are found in the claystone horizons in the Brent group. The kerogen in these rocks is mostly of terrestrial plant origin, and at best would produce a waxy oil or condensate at optimum thermal maturity. The claystones in the Brent group only have marginal to moderate thermal maturity in this well section and are unlikely to be significant source rocks at this time. Based on tentative data thermal maturity may be achieved in the rocks of Dunlin group, although turbo-drilling tends to obscure things.

The rocks of the Tertiary, Cretaceous and Viking group contain immature, highly degraded kerogen of no hydrocarbon source potential.

Drill stem test (DST) oils from the Brent group and the intra-Dunlin sands are thermally mature, light oils with an API gravity of about 39⁰. These oils are essentially similar in nature, and probably share a common source.

The oils and hydrocarbons extracted from core samples also appear to share a common origin. The cores appear to mostly contain a heavier residual bitumen.

Tables 3-13

CUTTINGS AND SIDEWALL CORES

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3a

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN HEADSPACE

IKU no.	DEPTH m	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 nC4
I C 1606	1000	42050	443	258				42752	702	1.64	
I C 1607	1050	8437	43	38				8518	81	0.95	
I C 1608	1100	4973	60					5032	60	1.19	
I C 1609	1150	2080	33	16				2129	49	2.30	
I C 1610	1200	301	11	17				329	28	8.38	
I C 1611	1250	25						25		0.00	
I C 1612	1300	74						74		0.00	
I C 1613	1350	62						62		0.00	
I C 1614	1400	49		5				55	5	9.81	
I C 1615	1450	40						40		0.00	
I C 1616	1500	48						48		0.00	
I C 1617	1550	94	6	9				109	15	13.96	
I C 1618	1600	258	16	22				297	38	12.88	
I C 1619	1650	495	24	37	25	15	19	596	101	16.98	1.63
I C 1620	1700	505	17	25	11			559	54	9.66	
I C 1621	1750	371	12	22				405	34	8.39	
I C 1622	1800	315	10	21	13			359	44	12.24	
I C 1516	1850	840	26	26				892	52	5.83	
I C 1517	1900	784	25	26	15			849	66	7.72	
I C 1518	1950	335	26	36	24	13	178	435	99	22.82	1.82
I C 1519	2000	312	16	26	16		382	370	58	15.64	
I C 1520	2015	1041	49	83	47	60	551	1281	240	18.73	0.79

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3a

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN HEADSPACE

IKU no.	DEPTH m	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 nC4
I C 1521	2030	89	11	57	34	50	1144	242	153	63.11	0.69
I C 1522	2045	143	24	132	133	200	1917	631	488	77.37	0.66
I C 1523	2060	1375	59	142	91	131	1279	1798	423	23.52	0.69
I C 1524	2075	1408	52	102	53	85	890	1700	292	17.18	0.63
I C 1525	2090	1022	67	145	93	145	1487	1473	451	30.59	0.64
I C 1526	2105	1903	86	158	98	161	2081	2405	503	20.89	0.61
I C 1527	2120	1038	69	137	83	136	1536	1463	425	29.05	0.61
I C 1528	2135	1627	85	143	72		1589	1927	300	15.55	
I C 1529	2150	80	8				821	88	8	9.21	
I C 1530	2165	16						16		0.00	
I C 1531	2180	2090	92	78	25			2284	195	8.53	
I C 1533	2210	1185	135	166	90		790	1576	391	24.82	
I C 1534	2225	1176	73	95				1344	168	12.50	
I C 1535	2240	7026	254	138	49			7467	441	5.91	
I C 1536	2255	3045	113	71				3230	185	5.72	
I C 1537	2270	1421	85	74	29			1610	188	11.70	
I C 1538	2285	70	3					73	3	3.71	
I C 1539	2300	3819	143	93				4056	237	5.84	
I C 1540	2315	3436	170	58				3664	228	6.21	
I C 1541	2330	4015	151	60	21			4247	233	5.48	
I C 1542	2345	7578	290	110	46	27		8051	473	5.87	1.72
I C 1543	2360	8424	444	245	95	64		9272	848	9.14	1.49

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3a

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN HEADSPACE

I	I	I	I	I	I	I	I	I	I	I	I	I	I
I	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM	SUM	WET-	iC4	I
I	no.	m							C1-C4	C2-C4	NESS	-----	I
I											(%)	nC4	I
I	C 1589	3075	9191	1415	741	140	440	1074	11927	2737	22.94	0.32	I
I	C 1590	3090	1430	452	543	112	389	1433	2926	1496	51.12	0.29	I
I	C 1591	3105	1863	971	1005	99	353	1048	4291	2428	56.58	0.28	I
I	C 1592	3120	5002	1780	1622	203	657	2253	9263	4261	46.00	0.31	I
I	C 1593	3135	2427	423	353	45	151	421	3399	972	28.60	0.30	I
I	C 1594	3150	1959	297	231	55	163	479	2706	746	27.59	0.34	I
I	C 1595	3165	4634	711	523	132	395	1322	6395	1761	27.53	0.33	I
I	C 1596	3180	9667	1337	599	127	435	1413	12165	2498	20.54	0.29	I
I	C 1597	3195	3529	475	456	117	396	891	4973	1444	29.04	0.30	I
I	C 1598	3210	3190	430	314	78	262	918	4274	1084	25.36	0.30	I
I	C 1599	3225	4026	797	650	163	493	1944	6128	2102	34.31	0.33	I
I	C 1600	3240	8547	1868	710	147	446	2308	11718	3171	27.06	0.33	I
I	C 1601	3255	10197	3408	1223	104	306	999	15237	5040	33.08	0.34	I
I	C 1602	3270	2672	1265	716	61	195	581	4909	2237	45.56	0.31	I
I	C 1603	3285	30	35	26				91	61	66.77		I

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3b

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN OCLUDED

IKU no.	DEPTH m	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 nC4
I C 1521	2030	146	19	46	27	51	1113	288	143	49.52	0.52
I C 1522	2045	185	22	43	19	45	1412	314	129	41.04	0.42
I C 1523	2060	193	21	32			990	246	53	21.50	
I C 1524	2075	234	26	43			1417	304	69	22.79	
I C 1525	2090	224	26	48	20	52	2666	370	145	39.33	0.39
I C 1526	2105	187	23	51	21	56	3732	338	151	44.75	0.38
I C 1527	2120	221	25	54	23	57	4429	379	159	41.83	0.40
I C 1528	2135	186	20				2479	206	20	9.65	
I C 1529	2150	178	20	1			1424	200	22	10.95	
I C 1530	2165	119	14					133	14	10.77	
I C 1531	2180	134	15	4			659	153	19	12.24	
I C 1533	2210	140	14	20				174	34	19.55	
I C 1534	2225	171	18	4				193	22	11.46	
I C 1535	2240	120	14	5				140	19	13.79	
I C 1536	2255	126	15	3				144	18	12.35	
I C 1537	2270	146	16	6				168	22	13.27	
I C 1538	2285	162	17	4				183	21	11.63	
I C 1539	2300	156	15	17				189	32	17.16	
I C 1540	2315	175	19	26				220	45	20.58	
I C 1541	2330	136	14					150	14	9.06	
I C 1542	2345	264	34	25		2	442	325	61	18.70	0.00
I C 1543	2360	256	29	22		3		310	54	17.46	0.00

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3b

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN OCLUDED

IKU no.	DEPTH m	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 nC4
I C 1544	2375	159	19					178	19	10.86	
I C 1545	2390	235	29	5				269	34	12.60	
I C 1546	2405	248	32	7				287	39	13.74	
I C 1547	2420	288	36	43				367	80	21.68	
I C 1549	2450	308	35	6				349	41	11.79	
I C 1550	2465	473	67	27				567	94	16.54	
I C 1551	2480	158	22	39				218	60	27.67	
I C 1552	2495	72	9					80	9	10.61	
I C 1553	2510	145	15	21				181	36	19.84	
I C 1554	2525	129	15	21				164	36	21.82	
I C 1555	2540	147	17	27				191	44	23.10	
I C 1556	2555	158	19					177	19	10.63	
I C 1557	2570	277	37					314	37	11.66	
I C 1558	2585	176	21	34				231	55	23.96	
I C 1559	2600	359	49	13				420	61	14.59	
I C 1560	2615	619	90	185				894	275	30.77	
I C 1561	2630	407	59	108				574	167	29.07	
I C 1562	2645	356	53	140				549	193	35.21	
I C 1563	2660	205	27	103	33	47		415	210	50.65	0.69
I C 1564	2675	255	75	316	78	151	620	875	621	70.92	0.51
I C 1565	2690	218	58	220	36	82	361	614	396	64.51	0.45
I C 1566	2705	325	53	224	59	133	706	794	469	59.12	0.44

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3b

CONCENTRATION (u1 Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS IN OCLUDED

I	I	I	I	I	I	I	I	I	I	I	I	I	I
I	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM	SUM	WET-	iC4	I
I	no.	m							C1-C4	C2-C4	NESS	-----	I
I											(%)	nC4	I
I													I
I	C 1589	3075	23660	2903	3155	221	1150	1850	31089	7429	23.90	0.19	I
I	C 1590	3090	24718	1534	968	75	351	1568	27646	2928	10.59	0.21	I
I	C 1591	3105	32303	1831	1218	108	501	2194	35961	3658	10.17	0.22	I
I	C 1592	3120	26147	1773	1536	163	772	3308	30392	4244	13.97	0.21	I
I	C 1593	3135	14186	982	925	72	362	966	16528	2342	14.17	0.20	I
I	C 1594	3150	30803	1511	115	9	146	1241	32585	1782	5.47	0.06	I
I	C 1595	3165	31841	2099	1305	104	465	1542	35814	3973	11.09	0.22	I
I	C 1596	3180	41941	1991	626	13	260	1415	44832	2891	6.45	0.05	I
I	C 1597	3195	38800	1554	373	9	153	882	40888	2088	5.11	0.06	I
I	C 1598	3210	40063	1374	87	33	105	491	41661	1598	3.84	0.31	I
I	C 1599	3225	40080	2156	1190	92	425	1088	43943	3863	8.79	0.22	I
I	C 1600	3240	31363	1742	120	54	151	1239	33431	2068	6.19	0.36	I
I	C 1601	3255	25739	2051	916	19	206	2513	28932	3192	11.03	0.09	I
I	C 1602	3270	16273	769	740	117	294	3311	18193	1920	10.55	0.40	I
I	C 1603	3285	9194	686	1212	184	786	3499	12062	2868	23.78	0.23	I

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3c

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS SUMMATION

IKU no.	DEPTH m	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET-NESS (%)	iC4 nC4
I C 1521	2030	235	30	103	61	101	2256	531	296	55.72	0.61
I C 1522	2045	328	46	175	152	245	3329	946	617	65.29	0.62
I C 1523	2060	1568	79	175	91	131	2270	2044	476	23.28	0.69
I C 1524	2075	1643	78	145	53	85	2306	2004	361	18.03	0.63
I C 1525	2090	1247	93	193	113	197	4153	1843	596	32.34	0.57
I C 1526	2105	2090	109	208	119	217	5813	2744	654	23.83	0.55
I C 1527	2120	1258	95	191	105	193	5965	1842	584	31.68	0.55
I C 1528	2135	1813	105	143	72		4068	2133	320	14.98	
I C 1529	2150	259	29	1			2245	289	30	10.41	
I C 1530	2165	135	14					149	14	9.59	
I C 1531	2180	2224	107	82	25		659	2437	213	8.76	
I C 1533	2210	1325	149	186	90		790	1750	425	24.29	
I C 1534	2225	1347	91	99				1537	190	12.37	
I C 1535	2240	7146	268	143	49			7606	460	6.05	
I C 1536	2255	3172	129	74				3374	202	6.00	
I C 1537	2270	1567	102	80	29			1778	211	11.85	
I C 1538	2285	232	20	4				256	24	9.37	
I C 1539	2300	3976	159	110				4245	269	6.34	
I C 1540	2315	3611	189	83				3883	273	7.03	
I C 1541	2330	4151	165	60	21			4397	246	5.60	
I C 1542	2345	7843	324	135	46	29	442	8376	534	6.37	1.58
I C 1543	2360	8680	473	267	95	67		9582	902	9.41	1.41

Project no.: 22.1793.00
 Well ident.: 30/3-4
 DATE : 31 - 7 - 85.

TABLE 3c

CONCENTRATION (ul Gas / kg dry Rock) OF C1 - C5+ HYDROCARBONS SUMMATION

I	I	I	I	I	I	I	I	I	I	I	I	I	I
I	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM	SUM	WET-	iC4	I
I	no.	m							C1-C4	C2-C4	NESS	-----	I
I											(%)	nC4	I
I													I
I	I	I	I	I	I	I	I	I	I	I	I	I	I
I	C 1544	2375	6284	257	108	38			6687	403	6.03		I
I	C 1545	2390	11950	846	451	150			13397	1447	10.80		I
I	C 1546	2405	9225	713	448	157	107		10650	1425	13.38	1.47	I
I	C 1547	2420	7230	547	366	115			8258	1028	12.45		I
I	C 1549	2450	5270	467	343	131	100		6311	1041	16.50	1.31	I
I	C 1550	2465	8196	792	604	202	167	1388	9961	1765	17.72	1.21	I
I	C 1551	2480	7756	457	314	75	59		8662	906	10.45	1.27	I
I	C 1552	2495	137	16					153	16	10.52		I
I	C 1553	2510	2003	150	148	39	34		2374	371	15.63	1.14	I
I	C 1554	2525	3014	328	406	108			3855	841	21.82		I
I	C 1555	2540	869	152	255	75	64		1415	546	38.58	1.16	I
I	C 1556	2555	1608	294	580	169	160		2811	1203	42.81	1.05	I
I	C 1557	2570	3400	650	1055	287			5391	1992	36.94		I
I	C 1558	2585	1743	307	666	216	180		3111	1368	43.98	1.20	I
I	C 1559	2600	4208	803	1756	537	476		7779	3572	45.91	1.13	I
I	C 1560	2615	4456	637	1411	277			6781	2325	34.29		I
I	C 1561	2630	4531	973	2120	560	517		8701	4170	47.92	1.08	I
I	C 1562	2645	3078	730	1526	368	330		6033	2955	48.98	1.11	I
I	C 1563	2660	227	38	146	33	47		491	264	53.74	0.69	I
I	C 1564	2675	5011	3092	4911	1021	1132	1743	15168	10157	66.96	0.90	I
I	C 1565	2690	1399	830	1723	388	431	636	4771	3372	70.68	0.90	I
I	C 1566	2705	2285	955	2611	603	898	1510	7352	5068	68.92	0.67	I



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1606	950-1000	1.40	* 100% <u>Claystone</u> , silty, light brownish grey to greyish brown, slightly micaceous, glauconitic Sm.am. Metamorphic rock fragment; Shell fragments; Pyrite filling burrows; Glauconite; Forams
C-1607	1000-1050	0.60	* 100% <u>Claystone</u> , silty, sandy, light grey, light brownish grey to greyish brown, micromicaceous, Glauconite, with some spicules Sm.am. Glauconite; Fish tooth
C-1608	1100	1.13	* 100% <u>Claystone</u> , silty, sandy, light brownish grey to greyish brown, with Glauconite and spicules, calcareous Sm.am. Pyrite; Glauconite; Sevid; Spicules; Forams; Oolites
C-1609	1150	1.60	* 100% <u>Claystone</u> , silty, sandy, light brownish grey to greyish brown, with Glauconite and spicules, calcareous Sm.am. Pyrite
C-1610	1160-1200	1.89	* 100% <u>Claystone</u> , silty, light brownish grey, glauconitic, micromicaceous, with some spicules and oolites, slightly pyritic Sm.am. Limestone; Glauconite
C-1611	1210-1250	1.62	* 100% <u>Claystone</u> , silty, light brownish grey, micromicaceous, slightly pyritic Sm.am. Pyrite; Glauconite; Olites



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1612	1250-1300	1.26	* 90% <u>Claystone</u> , silty, grey to brownish grey, micromicaceous, slightly pyritic 10% <u>Claystone</u> , silty, light brownish grey, micromicaceous Sm.am. Pyrite
C-1613	1300-1350	1.30	* 100% <u>Claystone</u> , silty, grey to brownish grey, micromicaceous Sm.am. Claystone, light grey; Siderite
C-1614	1350-1400	1.28	* 100% <u>Claystone</u> , silty, grey to brownish grey, micromicaceous, occasionally fissile to subfissile Sm.am. Claystone, light grey; Pyrite
C-1615	1450	1.38	* 90% <u>Claystone</u> , grey to greyish brown, micromicaceous, occasionally fissile to subfissile, pyritic 10% <u>Claystone</u> , silty, light grey, blocky Sm.am. Pyrite
C-1616	1500		90% <u>Sand</u> , coarse rounded to subrounded, frosted surface 10% <u>Claystone</u> , grey to greyish brown, micromicaceous, occasionally fissile to subfissile Sm.am. Glauconite
C-1617	1500-1550		90% Sand, medium to coarse, rounded to subrounded, frosted surface 10% <u>Claystone</u> , grey to greyish brown, micromicaceous, occasionally fissile to subfissile Sm.am. Glauconite



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1618	1600	1.34	* 90% <u>Claystone</u> , grey to greyish brown, micromicaceous, occasionally fissile to subfissile 10% <u>Claystone</u> , dark grey, micromicaceous, fissile to subfissile Sm.am. Siderite; Pyrite
C-1619	1650	1.41	* 100% <u>Claystone</u> , grey to greyish brown, micromicaceous, occasionally fissile to subfissile with occasional foraminifera Sm.am. Claystone, greenish grey, grey; Siderite
C-1620	1700	0.64	* 90% <u>Claystone</u> , grey, occasionally greenish grey 10% <u>Claystone</u> , grey, greyish brown Sm.am. Siderite; Pyrite
C-1621	1750		100% <u>Claystone</u> , grey, greenish grey, micromicaceous Sm.am. Claystone, greyish brown, grey; Siderite
C-1622	1800	0.36	* 100% <u>Claystone</u> , grey, greenish grey, micromicaceous Sm.am. Claystone, greyish brown; Siderite
C-1516	1810-50	0.37	* 100% <u>Claystone</u> , grey, greenish grey, micromicaceous Sm.am. Siderite
C-1517	1850-1900	0.42	* 100% <u>Claystone</u> , grey, greenish grey, micromicaceous Sm.am. Siltstone, greyish white; Siderite



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1518	1900-1950	0.46	* 90% <u>Claystone</u> , grey, greenish grey, calcareous 10% <u>Tuffaceous material</u> , mainly greyish brown, thinly laminated, trick in pyrite Sm.am. Siderite; Claystone, weak red
C-1519	1950-2000	0.04	* 70% <u>Claystone</u> , weak red to reddish brown, slightly calcareous, slightly micromicaeous 30% <u>Claystone</u> , grey, olive grey Sm.am. Chalk, white; Pyrite; Claystone, white
C-1520	2000-2015	0.62	* 80% <u>Claystone</u> , grey, olive grey, calcareous 20% <u>Claystone</u> , weak red to reddish brown, slightly calcareous Sm.am. <u>Claystone</u> , light grey; Siderite; Pyrite; Tuff.
C-1521	2015-2030	1.02	* 90% <u>Claystone</u> , grey, olive grey, calcareous 10% <u>Claystone</u> , weak red to reddish brown, slightly calcareous Sm.am. Claystone, light grey, silty, probably tuffaceous; Tuff., greyish brown, laminated; Pyrite
C-1522	2030-2045	0.83	* 50% <u>Claystone</u> , grey, olive grey, calcareous 40% <u>Tuff</u> , light grey to greyish brown, often laminated, occasionally very coarse 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Claystone, light grey, ?tuffaceous; Pyrite



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1523	2045-2060	0.74	50% <u>Tuff</u> , light grey to grey, brownish grey. Often laminated, often coarse grained * 40% <u>Claystone</u> , grey olive grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Pyrite
C-1524	2060-2075	0.52	60% <u>Tuff</u> , light grey to grey, brownish grey, occasionally laminated * 30% <u>Claystone</u> , grey, olive grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Siderite; Pyrite
C-1525	2075-2090	0.55	60% <u>Tuff</u> , white to grey, brownish grey, often finely laminated, often coarse grained 30% <u>Claystone</u> , grey, greenish grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Claystone, light grey, light greenish grey; Fragments of volcanic glass; Siderite
C-1526	2090-2105	0.30	60% <u>Tuff</u> , white to grey, often laminated, often coarse grained * 30% <u>Claystone</u> , grey, greenish grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Pyrite
C-1527	2105-2120	0.34	* 80% <u>Claystone</u> , grey, olive grey, calcareous 20% <u>Tuff</u> , light grey to grey, laminated, often coarse grained Sm.am. Pyrite; Fragments of volcanic glass; Claystone, weak red to reddish brown <u>Cosinodiscus</u>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1528	2120-2135	0.34	* 80% <u>Claystone</u> , grey, olive grey, calcareous 10% <u>Claystone</u> , weak red to reddish brown 10% <u>Tuff</u> , light grey to grey, often laminated Sm.am. Volcanic glass fragments; Pyrite
C-1529	2135-2150	0.33	* 90% <u>Claystone</u> , grey, olive grey, calcareous 10% <u>Tuff</u> , mainly light grey to greyish brown, often laminated Sm.am. Claystone, weak red to reddish brown; Siderite, occasionally sphaerosiderite; Pyrite
C-1530	2150-2165	0.38	* 90% <u>Claystone</u> , grey, olive grey, calcareous 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Tuff; Siderite, occasionally sphaerosiderite; Claystone, light grey
C-1531	2165-2180	0.46	* 90% <u>Claystone</u> , grey, olive grey to brownish grey, calcareous 10% <u>Claystone</u> , light grey Sm.am. Claystone, weak red to reddish brown; Siderite; Pyrite
C-1532	2180-2195	0.42	* 80% <u>Claystone</u> , grey, olive grey to brownish grey, calcareous 10% <u>Claystone</u> , weak red 10% <u>Claystone</u> , light grey Sm.am. Tuff; Pyrite
C-1533	2195-2210	0.34	* 90% <u>Claystone</u> , grey, olive grey, occasionally brownish grey, calcareous 10% <u>Claystone</u> , often silty, dark grey Sm.am. Claystone, weak red to reddish brown; Tuff



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1534	2210-2225	0.35	* 90% <u>Claystone</u> , grey, olive grey 10% <u>Claystone</u> , dark grey, often silty, sandy, glauconitic Sm.am. Claystone, weak red to reddish brown; Siderite
C-1535	2225-2240	0.29 0.62	* 40% <u>Claystone</u> , grey, olive grey * 40% <u>Claystone</u> , dark grey 20% <u>Claystone</u> , weak red to reddish brown Sm.am. Pyrite; Chalk; Tuff.
C-1536	2240-2255	0.79	* 80% <u>Claystone</u> , silty, dark grey to grey 10% <u>Claystone</u> , weak red to reddish brown 10% <u>Claystone</u> , grey, olive grey Sm.am. Claystone, light grey
C-1537	2255-2270	0.70	* 70% <u>Claystone</u> , dark grey to grey 20% <u>Claystone</u> , grey to greenish (or olive) grey 10% <u>Claystone</u> , light grey Sm.am. Glauconite
C-1538	2270-2285	0.67	* 60% <u>Claystone</u> , dark grey to grey 30% <u>Claystone</u> , grey, olive grey 10% <u>Chalk</u> , white Sm.am. Claystone, weak red to reddish brown; Glauconite; Pyrite



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1539	2285-2300	0.67	<p>* 60% <u>Claystone</u>, dark grey to grey, micromicaceous, calcareous 20% <u>Claystone</u>, grey to olive grey 10% <u>Limestone</u>, white 10% <u>Casing cement</u> Sm.am. Sideritic Limestone; Claystone, pale red to reddish brown</p>
C-1540	2300-2315	0.36	<p>* 60% <u>Claystone</u>, dark grey to grey, micromicaceous, calcareous 20% <u>Claystone</u>, grey to olive grey 10% <u>Limestone</u>, chalky white 10% <u>Casing cement</u> Sm.am. Claystone, weak red to reddish brown; Pyrite; Sand; Mud additives (mica) and steel</p>
C-1541	2315-2330	0.53	<p>* 40% <u>Claystone</u>, dark grey to grey 40% <u>Claystone</u>, grey to olive grey 20% <u>Limestone</u>, chalky, white to off-white Sm.am. Claystone, weak red to reddish brown; Casing cement; Pyrite; Siderite</p>
C-1542	2330-2345	0.72	<p>* 40% <u>Claystone</u>, dark grey to grey 40% <u>Claystone</u>, grey to olive grey 10% <u>Claystone</u>, weak red to reddish brown 10% <u>Limestone</u>, chalky, white, light grey Sm.am. Casing cement; Pyrite</p>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1543	2345-2360	0.70	<p>* 50% <u>Claystone</u>, dark grey to grey, micromicaceous, occasionally silty</p> <p>40% <u>Claystone</u>, grey, olive grey</p> <p>10% <u>Limestone</u>, chalky, white, off-white, light grey</p> <p>Sm.am. Claystone, weak red to reddish brown; Pyrite; Casing cement</p>
C-1544	2360-2375	0.74	<p>* 50% <u>Claystone</u>, dark grey to grey</p> <p>50% <u>Claystone</u>, grey, olive grey, greenish grey, occasionally very silty and micromicaceous</p> <p>Sm.am. Limestone, white; Claystone, weak red to reddish brown; Pyrite; Forams; Siderite</p>
C1545	2375-2390	0.74	<p>* 60% <u>Claystone</u>, dark grey to grey, occasionally dark brownish grey</p> <p>40% <u>Claystone</u>, grey, olive grey</p> <p>Sm.am. Forams; Glauconite; Pyrite; Steel, Calcite crystals; Claystone, weak red</p>
C-1546	2390-2405	0.67	<p>* 80% <u>Claystone</u>, dark grey to grey</p> <p>20% <u>Claystone</u>, grey, olive grey</p> <p>Sm.am. Sandstone, very fine to Siltstone; Limestone, chalky, white; Pyrite (trace); Forams</p>
C-1547	2405-2420	0.40	<p>* 60% <u>Claystone</u>, grey to olive grey</p> <p>40% <u>Claystone</u>, dark grey to grey, occasionally greyish brown</p> <p>Sm.am. Limestone, often chalky, white, off-white; Claystone, weak red to reddish brown; Forams; Glauconite; Pyrite</p>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1548	2420-2435	0.44	* 50% <u>Claystone</u> , grey to olive grey
		0.72	* 40% <u>Claystone</u> , dark grey to grey 10% <u>Limestone</u> , off-white Sm.am. Claystone, weak red to reddish brown; Siderite; Forams; Pyrite
C-1549	2435-2450	0.43	* 50% <u>Claystone</u> , grey to olive grey 30% <u>Claystone</u> , dark grey to grey Sm.am. Forams; Limestone, off-white; Oolite; Pyrite; Siderite; Sandstone, well cemented with Glauconite grains; Claystone, pale red; Claystone, light grey
C-1550	2450-65	0.60	* 60% <u>Claystone</u> , dark grey to grey, occasionally brownish grey
		0.36	* 30% <u>Claystone</u> , grey to olive grey 10% <u>Claystone</u> , light grey Sm.am. Limestone; off-white; Siderite; Pyrite; Forams
C-1551	2465-2480		60% <u>Limestone</u> , chalky, occasionally sandy, white to off-white
		0.60	* 20% <u>Claystone</u> , dark grey to grey 10% <u>Claystone</u> , grey to olive grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Claystone, light grey; ?Glauconite, pale green; Forams
C-1552	2480-2495	0.25	* 70% <u>Claystone</u> , grey to olive grey 10% <u>Claystone</u> , dark grey to grey 10% <u>Claystone</u> , weak red to reddish brown 10% <u>Claystone</u> , light grey Sm.am. Limestone, white, off-white, often chalky; Pyrite; ?Tuff



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1553	2495-2510	0.34	<p>* 70% <u>Claystone</u>, grey to olive grey</p> <p>20% <u>Claystone</u>, dark grey to grey, occasionally dark greyish brown, pyritic</p> <p>10% <u>Limestone</u>, white, off-white, often chalky</p> <p>Sm.am. Claystone, light grey; Claystone, weak red to reddish brown; Pyrite; Sandstone; very fine, micaceous</p>
C-1554	2510-2525	0.37	<p>* 80% <u>Claystone</u>, grey to olive grey, occasionally greenish grey</p> <p>10% <u>Claystone</u>, dark grey</p> <p>10% Siderite, brownish grey to brown</p> <p>Sm.am. Limestone, mainly white, chalky; Claystone, greyish red to reddish brown; Pyrite</p>
C-1555	2525-2540	0.34 1.01	<p>* 70% <u>Claystone</u>, grey to olive grey, occasionally greenish grey</p> <p>* 30% <u>Claystone</u>, dark grey to grey, occasionally dark greyish brown</p> <p>Sm.am. Claystone, greyish red to reddish brown; Siderite; Pyrite</p>
C-1556	2540-2555	0.36 1.08	<p>* 70% <u>Claystone</u>, grey to olive grey</p> <p>* 30% <u>Claystone</u>, dark grey to grey, occasionally dark greyish brown</p> <p>Sm.am. Siderite; Pyrite; Sandstone, very fine with some mica glauconite; Claystone, greyish red</p>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1557	2555-2570	0.73	40% <u>Limestone</u> , white to brownish white, with some Glauconite * 40% <u>Claystone</u> , dark grey to grey, occasionally dark greyish brown 20% <u>Claystone</u> , olive grey to grey Sm.am. Pyrite; Claystone, greyish red to reddish brown
C-1558	2570-2585	0.77	* 60% <u>Claystone</u> , dark grey to grey, occasionally brownish grey
		0.37	* 40% <u>Claystone</u> , grey to olive grey, occasionally greenish grey Sm.am. Claystone, reddish brown to greyish red; Siderite; Pyrite
C-1559	2585-2600	0.98	* 60% <u>Claystone</u> , medium dark grey to dark grey, occasionally brownish grey
		0.44	* 40% <u>Claystone</u> , grey to light olive grey Sm.am. Siderite; Limestone, white to brownish white; Pyrite
C-1560	2600-2615	1.06	* 70% <u>Claystone</u> , medium dark grey to dark grey, occasionally silty
		0.68	* 30% <u>Claystone</u> , grey to light olive grey Sm.am. Claystone, weak red to reddish brown; Claystone, light grey; Siderite; Pyrite
C-1561	2615-2630	1.00	* 70% <u>Claystone</u> , medium dark grey to dark grey
		0.69	* 20% <u>Claystone</u> , brownish grey 10% Claystone, grey to light olive grey Sm.am. Pyrite; Siderite; Claystone, light grey; Claystone, weak red



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1562	2630-2645	0.98	* 80% <u>Claystone</u> , medium to dark grey 10% <u>Claystone</u> , brownish grey 10% <u>Claystone</u> , grey to light olive grey Sm.am. Pyrite; Siderite; Claystone, light grey
C-1563	2645-2660	0.36	* 50% <u>Claystone</u> , grey to olive grey
		0.85	* 30% <u>Claystone</u> , dark grey to medium dark grey 10% <u>Claystone</u> , brownish grey 10% <u>Claystone</u> , weak red to reddish brown Sm.am. Sand, medium to fine, angular to subrounded Siderite; Claystone, light grey; Pyrite; Glauconite
C-1564	2660-2675	1.02	* 100% <u>Claystone</u> , dark grey to medium dark grey Sm.am. Claystone, grey to olive grey; Claystone, brownish grey; Pyrite; Siderite; Steel, Sand
C-1565	2675-2690	0.32	* 50% <u>Claystone</u> , grey to light olive grey, occasionally subfissile
		1.20	* 50% <u>Claystone</u> , medium dark grey to dark grey, occasionally brownish grey Sm.am. Claystone, weak red to reddish brown; Claystone, light grey; Siderite; Steel
C-1566	2690-2705	0.85	* 90% <u>Claystone</u> , medium dark grey to dark grey, occasionally subfissile 10% <u>Claystone</u> , grey to olive grey Sm.am. Siltstone, grey, micaceous; Siderite; Claystone, weak red; Pyrite
C-1567	2705-2720	0.78	* 100% <u>Claystone</u> , medium dark grey to dark grey Sm.am. Claystone, grey to light olive grey; Siderite; Claystone, weak red; Pyrite



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1568	2720-2735	0.82	* 100% <u>Claystone</u> , medium dark grey to dark grey, micromicaceous, occasionally subfissile, occasionally silty Sm.am. Claystone, grey to olive grey; Siderite
C-1569	2735-2750	0.75	* 100% <u>Claystone</u> , medium dark grey to dark grey, occasionally laminated, subfissile Sm.am. Claystone, grey to light olive grey; Siderite; Sandstone, very fine to fine
C-1570	2750-2765	0.87	* 90% <u>Claystone</u> , medium dark grey to dark grey, micaceous, often silty laminated 10% <u>Siderite</u> , brownish white to yellowish brown Sm.am. Sandstone, very fine to fine; Pyrite; Siltstone, grey
C-1571	2765-2780	0.80	* 90% <u>Claystone</u> , medium dark grey to dark grey 10% <u>Claystone</u> , grey to olive grey Sm.am. Siderite; Steel fragments
C-1572	2780-2795	0.80	* 100% <u>Claystone</u> , medium dark grey to dark grey Sm.am. Claystone, grey to light olive grey; Siderite; Claystone, weak red to reddish brown; Chalk, white
C-1573	2795-2810	5.24	* 70% <u>Claystone</u> , greyish black, pyritic, micromicaceous, fissile, laminated, rich in organic material
		1.01	* 30% <u>Claystone</u> , medium dark grey to dark grey Sm.am. Claystone, greyish brown; Claystone, grey to olive grey, Pyrite; Siderite; Limestone/Chalk



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1574	2810-2825	12.15	* 100% <u>Coal</u> , black, shiny, fragmentary Sm.am. Limestone, white to brownish white; Claystone, brownish grey; Siderite
C-1575	2825-2840	10.25	* 90% <u>Coal</u> , black 10% <u>Claystone</u> , of various lithologies, from light greyish brown to greyish black Sm.am. Limestone, brownish white; Pyrite
C-1576	2855-2870		50% <u>Sand</u> , fine to coarse angular to subangular mainly quartz, with brown hydrocarbon staining 40% <u>Coal</u> , black 10% <u>Claystone</u> ; mainly greyish black Sm.am. Chalk
C-1577	2870-2885	4.46	* 60% <u>Claystone</u> , greyish black to brownish black 30% <u>Coal</u> , black 10% <u>Sand</u> , fine to coarse Sm.am. Brownish grey clay of "underclay" type Chalk. (The sample is heavily contaminated by hydrocarbons)
C-1578	2885-2900		60% <u>Coal</u> , black 30% <u>Sand</u> , fine to coarse 10% <u>Claystone</u> , greyish black, brownish black, partly of "underclay" type Sm.am. Claystone, greyish brown of "underclay" type; Chalk. (The sample is heavily contaminated by hydrocarbons)



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1579	2900-2915	1.90	* 50% <u>Claystone</u> , mainly brownish grey. The colour is partly due to hydrocarbon staining 40% <u>Coal</u> , black 10% <u>Sand</u> , fine to coarse, hydrocarbon stained The sample is strongly contaminated by hydrocarbons
C-1580	2915-2930	5.28	60% <u>Sand</u> , medium to coarse, angular to subangular 30% <u>Coal</u> , black * 10% <u>Claystone</u> , greyish brown to brownish black (Some hydrocarbon staining)
C-1581	2930-2945		60% <u>Sand</u> , medium to coarse, angular to subangular 30% <u>Coal</u> , black 10% <u>Claystone</u> , greyish black Sm.am. Chalk (Some hydrocarbon staining)
C-1582	2945-60	1.55	50% <u>Claystone</u> , greyish black 30% <u>Sand</u> , medium to coarse, angular to subangular, with some hydrocarbon staining 20% <u>Coal</u> , black Sm.am. Chalk; Limestone; brownish white



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1583	2960-2975	7.60	<p>40% <u>Sand</u>, medium to coarse, angular to subangular</p> <p>* 40% <u>Claystone</u>, dark grey to greyish black, micromicaceous, often silty</p> <p>20% <u>Coal</u>, black</p> <p>Sm.am. Limestone, brownish white (The claystone is somewhat affected by turbodrilling)</p>
C-1584	2975-2990	13.51	<p>* 90% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>10% <u>Coal</u>, black</p> <p>Sm.am. Claystone, brownish grey, not affected by turbo-drilling, could represent caved material</p>
C-1585	2990-3005	2.08	<p>* 80% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>10% <u>Coal</u>, black</p> <p>10% <u>Sand</u>, medium to coarse, subangular to angular</p> <p>Sm.am. Claystone, brownish grey</p>
C-1586	3005-3020	3.60	<p>* 80% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>10% <u>Coal</u>, black</p> <p>10% <u>Sand</u>, angular to subangular</p> <p>Sm.am. Pyrite; Claystone, grey</p>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1587	3020-3035	4.35	* 80% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black 10% <u>Sand</u> , medium to coarse, angular to subangular Sm.am. Claystone, greyish brown
C-1588	3035-3050	0.86	* 90% <u>Claystone</u> , greyish black, strongly affected by turbodrilling 10% <u>Coal</u> , black Sm.am. Claystone, brownish grey to grey,
C-1589	3060-3075	0.85	* 90% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. <u>Claystone</u> , grey to brownish grey
C-1590	3075-3090	1.04	60% <u>Sand</u> , medium grained, well sorted * 30% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Chalk, with Claystone, brownish grey; Claystone, pinkish to yellow grey
C-1591	3090-3105		80% <u>Sand</u> , medium grain well sorted, brownish white, angular to subangular 10% <u>Claystone</u> , greyish black, affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Claystone, greyish brown (Some hydrocarbon staining of sample)



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1592	3105-3120		<p>40% <u>Sand</u>, medium to coarse, brownish white, angular to subangular</p> <p>40% <u>Coal</u>, black</p> <p>20% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>Sm.am. Claystone, brownish grey, grey (Some hydrocarbon staining of sample)</p>
C-1593	3120-35	1.55	<p>* 60% <u>Claystone</u>, greyish black, brownish black, affected by turbo-drilling</p> <p>40% <u>Coal</u>, black</p> <p>Sm.am. <u>Sand</u>, medium to coarse; Claystone, greyish brown (Some hydrocarbon staining of sample)</p>
C-1594	3135-3150	0.75	<p>* 100% <u>Claystone</u>, greyish black strongly affected by turbo-drilling</p> <p>Sm.am. Coal, black; Claystone, grey to brownish grey</p>
C-1595	3150-3165	0.69	<p>* 90% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>10% <u>Coal</u>, black</p> <p>Sm.am. Chalk, brownish white; Sand</p>
C-1596	3165-3180	0.81	<p>* 80% <u>Claystone</u>, greyish black, strongly affected by turbo-drilling</p> <p>10% <u>Sand</u>, medium well sorted, angular to subangular</p> <p>10% <u>Coal</u>, black</p> <p>Sm.am. Claystone, brownish grey</p>



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1597	3180-3195	0.66	* 90% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Sand, medium
C-1598	3195-3210	0.70	* 90% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Claystone, brownish grey; Chalk, brownish white, ?Siderite
C-1599	3210-3225	0.66	* 90% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Sand/Sandstone, fine to medium
C-1600	3225-3240	0.84	* 40% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 40% <u>Sand/Sandstone</u> , medium to very coarse, well cemented 20% <u>Coal</u> , black Sm.am. Pyrite (Sample stained by hydrocarbons)
C-1601	3240-3255	0.70	60% <u>Sand</u> , medium to very coarse * 20% <u>Claystone</u> , light grey, strongly affected by turbo-drilling 10% <u>Claystone</u> , greyish brown, strongly affected by turbo-drilling 10% <u>Coal</u> , black Sm.am. Pyrite (Some hydrocarbon staining of sample)



Lithology and Total Organic Carbon measurements

TABLE NO.: 4.
WELL NO.: 30/3-4

Sample	Depth (m)	TOC	Lithology
C-1602	3255-3270		80% <u>Sand/Sandstone</u> , medium to very coarse 10% <u>Claystone</u> , greyish black, strongly affected by turbo-drilling 10% <u>Claystone</u> , light grey, strongly affected by turbo-drilling Sm.am. Coal, black; Chalk (Some hydrocarbon staining)
C-1603	3270-3285		90% <u>Sand</u> , medium to very coarse 10% <u>Claystone</u> , light grey, strongly affected by turbo-drilling Sm.am. Claystone, greyish black, strongly affected by turbo-drilling (Some hydrocarbon staining)

TABLE 5.
Cuttings
DATA FROM ROCK EVAL PYROLYSIS

I	I	I	I	I	I	I	I	I	I	I	I		
I	IKU	DEPTH	:	S1	S2	S3	TOC	HYDR. INDEX	OXYGEN INDEX	PETROLEUM POTENTIAL	PROD. INDEX	TEMP. MAX	
I	No.	:	:	:	:	:	:	:	:	:	S1	I	
I	:	:	:	:	:	:	:	:	:	:	-----	I	
I	m/ft	:	(mg/g ROCK)	(%)	(mg/g TOC)	S1+S2	S1+S2	(C)	I	I	I	I	
I	:	:	:	:	:	:	:	:	:	:	:	I	
I	C 1606	1000	:	0.26	1.13	1.17	1.40	81	84	1.39	0.19	413	
I			:	:CLST									I
I	C 1608	1100	:	0.16	1.10	1.29	1.13	97	114	1.26	0.13	413	
I			:	:CLST									I
I	C 1609	1150	:	0.26	2.54	1.14	1.60	159	71	2.80	0.09	414	
I			:	:CLST									I
I	C 1611	1250	:	0.39	2.22	1.87	1.62	137	115	2.61	0.15	422	
I			:	:CLST									I
I	C 1613	1350	:	0.13	1.38	0.84	1.30	106	65	1.51	0.09	431	
I			:	:CLST									I
I	C 1615	1450	:	0.11	1.65	0.66	1.38	120	48	1.76	0.06	426	
I			:	:CLST, GY									I
I	C 1618	1600	:	0.12	0.70	0.50	1.34	52	37	0.82	0.15	429	
I			:	:CLST									I
I	C 1619	1650	:	0.08	0.81	1.07	1.41	57	76	0.89	0.09	426	
I			:	:CLST									I
I	C 1620	1700	:	0.15	1.03	1.22	0.64	161	191	1.18	0.13	427	
I			:	:CLST									I
I	C 1517	1900	:	0.16	0.16	0.92	0.42	38	219	0.32	0.50	417	
I			:	:CLST									I
I	C 1518	1950	:	0.07	0.17	0.78	0.46	37	170	0.24	0.29	420	
I			:	:CLST									I
I	C 1520	2015	:	0.13	0.31	0.38	0.62	50	61	0.44	0.30	429	
I			:	:CLST, OL									I
I	C 1521	2030	:	0.14	1.33	0.37	1.02	130	36	1.47	0.10	434	
I			:	:CLST, OL									I
I	C 1522	2045	:	0.06	0.49	0.65	0.83	59	78	0.55	0.11	432	
I			:	:CLST, OL									I
I	C 1523	2060	:	0.13	0.48	0.77	0.74	65	104	0.61	0.21	426	
I			:	:CLST, OL									I
I	C 1524	2075	:	0.12	0.20	0.67	0.52	38	129	0.32	0.38	424	
I			:	:CLST, GY									I
I	C 1525	2090	:	0.09	0.23	0.98	0.53	43	185	0.32	0.28	424	
I			:	:CLST, GY-GR									I
I	C 1527	2120	:	0.20	0.13	1.28	0.34	38	376	0.33	0.61	417	
I			:	:CLST, OL									I
I	C 1529	2150	:	0.12	0.03	0.62	0.33	9	188	0.15	0.80	303	
I			:	:CLST, OL									I
I	C 1531	2180	:	0.13	0.15	0.85	0.46	33	185	0.28	0.46	417	
I			:	:CLST, OL									I
I	C 1533	2210	:	0.06	0.11	0.84	0.34	32	247	0.17	0.35	351	
I			:	:CLST, OL									I
I	C 1535	2240	:	0.12	0.18	0.36	0.62	29	58	0.30	0.40	419	
I			:	:CLST, DK GY									I
I	C 1535	2240	:	0.08	0.08	0.87	0.29	28	300	0.16	0.50	386	
I			:	:CLST, OL									I

TABLE 5.
Cuttings

DATA FROM ROCK EVAL PYROLYSIS

IKU No.	DEPTH m/ft	S1 (mg/g ROCK)	S2 (mg/g ROCK)	S3 (mg/g ROCK)	TOC (%)	HYDR. INDEX (mg/g TOC)	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)
I C 1536	2255	0.10	0.33	0.52	0.79	42	66	0.43	0.23	426
		: CLST, DK GY								
I C 1537	2270	0.10	0.29	1.11	0.70	41	159	0.39	0.26	423
		: CLST, DK GY								
I C 1538	2285	0.09	0.25	0.25	0.67	37	37	0.34	0.26	426
		: CLST, DK GY								
I C 1540	2315	0.29	0.20	0.73	0.36	56	203	0.49	0.59	423
		: CLST, DK GY								
I C 1541	2330	0.07	0.14	1.30	0.53	26	245	0.21	0.33	424
		: CLST, DK GY								
I C 1542	2345	0.09	0.09	0.11	0.72	12	15	0.18	0.50	412
		: CLST, DK GY								
I C 1543	2360	0.10	0.27	0.86	0.76	36	113	0.37	0.27	429
		: CLST, DK GY								
I C 1544	2375	0.18	0.16	0.04	0.74	22	5	0.34	0.53	421
		: CLST, DK GY								
I C 1546	2405	0.26	0.35	0.16	0.67	52	24	0.61	0.43	426
		: CLST, DK GY								
I C 1548	2435	0.09	0.17	1.06	0.44	39	241	0.26	0.35	412
		: CLST, OL								
I C 1548	2435	0.11	0.35	0.10	0.72	49	14	0.46	0.24	425
		: CLST, DK GY								
I C 1549	2450	0.07	0.17	0.87	0.43	40	202	0.24	0.29	422
		: CLST, GY								
I C 1550	2465	0.09	0.24	0.30	0.60	40	50	0.33	0.27	421
		: CLST, DK GY								
I C 1551	2480	0.14	0.20	1.62	0.60	33	270	0.34	0.41	423
		: CLST, DK GY								
I C 1553	2510	0.09	0.11	0.72	0.34	32	212	0.20	0.45	367
		: CLST, OL								
I C 1555	2540	0.11	0.55	0.17	1.01	54	17	0.66	0.17	425
		: CLST, DK GY								
I C 1555	2540	0.11	0.07	0.76	0.34	21	224	0.18	0.61	408
		: CLST, OL								
I C 1556	2555	0.08	0.63	0.33	1.08	58	31	0.71	0.11	427
		: CLST, DK GY								
I C 1557	2570	0.10	0.21	0.19	0.73	29	26	0.31	0.32	423
		: CLST, DK GY								
I C 1558	2585	0.17	0.26	0.77	0.77	34	100	0.43	0.40	430
		: CLST, DK GY								
I C 1560	2615	0.11	0.58	1.33	1.06	55	125	0.69	0.16	426
		: CLST, DK GY								
I C 1560	2615	0.08	0.37	0.95	0.68	54	140	0.45	0.18	421
		: CLST, OL								
I C 1561	2630	0.11	0.57	0.61	1.00	57	61	0.68	0.16	424
		: CLST, DK GY								

TABLE 5.
Cuttings

DATA FROM ROCK EVAL PYROLYSIS

IKU No.	DEPTH m/ft	S1 (mg/g ROCK)	S2 (mg/g ROCK)	S3 (mg/g ROCK)	TOC (%)	HYDR. INDEX (mg/g TOC)	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)
I C 1562	2645	0.11	0.57	1.33	0.98	58	136	0.68	0.16	427
I		: CLST, DK GY								
I C 1564	2675	0.14	0.65	0.19	1.02	64	19	0.79	0.18	433
I		: CLST, DK GY								
I C 1565	2690	0.15	0.79	0.73	1.20	66	61	0.94	0.16	431
I		: CLST, DK GY								
I C 1566	2705	0.08	0.49	0.35	0.85	58	41	0.57	0.14	433
I		: CLST, DK GY								
I C 1567	2720	0.15	0.34	0.86	0.78	44	110	0.49	0.31	437
I		: CLST, DK GY								
I C 1568	2735	0.15	0.47	1.50	0.82	57	183	0.62	0.24	435
I		: CLST, DK GY								
I C 1569	2750	0.13	0.66	0.26	0.75	88	35	0.79	0.16	440
I		: CLST, MED DK GY								
I C 1570	2765	0.11	0.77	0.08	0.87	89	9	0.88	0.13	434
I		: CLST, DK GY								
I C 1572	2795	0.09	0.28	0.19	0.80	35	24	0.37	0.24	445
I		: CLST, DK GY								
I C 1573	2810	1.12	7.85	1.11	5.24	150	21	8.97	0.12	438
I		: CLST, GY BLK								
I C 1574	2825	1.04	15.74	27.56	12.15	130	227	16.78	0.06	433
I		: COAL								
I C 1575	2840	0.88	12.24	13.49	10.25	119	132	13.12	0.07	435
I		: COAL								
I C 1577	2885	0.68	5.70	2.96	4.46	128	66	6.38	0.11	437
I		: CLST, GY BLK								
I C 1579	2915	0.44	2.18	3.61	1.90	115	190	2.62	0.17	437
I		: CLST, BRN GY								
I C 1580	2930	2.59	8.43	5.08	5.28	160	96	11.02	0.24	436
I		: CLST, GY BRN								
I C 1582	2960	0.34	1.58	1.56	1.55	102	101	1.92	0.18	436
I		: CLST, GY BLK								
I C 1583	2975	0.94	9.48	6.69	7.60	125	88	10.42	0.09	436
I		: CLST, DK GY								
I C 1584	2990	2.95	30.83	0.97	13.51	228	7	33.78	0.09	437
I		: CLST, T-D'								
I C 1585	3005	0.32	1.41	1.27	2.08	68	61	1.73	0.18	434
I		: CLST, T-D'								
I C 1586	3020	0.67	5.14	0.45	3.60	143	13	5.81	0.12	437
I		: CLST, T-D'								
I C 1587	3035	0.91	7.29	0.40	4.35	168	9	8.20	0.11	436
I		: CLST, T-D'								
I C 1588	3050	0.23	0.07	0.17	0.86	8	20	0.30	0.77	366
I		: CLST, T-D'								
I C 1589	3075	0.21	0.07	0.14	0.85	8	16	0.28	0.75	299
I		: CLST, T-D'								

TABLE 5.
Cuttings

DATA FROM ROCK EVAL PYROLYSIS

IKU No.	DEPTH m/ft	S1 (mg/g ROCK)	S2 (mg/g ROCK)	S3 (mg/g ROCK)	TOC (%)	HYDR. INDEX (mg/g TOC)	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)	
C 1590	3090	2.95	30.83	0.97	13.51	228	7	33.78	0.09	437	
		:CLST,T-D'									
C 1593	3135	0.30	0.38	1.35	1.55	25	87	0.68	0.44	437	
		:CLST,T-D'									
C 1594	3150	0.21	0.06	0.18	0.75	8	24	0.27	0.78	371	
		:CLST,T-D'									
C 1596	3180	0.20	0.08	0.11	0.81	10	14	0.28	0.71	264	
		:CLST,T-D'									
C 1598	3210	0.17	0.04	0.10	0.70	6	14	0.21	0.81	264	
		:CLST,T-D'									
C 1600	3240	0.26	0.09	0.20	0.84	11	24	0.35	0.74	426	
		:CLST,T-D'									
C 1601	3255	0.22	0.12	0.04	0.70	17	6	0.34	0.65	305	
		:CLST,T-D'									

TABLE 5.
Sidewall cores

DATA FROM ROCK EVAL PYROLYSIS

IKU No.	DEPTH m/ft	S1 (mg/g ROCK)	S2 (mg/g ROCK)	S3 (mg/g ROCK)	TOC (%)	HYDR. INDEX (mg/g TOC)	OXYGEN INDEX	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)
C 1633	2796	1.06	7.54	0.36	4.59	164	8	8.60	0.12	432
		:CLST,DK GY								
C 1634	2797	0.83	6.89	0.03	4.34	159	1	7.72	0.11	434
		:CLST,MED-DK GY								
C 1635	2801	0.95	4.70	0.04	3.93	120	1	5.65	0.17	434
		:CLST,MED-DK GY								
C 1636	2802	0.79	7.06	0.14	4.45	159	3	7.85	0.10	430
		:CLST,DK GY								
C 1637	2806	1.71	12.89	0.95	6.74	191	14	14.60	0.12	435
		:CLST,DK GY								
C 1638	2810.50	0.40	2.57	0.54	1.81	142	30	2.97	0.13	435
		:CLST,MED GY								
C 1639	2815	0.40	4.30	0.11	1.72	250	6	4.70	0.09	440
		:CLST,LT-MED GY								
C 1640	2820.50	0.69	6.08	0.34	2.85	213	12	6.77	0.10	438
		:CLST,MED-DK GY								
C 1641	2823	0.41	2.16	0.62	1.67	129	37	2.57	0.16	436
		:CLST,DK GY								
C 1642	2978	0.40	2.27	0.89	1.81	125	49	2.67	0.15	440
		:CLST,MED GY								
C 1643	3206.50	0.36	1.33	0.94	1.35	99	70	1.69	0.21	444
		:SILTST,MED GY								
C 1644	3231.50	1.05	6.70	0.07	0.37	1811	19	7.75	0.14	447
		:MARL								

DATE : 13 - 8 - 85.



Visual Kerogen Analysis

TABLE NO.: 6.
WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1606	950-1000	Am., Cy/W	F-M	Good	1/1+	Fluffy aggregates embed degraded ?woody particles and bacterial remains.
C-1610	1160-1200	Am, Cy/W	F-M	Good	1/1+	As C-1606 above. Some pyrite.
C-1613	1300-1350	Am, Cy/W	F-M	Fair	1/1+	As C-1606, 1610 above.
C-1618	1600	Am, Cy/W	F-M	Fair	1/1+	As C-1606-1610-1613. Degraded material embeds and obscure palynomorphs.
C-1620	1700	Am, Cy/W, P, S	F-M	fair to good	1/1+, 1+	Strongly degraded amorphous remains as pyritic aggregates embedding small bodies (bacteria/algal/fungal) and woody particles.
C-1622	1800	Am, Cy/P, S	F-M	fair to good	1/1+, 1+	As C-1620 above.
C-1518	1900-1950	Am, Cy/W, P, S	F-M	fair	1/1+	Increase of woody material from an oxidative environment otherwise as investigated samples above. Palynomorphs very thin-walled.

ABBREVIATIONS

Am Amorphous
He Herbaceous
Cut Cuticles

Cy Cysts, algae
P Pollen grains
S Spores

W Woody material
C Coal
R! Reworked

F Fine
M Medium
L Large



Visual Kerogen Analysis

TABLE NO.: 6.
WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1520	2000-2015	Algal, Cy/W, P, S	F-M	fair to good	1+	Residue small better dispersed than in samples above. Presence of haematite? support a more oxidative environment.
C-1521	2015-2030	Am, Cy/W, WR!, P, S	F-M	fair to good	1+	Pyritic residue. Degraded remains in aggregates embed bacterial/fungal/algal bodies.
C-1524	2060-2075	Am, Cy/W, WR!, P, S	F-M	fair to good	1+	Strongly pyritic residue of degraded remains in aggregates embedding bacterial/fungal/algal bodies.
C-1531	2165-2180	Am, Algal, Cy/W, P, S	F-M	fair	1+1	Strongly pyritic residue. Loose aggregates embed bact./fungal/algal bodies. Increase of angular woody material.
C-1534	2210-2225	W, WR!, S/Am, Cy	F-M	fair to poor	1+	Strongly pyritic residue, loose aggregates embed bacterial/fungal/algal remains and palynomorphs. Some woody angular (structured) particles.

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Visual Kerogen Analysis

TABLE NO.: 6.
WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1540	2300-2315	Am, Algal, Cy, W, P, S	F-M	fair to poor	1+, 1+/2-	Abundant pyrite and amorphous aggregates of strongly degraded material and ?bacterial, algal or fungal remains. Pollen thin-walled very light-coloured. Woody material brown, occasionally structured.
C-1544	2360-2375	Am, Cy/WR!, W, P, S	F-M	fair-good	1+/2-	Very abundant in pyrite and other black minerals. Aggregates of degraded, amorphous material as in C-1540 above.
C-1549	2435-2450	Am, Cy/W, P, S	F-M	fair	2-/2, 2	Small aggregates of degraded amorphous. Residue with more grey appearance than in C-1540. Occasional spores.
C-1555	2525-2540	Am, Cy/W, P, S	F-M	fair to poor	2-/2, 1+	Pyritic firm aggregates of strongly biodegraded material. Staining.
C-1560	2600-2615	Am, Cy/W, P, S	F-M	fair to poor	2	A mixture of biodegraded material in aggregates and more grey material.

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**IKU**

Visual Kerogen Analysis

TABLE NO.: 6.
WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1564	2660-2675	Am,Cy/W,P,S	F-M		1+,1+2-	Grey aggregates with enclosed minerals or scars after dissolved minerals. Very thin-walled palynomorphs. Occasional well preserved cysts supposed caved.
C-1569	2735-2750	Am,Cy/W,P,S	F-M	variable	2	Mixture of grey aggregates, some cuticles and lighter brown aggregates.
C-1572	2780-2795	Am,Cy/W,P,S	F-M	poor	?	Grey aggregates. Very thin-walled palynomorphs.
C-1574	2810-2825	W,Cut,WR!,S,P/Am	F-M	fair to good	1+,1+2-	Coaly material.
C-1575	2825-2840	W,Cut,S,P/Am	F-M	fair to good	2-,2-/2,2 +	Some coaly material and aggregates of biodegraded remains related with the interval above. Some scars after minerals/crystals embedded.

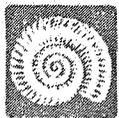
ABBREVIATIONS

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**IKU**

Visual Kerogen Analysis

TABLE NO.: 6.
WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1577	2870-2885	W,Cut,S,P/Am	F-M	fair to good	2-,2-/2	Related with the samples C-1575 and C-1574 above. Admixtures of grey material: aggregates with scars from embedded minerals removed during processing.
C-1580	2915-2930	W,WR!,Cut,S/Bact.	F-M-L	variable	2-/2,2	A mixture of strongly degraded remains and fairly coarse material from oxidative environment, but later degraded under quiet conditions.
C-1583	2960-2975	W,WR!,Cut,S/Bact.	F-M-L	good to fair	2-/2,2	As above.
C-1584	2975-2990	N.D.P.	F-M	variable	N.D.P. (2-/2)	Mixture of coaly material with fairly light coloured palynomorphs and grey amorphous material with very thinwalled palynomorphs - probably representing different levels of the well.

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**IKU**

Visual Kerogen Analysis

TABLE NO.: 6.

WELL NO.: 30/3-4

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index	Remarks
C-1588	3035-3050	N.D.P.	F-M	poor	N.D.P.	Small grey aggregates of degraded material and with enclosed angular cavities from dissolved minerals.
C-1593	3120-3135	N.D.P.	F-M	poor	N.D.P.	Firmer, generally darker aggregates, probably a larger content of woody material. The same type of angular cavities from dissolved minerals as above.
C-1599	3210-3225	N.D.P.	F-M	poor	N.D.P.	Firm grey-brown aggregates only pseudostructures remain. High power lenses reveal an "amorphous" granular substance embedding crystals and angular cavities from dissolved crystals.

ABBREVIATIONS

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 R! Reworked

F Fine
 M Medium
 L Large

Well Identification: 30/3-4
 Reference number: 22.1793
 (1/3)

Table 7. VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	PP	STANDARD DEVIATION	FLUORESCENCE
C 1606	----	1000	0.33 (10)* 0.22 (5) 0.49 (3)	Y N N	0.04 0.02 0.26	1
C 1610	----	1200	0.30 (14)* 0.19 (2) 0.56 (2)	Y N N	0.06 0.01 0.07	2,4-5
C 1613	----	1350	0.31 (6)	Y	0.08	1-2
C 1617	----	1550	0.37 (13)* 0.62 (4)	Y N	0.08 0.08	1-2
C 1618	----	1600	0.36 (10)* 0.79 (4)	Y N	0.04 0.17	2-3
C 1620	----	1700	0.34 (6) 0.65 (3) 0.93 (5)	Y N N	0.04 0.04 0.05	2-4
C 1622	----	1800	0.41 (1) 0.59 (3)	Y N	0.00 0.06	2-3
C 1518	----	1950	0.39 (6) 0.60 (10)	Y N	0.07 0.07	1-2
C 1520	----	2015	0.44 (18)* 0.73 (2)	Y N	0.07 0.01	1-3
C 1521	----	2030	0.43 (4) 0.81 (4)	Y N	0.10 0.11	2-3
C 1524	----	2075	0.32 (1) 0.74 (3)	Y N	0.00 0.05	3
C 1530	----	2165	N.D.P.	-	----	2
C 1534	----	2225	0.39 (7) 0.73 (9)	Y N	0.06 0.11	2
C 1540	----	2315	0.42 (8)* 0.80 (4)	Y N	0.07 0.10	2

*=Readings are reasonably representative

Well Identification:30/3-4
Reference number:22.1793
(2/3)

Table 7. VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	PP	STANDARD DEVIATION	FLUORESCENCE
C 1544	----	2375	0.41 (3) 0.66 (4)	Y N	0.04 0.08	2
C 1548	----	2450	0.42 (3) 0.72 (5)	Y N	0.12 0.10	2-3
C 1555	----	2540	0.40 (16)* 0.93 (2)	Y N	0.09 0.17	3
C 1560	----	2615	0.42 (10)*	Y	0.08	3-4
C 1564	----	2675	0.47 (6) 0.75 (4)	Y N	0.09 0.09	3-4
C 1569	----	2750	0.45 (6) 0.72 (4)	Y N	0.07 0.08	2-4
C 1572	----	2795	0.45 (5)	Y	0.09	3-4
C 1573	----	2810	0.53 (20) _r 0.82 (4)	Y N	0.10 0.05	4-5
C 1574	----	2825	0.46 (30)*	Y	0.07	2-4
C 1575	----	2840	0.51 (28)* 0.76 (2)	Y N	0.07 0.01	3-4
C 1577	----	2885	0.50 (8)* 0.75 (12)	Y N	0.08 0.08	4
C 1578	----	2900	0.60 (2) 0.77 (4)	Y N	0.01 0.05	4-5
C 1583t	----	2975	0.66 (6) 0.85 (15)	Y N	0.04 0.06	3-5
C 1588t	----	3050	N.D.P.	-	----	---
C 1591t	----	3108	0.60 (13) 0.86 (2)	Y N	0.08 0.08	4c,8

*=Readings are reasonably representative
c=Caved material
r=This principal population contains reworked material
t=Turbo-drill affected

Well Identification:30/3-4
 Reference number:22.1793
 (3/3)

Table 7. VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	PP	STANDARD DEVIATION	FLUORESCENCE
C 1593t	----	3135	0.56 (11)	Y	0.06	3-4c
			0.77 (5)	N	0.05	
			1.02 (3)	N	0.03	
C 1598t	----	3210	N.D.P.	-	----	---
C 1599t	----	3225	N.D.P.	-	----	---
C 1603t	----	3285	0.50 (9)	Y	0.11	---
			0.81 (2)	N	0.06	

*=Readings are reasonably representative
 c=Caved material
 t=Turbo-drill affected

T A B L E : 8a

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

I	I	I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	Rock Extr.	EOM	Sat.	Aro.	HC	Non HC	TOC		I
I		(m)	(g)	(mg)	(mg)	(mg)	(mg)	(mg)	(%)		I
I											I
I	C 1620	1700	40.8	8.7	2.9	1.7	4.6	4.1	0.59		I
I	C 1521	2030	44.5	17.1	2.4	1.7	4.1	13.0	0.92		I
I	C 1555	2540	1.2	1.6	0.4	0.1	0.5	1.1	1.13		I
I	C 1570	2765	36.0	13.6	2.2	2.5	4.7	8.9	0.81		I
I	C 1574	2825	7.1	17.3	12.8	0.5	13.3	4.0	33.96		I
I	C 1577	2885	1.1	6.7	1.2	1.2	2.4	4.3	26.33		I
I	C 1583	2975	1.4	2.4	0.8	0.3	1.1	1.3	2.85		I
I	C 1584	2990	13.6	16.9	3.1	3.4	6.5	10.4	1.79		I
I	C 1587	3035	21.8	26.0	5.2	5.4	10.6	15.4	2.36		I

DATE : 20 - 8 - 85.

T A B L E : 8b

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

I	IKU-No	DEPTH	EOM	Sat.	Aro.	HC	Non HC	I
I	:	(m)	:	:	:	:	:	I
I	C 1620	1700	213	71	41	112	101	I
I	C 1521	2030	384	54	38	92	293	I
I	C 1555	2540	1322	298	99	397	926	I
I	C 1570	2765	378	60	70	130	248	I
I	C 1574	2825	2447	1810	71	1881	566	I
I	C 1577	2885	5982	1071	1071	2143	3839	I
I	C 1583	2975	1714	571	214	786	929	I
I	C 1584	2990	1243	229	247	476	766	I
I	C 1587	3035	1193	237	248	484	708	I

DATE : 20 - 8 - 85.

T A B L E : 8c

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

I	IKU-No	DEPTH	EOM	Sat.	Aro.	HC	Non HC	I
I	:	(m)	:	:	:	:	:	I
I	C 1620	1700	36.1	12.0	7.0	18.9	17.2	I
I	C 1521	2030	41.8	5.9	4.1	10.0	31.8	I
I	C 1555	2540	117.0	26.3	8.8	35.1	81.9	I
I	C 1570	2765	46.6	7.4	8.6	16.0	30.6	I
I	C 1574	2825	7.2	5.3	0.2	5.5	1.7	I
I	C 1577	2885	22.7	4.1	4.1	8.1	14.6	I
I	C 1583	2975	60.2	20.1	7.5	27.6	32.6	I
I	C 1584	2990	69.4	12.8	13.8	26.6	42.8	I
I	C 1587	3035	50.5	10.0	10.5	20.5	30.0	I

DATE : 20 - 8 - 85.

T A B L E : 8d

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

I	IKU-No	DEPTH	Sat	Aro	HC	SAT	Non HC	HC	I
I	:	:	---	---	---	---	---	---	I
I	:	:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I	:	(m)	:	:	:	:	:	:	I
I	C 1620	1700	33.1	19.3	52.4	171.4	47.6	110.1	I
I	C 1521	2030	14.0	9.8	23.9	142.9	76.1	31.3	I
I	C 1555	2540	22.5	7.5	30.0	300.0	70.0	42.9	I
I	C 1570	2765	15.9	18.5	34.4	85.7	65.6	52.5	I
I	C 1574	2825	74.0	2.9	76.9	2560.0	23.1	332.5	I
I	C 1577	2885	17.9	17.9	35.8	100.0	64.2	55.8	I
I	C 1583	2975	33.3	12.5	45.8	266.7	54.2	84.6	I
I	C 1584	2990	18.5	19.9	38.3	92.9	61.7	62.2	I
I	C 1587	3035	19.8	20.8	40.6	95.6	59.4	68.4	I

DATE : 20 - 8 - 85.

Table 8e. Content of asphaltenes in cuttings.

Sample code	Depth (m)	EOM (mg)	Asphaltenes	
			(mg)	(%)
C-1620	1700	8.7	0.8	9.2
C-1521	2015-30	17.1	2.0	11.7
C-1555	2525-40	1.6	1.0	-
C-1570	2750-65	13.6	2.5	18.4
C-1574	2810-25	17.3	0.4	2.3
C-1577	2870-85	6.7	1.6	23.9
C-1583	2960-75	2.4	0.2	8.3
C-1584	2975-90	16.9	5.1	30.2
C-1587	3020-35	26.0	7.5	28.8

TABLE 9.

TABULATION OF DATA FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE	PRISTANE	PHYTANE	A	n-C17	CPI
		PHYTANE	n-C17	n-C18	B	n-C27	
C 1620	1700	2.2	1.6	0.9	1.8	0.5	2.3
C 1521	2030	2.6	1.4	0.7	2.2	4.0	1.4
C 1555	2540	1.2	0.8	0.5	1.5	1.2	1.3
C 1570	2765	2.5	1.0	0.4	2.3	2.2	1.1
C 1574	2825	8.1	5.7	0.7	8.3	0.1	1.9
C 1577	2885	3.4	1.7	0.5	3.7	0.5	1.3
C 1583	2975	1.6	1.4	0.5	2.7	0.5	1.4
C 1584	2990	1.9	0.9	0.5	1.8	1.8	1.2
C 1587	3035	2.1	1.0	0.5	1.9	2.0	1.2

DATE : 20 - 8 - 85.

Table 9b. Methyl-phenanthrene Index (MPI) ratios calculated from aromatic gas chromatograms: Cuttings.

Sample ID	Depth (m)	MPI-1	MPI-2
C-1620	1650-1700	0.77	0.74
C-1521	2015-2030	0.49	0.78
C-1535	2525-2540	-	-
C-1570	2750-2765	0.49	0.79
C-1574	2810-2825	0.53	0.85
C-1577*	2870-2885	0.43	0.65
C-1583	2960-2975	-	-
C-1584	2975-2990	0.44	0.70
C-1587	3020-3035	0.45	0.71

* Loss of front-end, MPI values may not be reliable.

$$\text{MPI-1} = \frac{1.5 (2\text{-MP} + 3\text{-MP})}{\text{P} + 1\text{-MP} + 9\text{-MP}}$$

$$\text{MPI-2} = \frac{3 (2\text{-MP})}{\text{P} + 1\text{-MP} + 9\text{-MP}}$$

Table 10. Molecular ratios calculated from peak heights in mass chromatograms. Maturity parameters.

Sample code	Depth (m)	$\alpha\beta/\alpha\beta+\beta\alpha$	%22S	% $\beta\beta$	%20S
Cuttings					
C-1620	1700	0.70	-	66.7	35.0
C-1521	2015-30	0.35	23.1	28.0	16.7
C-1555	2525-40	0.69	33.7	54.7	43.8
C-1570	2750-65	0.68	55.8	52.9	38.5
C-1574	2810-25	0.60	48.7	44.9	15.9
C-1577	2870-85	0.77	56.6	65.9	41.4
C-1583	2960-75	0.82	56.6	67.0	43.3
C-1584	2975-90	0.84	57.7	68.0	44.0
C-1587	3020-35	0.83	60.3	65.3	44.9

Table 11. Molecular ratios calculated from peak heights in mass chromatograms.

Maturity and source characteristic parameters.

Sample code	Depth (m)	Q/E	T _m /T _s	Z/E	X/E	a/a+j
Cuttings						
C-1620	1700	0.17	2.8	0.24	-	0.39
C-1521	2015-30	-	1.1	5.00	-	0.14
C-1555	2525-40	0.10	6.0	0.35	-	0.33
C-1570	2750-65	0.04	9.1	0.05	-	0.48
C-1574	2810-25	-	85.0	0.08	-	0.29
C-1577	2870-85	0.05	5.1	0.12	0.04	0.56
C-1583	2960-75	0.08	3.9	0.10	0.05	0.46
C-1584	2975-90	0.11	3.0	0.11	0.07	0.53
C-1587	3020-35	0.11	2.9	0.07	0.06	0.61

Table 12. $\delta^{13}\text{C}$ isotope data for selected cuttings samples.

Sample code	Depth (m)	$\delta^{13}\text{C}$		
		SAT	AROM	KEROGEN
C-1620	1700	-27.7	-	-25.1
C-1521	2015-30	-29.8	-	-31.7*
C-1570	2750-65	-29.0	-27.9	-
C-1574	2810-25	-29.6	-	-28.0
C-1575	2825-40	-	-	-26.4
C-1577	2870-85	-	-	-25.6
C-1580	2915-30	-	-	-25.3
C-1583	2960-75	-	-	-24.8
C-1584	2975-90	-28.1	-	-25.1
C-1587	3020-35	-28.7	-26.8	-

* Very small sample size.

Table 13a. Semiquantitative data from pyrolysis-gc.

IKU no.	Depth (m)	Percent				$\frac{(m+p)\text{-xylene}}{n\text{-octene}}$
		C ₁	C ₂ -C ₅	C ₆ -C ₁₄	C ₁₅₊	
C-1620	1700	26.25	5.15	19.99	48.61	-
C-1521	2015-2030	19.97	7.58	33.87	43.83	0.34
C-1574	2810-2825	8.15	13.78	35.09	42.98	2.03
C-1575	2825-2840	19.62	6.92	25.72	47.74	3.31
C-1577	2870-2885	26.99	9.53	25.26	38.22	3.17
C-1580	2915-2930	21.09	8.83	26.25	48.83	0.94
C-1583	2960-2975	26.50	9.67	30.56	33.27	3.67
C-1584	2975-2990	28.07	12.67	22.90	36.36	4.91

Table 13b. Semiquantitative data from pyrolysis-gc.

IKU no.	Depth (m)	HEIGHT			
		D ₁	C ₂ -C ₅	C ₆ -C ₁₄	C ₁₅ ⁺
C-1620	1700	807869	380053	262086	358088
C-1521	2015-2030	1145614	1355702	793553	603913
C-1574	2810-2825	410324	7539894	3609963	2684776
C-1575	2825-2840	2748562	2454249	2242339	2671452
C-1577	2870-2885	2879414	2183866	1508147	1210582
C-1580	2915-2930	2770059	2125860	1585399	1629271
C-1583	2960-2975	5263802	3835616	3115119	2308910
C-1584	2975-2990	3297177	3427753	1168570	1124060

Table 13c. Semiquantitative data from pyrolysis-gc.

IKU no.	Depth (m)	AREA			
		C ₁	C ₂ -C ₅	C ₆ -C ₁₄	C ₁₅ ⁺
C-1620	1700	3524120	691140	2684715	6527123
C-1521	2015-2030	4061387	1541796	6887195	7845857
C-1574	2810-2825	6466281	10932960	27840720	34102400
C-1575	2825-2840	14060880	4962040	18437580	34222660
C-1577	2870-2885	12273860	4336067	11487990	17383090
C-1580	2915-2930	10371700	4342590	1293900	21559900
C-1583	2960-2975	22204930	8097329	25598140	27876350
C-1584	2975-2990	12631530	5704109	10306830	16362640

Tables 14-20
Oils and conventional cores

Table 14: API gravity data.

IKU no.	Sample ID	Depth (m)	Whole oil	>210°C fraction
C-1647	DST no.1	3079-3096	39.5° (0.8273 g/cc)	30.8° (0.8716 g/cc)
C-1648	DST no.4	2866-2882	38.1° (0.8341 g/cc)	30.3° (0.8745 g/cc)

Table 15.
List of C2-C8 hydrocarbons

C2	ethane
C3	propane
MC3	methyl-propane
nC4	butane
isoC5	iso-pentane
nC5	pentane
2,2DMC4	2,2-dimethyl-butane
CyC5	cyclopentane
2,3DMC4	2,3-dimethyl-butane
2MC5	2-methyl-pentane
3MC5	3-methyl-pentane
nC6	hexane
MCyC5	methyl-cyclopentane
benzene	
CyC6	cyclohexane
2MC6	2-methyl-hexane
2,3DMC5	2,3-dimethyl-pentane
3MC6	3-methyl-hexane
DMCyC5	dimethyl-cyclopentane
nC7	heptane
MCyC6	methyl-cyclohexane
EtCyC5	ethyl-cyclopentane
2,5DMC6	2,5-dimethyl-hexane
2,4DMC6	2,4-dimethyl-hexane
TMCyC5	trimethyl-cyclopentane
toluene	
2MC7	2-methyl-heptane
4MC7	4-methyl-heptane
3MC7	3-methyl-heptane
DMCyC6	dimethyl-cyclohexane
nC8	octane
2,4DMC7	2,4-dimethyl-heptane
EtCyC6	ethyl-cyclohexane
Et benzene	ethyl-benzene
m,p-xylene	meta,para-xylene
2MC8	2-methyloctane
4MC8	4-methyloctane
o-xylene	orto-xylene
int.std.	2,3,4-trimethyl-pentane

C-1648	area	ug	mg/ml	% of t.oil
nC3	22154	.205	.684	.082
iso-C4	45728	.424	1.413	.169
nC4	266095	2.466	8.220	.985
iso-C5	248014	2.298	7.661	.919
nC5	469581	4.352	14.506	1.739
CyC5+2,3diMeC4	80541	.746	2.488	.298
2MeC5	242149	2.244	7.480	.897
3MeC5	148786	1.379	4.596	.551
nC6	483669	4.482	14.941	1.791
MeCyC5	253847	2.352	7.841	.940
benzene	103022	.955	3.182	.382
CyC6	297095	2.753	9.177	1.100
2MeC6	130480	1.209	4.031	.483
2,3diMeC5	49354	.457	1.525	.183
3MeC6	204449	1.895	6.316	.757
DiMeCyC5 [3]	261866	2.427	8.089	.970
nC7	483575	4.481	14.938	1.791
MeCyC6	551204	5.108	17.027	2.041
EtCyC5+2,5diMeC6	81918	.759	2.530	.303
2,4diMeC6	41990	.389	1.297	.156
triMeCyC5	39326	.364	1.215	.146
toluene	240380	2.228	7.425	.890
2+4MeC7	234599	2.174	7.247	.869
3MeC7	91358	.847	2.822	.338
DiMeCyC6 [3]	223515	2.071	6.905	.828
nC8	424988	3.938	13.128	1.574
2,4diMeC7+diMeCyC6	73495	.681	2.270	.272
EtCyC6	134051	1.242	4.141	.496
EtBenzene	76163	.706	2.353	.282
m,p-Xylene	158515	1.469	4.897	.587
2+4MeC8	96170	.891	2.971	.356
o-xylene	58973	.547	1.822	.218
sum		58.541	195.137	23.3

tot.oil - ug inj.: 250.230ug

%C2-C8 (tot.area) in tot.oil: 29.3 %

C-1647	area	ug	mg/ml	% of t.oil
nC3	25348	.259	.863	.104
iso-C4	72506	.741	2.469	.298
nC4	284326	2.904	9.681	1.170
iso-C5	249027	2.544	8.479	1.025
nC5	482533	4.929	16.430	1.986
CyC5+2,3diMeC4	90612	.926	3.085	.373
2MeC5	234603	2.396	7.988	.966
3MeC5	148134	1.513	5.044	.610
nC6	499349	5.101	17.002	2.055
MeCyC5	266013	2.717	9.058	1.095
benzene	132662	1.355	4.517	.546
CyC6	355404	3.630	12.101	1.463
2MeC6	134433	1.373	4.577	.553
2,3diMeC5	47999	.490	1.634	.198
3MeC6	206062	2.105	7.016	.848
DiMeCyC5 [3]	257885	2.634	8.781	1.061
nC7	509424	5.204	17.346	2.097
MeCyC6	613277	6.264	20.882	2.524
EtCyC5+2,5diMeC6	78298	.800	2.666	.322
2,4diMeC6	42574	.435	1.450	.175
triMeCyC5	38349	.392	1.306	.158
toluene	296414	3.028	10.093	1.220
2+4MeC7	238370	2.435	8.116	.981
3MeC7	109944	1.123	3.744	.452
DiMeCyC6 [3]	243773	2.490	8.300	1.003
nC8	481563	4.919	16.397	1.982
2,4diMeC7+diMeCyC6	76884	.785	2.618	.316
EtCyC6	133511	1.364	4.546	.549
EtBenzene	79484	.812	2.706	.327
m,p-Xylene	194933	1.991	6.637	.802
2+4MeC8	107650	1.100	3.665	.443
o-xylene	66027	.674	2.248	.272
sum		69.434	231.445	27.9

tot.oil - ug inj.: 248.190ug

%C2-C8 (tot.area) in tot.oil: 34.7 %

T A B L E : 16a

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
C 1623	2832.55	23.6	241.9	138.0	46.3	184.3	57.6	0.79
C 1624	2833.40	21.2	218.0	115.9	42.7	158.6	59.4	0.79
C 1625	2848.45	21.0	170.2	90.8	30.6	121.4	48.8	0.63
C 1626	2873.95	21.7	209.6	105.9	38.0	143.9	65.7	0.58
C 1627	2924.80	21.1	99.3	51.5	16.6	68.1	31.2	0.32
C 1628	2927.65	21.0	107.1	60.7	20.6	81.3	25.8	0.36
C 1629	2930.50	20.0	97.1	53.9	17.0	70.9	26.2	0.32
C 1630	2934.50	20.2	38.7	25.1	7.4	32.5	6.2	0.11
C 1631	3086.45	21.8	152.7	77.8	17.5	95.3	57.4	0.74
C 1632	3088.75	20.7	138.2	77.3	23.6	100.9	37.3	0.50

IKU-No	CODE	Crude oil (mg)	EOM >210' (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)
C 1647	DST 1	284.5	206.8	118.2	41.6	159.8	47.0
C 1648	DST 4	458.2	350.0	160.7	66.5	227.2	122.8

DATE : 12 - 7 - 85.

T A B L E : 16b

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

I	IKU-No	DEPTH	EOM	Sat.	Aro.	HC	Non HC	I
I	:	(m)	:	:	:	:	:	I
I	C 1623	2832.55	10254	5850	1963	7813	2442	I
I	C 1624	2833.40	10278	5464	2013	7478	2801	I
I	C 1625	2848.45	8089	4316	1454	5770	2319	I
I	C 1626	2873.95	9663	4882	1752	6634	3029	I
I	C 1627	2924.80	4708	2442	787	3229	1479	I
I	C 1628	2927.65	5095	2888	980	3868	1227	I
I	C 1629	2930.50	4855	2695	850	3545	1310	I
I	C 1630	2934.50	1918	1244	367	1611	307	I
I	C 1631	3086.45	7005	3569	803	4372	2633	I
I	C 1632	3088.75	6673	3732	1140	4872	1801	I

DATE : 18 - 7 - 85.

T A B L E : 16c

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

I	:	:	:	:	:	:	:	:	I
I	IKU-No	DEPTH	EOM	Sat.	Aro.	HC	Non	HC	I
I	:	:	:	:	:	:	:	:	I
I	:	(m)	:	:	:	:	:	:	I
I	:	:	:	:	:	:	:	:	I
I	C 1623	2832.55	1298.0	740.5	248.4	988.9	309.1		I
I	:	:	:	:	:	:	:	:	I
I	C 1624	2833.40	1301.0	691.7	254.8	946.5	354.5		I
I	:	:	:	:	:	:	:	:	I
I	C 1625	2848.45	1284.0	685.0	230.9	915.9	368.2		I
I	:	:	:	:	:	:	:	:	I
I	C 1626	2873.95	1666.1	841.8	302.1	1143.9	522.2		I
I	:	:	:	:	:	:	:	:	I
I	C 1627	2924.80	1471.4	763.1	246.0	1009.1	462.3		I
I	:	:	:	:	:	:	:	:	I
I	C 1628	2927.65	1415.3	802.1	272.2	1074.4	340.9		I
I	:	:	:	:	:	:	:	:	I
I	C 1629	2930.50	1517.2	842.2	265.6	1107.8	409.4		I
I	:	:	:	:	:	:	:	:	I
I	C 1630	2934.50	1743.4	1130.7	333.4	1464.1	279.3		I
I	:	:	:	:	:	:	:	:	I
I	C 1631	3086.45	946.6	482.3	108.5	590.8	355.8		I
I	:	:	:	:	:	:	:	:	I
I	C 1632	3088.75	1334.6	746.5	227.9	974.4	360.2		I
I	:	:	:	:	:	:	:	:	I

DATE : 18 - 7 - 85.

T A B L E : 16d

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

I	IKU-No	DEPTH	Sat	Aro	HC	SAT	Non HC	HC	I
I	:	:	---	---	---	---	---	---	I
I	:	:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I	:	(m)	:	:	:	:	:	:	I
I	:	:	:	:	:	:	:	:	I
I	C 1623	2832.55	57.0	19.1	76.2	298.1	23.8	320.0	I
I	:	:	:	:	:	:	:	:	I
I	C 1624	2833.40	53.2	19.6	72.8	271.4	27.2	267.0	I
I	:	:	:	:	:	:	:	:	I
I	C 1625	2848.45	53.3	18.0	71.3	296.7	28.7	248.8	I
I	:	:	:	:	:	:	:	:	I
I	C 1626	2873.95	50.5	18.1	68.7	278.7	31.3	219.0	I
I	:	:	:	:	:	:	:	:	I
I	C 1627	2924.80	51.9	16.7	68.6	310.2	31.4	218.3	I
I	:	:	:	:	:	:	:	:	I
I	C 1628	2927.65	56.7	19.2	75.9	294.7	24.1	315.1	I
I	:	:	:	:	:	:	:	:	I
I	C 1629	2930.50	55.5	17.5	73.0	317.1	27.0	270.6	I
I	:	:	:	:	:	:	:	:	I
I	C 1630	2934.50	64.9	19.1	84.0	339.2	16.0	524.2	I
I	:	:	:	:	:	:	:	:	I
I	C 1631	3086.45	50.9	11.5	62.4	444.6	37.6	166.0	I
I	:	:	:	:	:	:	:	:	I
I	C 1632	3088.75	55.9	17.1	73.0	327.5	27.0	270.5	I
I	:	:	:	:	:	:	:	:	I

I	IKU-No	CODE	Sat	Aro	HC	SAT	Non HC	HC	I
I	:	:	---	---	---	---	---	---	I
I	:	:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I	:	:	:	:	:	:	:	:	I
I	:	:	:	:	:	:	:	:	I
I	C 1647	DST 1	57.2	20.1	77.3	284.1	22.7	340.0	I
I	:	:	:	:	:	:	:	:	I
I	C 1648	DST 4	45.9	19.0	64.9	241.7	35.1	185.0	I
I	:	:	:	:	:	:	:	:	I

DATE : 12 - 7 - 85.

Table 16e. Content of asphaltenes in cores and oils.

Sample code	Depth (m)	EOM >210 ⁰ (mg)	Asphaltenes	
			(mg)	(%)
Oils				
C-1648	2866-82	350.0	5.8	1.7
C-1647	3079-96	206.8	2.7	1.3
Cores				
C-1623	2832.55	241.9	6.9	2.9
C-1624	2833.40	218.0	8.8	4.0
C-1625	2848.45	170.2	15.1	8.9
C-1626	2873.95	209.6	12.6	6.0
C-1627	2924.80	99.3	8.8	8.9
C-1628	2927.65	107.1	5.1	4.8
C-1629	2930.50	97.1	6.9	7.1
C-1630	2934.50	38.7	5.5	14.2
C-1631	3086.45	152.7	9.7	6.4
C-1632	3088.75	138.2	8.7	6.3

Table 17b. Methyl-phenanthrene Index (MPI) ratios calculated from aromatic gas chromatograms: Cores + DST samples.

Sample ID	Depth	MPI-1	MPI-2
OILS			
C-1648	2866-2882 (DST no.4)	0.44	0.56
C-1647	3079-3096 (DST no.1)	0.42	0.66
CORES			
C-1623	2832.55	0.43	0.73
C-1624	2832.40	0.42	0.72
C-1625	2848.45	0.42	0.73
C-1626	2873.95	0.41	0.73
C-1627	2924.80	0.44	0.77
C-1628	2927.65	0.45	0.79
C-1629	2930.50	0.48	0.83
C-1630	2934.50	0.44	0.75
C-1631	3086.45	0.46	0.80
C-1632	3088.75	0.44	0.73

$$\text{MPI-1} = \frac{1.5 (2\text{-MP}+3\text{-MP})}{\text{P}+1\text{-MP}+9\text{-MP}}$$

$$\text{MPI-2} = \frac{3 (2\text{-MP})}{\text{P}+1\text{-MP}+9\text{-MP}}$$

Table 18. Molecular ratios calculated from peak heights in mass chromatograms. Maturity ratios.

Sample code	Depth (m)	$\alpha\beta/\alpha\beta+\beta\alpha$	%22S	%88	%20S
Oils					
C-1648	2866-82	0.91	62.2	77.5	50.7
C-1647	3079-96	0.91	63.7	76.1	54.3
Cores					
C-1623	2832.55	0.91	63.9	78.6	52.4
C-1624	2833.40	0.91	61.5	77.1	49.2
C-1625	2848.45	0.91	59.8	76.2	53.4
C-1626	2873.95	0.91	62.1	75.9	53.9
C-1627	2924.80	0.90	62.7	77.0	53.9
C-1628	2927.65	0.91	61.0	76.8	53.3
C-1629	2930.50	0.92	61.4	76.4	55.4
C-1630	2934.50	0.93	62.0	75.6	53.4
C-1631	3086.45	0.91	62.4	76.3	51.6
C-1632	3088.75	0.90	62.0	78.1	54.5

Table 19. Molecular ratios calculated from peak heights in mass chromatograms.

Maturity and source characteristic parameters.

Sample code	Depth (m)	Q/E	Tm/Ts	Z/E	X/E	a/a+j
Oils						
C-1648	2866-82	0.05	0.71	0.16	0.08	0.79
C-1647	3079-96	0.04	0.65	0.14	0.12	0.81
Cores						
C-1623	2832.55	0.04	0.63	0.15	0.08	0.85
C-1624	2833.40	0.05	0.67	0.13	0.08	0.82
C-1625	2848.45	0.04	0.67	0.15	0.08	0.78
C-1626	2873.95	0.04	0.71	0.14	0.07	0.79
C-1627	2924.80	0.05	0.73	0.18	0.09	0.77
C-1628	2927.65	0.05	0.63	0.18	0.08	0.79
C-1629	2930.50	0.07	0.65	0.18	0.08	0.75
C-1630	2934.50	0.07	0.69	0.16	0.07	0.78
C-1631	3086.45	0.07	0.58	0.16	0.09	0.79
C-1632	3088.75	0.08	0.61	0.16	0.12	0.82

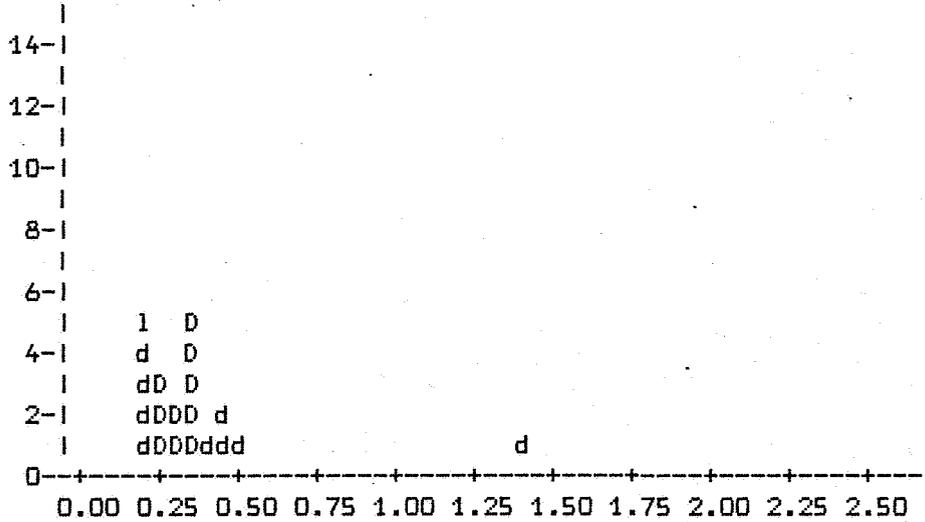
Table 20. $\delta^{13}\text{C}$ isotope data for oils and core samples.

Sample code	Depth (m)	SAT	$\delta^{13}\text{C}_{\text{PDB}}$	ARO
Cores				
C-1623	2832.55	-29.9		-28.7
C-1624	2833.40	-29.8		-28.7
C-1625	2848.45	-29.7		-28.5
C-1626	2873.95	-29.4		-28.2
C-1627	2924.80	-29.6		-28.6
C-1628	2927.65	-29.6		-28.5
C-1629	2930.50	-29.5		-28.5
C-1630	2934.50	-29.6		-28.4
C-1631	3086.45	-29.2		-28.0
C-1632	3088.75	-29.8		-28.9
Oils				
C-1648, DST 4	2866-82	-29.6		-28.4
C-1647, DST 1	3079-96	-29.1		-27.8

FIGURES 1-5

CUTTINGS AND SIDEWALL CORES

IKU# C-1606 1000.0M 30/3-4

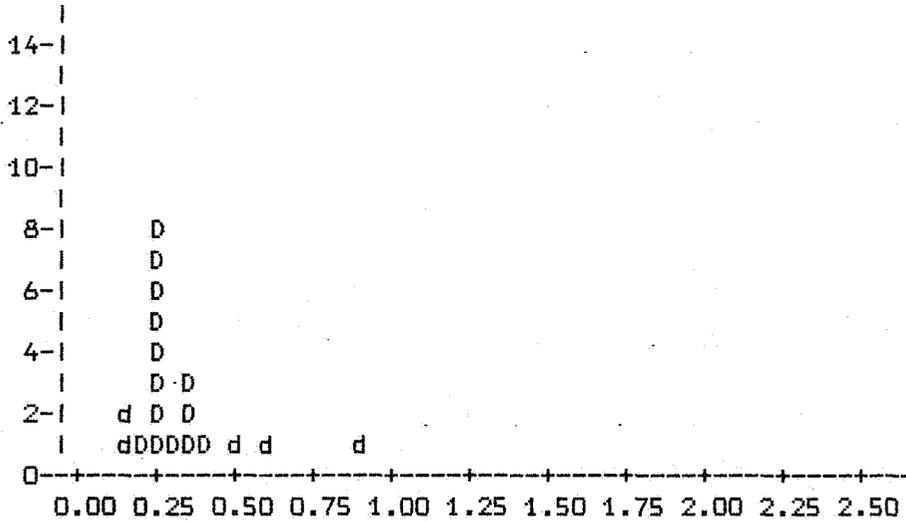


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.26	0.40	ALL	10	0.33	0.04
N	0.21	0.24	ALL	5	0.22	0.01
N	0.47	0.51	ALL	3	0.49	0.02
				OVERALL	20	0.38 0.26

ORDERED VALUES FOLLOW:

0.21d 0.21d 0.22d 0.23d 0.231 0.26D 0.27D 0.29D 0.31D 0.32D 0.35D
 0.36D 0.36D 0.38D 0.38D 0.40d 0.47d 0.49d 0.50d 1.41d

IKU# C-1610 1200.0M 30/3-4

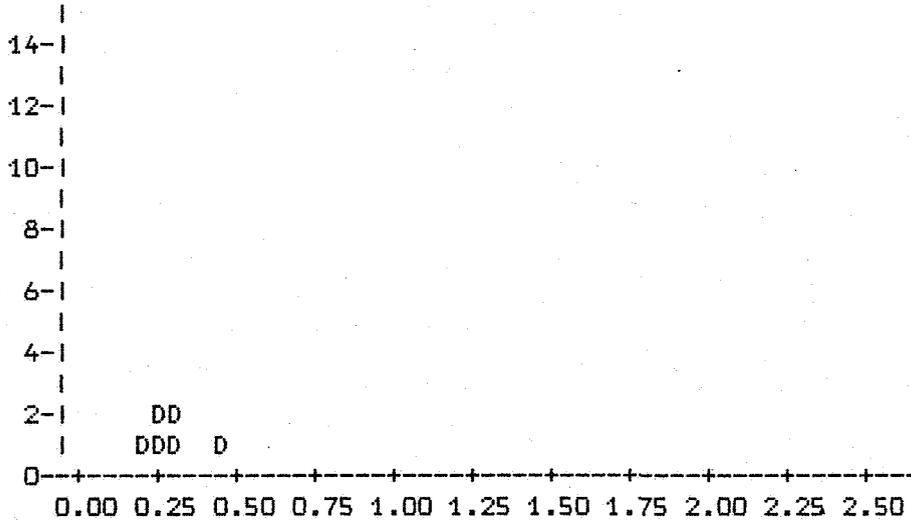


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.23	0.45	ALL	14	0.30	0.06
N	0.18	0.19	ALL	1	0.18	0.00
N	0.51	0.61	ALL	1	0.51	0.00
				OVERALL	19	0.35 0.18

ORDERED VALUES FOLLOW:

0.18d 0.19d 0.23D 0.25D 0.25D 0.26D 0.26D 0.26D 0.26D 0.27D 0.29D
 0.31D 0.35D 0.36D 0.36D 0.44D 0.51d 0.61d 0.93d

IKU# C-1613 1350.0M 30/3-4

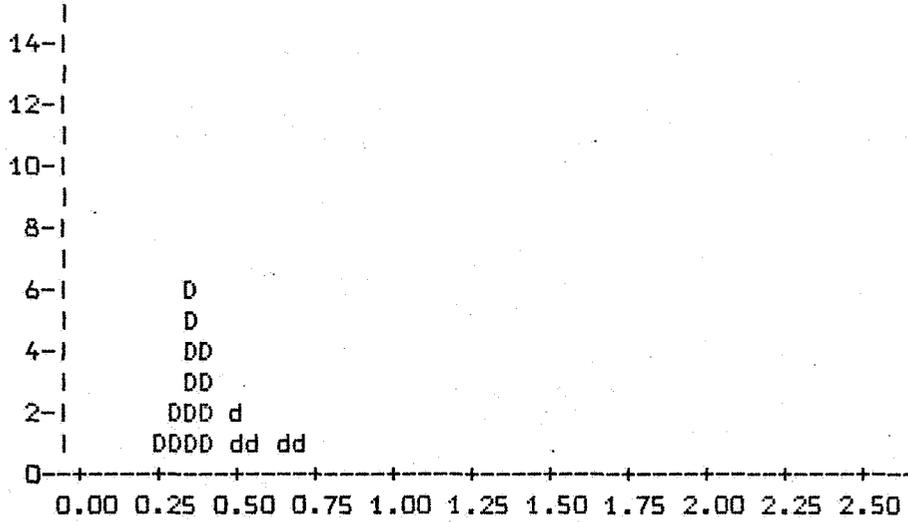


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.24	0.46	ALL	6	0.31	0.08
			OVERALL	6	0.31	0.08

ORDERED VALUES FOLLOW:

0.240 0.250 0.280 0.310 0.310 0.450

IKU# C-1617 1550.0M 30/3-4

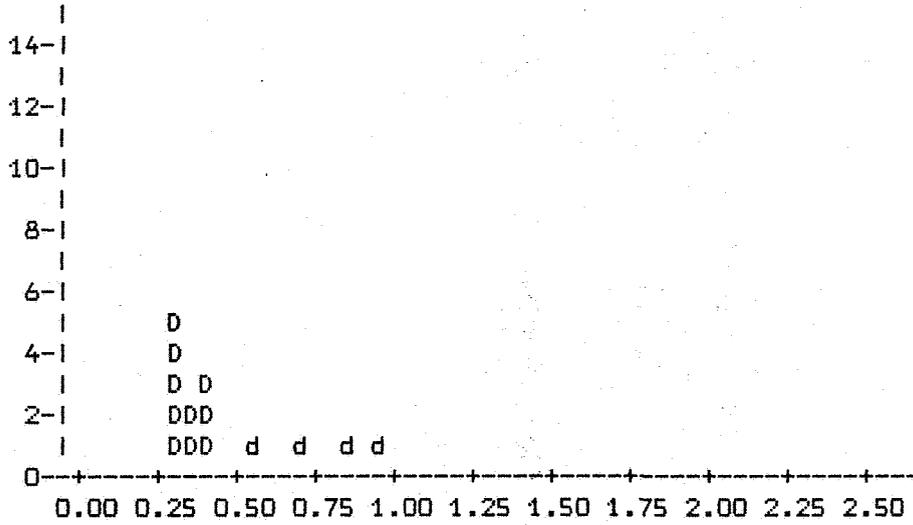


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.28	0.44	ALL	13	0.37	0.04
N	0.54	0.72	ALL	4	0.62	0.08
			OVERALL	18	0.43	0.12

ORDERED VALUES FOLLOW:

0.28D 0.31D 0.34D 0.35D 0.35D 0.36D 0.38D 0.39D 0.39D 0.41D 0.41D
 0.41D 0.43D 0.53d 0.54d 0.56d 0.67d 0.71d

IKU# C-1618 1600.0M 30/3-4

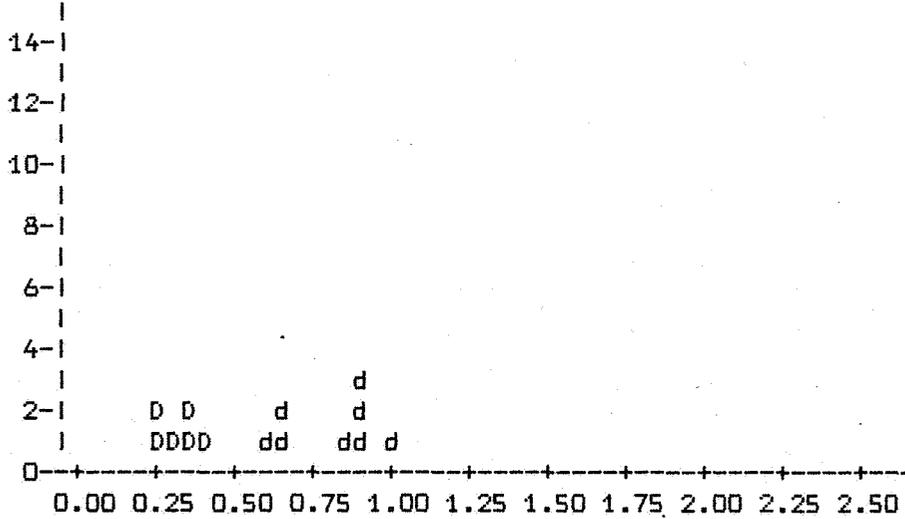


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.31	0.45	ALL	10	0.36	0.04
N	0.58	0.99	ALL	4	0.79	0.17
			OVERALL	14	0.48	0.22

ORDERED VALUES FOLLOW:

 0.31D 0.32D 0.33D 0.33D 0.34D 0.35D 0.35D 0.40D 0.41D 0.44D 0.58d
 0.72d 0.87d 0.98d

IKU# C-1620 1700.0M 30/3-4

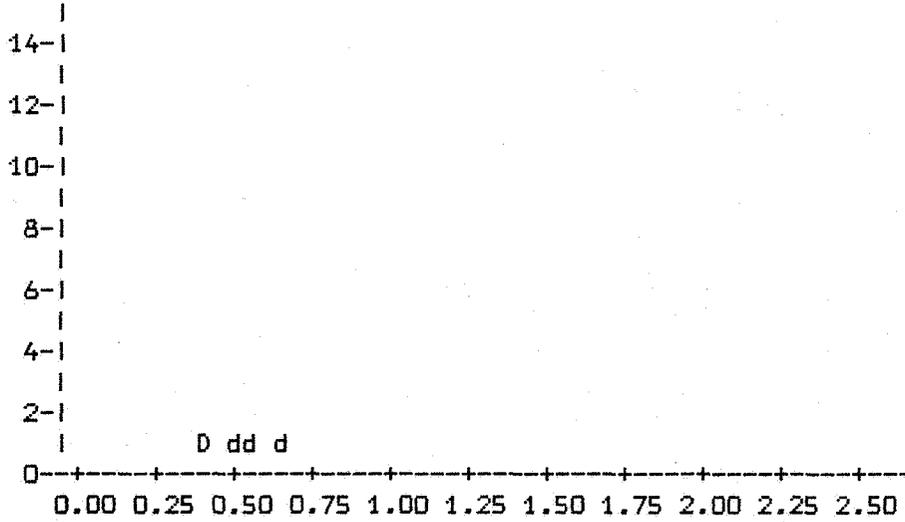


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.29	0.41	ALL	6	0.34	0.04
N	0.61	0.69	ALL	3	0.65	0.04
N	0.89	1.03	ALL	5	0.93	0.05
				OVERALL	14	0.62 0.28

ORDERED VALUES FOLLOW:

0.29D 0.29D 0.32D 0.35D 0.37D 0.40D 0.61d 0.65d 0.68d 0.89d 0.90d
 0.93d 0.93d 1.02d

IKU# C-1622 1800.0M 3D/3-4

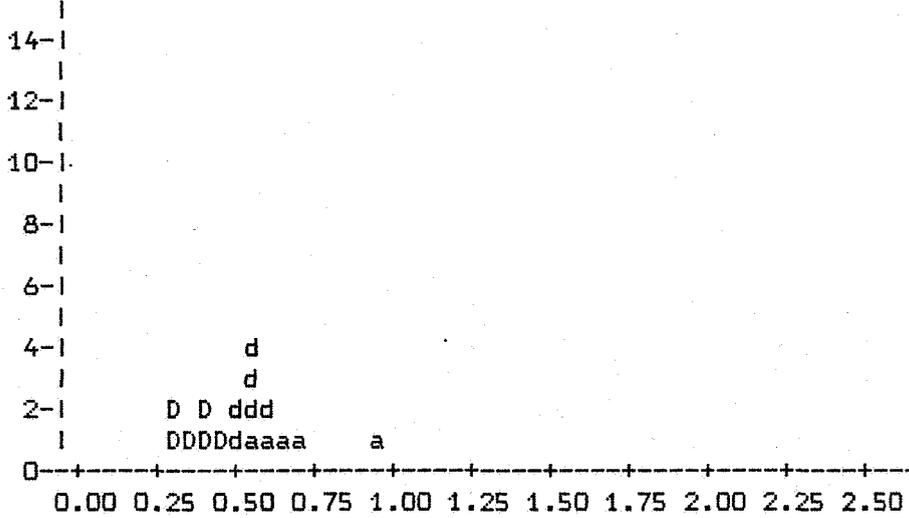


	PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.41	0.42	ALL		1	0.41	0.00
N	0.54	0.67	ALL		3	0.59	0.06
			OVERALL		4	0.54	0.10

ORDERED VALUES FOLLOW:

0.41D 0.54d 0.56d 0.66d

IKU# C-1518 1950.0M 30/3-4

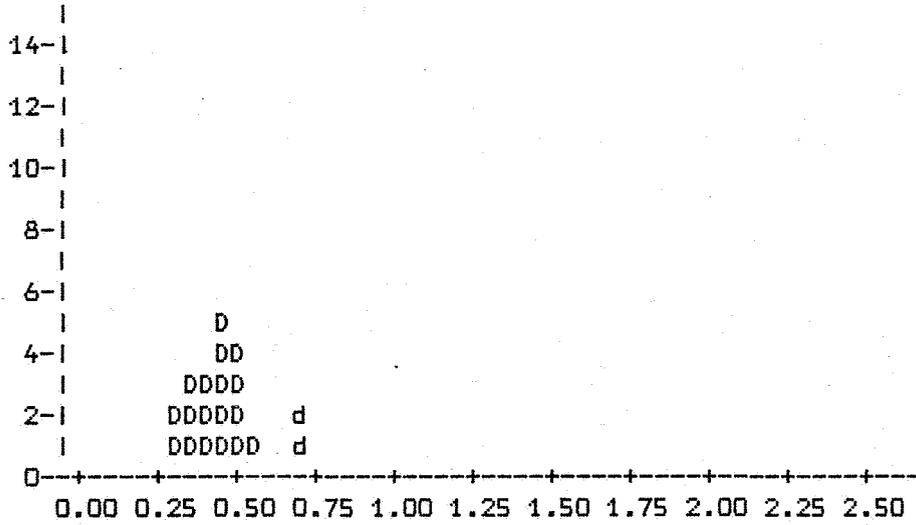


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.31	0.48	ALL	6	0.39	0.07
N	0.51	0.75	ALL	10	0.60	0.07
			OVERALL	17	0.55	0.17

ORDERED VALUES FOLLOW:

0.31D 0.32D 0.38D 0.42D 0.44D 0.47D 0.51d 0.54d 0.57d 0.58d 0.59a
 0.59d 0.61a 0.61d 0.69a 0.74a 0.99a

IKU# C-1520 2015.OM 30/3-4

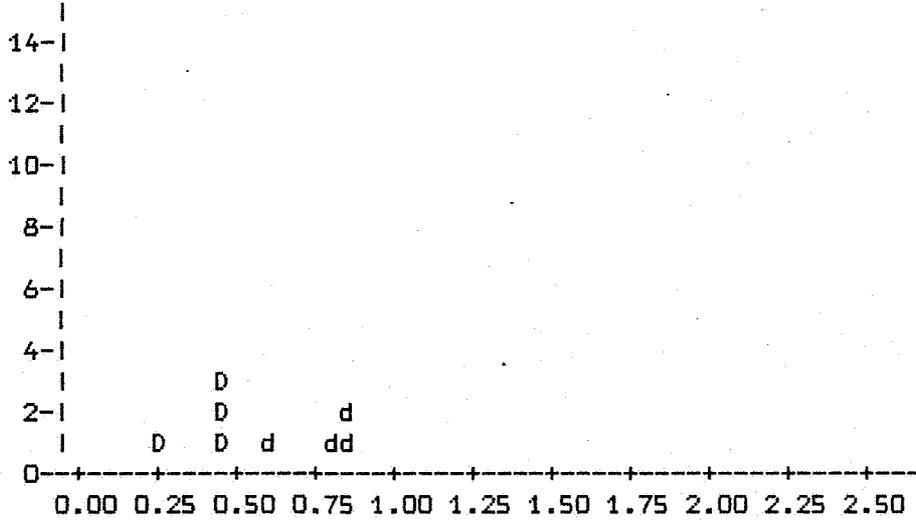


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.33	0.59	ALL	18	0.44	0.07
N	0.72	0.74	ALL	2	0.73	0.01
			OVERALL	20	0.47	0.11

ORDERED VALUES FOLLOW:

0.33D	0.34D	0.35D	0.37D	0.39D	0.40D	0.41D	0.42D	0.45D	0.47D	0.47D
0.47D	0.49D	0.50D	0.51D	0.51D	0.52D	0.58D	0.72d	0.73d		

IKU# C-1521 2030.OM 30/3-4

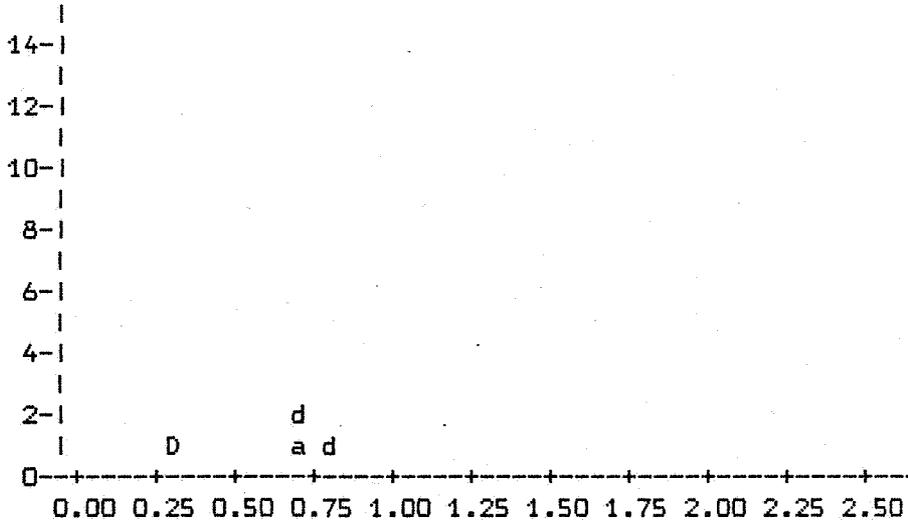


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.28	0.50	ALL	4	0.43	0.10
N	0.64	0.89	ALL	4	0.81	0.11
			OVERALL	8	0.62	0.23

ORDERED VALUES FOLLOW:

0.28D 0.46D 0.47D 0.49D 0.64d 0.84d 0.87d 0.88d

IKU# C-1524 2075.DM 30/3-4

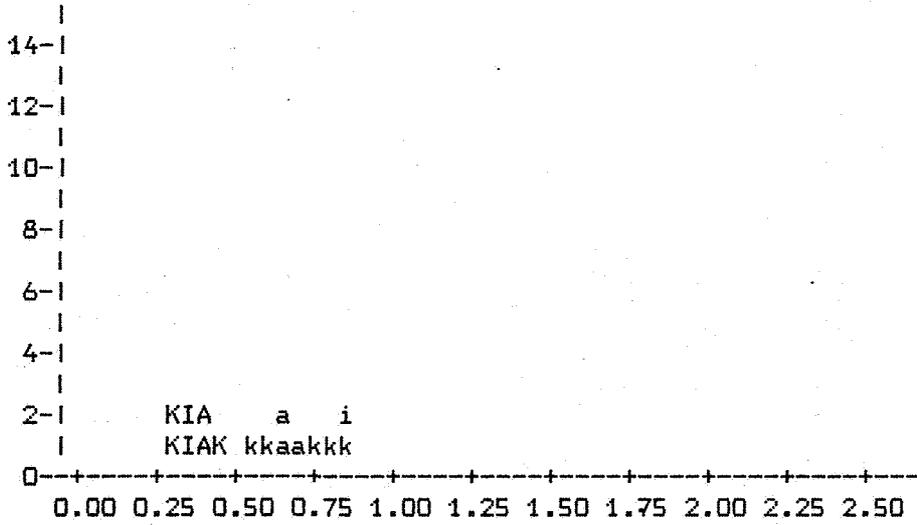


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.32	0.33	ALL	1	0.32	0.00
N	0.70	0.81	ALL	3	0.74	0.05
			OVERALL	4	0.63	0.21

ORDERED VALUES FOLLOW:

0.32D 0.70a 0.72d 0.80d

IKU# C-1534 2225.0M 30/3-4

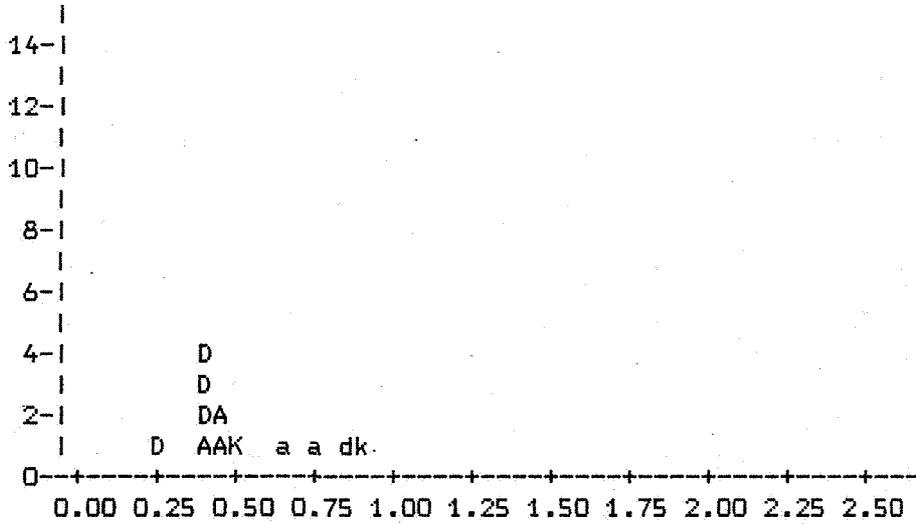


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.30	0.50	ALL	7	0.39	0.06
N	0.56	0.87	ALL	9	0.73	0.11
			OVERALL	16	0.58	0.19

ORDERED VALUES FOLLOW:

0.30K 0.33K 0.38I 0.39I 0.42A 0.43A 0.49K 0.56k 0.60k 0.67a 0.68a
 0.70a 0.77k 0.83k 0.86k 0.86i

IKU# C-1540 2315.OM 3D/3-4

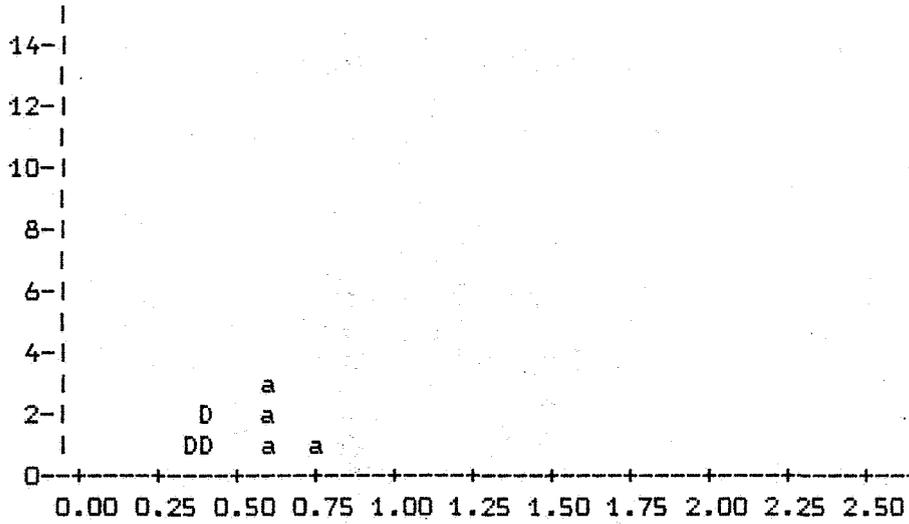


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.28	0.51	ALL	8	0.42	0.07
N	0.68	0.92	ALL	4	0.80	0.10
			OVERALL	12	0.55	0.20

ORDERED VALUES FOLLOW:

0.28D 0.40D 0.40D 0.41A 0.42D 0.48A 0.49A 0.50K 0.68a 0.76a 0.86d
0.91k

IKU# C-1544 2375.DM 30/3-4

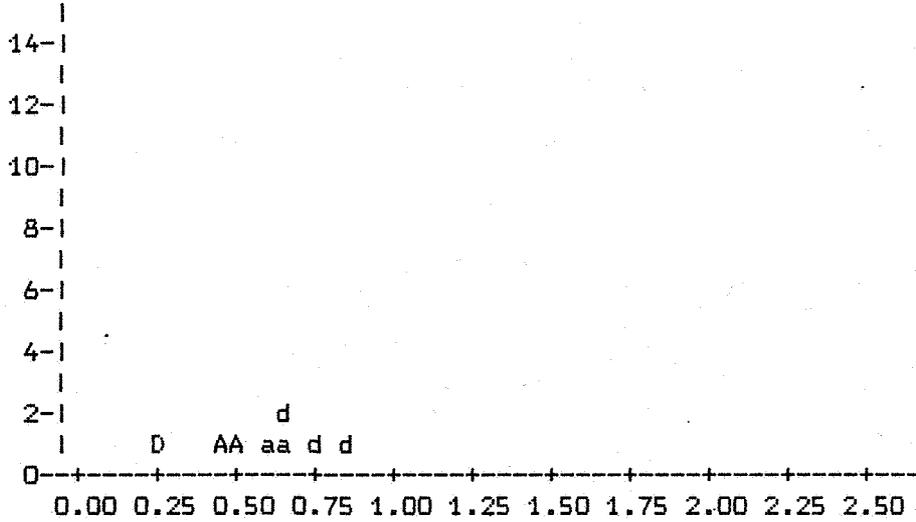


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.36	0.44	ALL	3	0.41	0.04
N	0.60	0.79	ALL	4	0.66	0.08
			OVERALL	7	0.55	0.15

ORDERED VALUES FOLLOW:

0.36D 0.43D 0.43D 0.60a 0.61a 0.64a 0.78a

IKU# C-1549 2450.0M 30/3-4

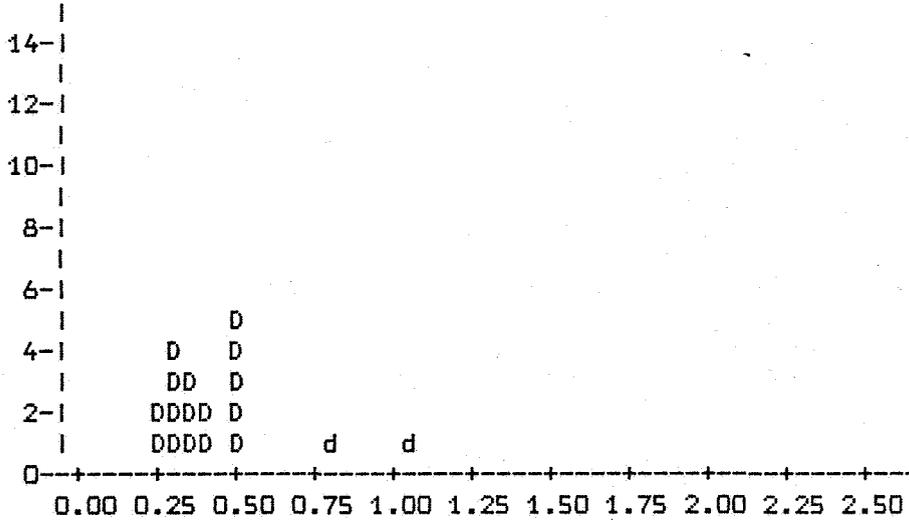


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.29	0.53	ALL	3	0.42	0.12
N	0.61	0.87	ALL	5	0.72	0.10
			OVERALL	8	0.61	0.18

ORDERED VALUES FOLLOW:

0.29D 0.45A 0.52A 0.61a 0.65a 0.67d 0.79d 0.86d

IKU# C-1555 2540.0M 30/3-4

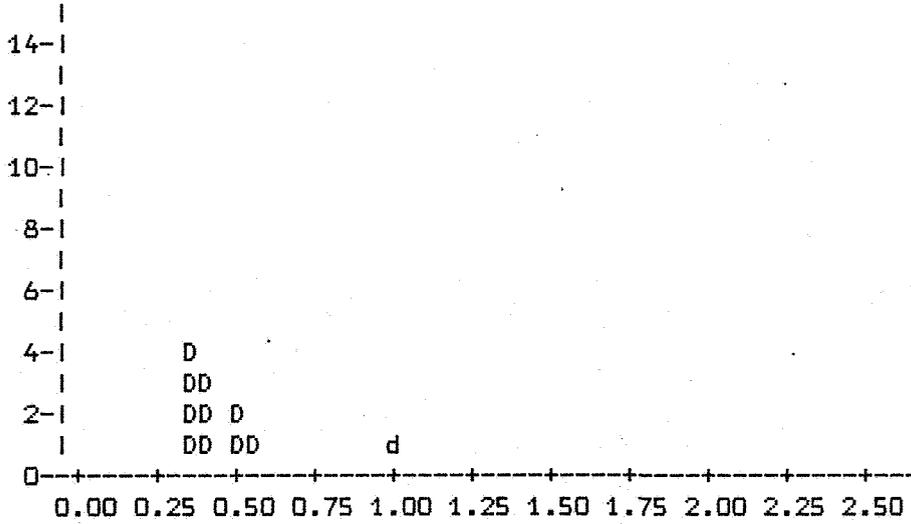


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.27	0.54	ALL	16	0.40	0.09
N	0.81	1.06	ALL	2	0.93	0.17
			OVERALL	18	0.46	0.20

ORDERED VALUES FOLLOW:

0.27D 0.29D 0.32D 0.32D 0.34D 0.34D 0.36D 0.37D 0.38D 0.40D 0.42D
 0.50D 0.51D 0.52D 0.53D 0.53D 0.81d 1.05d

IKU# C-1560 2615.0M 30/3-4

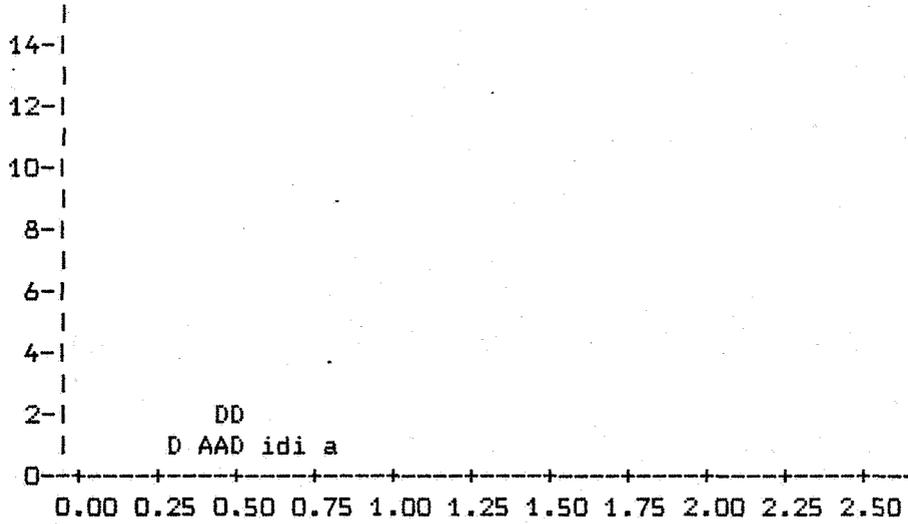


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.31	0.57	ALL	10	0.42	0.08
			OVERALL	11	0.48	0.20

ORDERED VALUES FOLLOW:

0.35D 0.35D 0.36D 0.37D 0.40D 0.41D 0.41D 0.50D 0.52D 0.56D 1.04d

IKU# C-1569 2750.0M 30/3-4

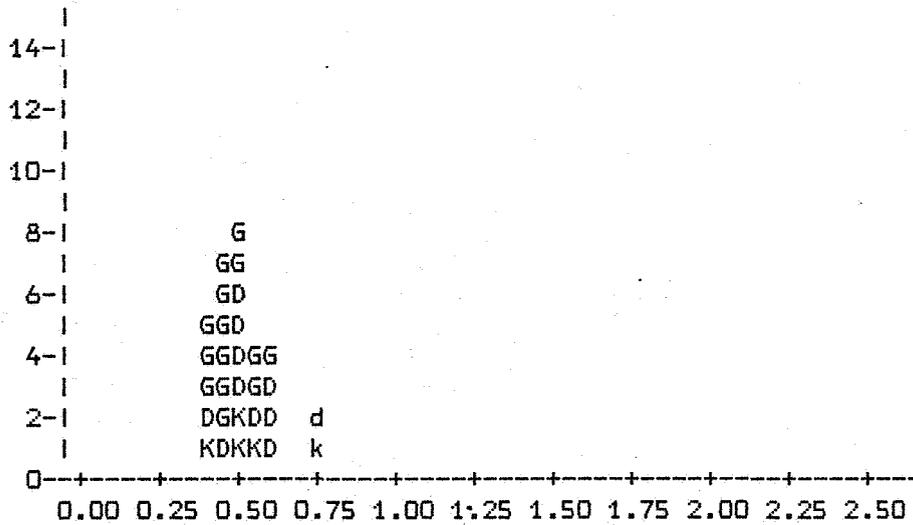


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.33	0.53	ALL	6	0.45	0.07
N	0.64	0.83	ALL	4	0.72	0.08
				OVERALL	10	0.56 0.15

ORDERED VALUES FOLLOW:

0.33D 0.44A 0.45A 0.47D 0.50D 0.52D 0.64i 0.69d 0.74i 0.82a

IKU# C-1575 2840.0M 30/3-4

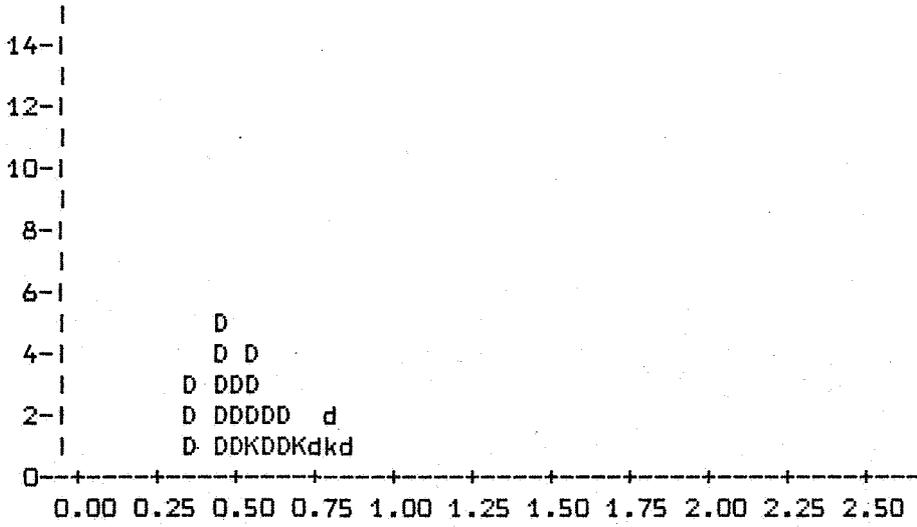


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.40	0.65	ALL	28	0.51	0.07
N	0.75	0.78	ALL	2	0.76	0.01
			OVERALL	30	0.53	0.09

ORDERED VALUES FOLLOW:

0.40G 0.41G 0.42K 0.44D 0.44G 0.45G 0.45G 0.47G 0.47G 0.48D 0.48G
 0.49G 0.50D 0.51D 0.51K 0.52D 0.53G 0.53D 0.53G 0.53K 0.55D 0.55G
 0.55G 0.58K 0.60D 0.61G 0.64D 0.64D 0.75d 0.77k

IKU# C-1573 2810.0M 30/3-4

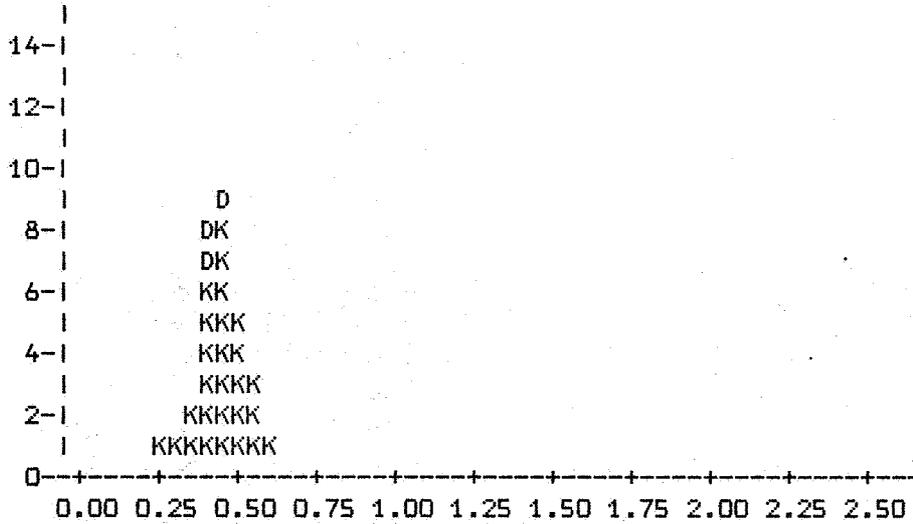


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.35	0.71	ALL	20	0.53	0.10
N	0.76	0.88	ALL	4	0.82	0.05
			OVERALL	24	0.58	0.15

ORDERED VALUES FOLLOW:

0.35D 0.36D 0.37D 0.45D 0.45D 0.46D 0.48D 0.48D 0.50D 0.53D 0.54D
 0.56D 0.58D 0.59D 0.59K 0.63D 0.64D 0.65D 0.67D 0.70K 0.76d 0.80k
 0.84d 0.87d

IKU# C-1574 2825.0M 30/3-4

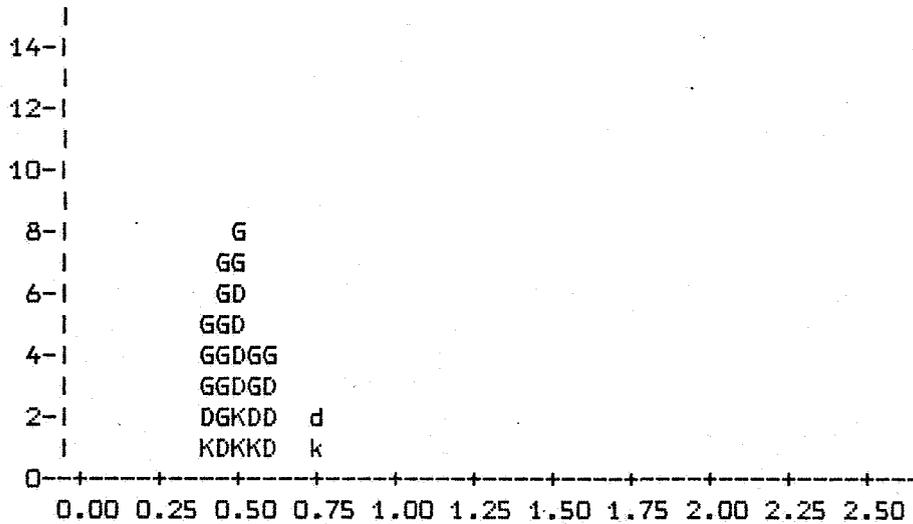


PP LOW HIGH LIT #VAL MEAN STDV
 Y 0.26 0.62 ALL 30 0.46 0.07
 OVERALL 30 0.46 0.07

ORDERED VALUES FOLLOW:

0.26K 0.34K 0.38K 0.39K 0.40D 0.41K 0.42K 0.42K 0.43D 0.43K 0.44K
 0.44K 0.45K 0.45K 0.45K 0.46K 0.47K 0.47K 0.48D 0.48K 0.49K 0.50K
 0.51K 0.53K 0.53K 0.54K 0.56K 0.56K 0.58K 0.61K

IKU# C-1575 2840.0M 30/3-4

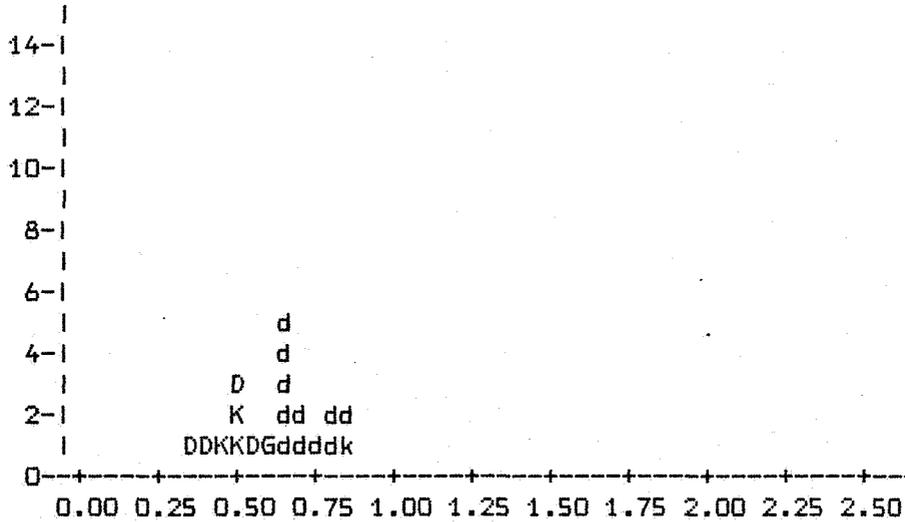


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.40	0.65	ALL	28	0.51	0.07
N	0.75	0.78	ALL	2	0.76	0.01
			OVERALL	30	0.53	0.09

ORDERED VALUES FOLLOW:

0.40G 0.41G 0.42K 0.44D 0.44G 0.45G 0.45G 0.47G 0.47G 0.48D 0.48G
 0.49G 0.50D 0.51D 0.51K 0.52D 0.53G 0.53D 0.53G 0.53K 0.55D 0.55G
 0.55G 0.58K 0.60D 0.61G 0.64D 0.64D 0.75d 0.77k

IKU# C-1577 2885.0M 30/3-4



	PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.37	0.62	ALL		8	0.50	0.08
N	0.66	0.89	ALL		12	0.75	0.08
					OVERALL	20	0.65 0.15

ORDERED VALUES FOLLOW:

 0.37D 0.42D 0.46K 0.50K 0.53K 0.53D 0.58D 0.61G 0.66d 0.66d 0.68d
 0.69d 0.69d 0.70d 0.73d 0.79d 0.81d 0.83d 0.86d 0.88k

IKU# C-1578 2900.0M 30/3-4

14-|

12-|

10-|

8-|

6-|

4-|

2-|

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 AA a a

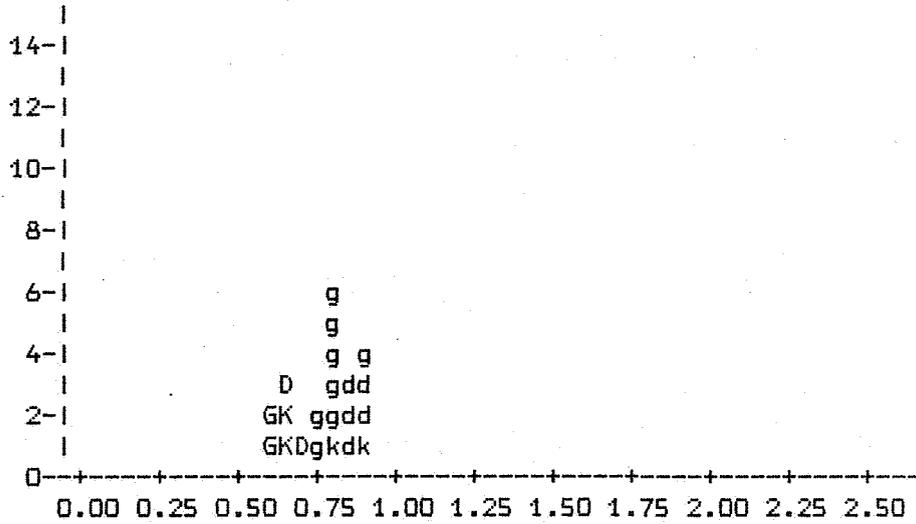
0.00 0.25 0.50 0.75 1.00 1.25 1.50 1.75 2.00 2.25 2.50

PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.59	0.61	ALL	2	0.60	0.01
N	0.73	0.84	ALL	4	0.77	0.05
OVERALL				6	0.71	0.10

ORDERED VALUES FOLLOW:

0.59A 0.60A 0.73d 0.73a 0.80a 0.83a

IKU# C-1583 2975.0M 30/3-4

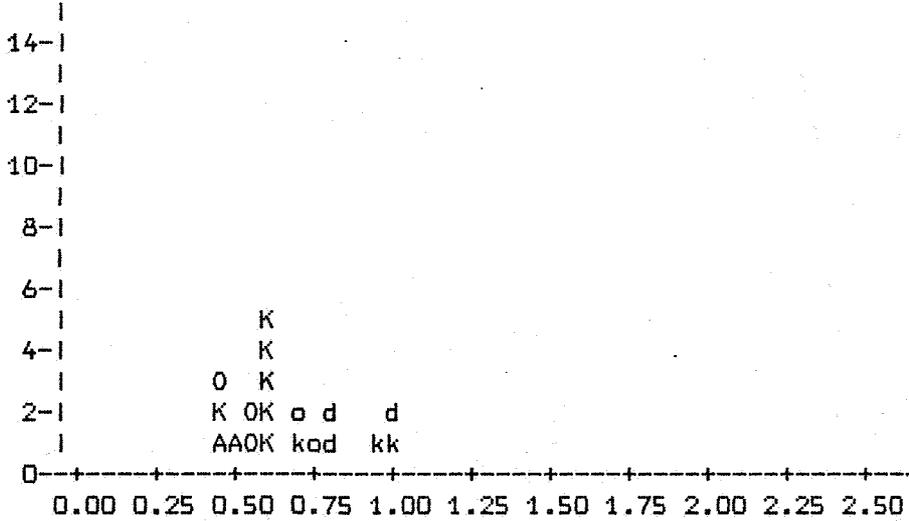


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.60	0.73	ALL	6	0.66	0.04
N	0.75	0.94	ALL	15	0.85	0.06
			OVERALL	21	0.80	0.10

ORDERED VALUES FOLLOW:

0.60G 0.62G 0.66D 0.68K 0.69K 0.72D 0.75g 0.77g 0.81k 0.81g 0.83g
 0.83g 0.83g 0.84g 0.85d 0.87d 0.89d 0.91d 0.92g 0.93d 0.93k

IKU# C-1593 3135.0M 30/3-4

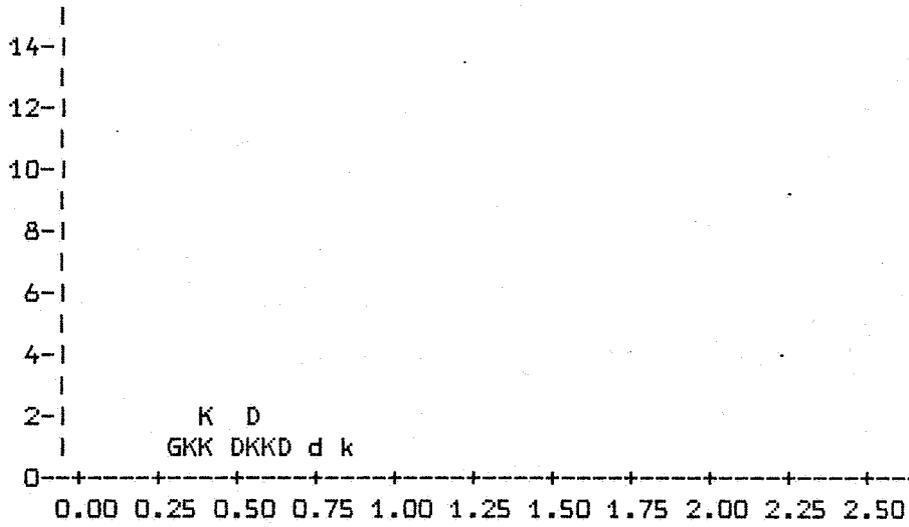


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.49	0.63	ALL	11	0.56	0.06
N	0.72	0.84	ALL	5	0.77	0.05
N	0.98	1.05	ALL	3	1.02	0.03
OVERALL				19	0.69	0.18

ORDERED VALUES FOLLOW:

 0.490 0.49K 0.49A 0.50A 0.570 0.570 0.60K 0.61K 0.61K 0.62K 0.62K
 0.72o 0.74k 0.76o 0.81d 0.83d 0.98k 1.04d 1.04k

IKU# C-1603 3285.DM 30/3-4



	PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.33	0.68	ALL		9	0.50	0.11
N	0.77	0.87	ALL		2	0.81	0.06
OVERALL					11	0.56	0.16

ORDERED VALUES FOLLOW:

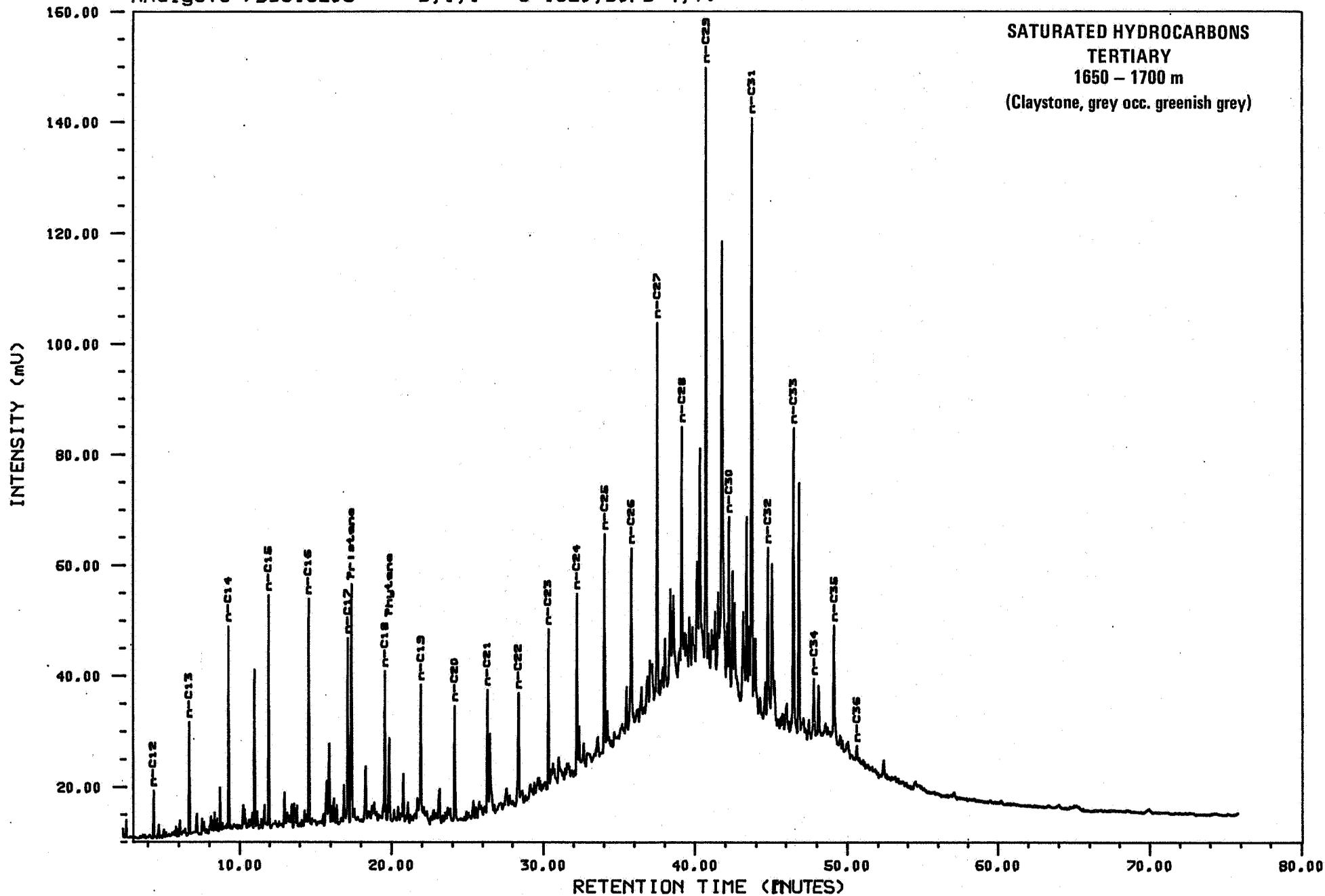
0.33G 0.39K 0.43K 0.44K 0.52D 0.55K 0.56D 0.63K 0.67D 0.77d 0.86k

FIGURE 2

SATURATED HYDROCARBON GAS CHROMATOGRAMS

Pr - pristane
Ph - phytane
n-C15 etc. - n-alkanes

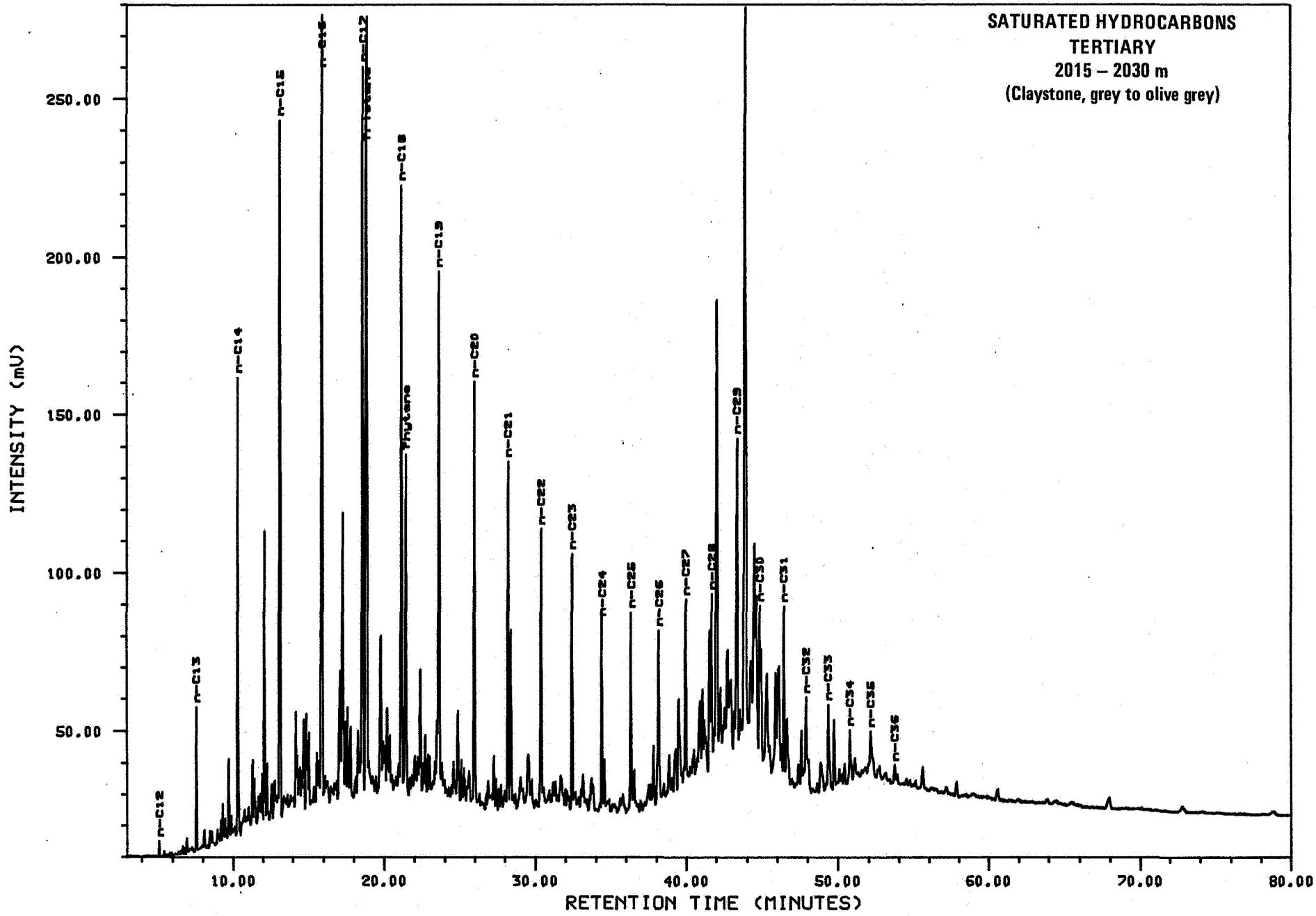
Analysis 793C1620S 3,1,1 C-1620,30/3-4,TU



Analysis 793C1521S

3,1,1

C-1521,30/3-4,SAT,TU

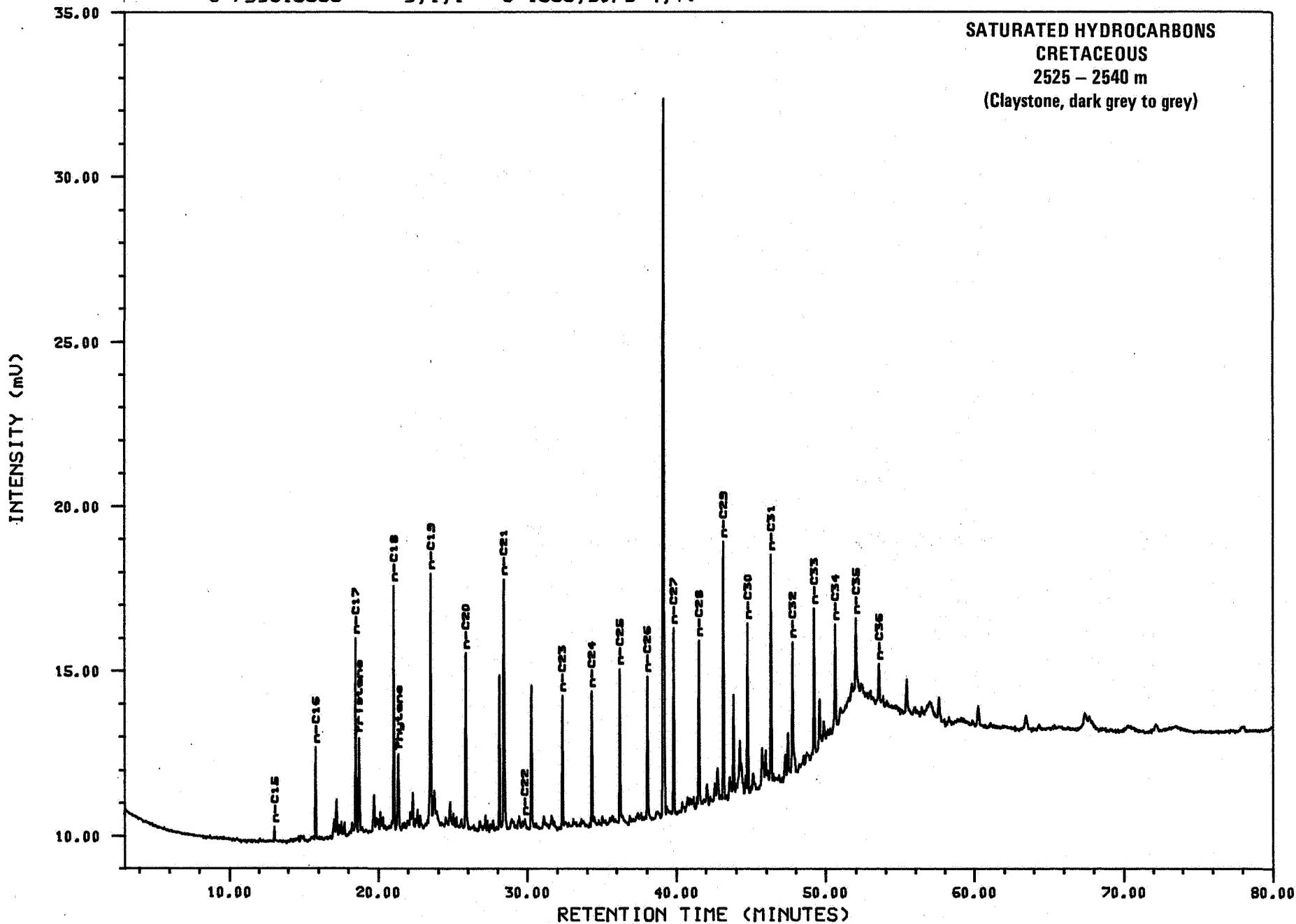


SATURATED HYDROCARBONS
TERTIARY
2015 - 2030 m
(Claystone, grey to olive grey)

s 793C1555S

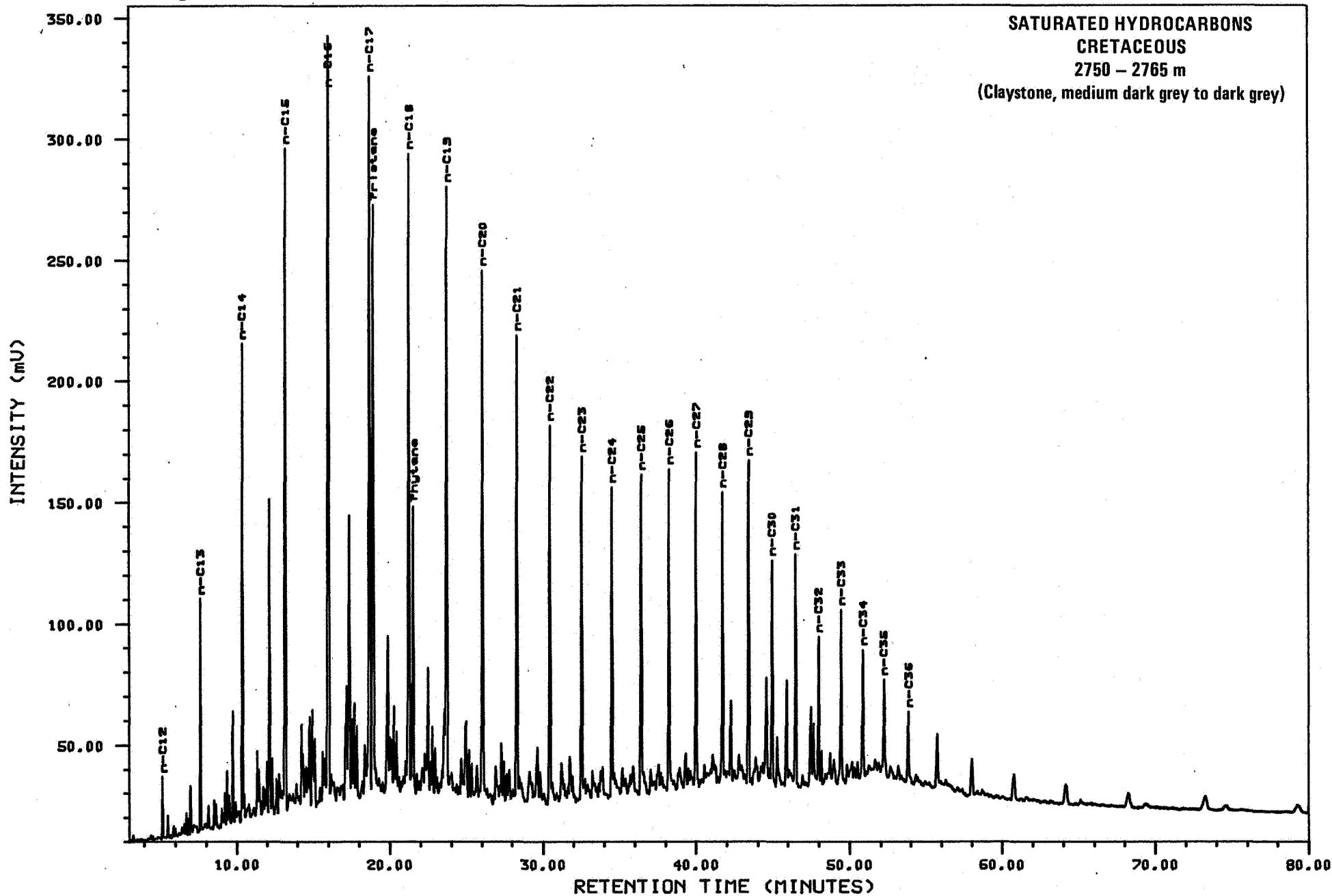
3,1,1

C-1555,30/3-4,TU

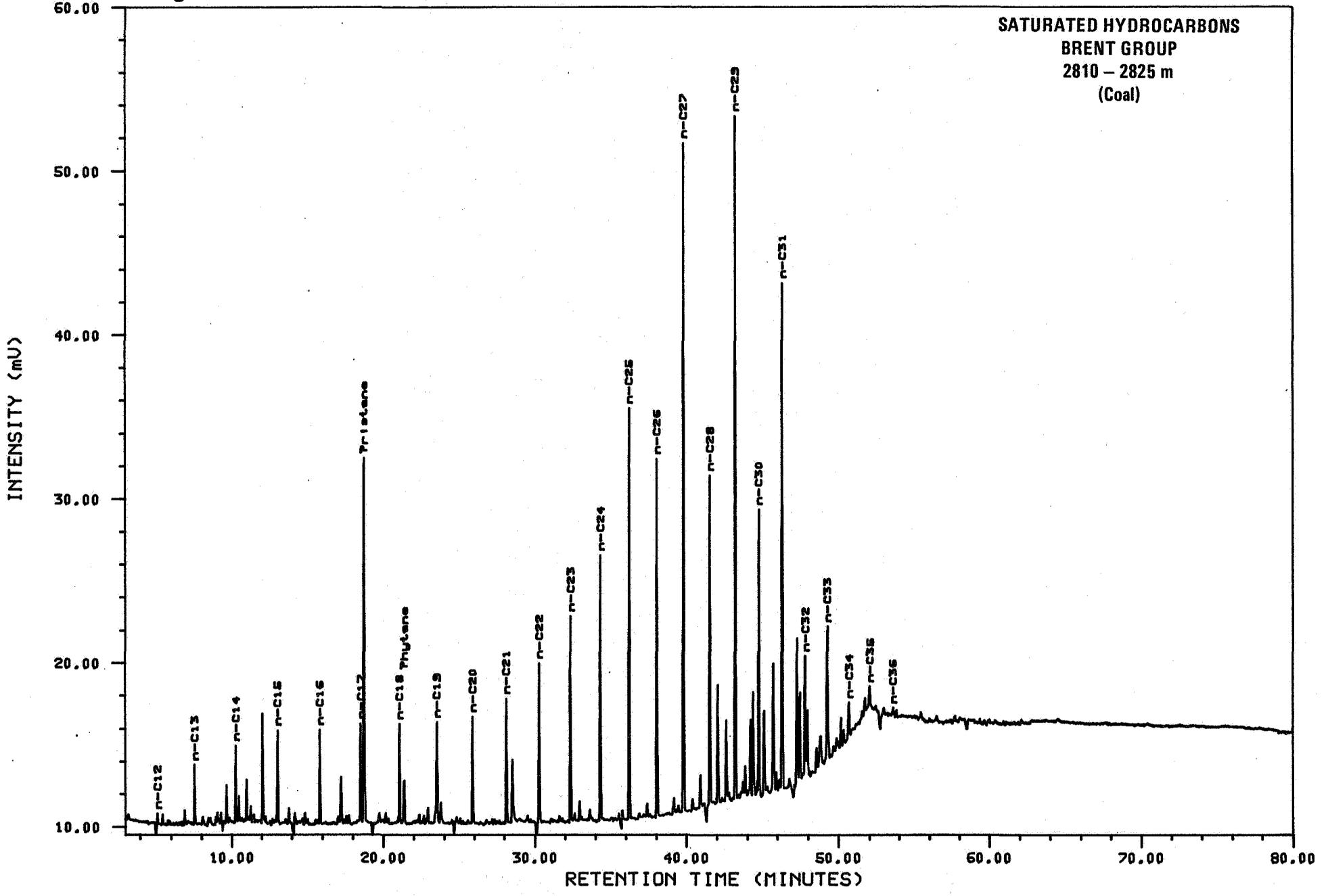


Analysis 793C1570S

3,1,1 C-1570,30/3-4,TU



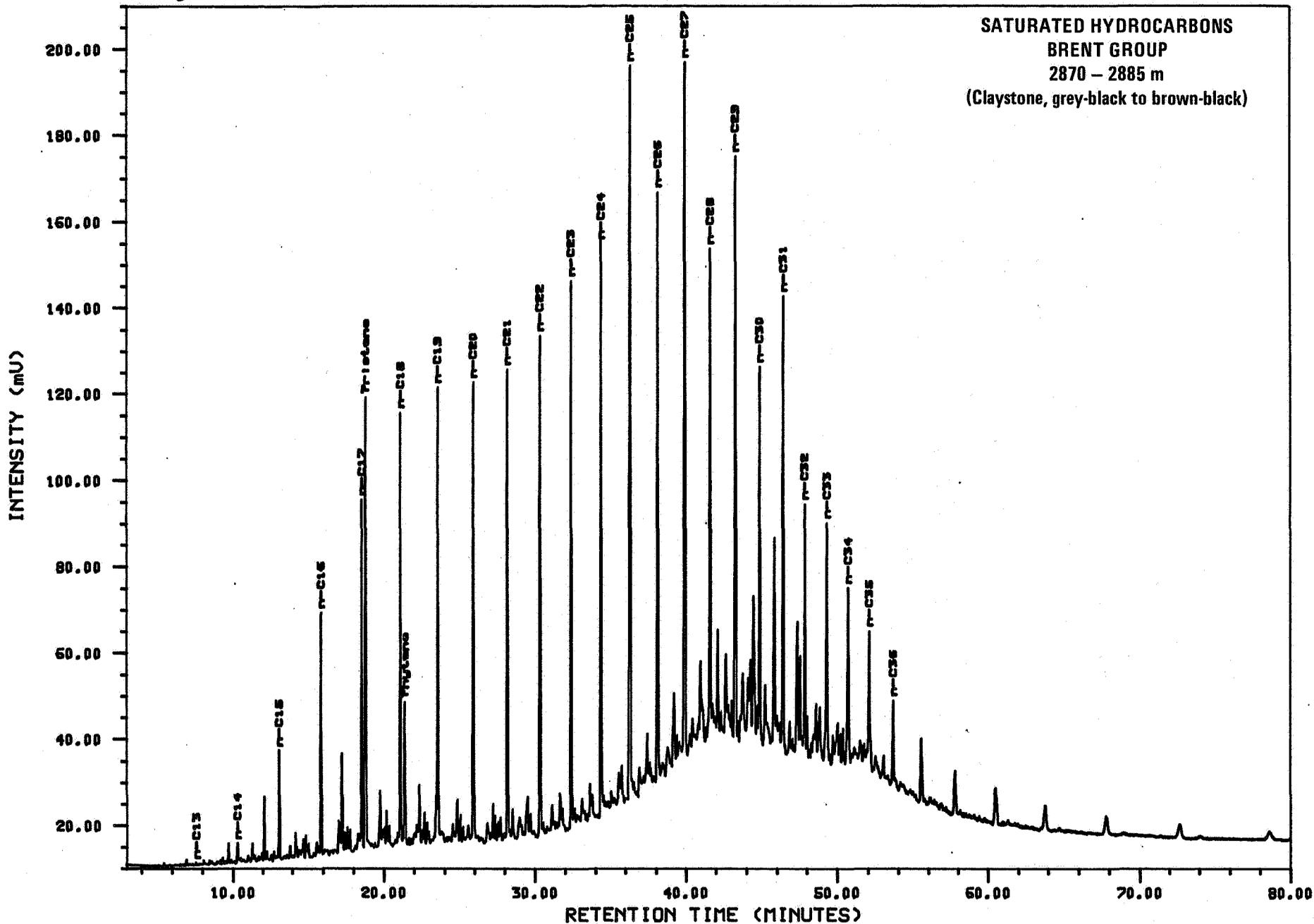
Analysis 793C1574S 3,1,1 C-1574,30/3-4,TU



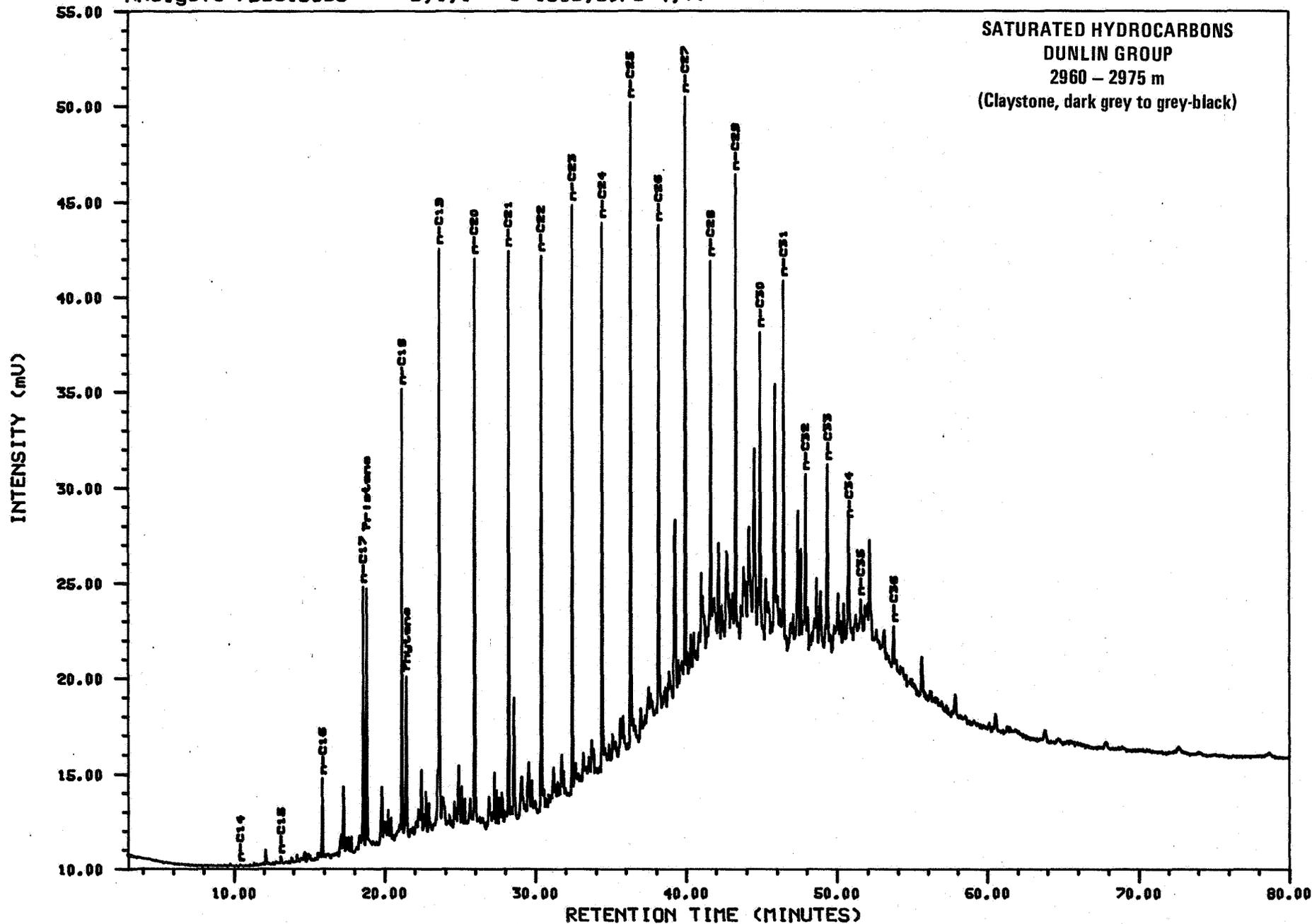
Analysis 793C1577S

3,1,1

C-1577,30/3-4,TU

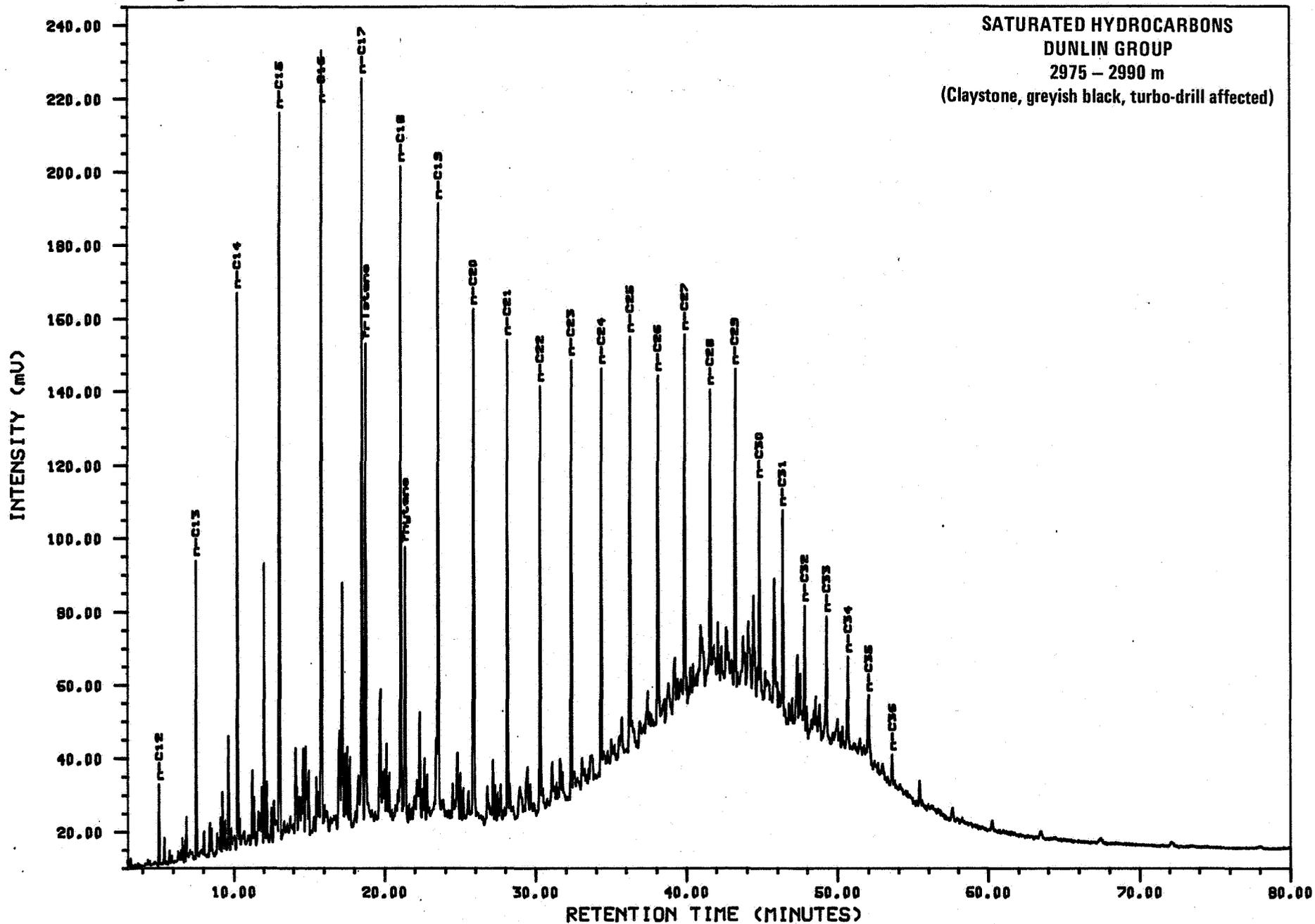


Analysis 793C1583S 3,1,1 C-1583,30/3-4,TU



Analysis 793C1584S

3,1,1 C-1584,30/3-4,TU



analysis 793C1587S

3,1,1

C-1587,30/3-4,TU

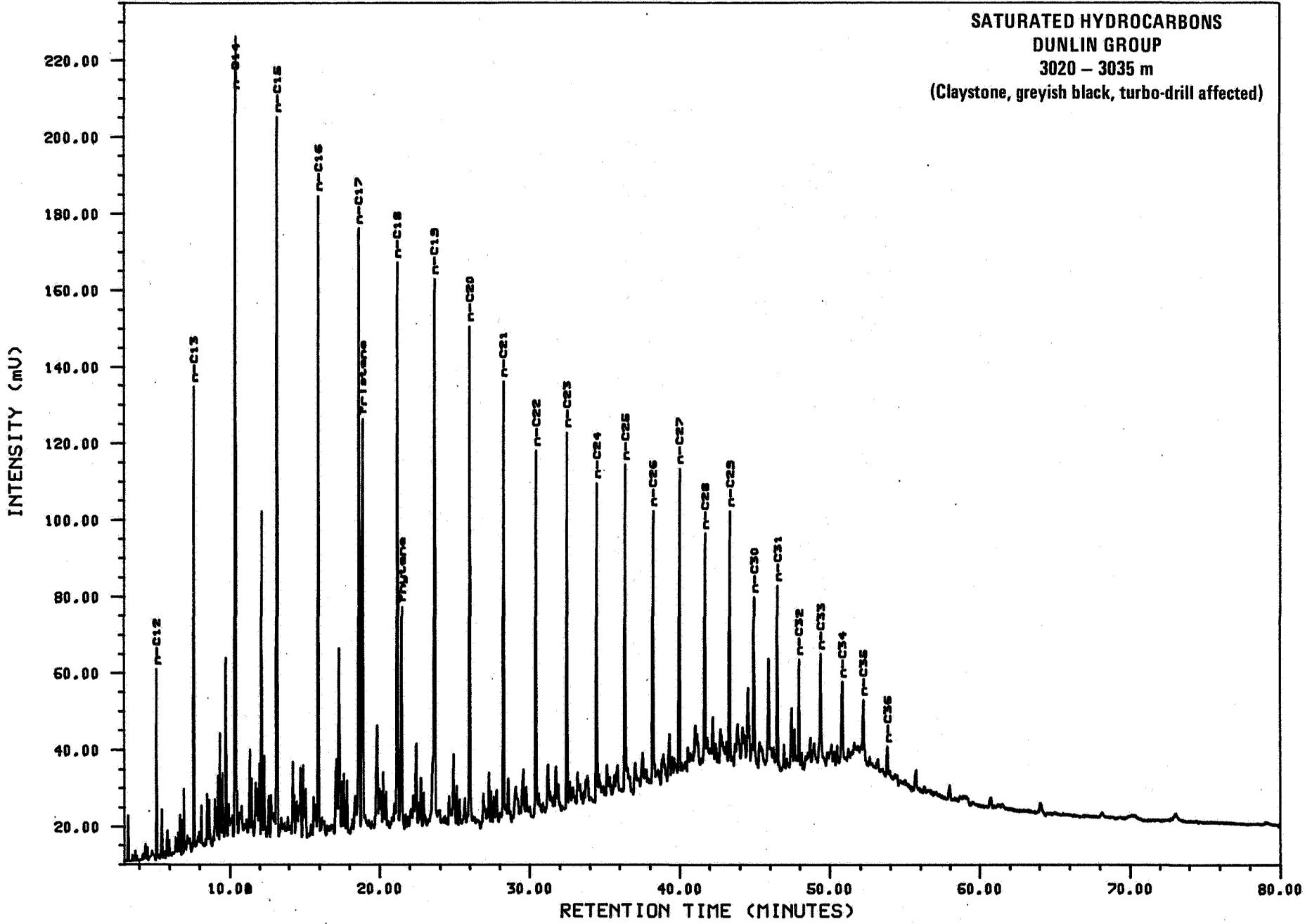
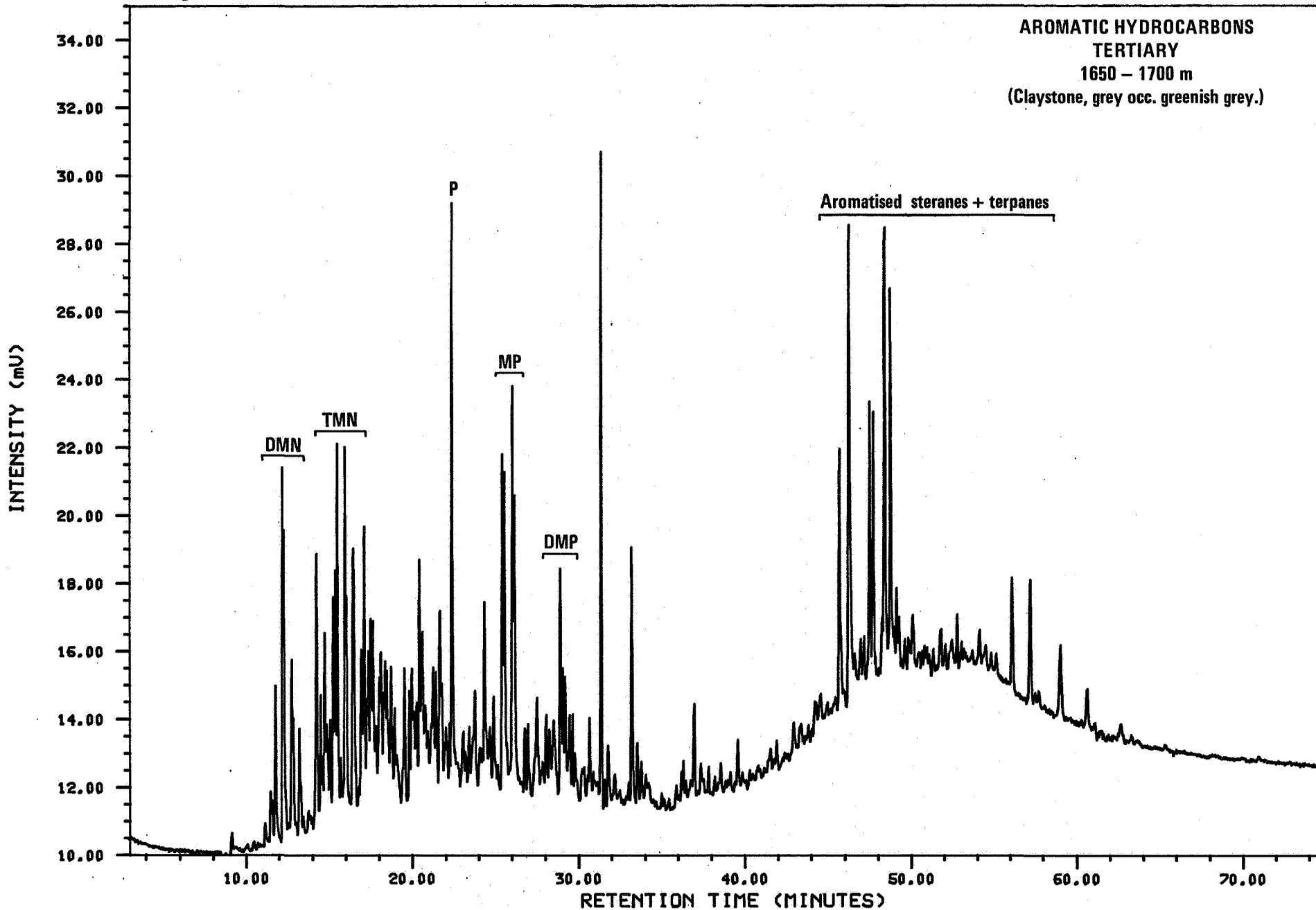


FIGURE 3

AROMATIC HYDROCARBON GAS CHROMATOGRAMS

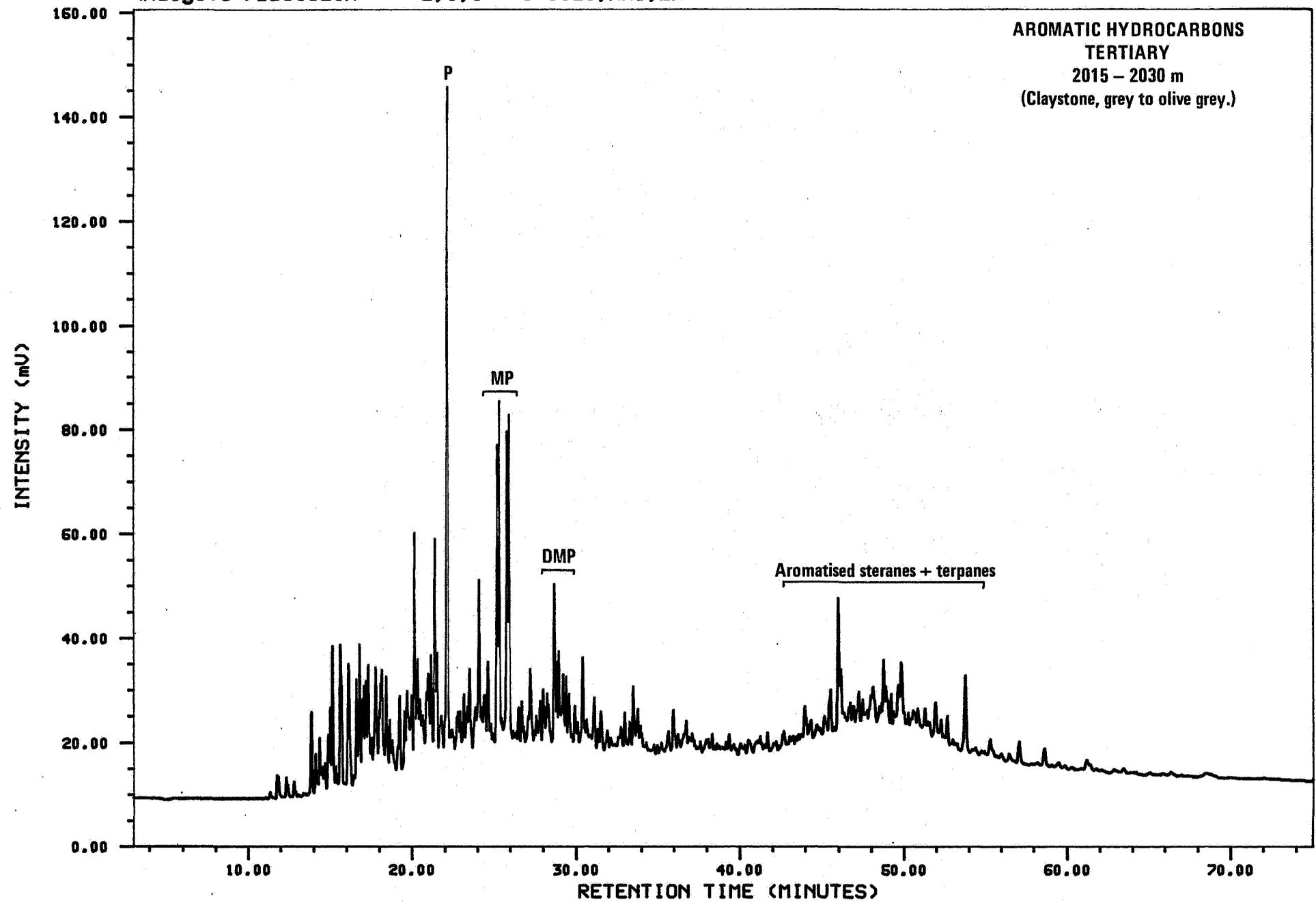
N,MN,DMN,TMN - naphthalene and alkylated homologs
P,MP,DMP - phenanthrene and alkylated homologs

Analysis 793C1620A 2,1,1 C-1620,ARO,LH

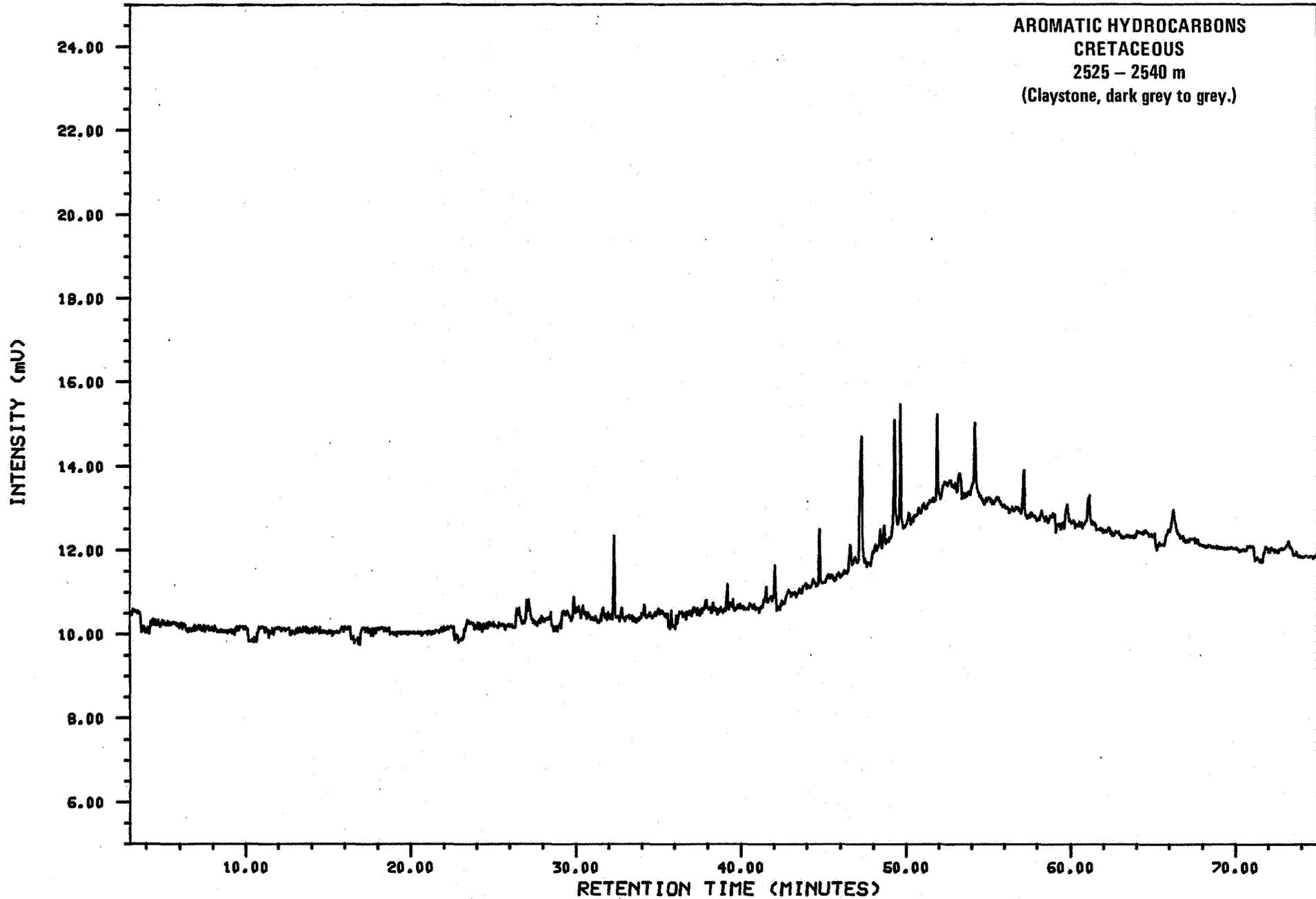


Analysis 793C1521A 2,1,1 C-1521,ARO,LH

AROMATIC HYDROCARBONS
TERTIARY
2015 - 2030 m
(Claystone, grey to olive grey.)

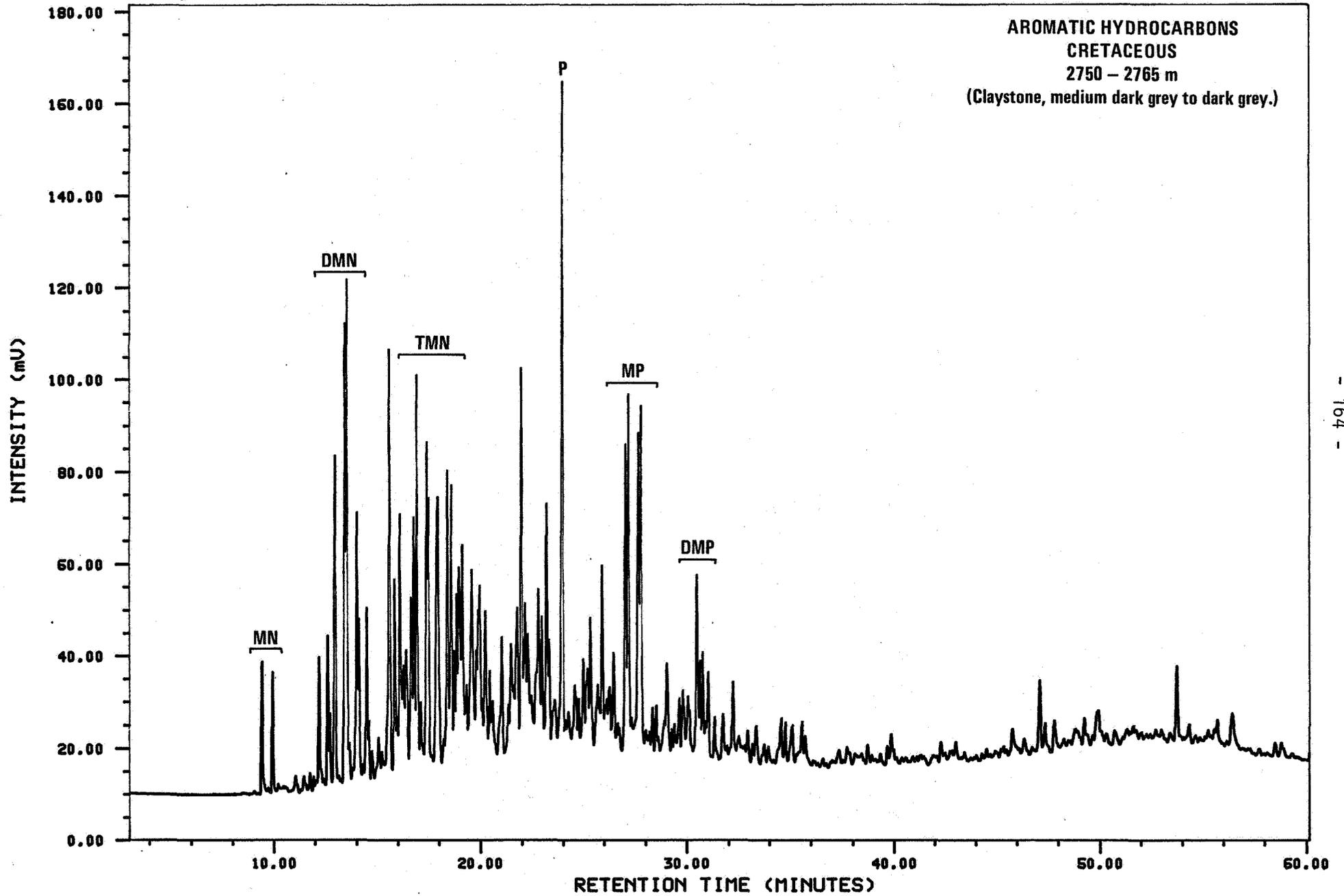


Analysis 793C1555A 2,1,1 C-1555,ARO,LH

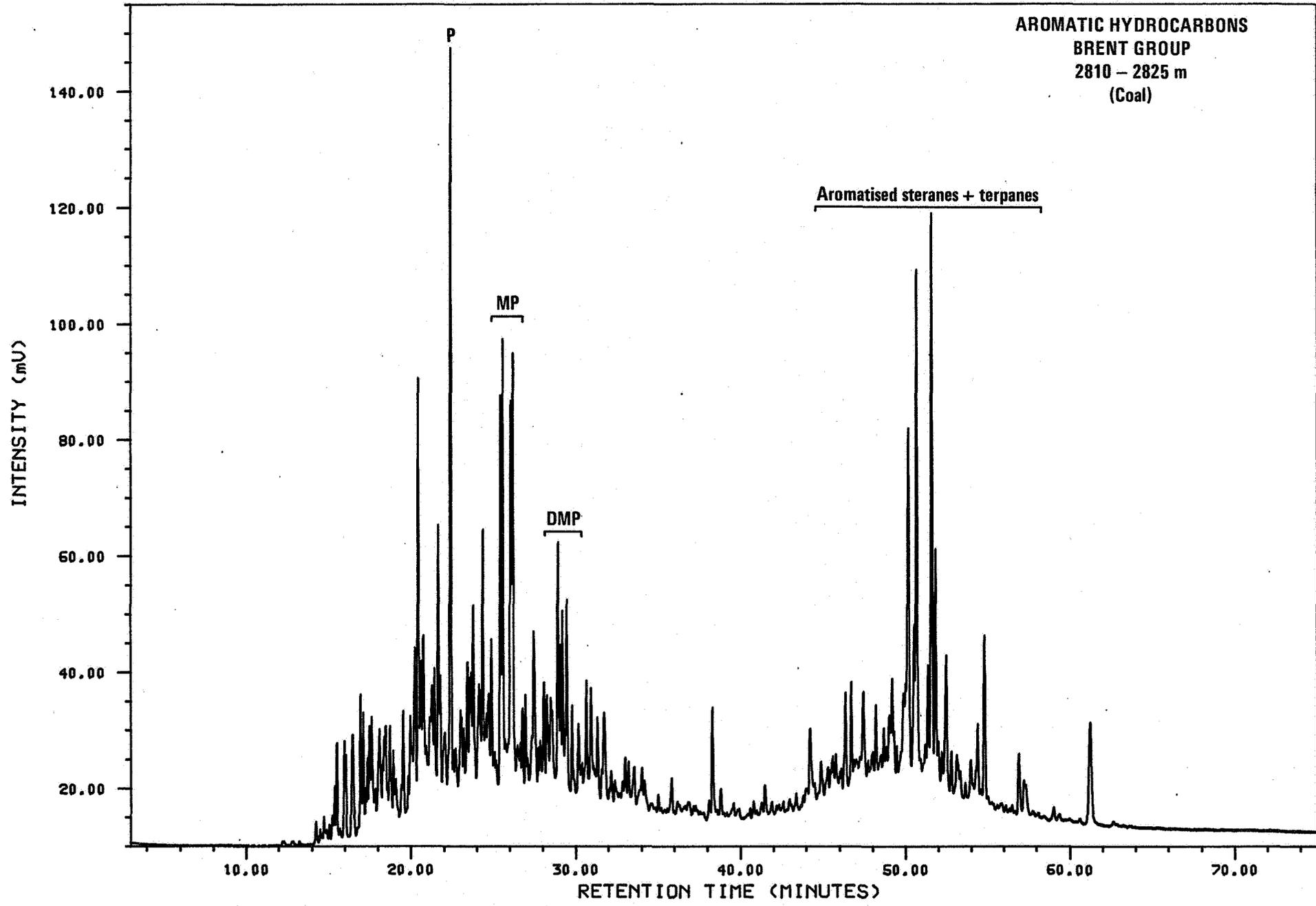


Analysis 793C1570A 2,1,1 C-1570,ARO,LH

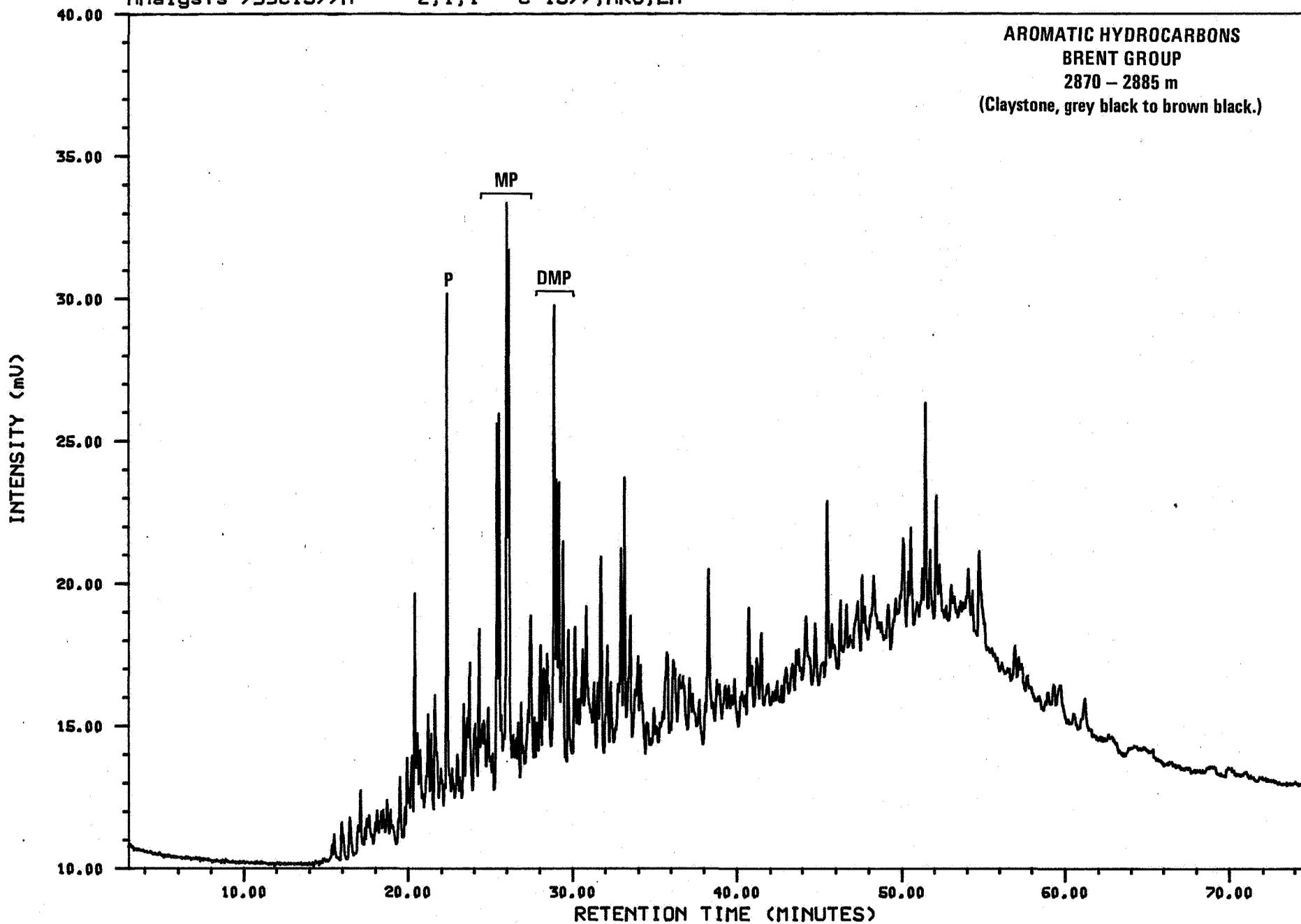
AROMATIC HYDROCARBONS
CRETACEOUS
2750 - 2765 m
(Claystone, medium dark grey to dark grey.)



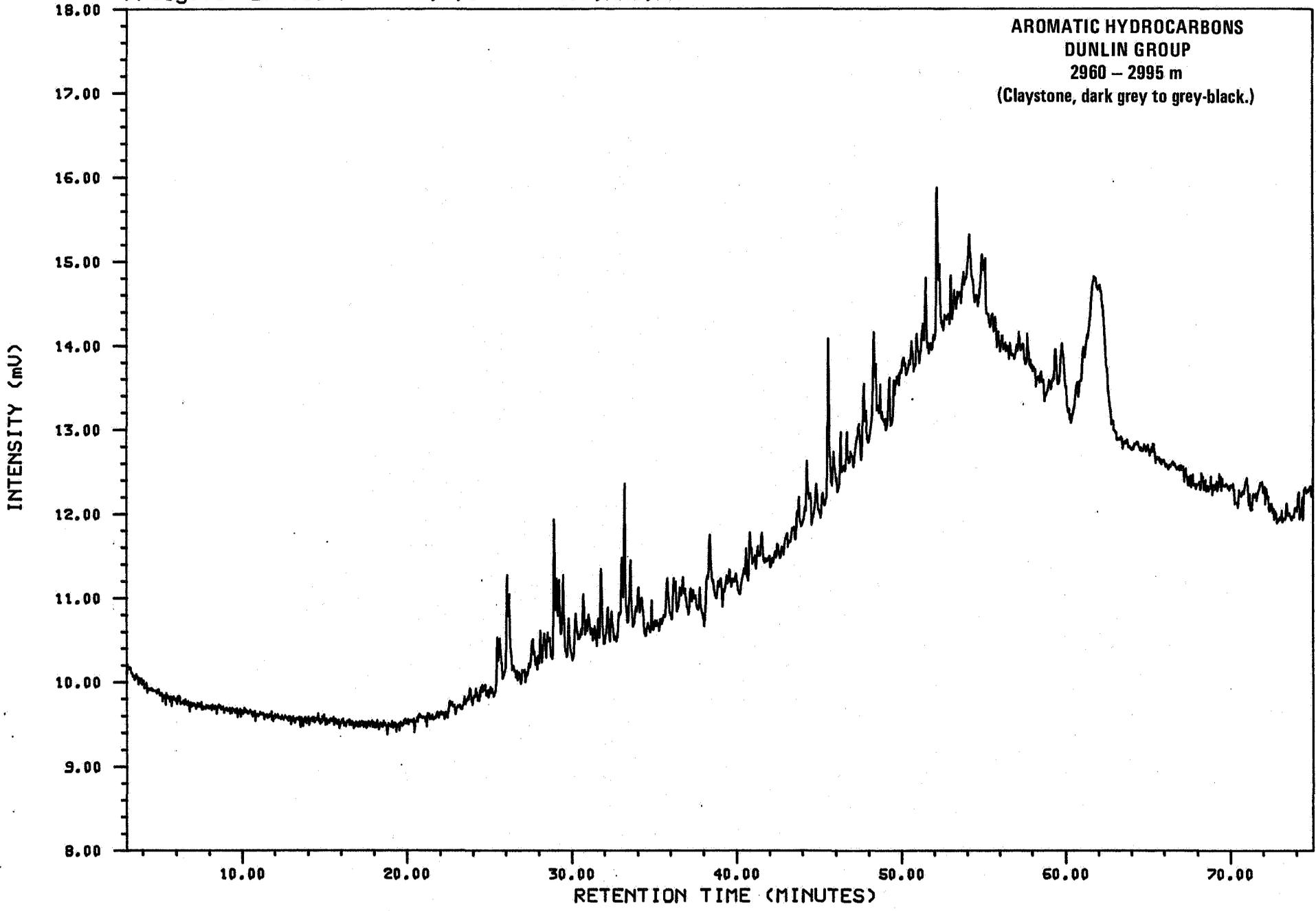
Analysis 793C1574R 2,1,1 C-1574,ARO,TU



Analysis 793C1577A 2,1,1 C-1577,ARO,LH



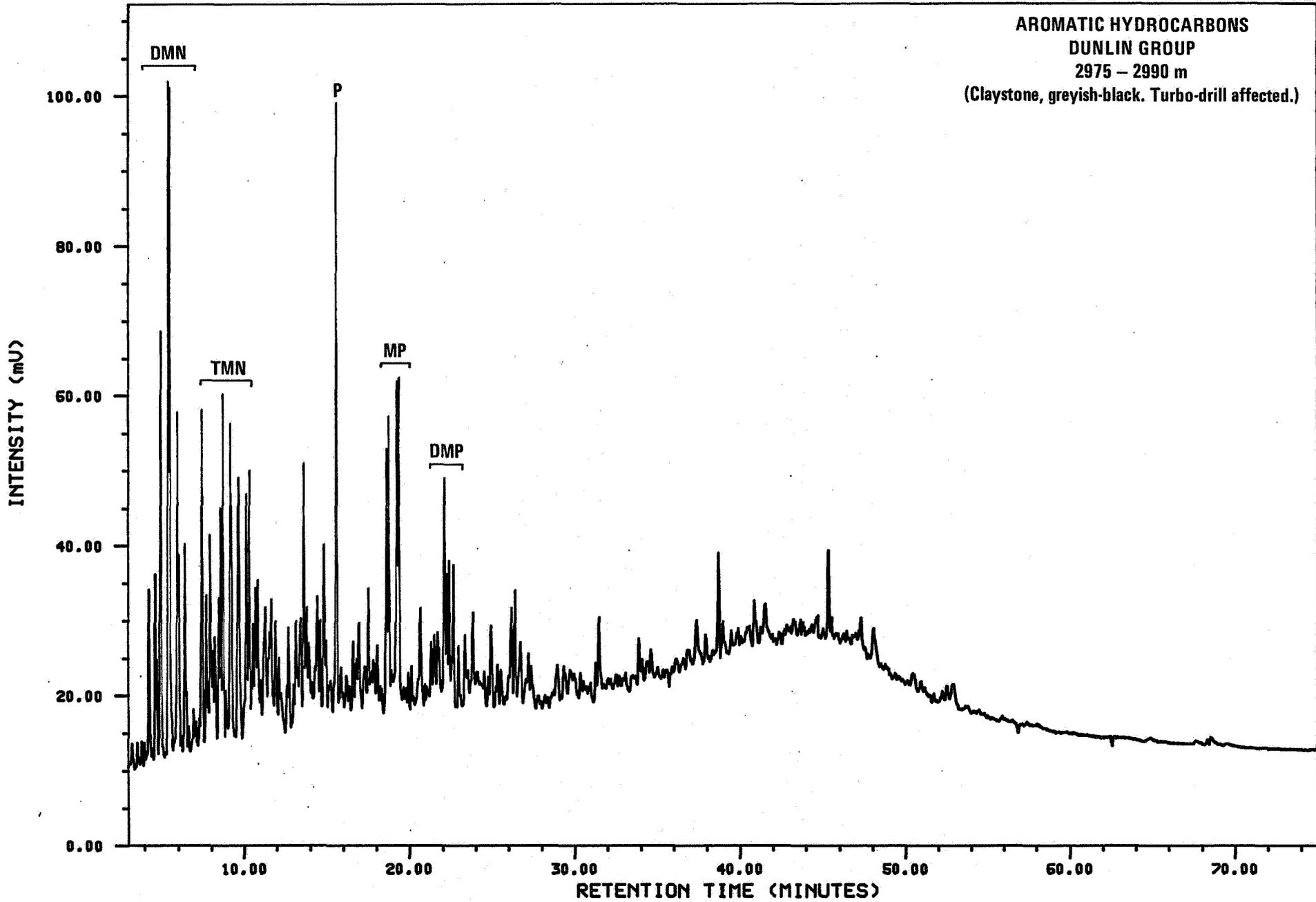
Analysis 793C1583A 2,1,1 C-1583,ARO,LH



Analysis 793C1584A

2,1,1 C-1584,ARO,LH

AROMATIC HYDROCARBONS
DUNLIN GROUP
2975 - 2990 m
(Claystone, greyish-black. Turbo-drill affected.)



Analysis 793C1587A 2,1,1 C-1587,ARO,LH

AROMATIC HYDROCARBONS
DUNLIN GROUP
3020 - 3035 m
(Claystone, greyish black. Turbo-drill affected.)

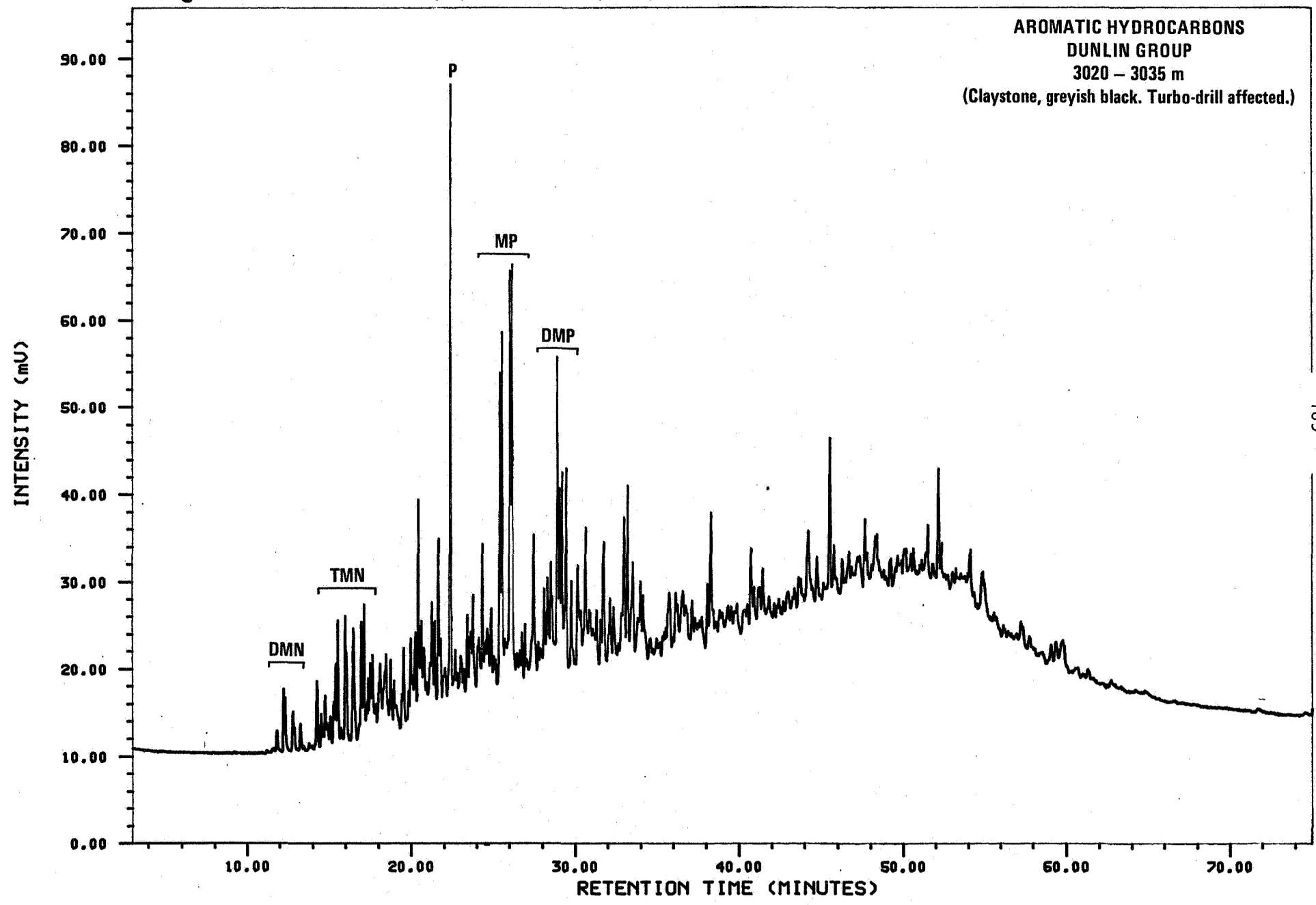
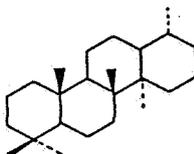
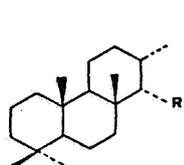
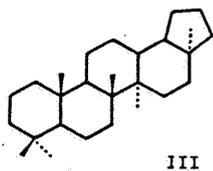
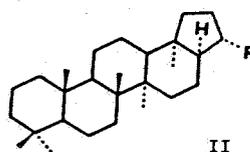
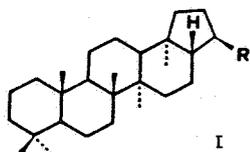


Figure 4a

Mass chromatograms representing terpanes (m/z 191)

A	T _s , 18α(H)-trisnorneohopane	C ₂₇ H ₄₆	(III)
B	T _m , 17α(H)-trisnorhopane	C ₂₇ H ₄₆	(I, R=H)
C	17α(H)-norhopane	C ₂₉ H ₅₀	(I, R=C ₂ H ₅)
D	17β(H)-normoretane	C ₂₉ H ₅₀	(II, R=C ₂ H ₅)
E	17α(H)-hopane	C ₃₀ H ₅₂	(I, R=C ₃ H ₇)
F	17β(H)-moretane	C ₃₀ H ₅₂	(II, R=C ₃ H ₇)
G	17α(H)-homohopane (22S)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
H	17α(H)-homohopane (22R)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
	+ unknown triterpane (gammacerane?)		
I	17β(H)-homomoretane	C ₃₁ H ₅₄	(II, R=C ₄ H ₉)
J	17α(H)-bishomohopane (22S,22R)	C ₃₂ H ₅₆	(I, R=C ₅ H ₁₁)
K	17α(H)-trishomohopane (22S,22R)	C ₃₃ H ₅₈	(I, R=C ₆ H ₁₃)
L	17α(H)-tetrakishomohopane (22S,22R)	C ₃₄ H ₆₀	(I, R=C ₇ H ₁₅)
M	17α(H)-pentakishomohopane (22S,22R)	C ₃₅ H ₆₂	(I, R=C ₈ H ₁₇)
Z	bisnorhopane	C ₂₈ H ₄₈	
X	unknown triterpane	C ₃₀ H ₅₂	
P	tricyclic terpene	C ₂₃ H ₄₂	(IV, R=C ₄ H ₉)
Q	tricyclic terpene	C ₂₄ H ₄₄	(IV, R=C ₅ H ₁₁)
R	tricyclic terpene (17R,17S)	C ₂₅ H ₄₆	(IV, R=C ₆ H ₁₃)
S	tetracyclic terpene	C ₂₄ H ₄₂	(V)
T	tricyclic terpene (17R,17S)	C ₂₆ H ₄₈	(IV, R=C ₇ H ₁₅)



C1620S

Sir:Voltage - 171 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 12531

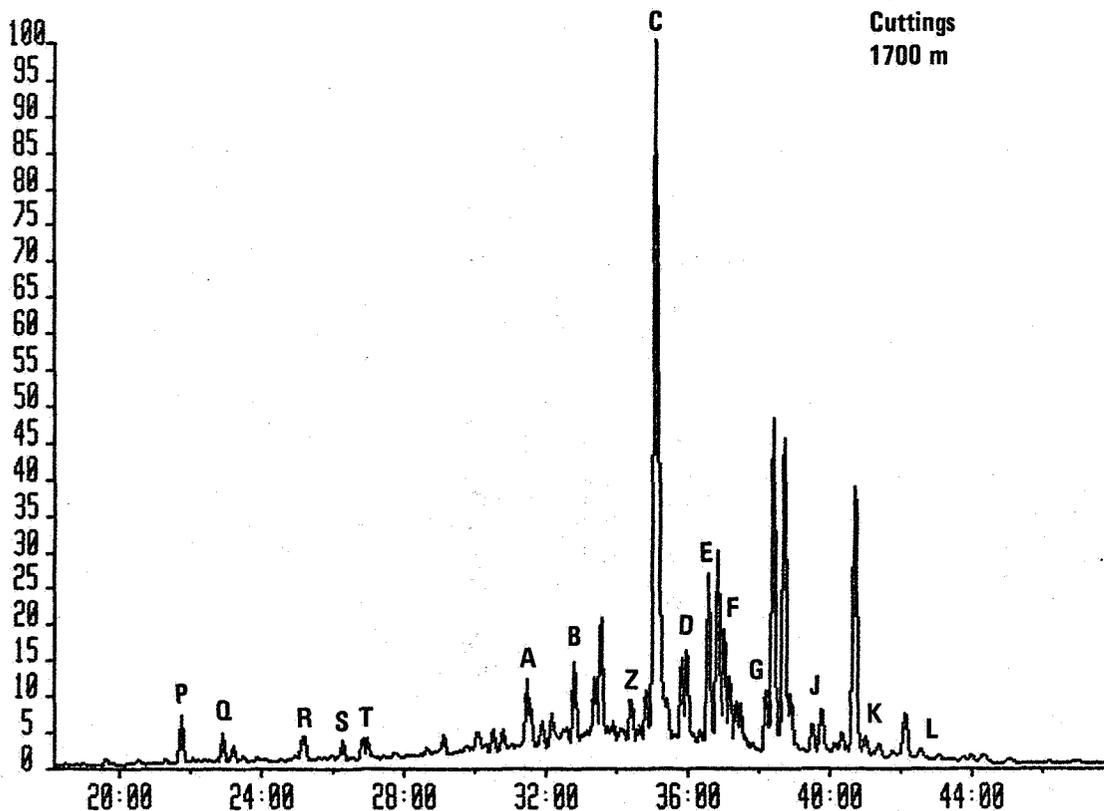
Text  IKU SINTEF-GRUPPEN

m/z 191

C1620

Cuttings

1700 m



C1521SA

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 65382

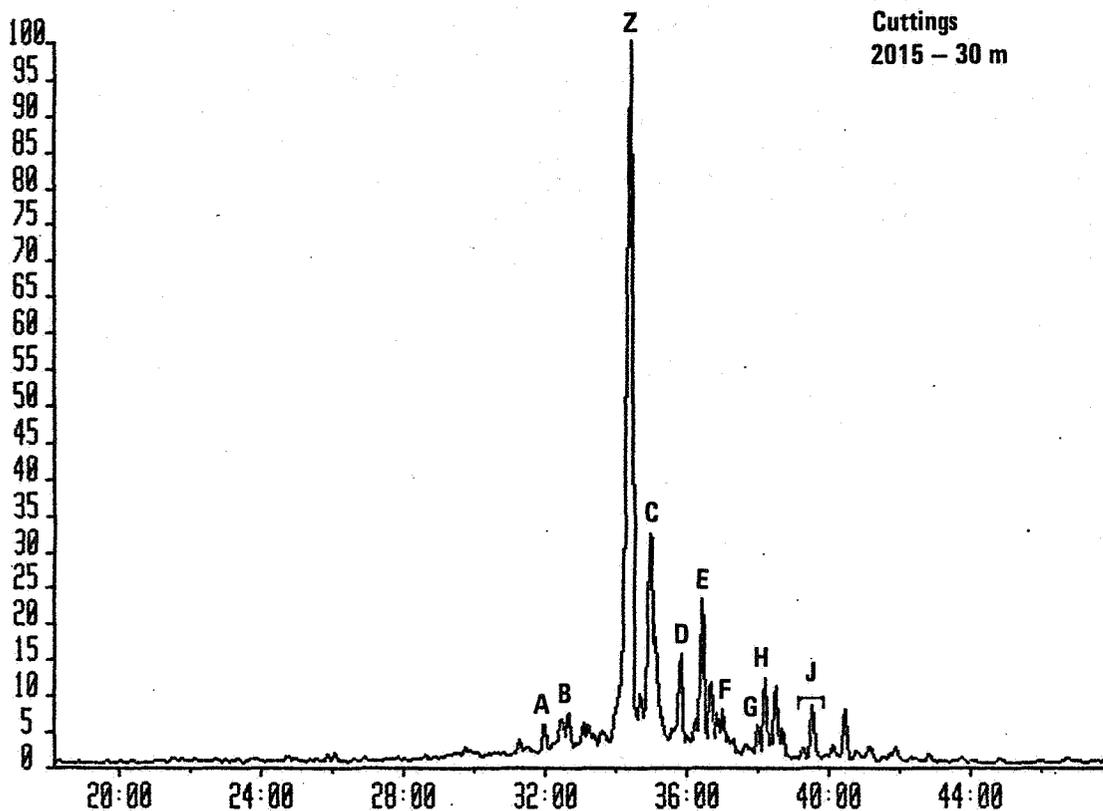
Text  IKU SINTEF-GRUPPEN

m/z 191

C1521

Cuttings

2015 - 30 m



C1555S

Sir:Voltage - 172 - Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 191.1000
Text  SINTEF-GRUPPEN

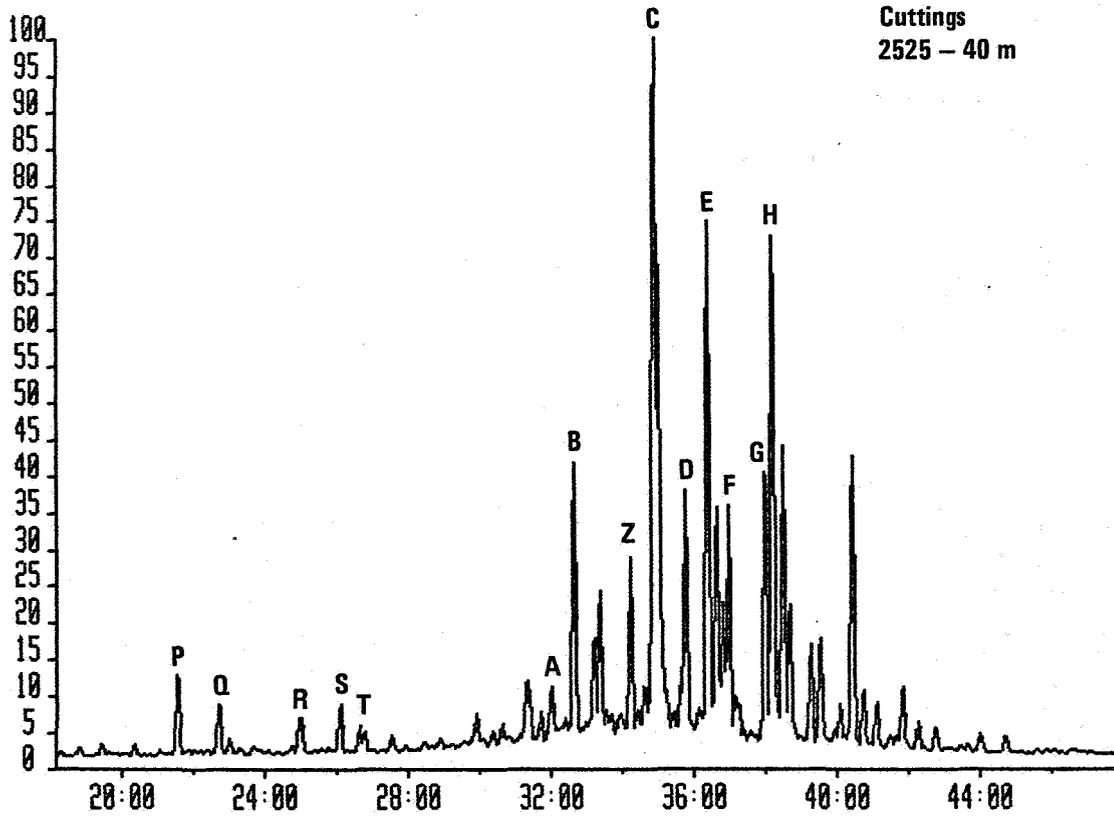
Norm: 7468

m/z 191

C1555

Cuttings

2525 - 40 m



C1570S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 191.1000
Text  SINTEF-GRUPPEN

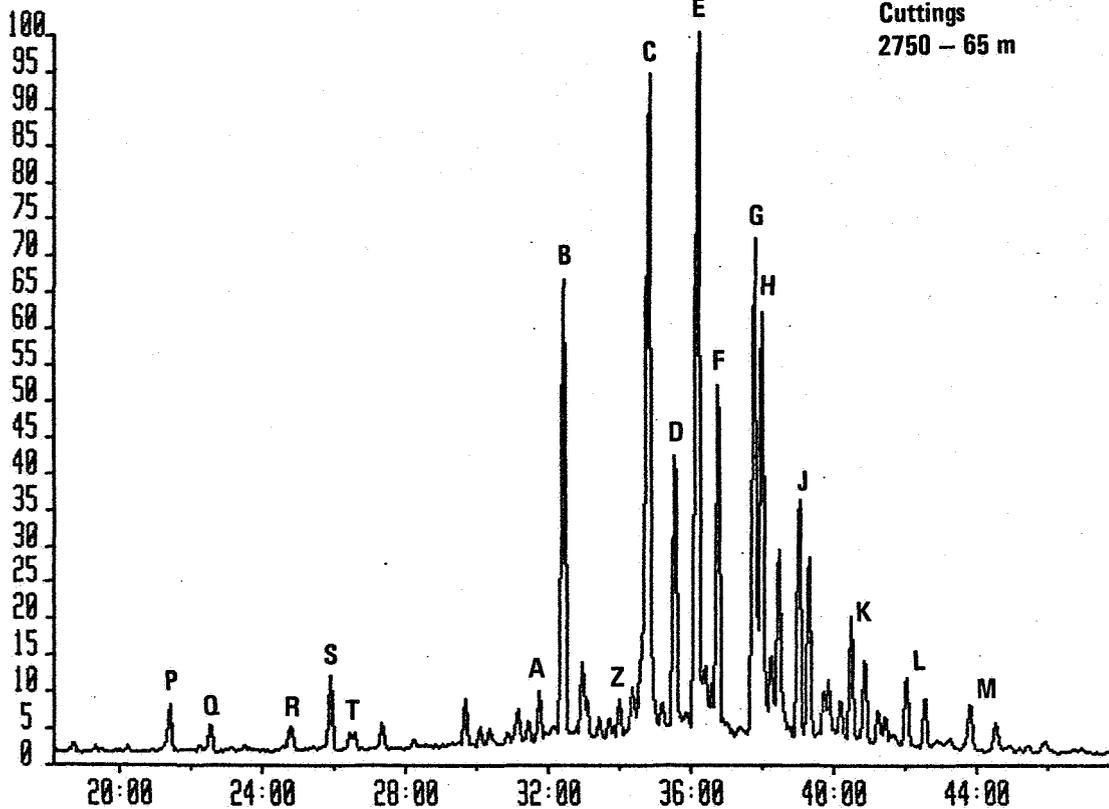
Norm: 35092

m/z 191

C1570

Cuttings

2750 - 65 m



C1574S

Sir:Voltage - 173 - Acnt:IKU

System:

Sampl: Injection 1

Group 1 Mass 191.1000

Norm: 6344

Text:  IKU SINTEF-GRUPPEN

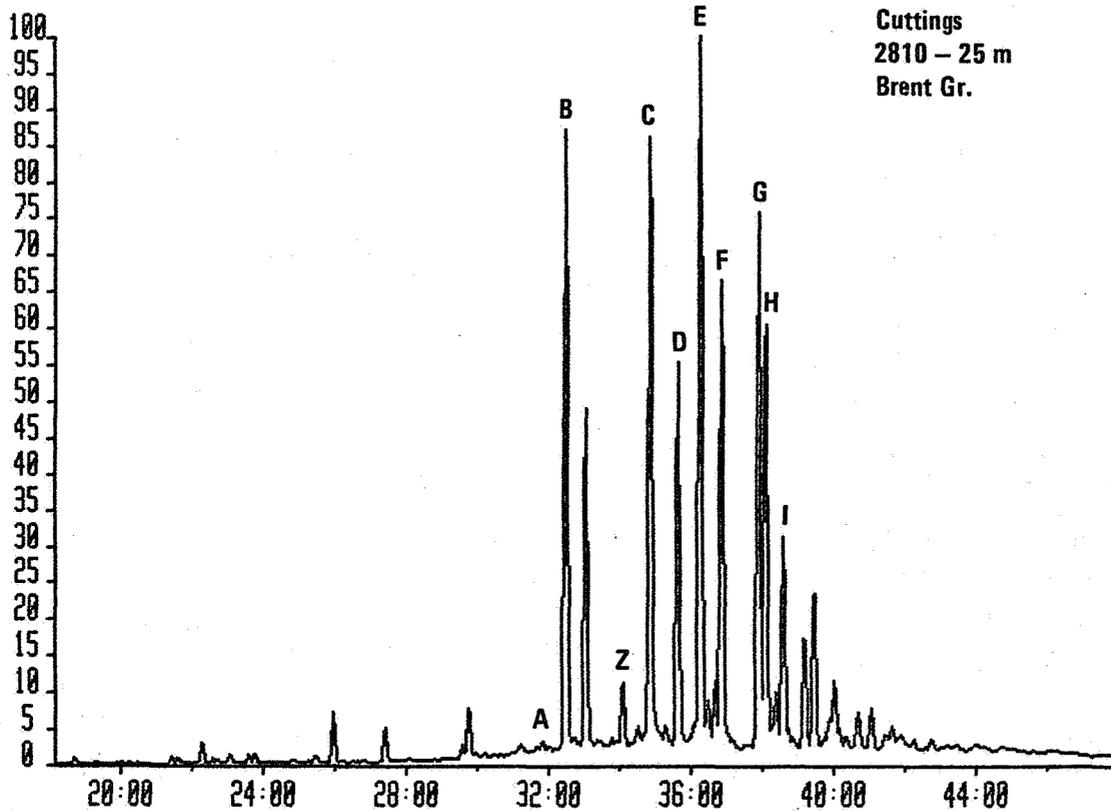
m/z 191

C1574

Cuttings

2810 - 25 m

Brent Gr.



C1577S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl: Injection 1

Group 1 Mass 191.1000

Norm: 3312

Text:  IKU SINTEF-GRUPPEN

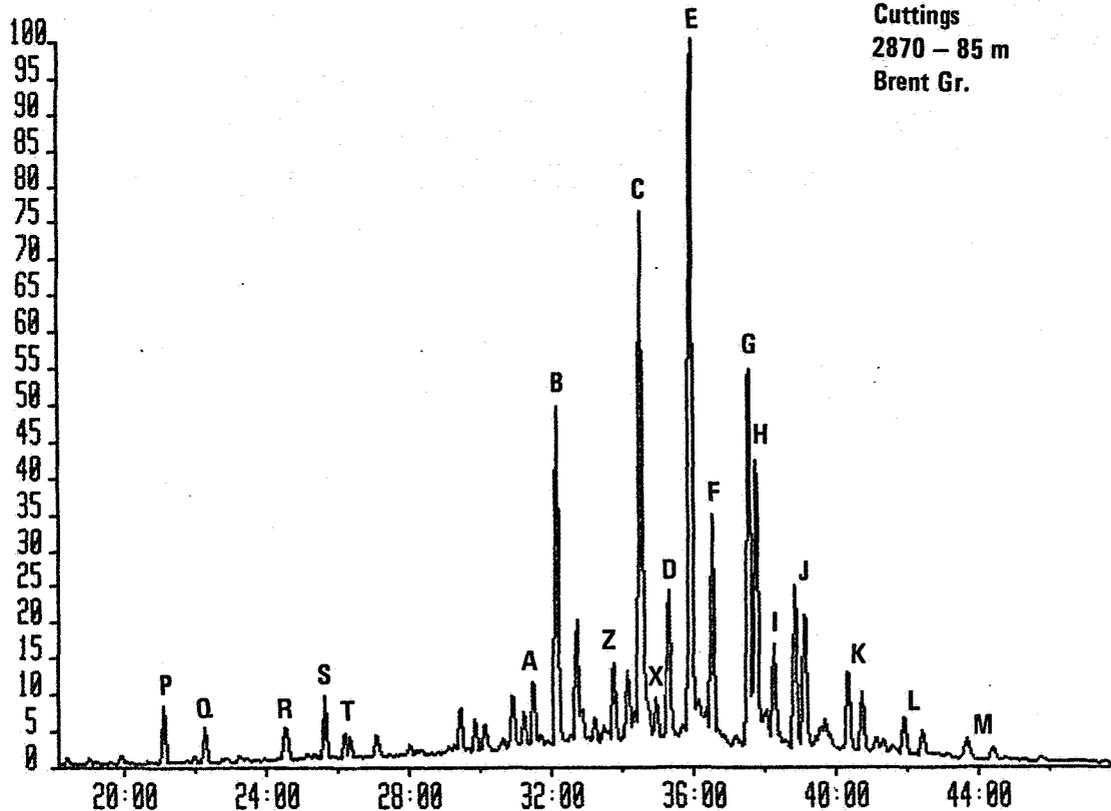
m/z 191

C1577

Cuttings

2870 - 85 m

Brent Gr.



C1583S

Sir:Voltage- 174 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 1954

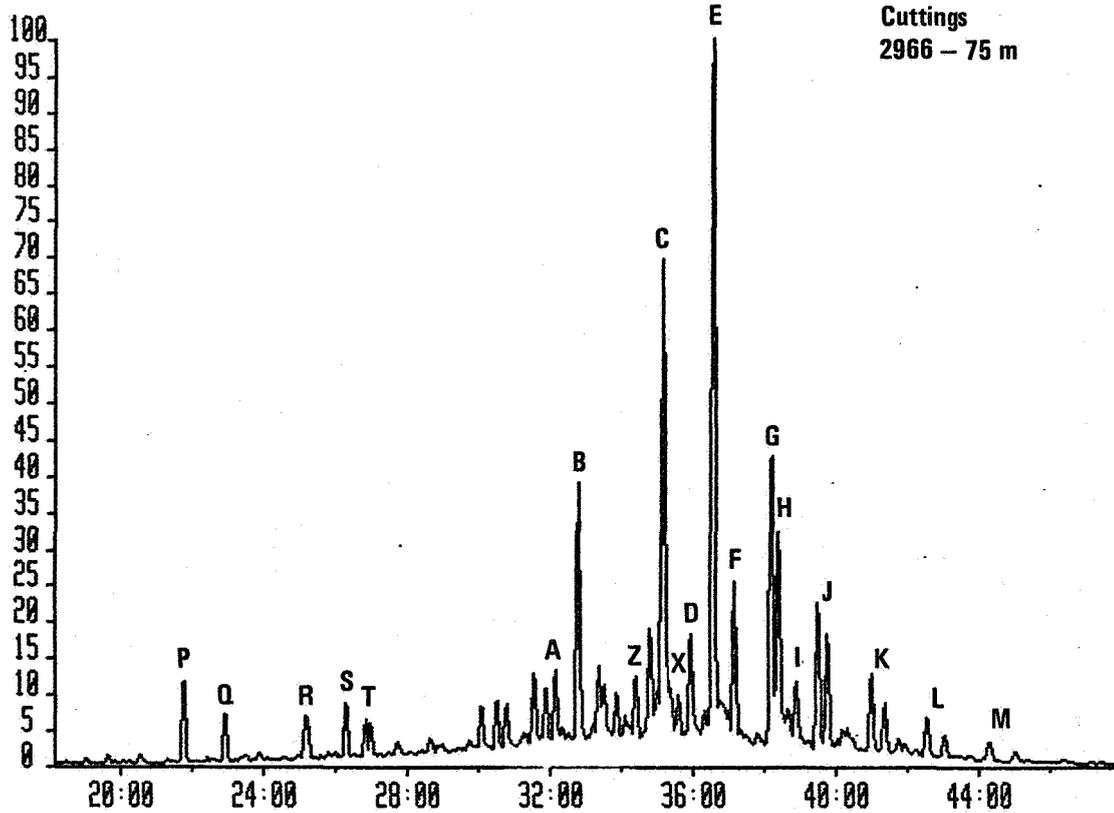
Text  SINTEF-GRUPPEN

m/z 191

C1583

Cuttings

2966 - 75 m



C1584

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 12016

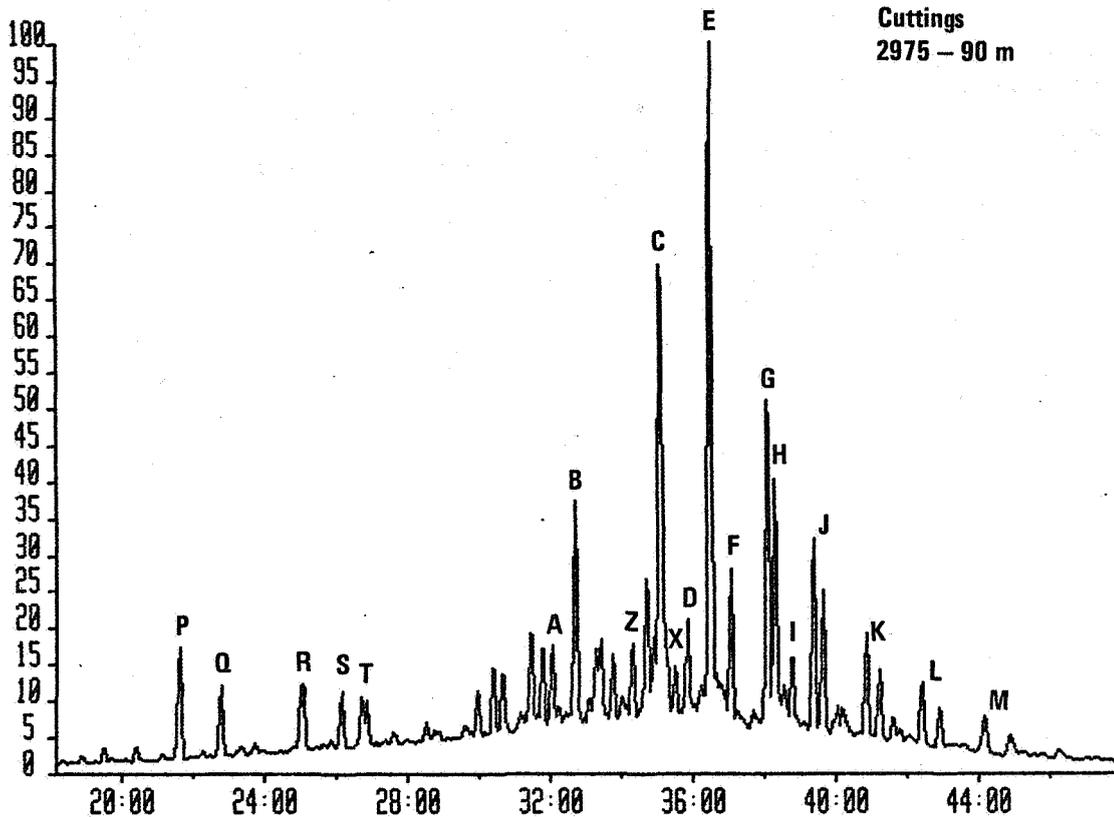
Text  SINTEF-GRUPPEN

m/z 191

C1584

Cuttings

2975 - 90 m



C1587S

Sample Injection 1
Text  IKU
SINTEF-GRUPPEN

Srv:Voltage 7070H Acnt:IKU
Group 1 Mass 191.1000

System:

Norm: 9118

m/z 191

C1587

Cuttings

3020 - 35 m

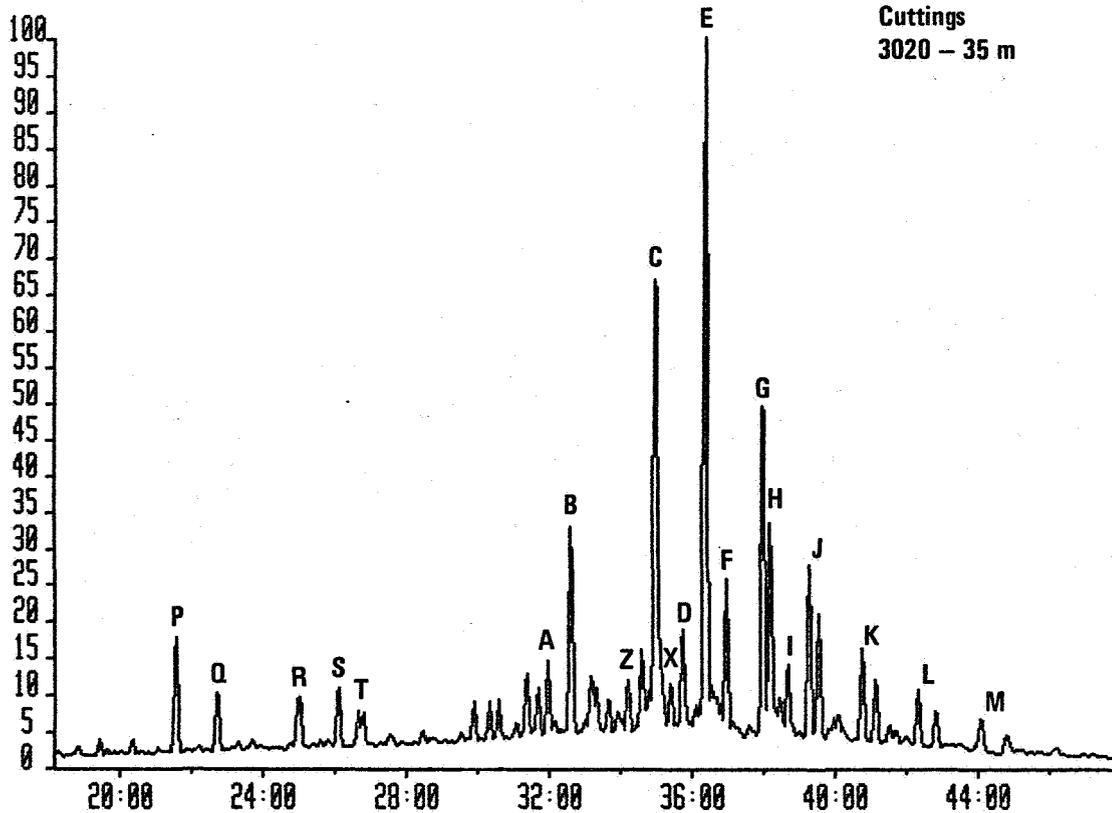
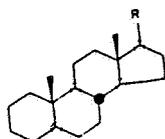
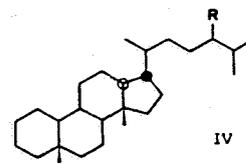
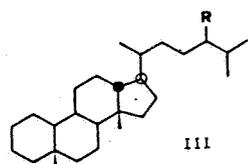
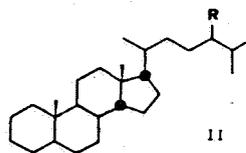
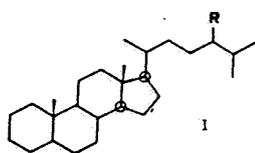


Figure 4b

Mass chromatograms representing steranes (m/z 217 and 218)

a	13 β (H),17 α (H)-diasterane (20S)	C ₂₇ H ₄₈	(III,R=H)
b	13 β (H),17 α (H)-diasterane (20R)	C ₂₇ H ₄₈	(III,R=H)
c	13 α (H),17 β (H)-diasterane (20S)	C ₂₇ H ₄₈	(IV,R=H)
d	13 α (H),17 β (H)-diasterane (20R)	C ₂₇ H ₄₈	(IV,R=H)
e	13 β (H),17 α (H)-diasterane (20S)	C ₂₈ H ₅₀	(III,R=CH ₃)
f	13 β (H),17 α (H)-diasterane (20R)	C ₂₈ H ₅₀	(III,R=CH ₃)
g	13 α (H),17 β (H)-diasterane (20S)	C ₂₈ H ₅₀	(IV,R=CH ₃)
	+ 14 α (H),17 α (H)-sterane (20S)	C ₂₇ H ₄₈	(I,R=H)
h	13 β (H),17 α (H)-diasterane (20S)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
	+ 14 β (H),17 β (H)-sterane (20R)	C ₂₇ H ₄₈	(II,R=H)
i	14 β (H),17 β (H)-sterane (20S)	C ₂₇ H ₄₈	(II,R=H)
	+ 13 α (H),17 β (H)-diasterane (20R)	C ₂₈ H ₅₀	(IV,R=CH ₃)
j	14 α (H),17 α (H)-sterane (20R)	C ₂₇ H ₄₈	(I,R=H)
k	13 β (H),17 α (H)-diasterane (20R)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
l	13 α (H),17 β (H)-diasterane (20S)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
m	14 α (H),17 α (H)-sterane (20S)	C ₂₈ H ₅₀	(I,R=CH ₃)
n	13 α (H),17 β (H)-diasterane (20R)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
	+ 14 β (H),17 β (H)-sterane (20R)	C ₂₈ H ₅₀	(II,R=CH ₃)
o	14 β (H),17 β (H)-sterane (20S)	C ₂₈ H ₅₀	(II,R=CH ₃)
p	14 α (H),17 α (H)-sterane (20R)	C ₂₈ H ₅₀	(I,R=CH ₃)
q	14 α (H),17 α (H)-sterane (20S)	C ₂₉ H ₅₂	(I,R=C ₂ H ₅)
r	14 β (H),17 β (H)-sterane (20R)	C ₂₉ H ₅₂	(II,R=C ₂ H ₅)
	+ unknown sterane		
s	14 β (H),17 β (H)-sterane (20S)	C ₂₉ H ₅₂	(II,R=C ₂ H ₅)
t	14 β (H),17 β (H)-sterane (20R)	C ₂₉ H ₅₂	(I,R=C ₂ H ₅)
u	5 α (H)-sterane	C ₂₁ H ₃₆	(V,R=C ₂ H ₅)
v	5 α (H)-sterane	C ₂₂ H ₃₈	(IV,R=C ₃ H ₇)



C16205

Sr:Voltage 7070H Acnt:IKU

System:

Sample Injection 1
Text:  IKU
SINTEF-GRUPPEN

Group 1 Mass 217.1000

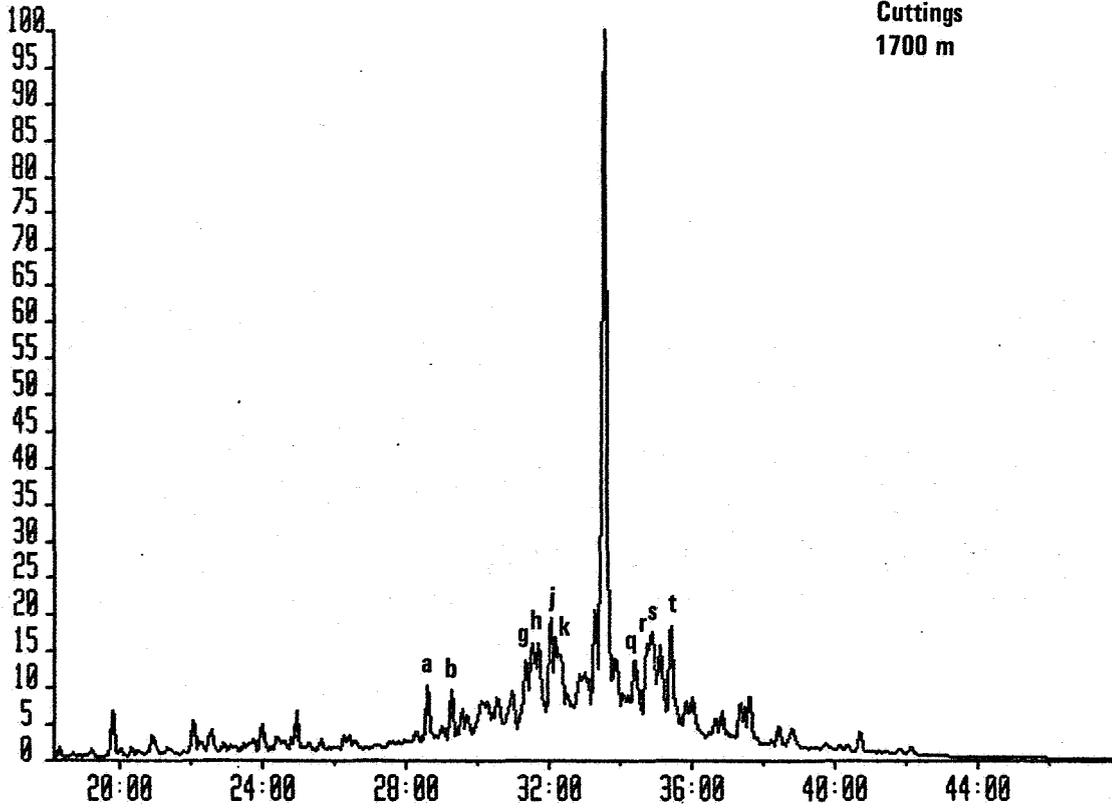
Norm: 2690

m/z 217

C1620

Cuttings

1700 m



C1521SA

Sir:Voltage - 178 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 217.1000

Norm: 12810

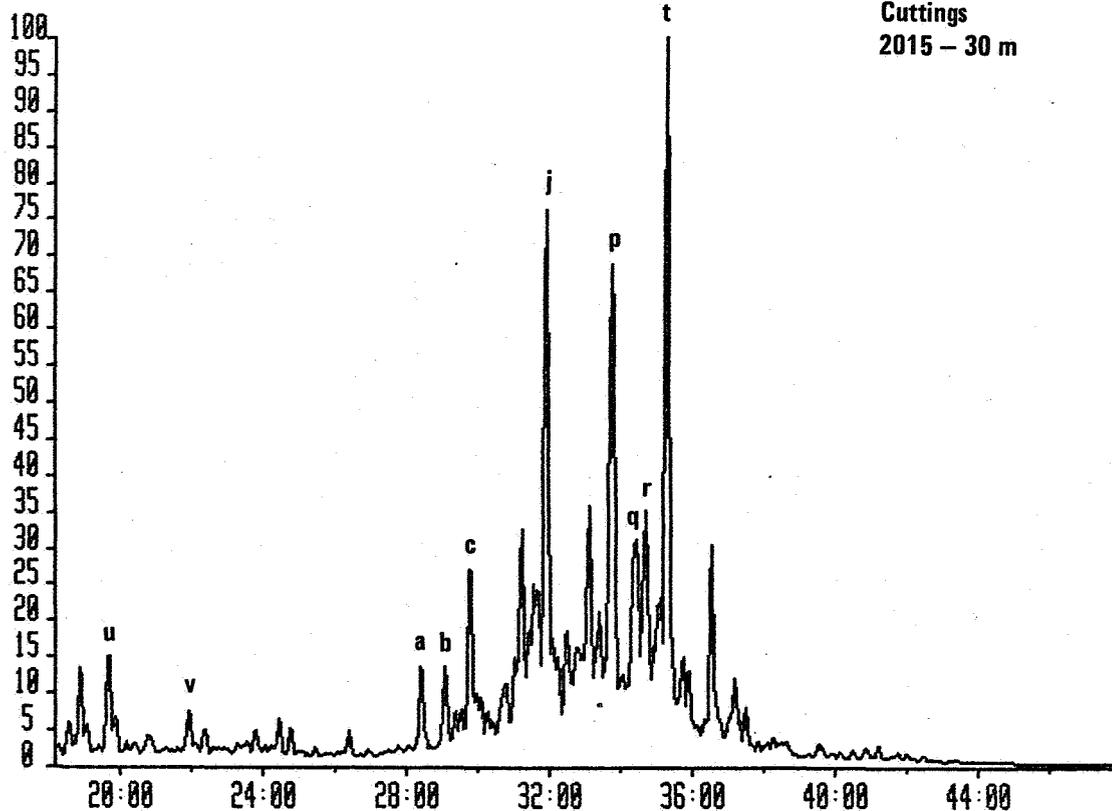
Text  SINTEF-GRUPPEN

m/z 217

C1521

Cuttings

2015 - 30 m



C1555S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 217.1000

Norm: 1997

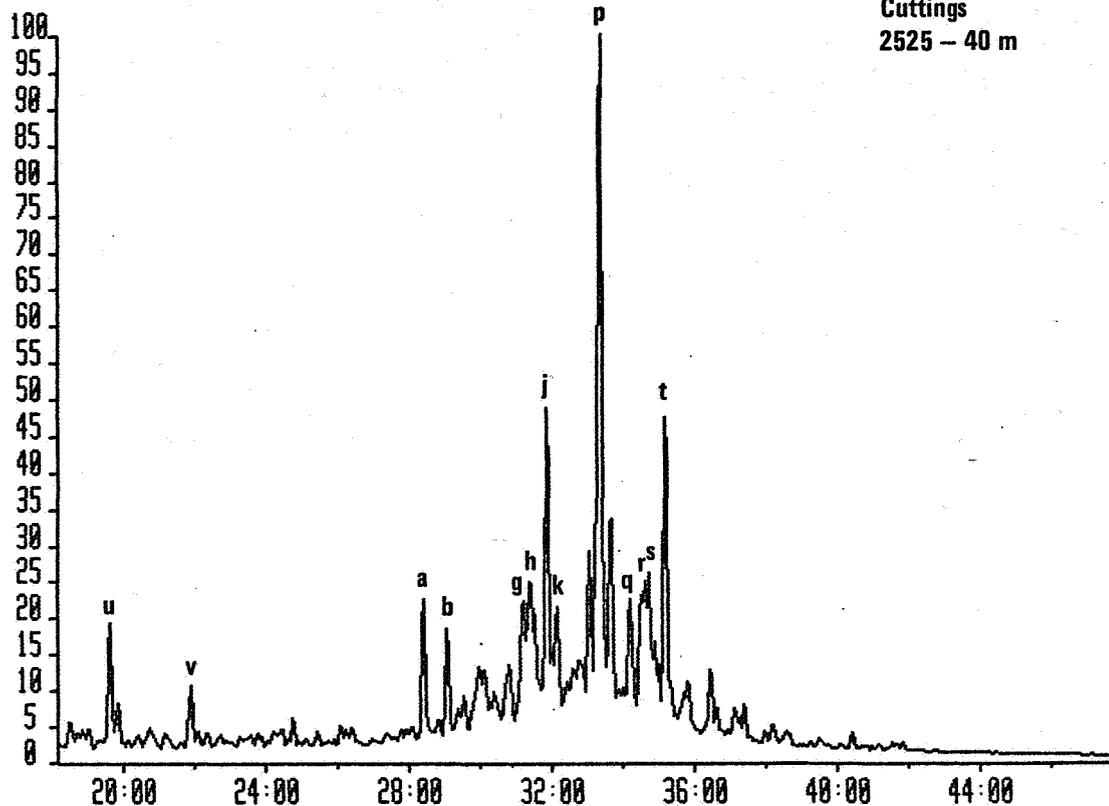
Text  SINTEF-GRUPPEN

m/z 217

C1555

Cuttings

2525 - 40 m



C1570S

Sir:Voltage - 179 - Acnt:IKU

System:

Sampl: Injection 1

Group 1 Mass 217.1000

Norm: 3136

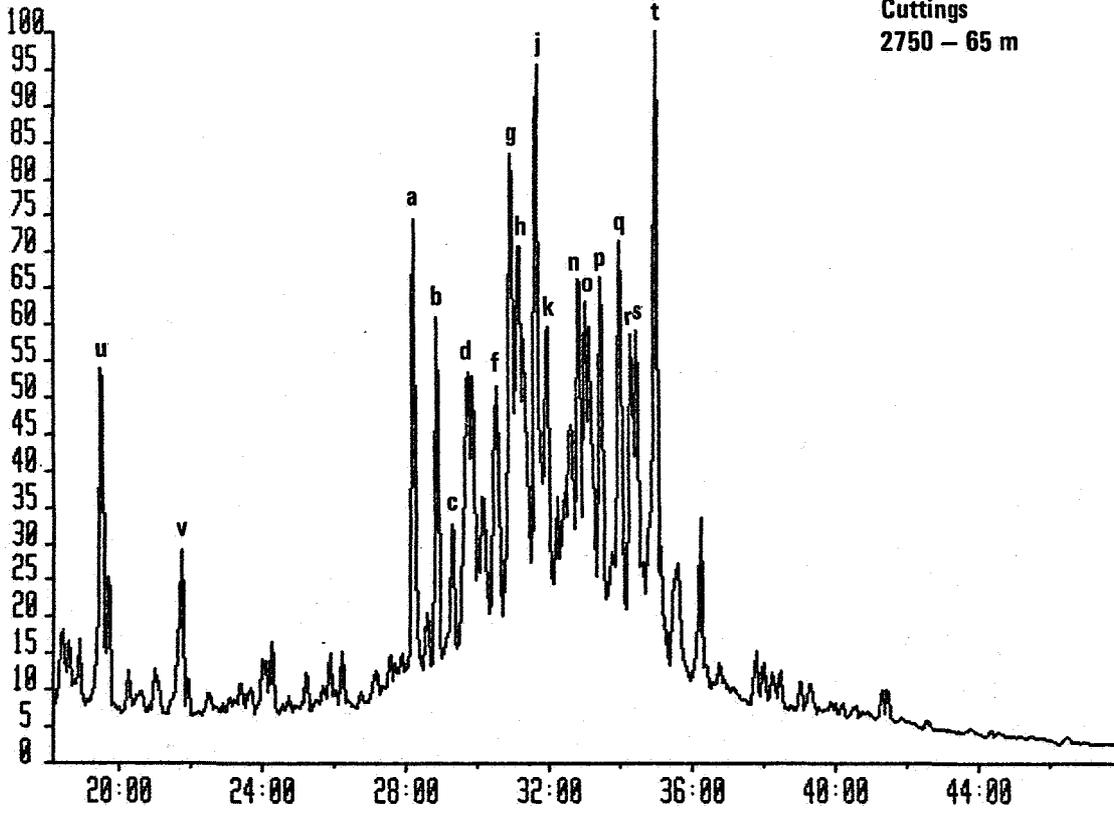
Text:  SINTEF-GRUPPEN

m/z 217

C1570

Cuttings

2750 - 65 m



C1574S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl: Injection 1

Group 1 Mass 217.1000

Norm: 267

Text:  SINTEF-GRUPPEN

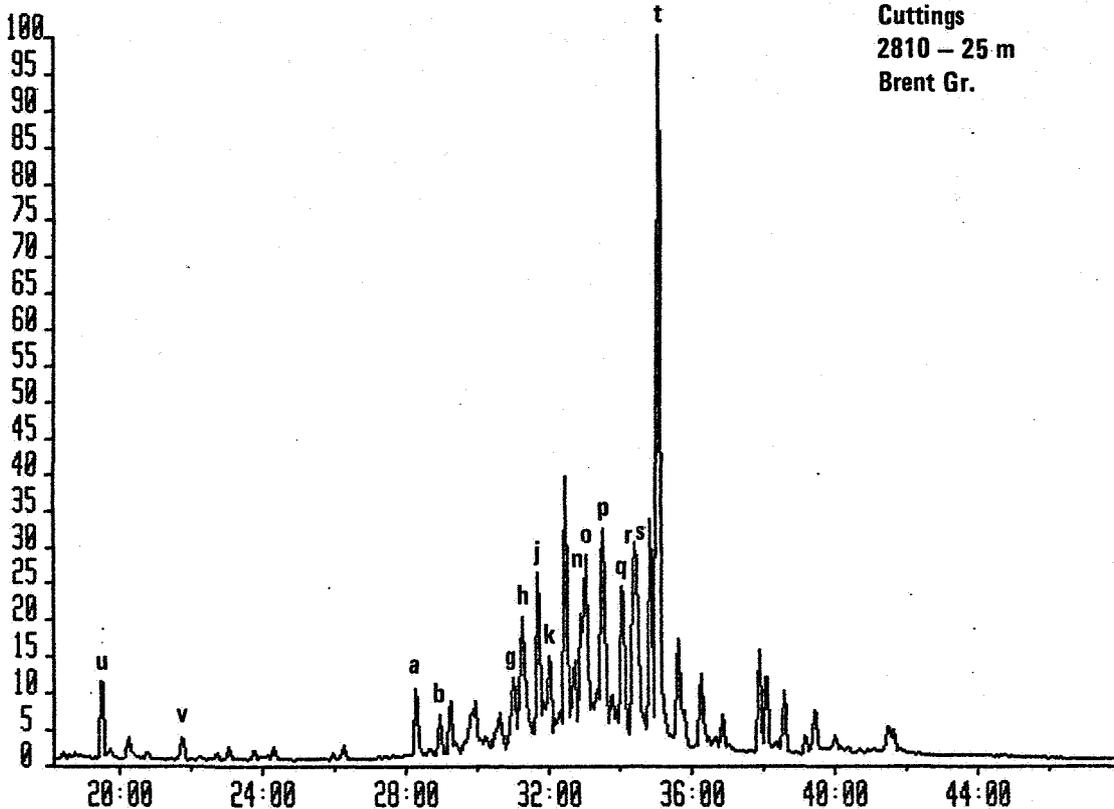
m/z 217

C1574

Cuttings

2810 - 25 m

Brent Gr.



C1577S

Sir: Voltage - 180 - Acnt: IKU

System:

Sampl: Injection 1

Group 1 Mass 217.1000

Norm: 248

Text:  IKU SINTEF-GRUPPEN

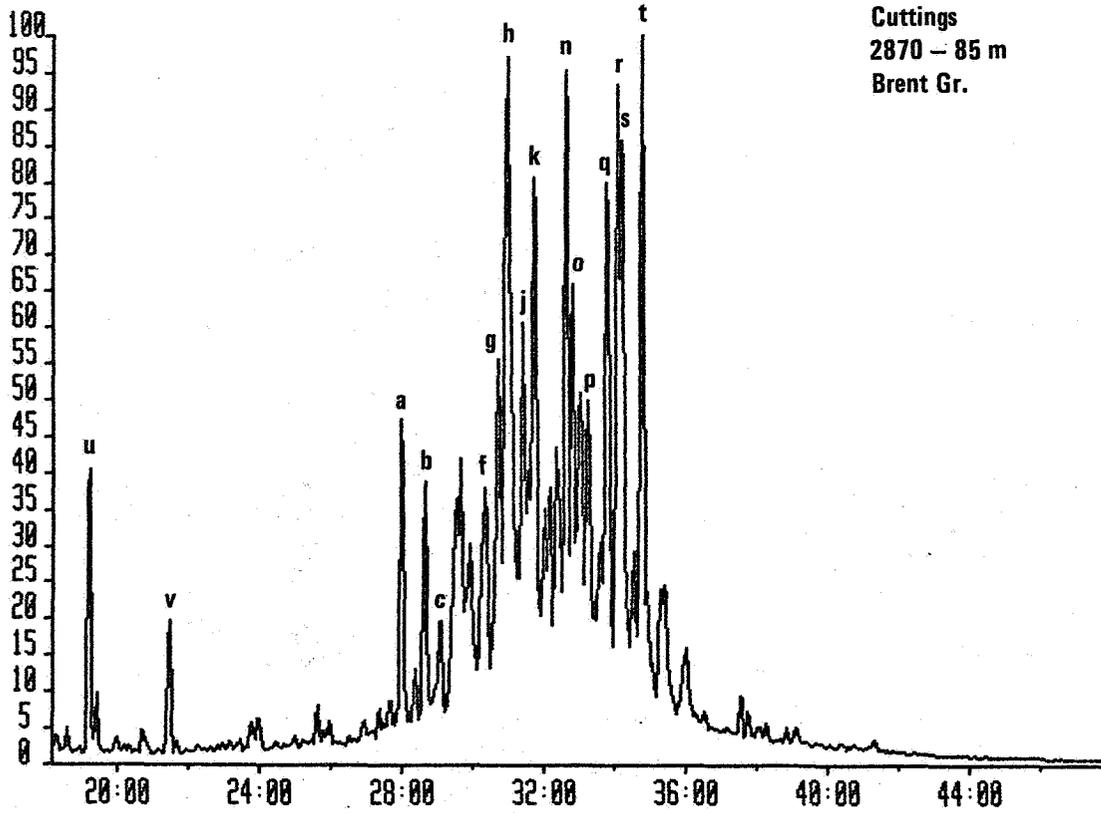
m/z 217

C1577

Cuttings

2870 - 85 m

Brent Gr.



C1583S

Sir: Voltage 7070H Acnt: IKU

System:

Sampl: Injection 1

Group 1 Mass 217.1000

Norm: 165

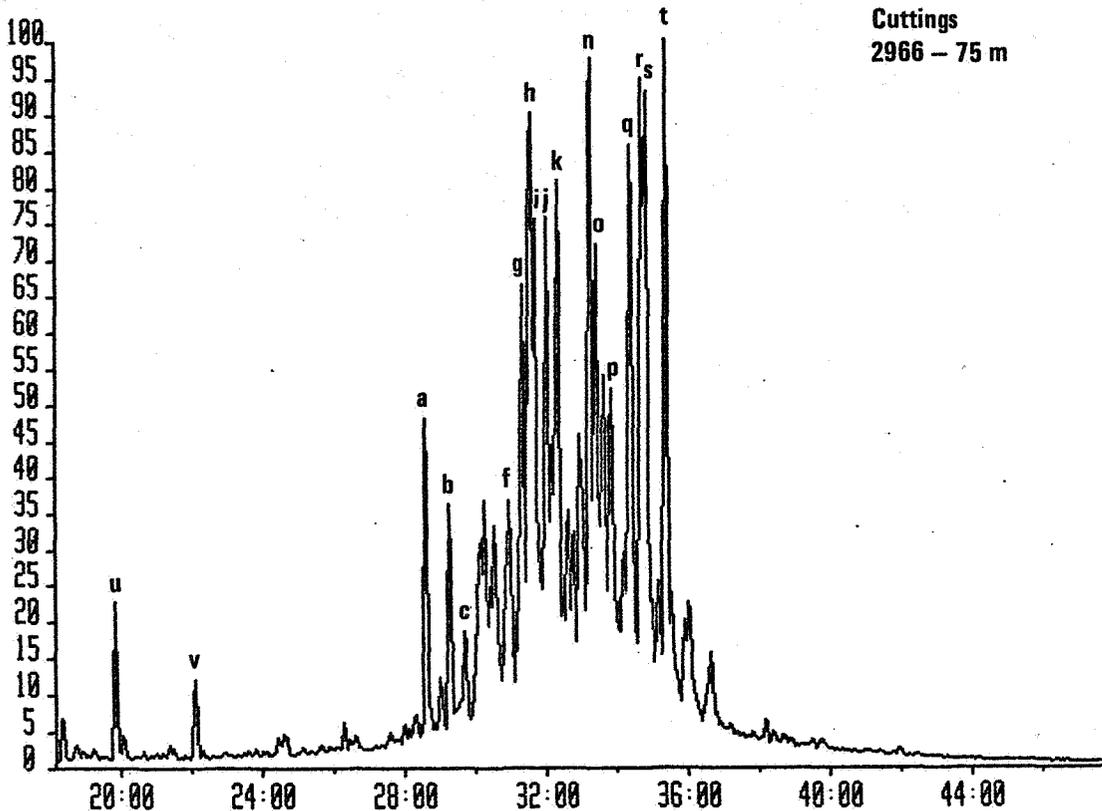
Text:  IKU SINTEF-GRUPPEN

m/z 217

C1583

Cuttings

2966 - 75 m



C1584

Sample Injection 1
Text

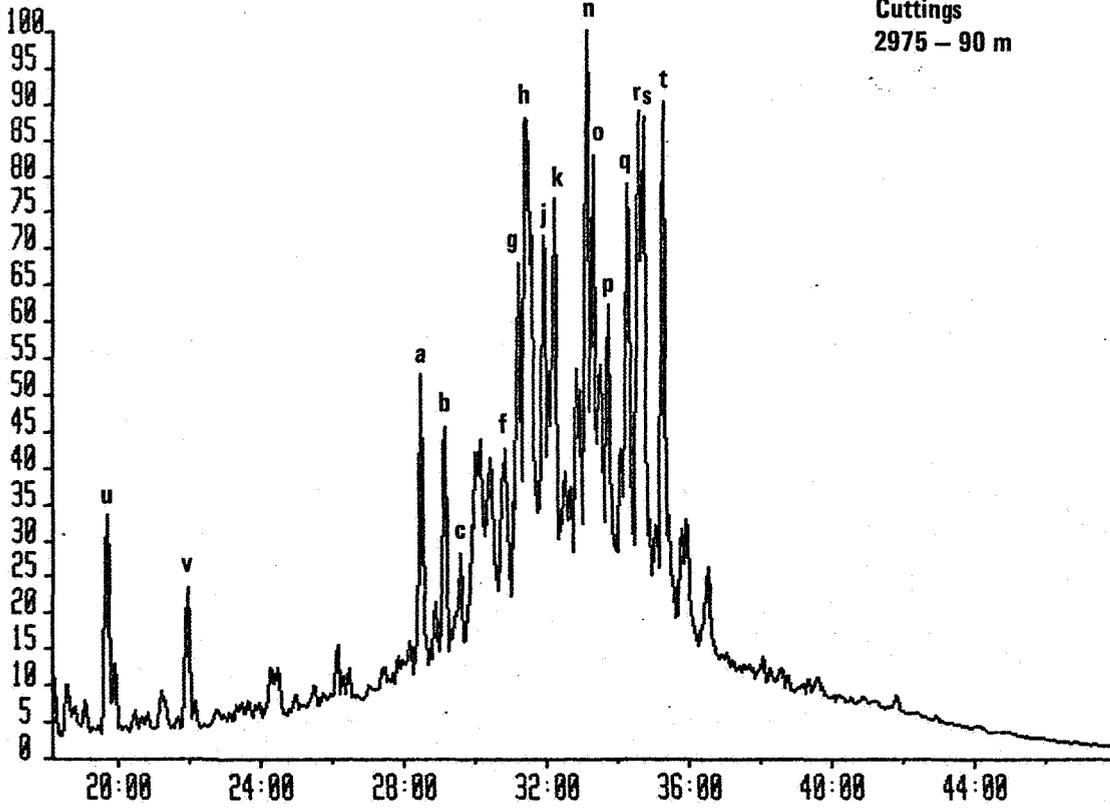


IKU
SINTEF-GRUPPEN

Srv:Voltage - 181 - Acnt:IKU
Group 1 Mass 217.1000

System:

Norm: 1571
m/z 217
C1584
Cuttings
2975 - 90 m



C1587S

Sample Injection 1
Text

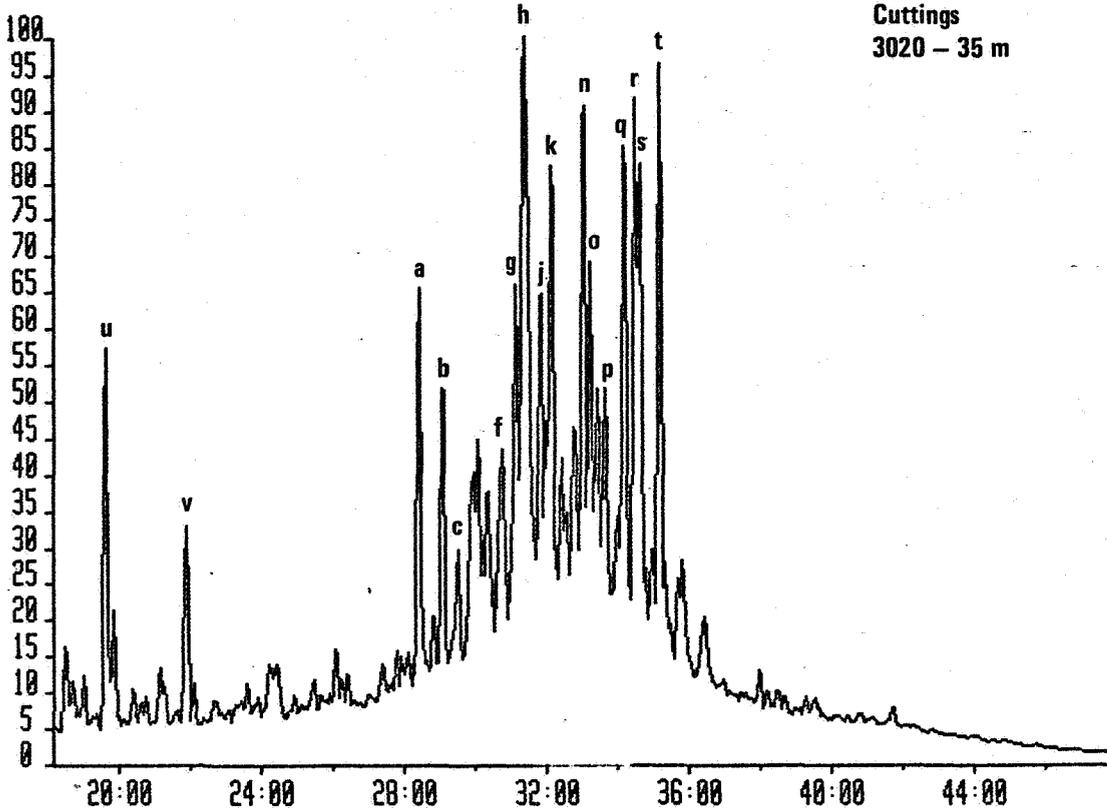


IKU
SINTEF-GRUPPEN

Srv:Voltage 7070H Acnt:IKU
Group 1 Mass 217.1000

System:

Norm: 925
m/z 217
C1587
Cuttings
3020 - 35 m



C1620S

Sir:Voltage - 182 - Acnt:IKU

System:

Sampl Injection 1
Text 

Group 1 Mass 218.1000

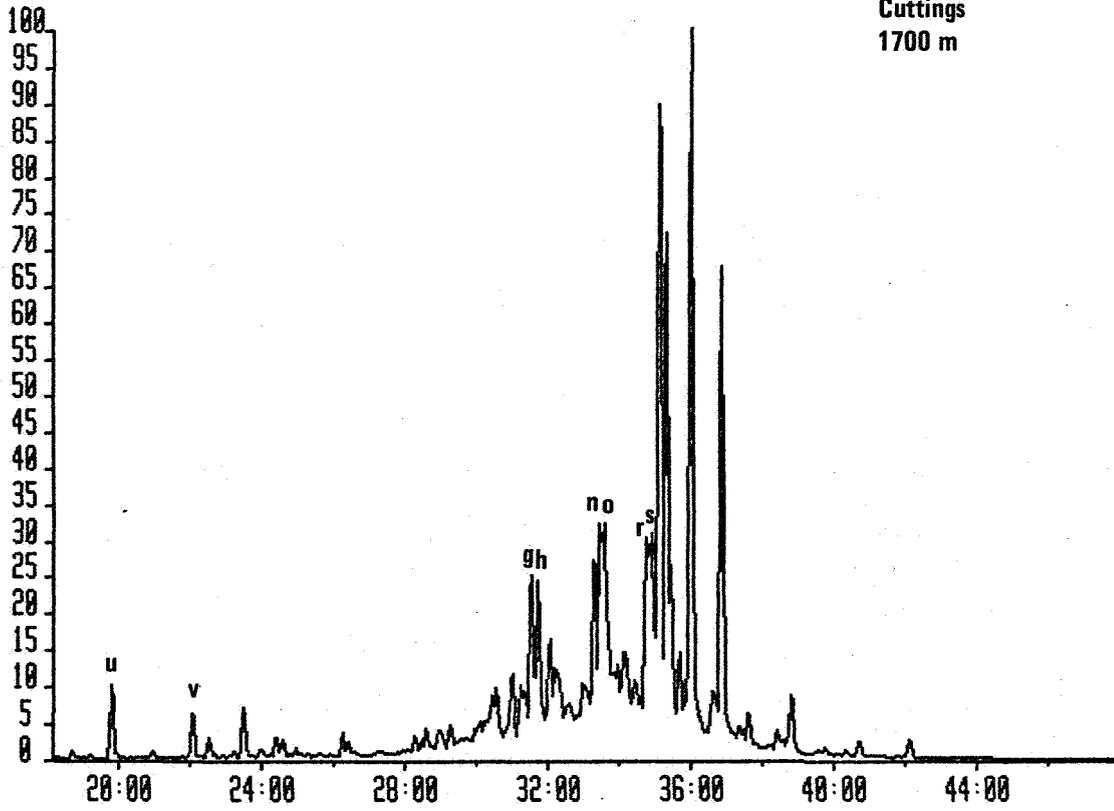
Norm: 2031

m/z 218

C1620

Cuttings

1700 m



C15215A

Sir:Voltage - 183 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 218.1000

Norm: 7212

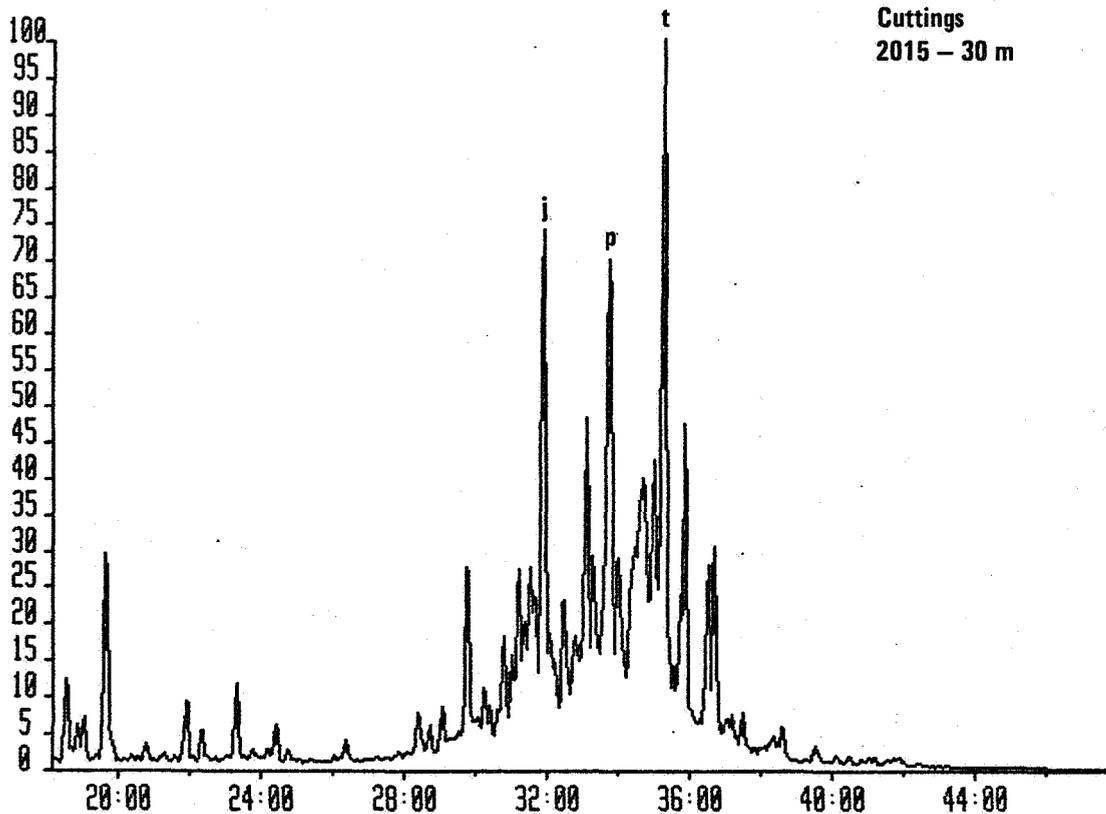
Text  SINTEF-GRUPPEN

m/z 218

C1521

Cuttings

2015 - 30 m



C1555S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 218.1000

Norm: 1186

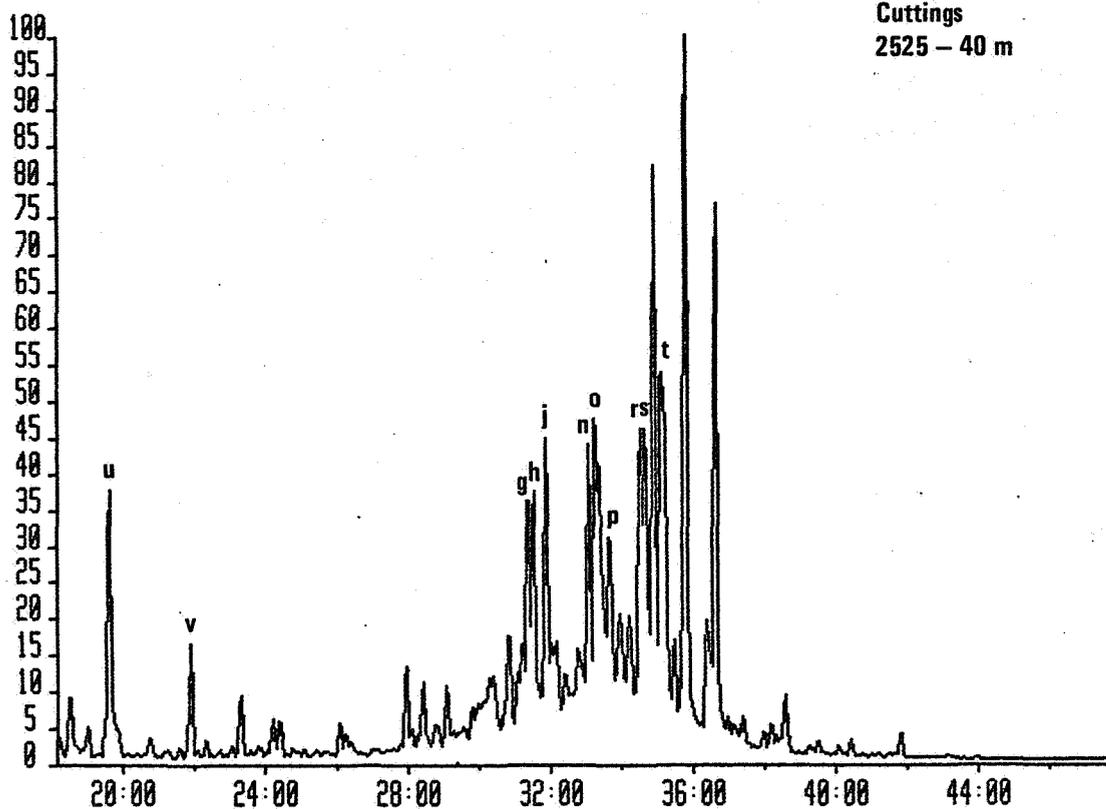
Text  SINTEF-GRUPPEN

m/z 218

C1555

Cuttings

2525 - 40 m



C1578S

Sir:Voltage - 184 - Acnt:IKU

System:

Sampl: Injection 1
Text:  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

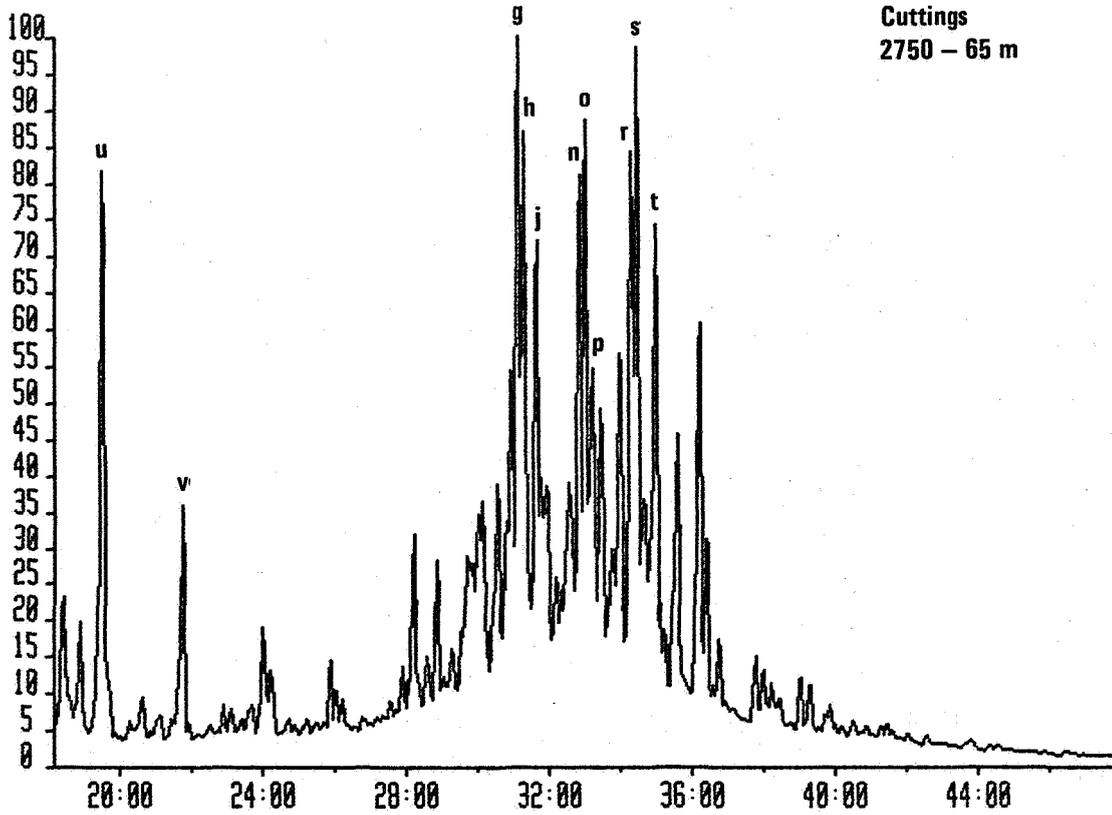
Norm: 2326

m/z 218

C1570

Cuttings

2750 - 65 m



C1574S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl: Injection 1
Text:  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

Norm: 188

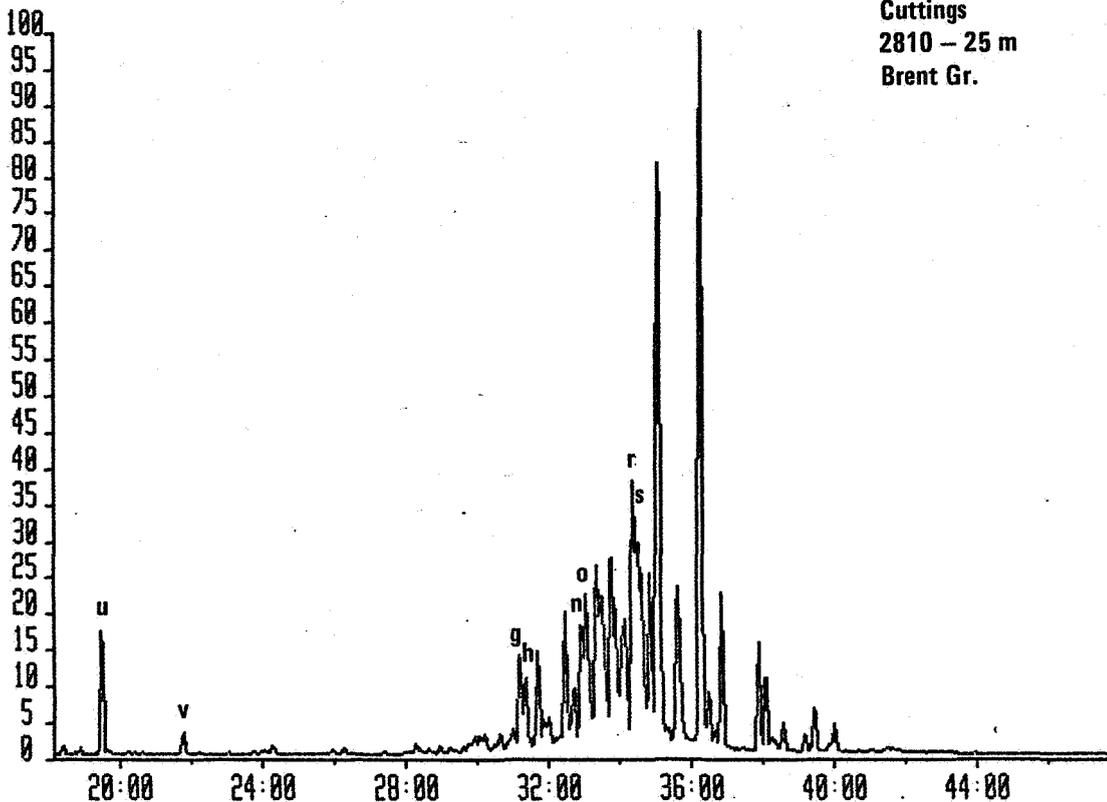
m/z 218

C1574

Cuttings

2810 - 25 m

Brent Gr.



C1577S

Sir:Voltage - 185 - Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 218.1000
Text 

Norm: 279

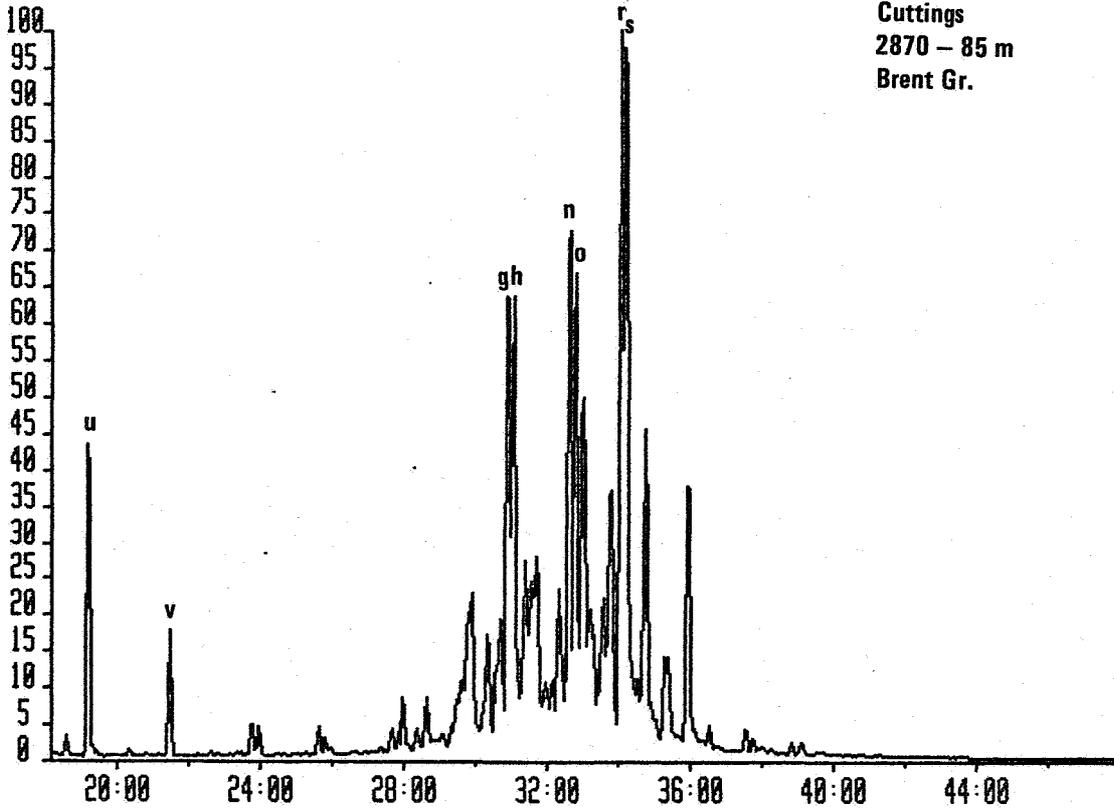
m/z 218

C1577

Cuttings

2870 - 85 m

Brent Gr.



C1583S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 218.1000
Text 

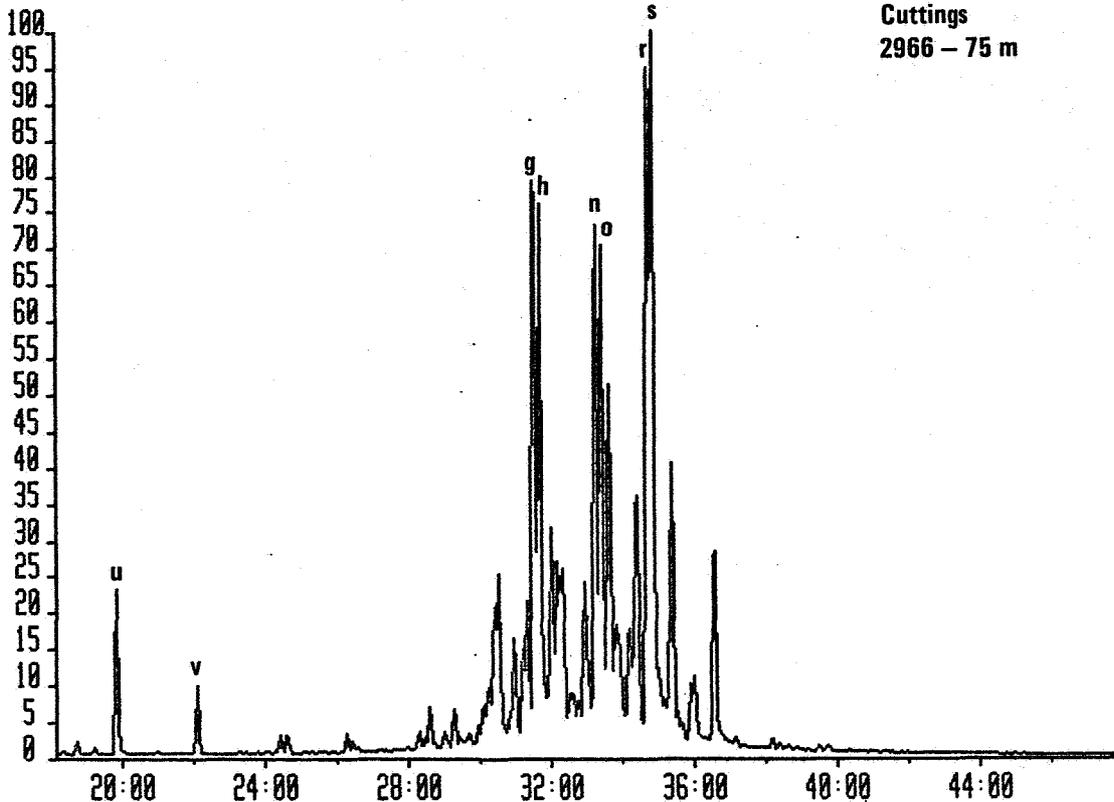
Norm: 194

m/z 218

C1583

Cuttings

2966 - 75 m



C1584

Sir:Voltage - 186 - Acnt:IKU

System:

Sampl Injection 1
Text  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

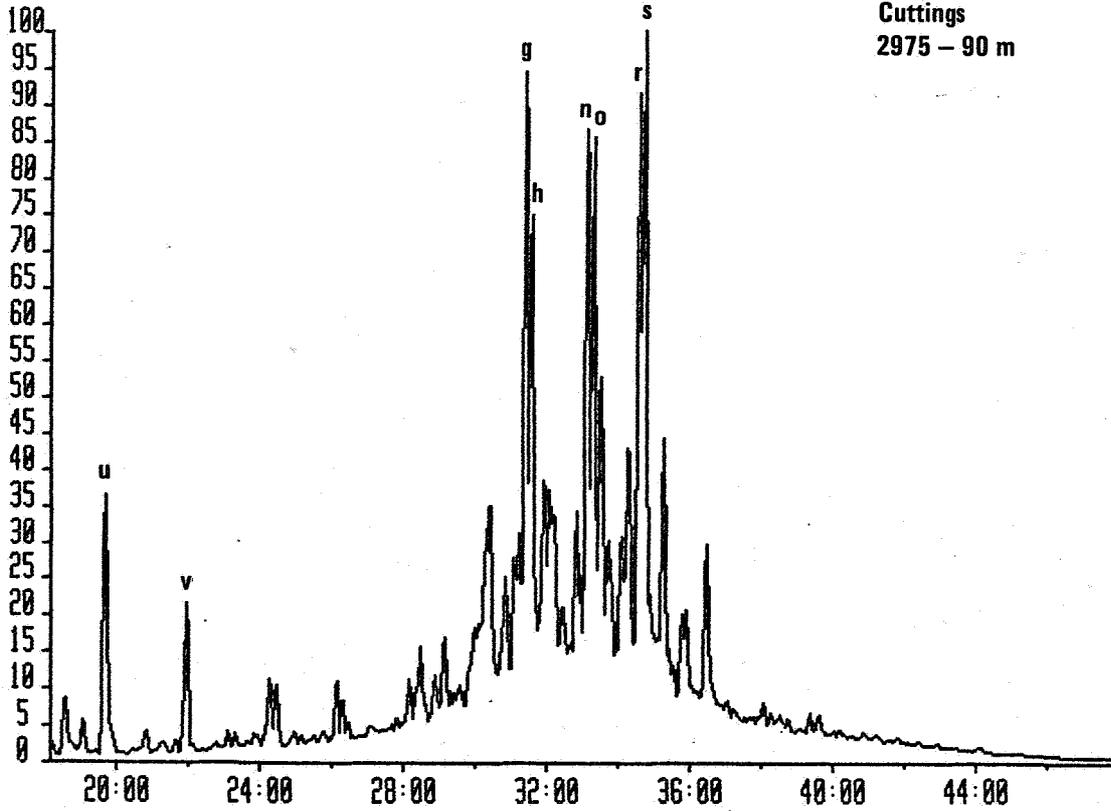
Norm: 1735

m/z 218

C1584

Cuttings

2975 - 90 m



C1587S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1
Text  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

Norm: 1007

m/z 218

C1587

Cuttings

3020 - 35 m

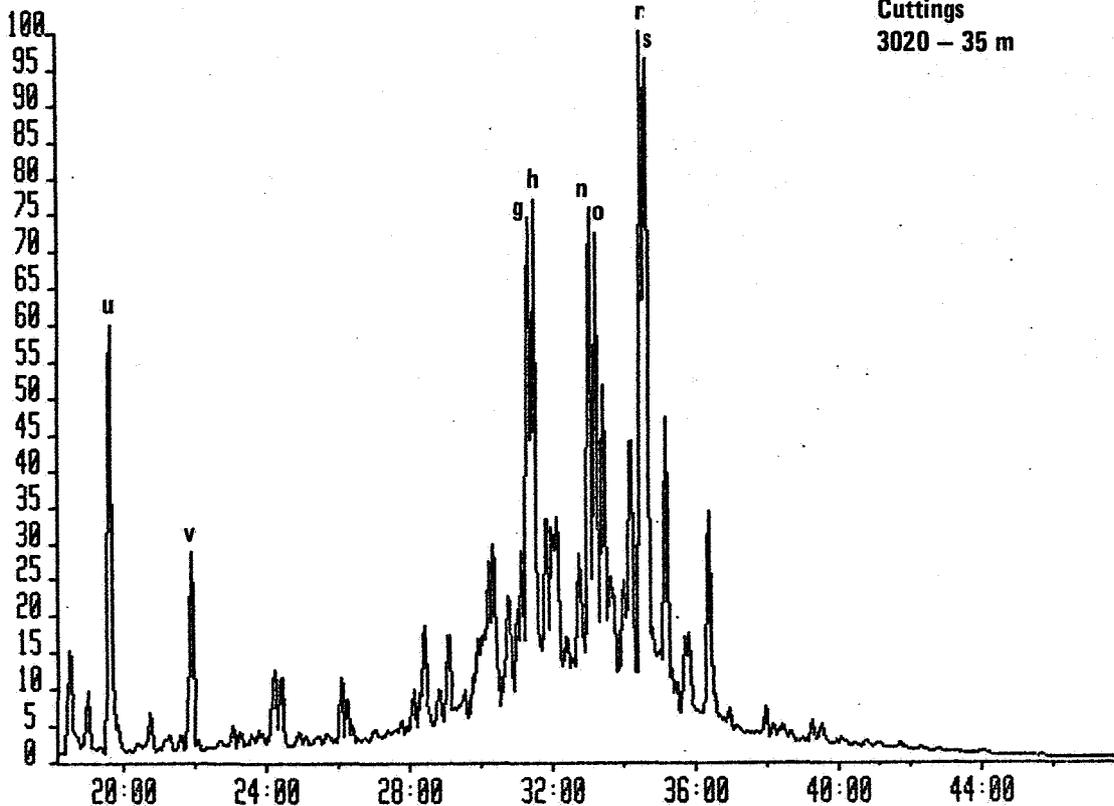
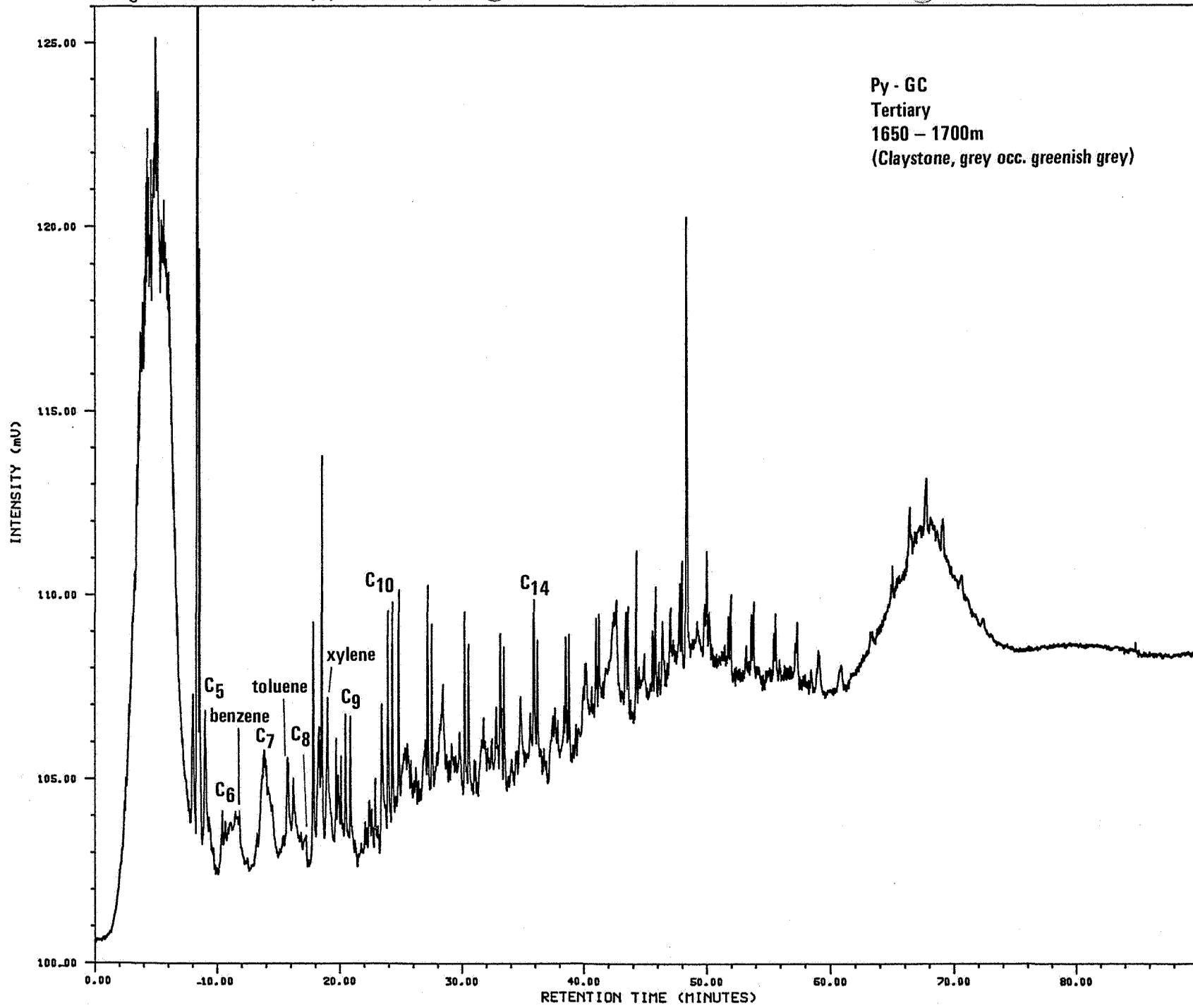


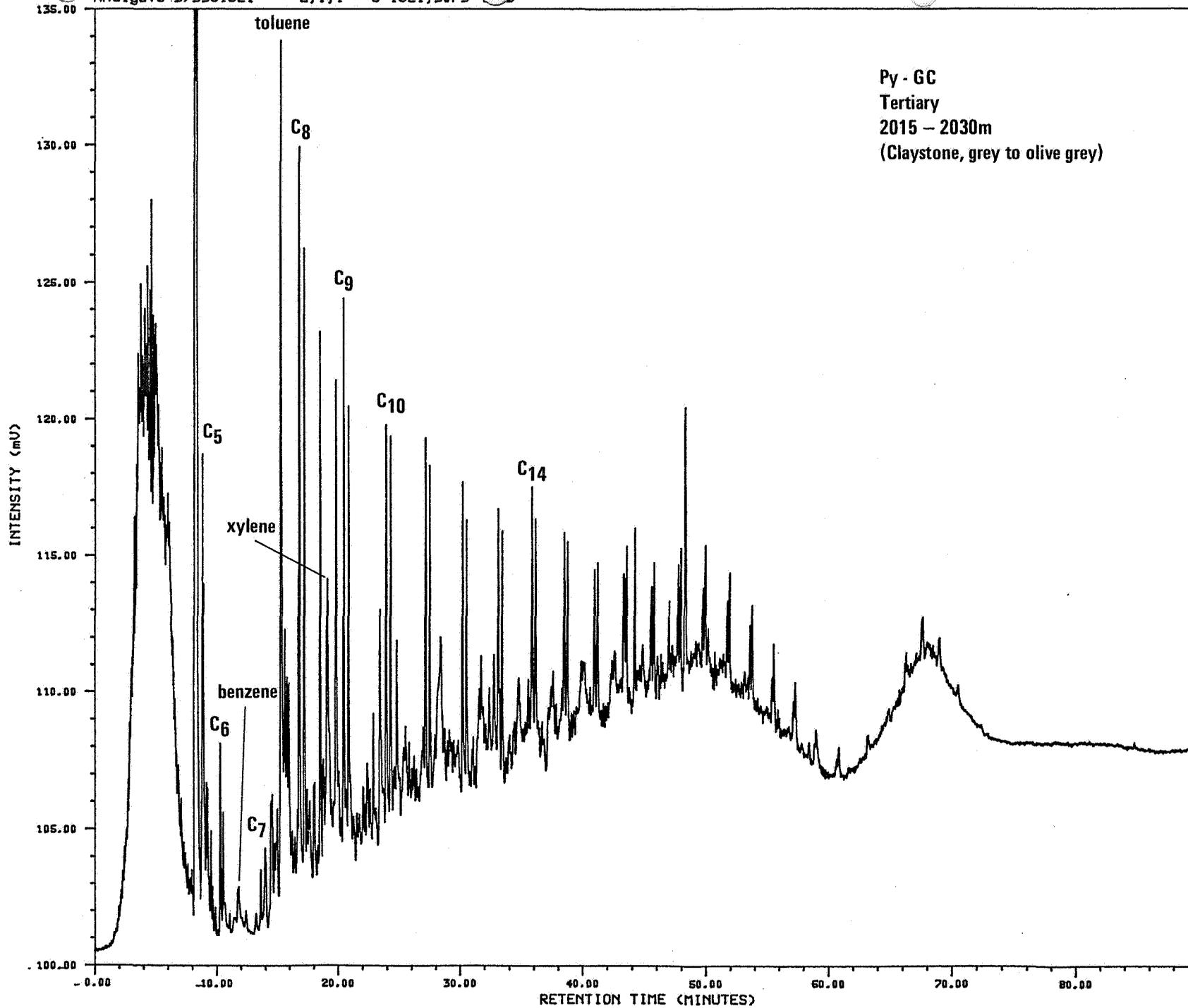
FIGURE 5

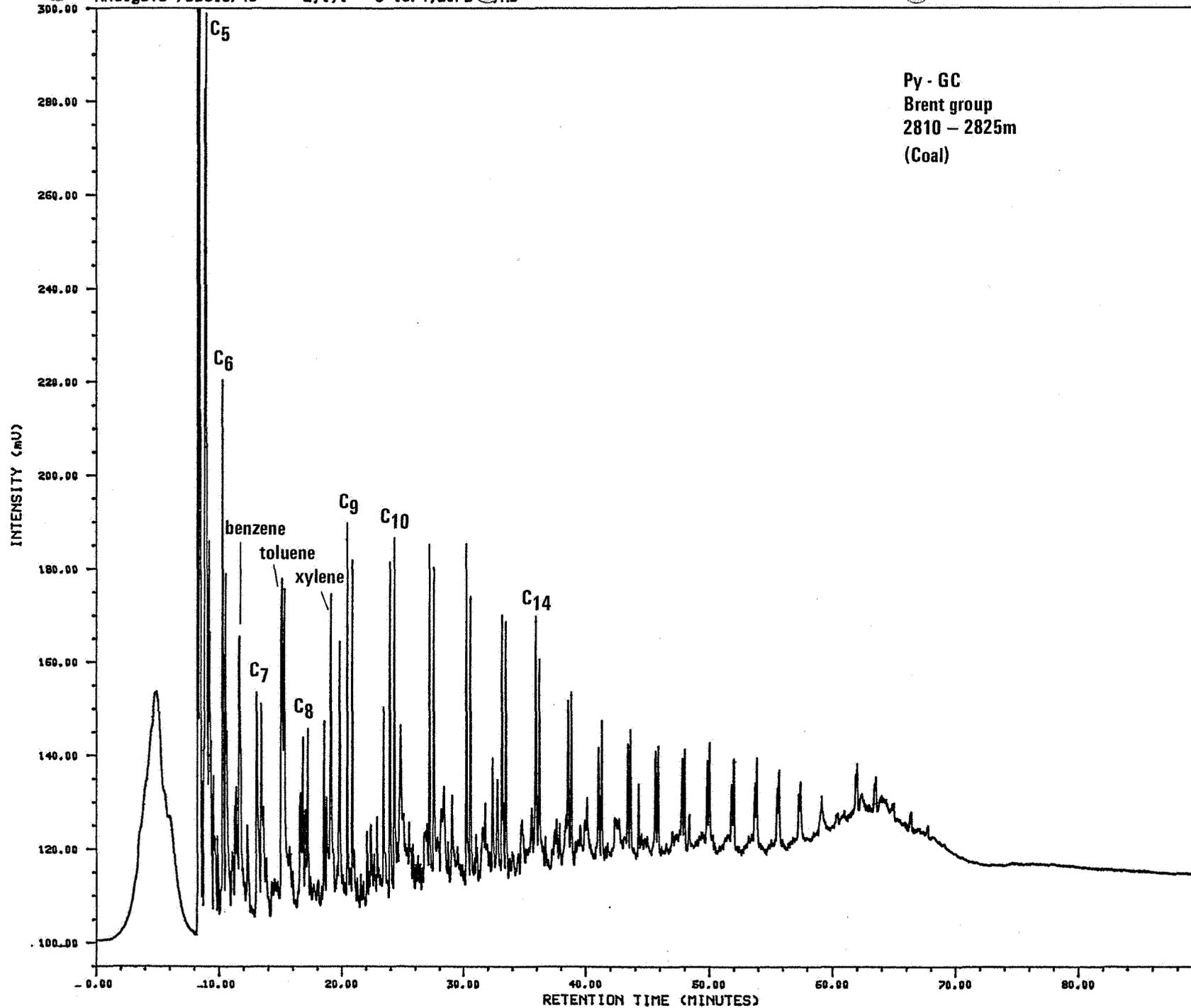
PYROLYSIS-GC OF CUTTINGS

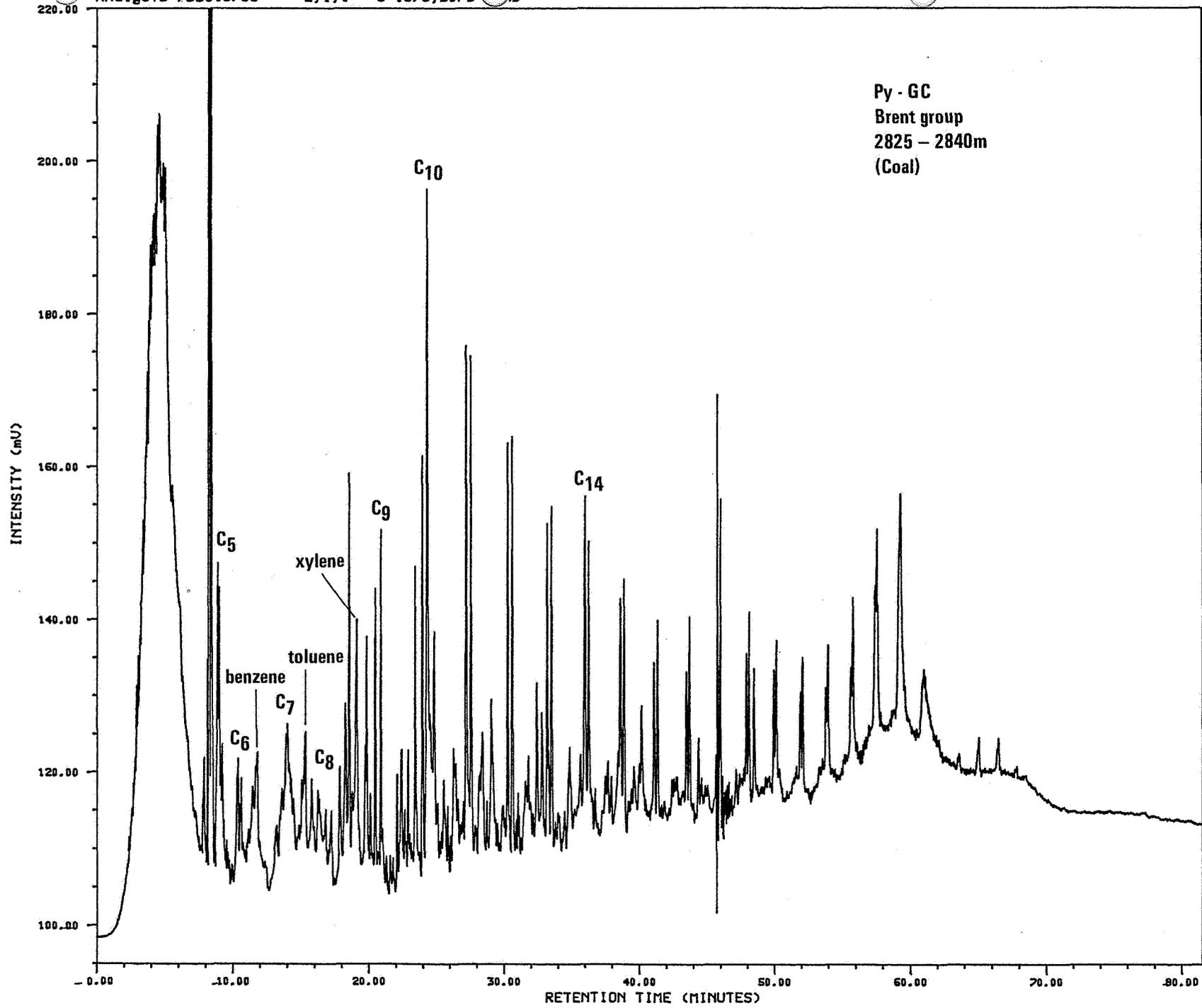


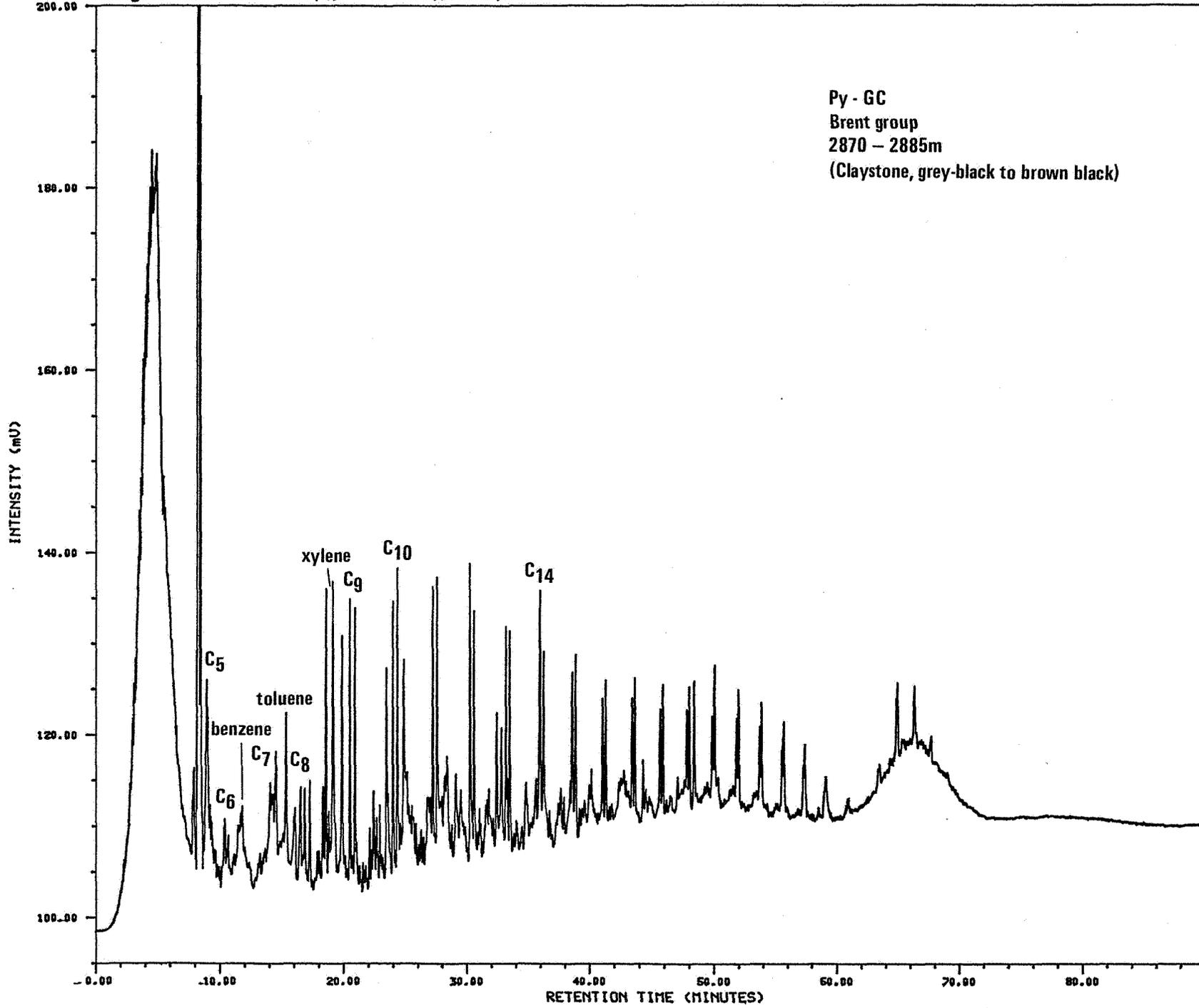
Py - GC
Tertiary
1650 - 1700m
(Claystone, grey occ. greenish grey)

Py - GC
Tertiary
2015 - 2030m
(Claystone, grey to olive grey)



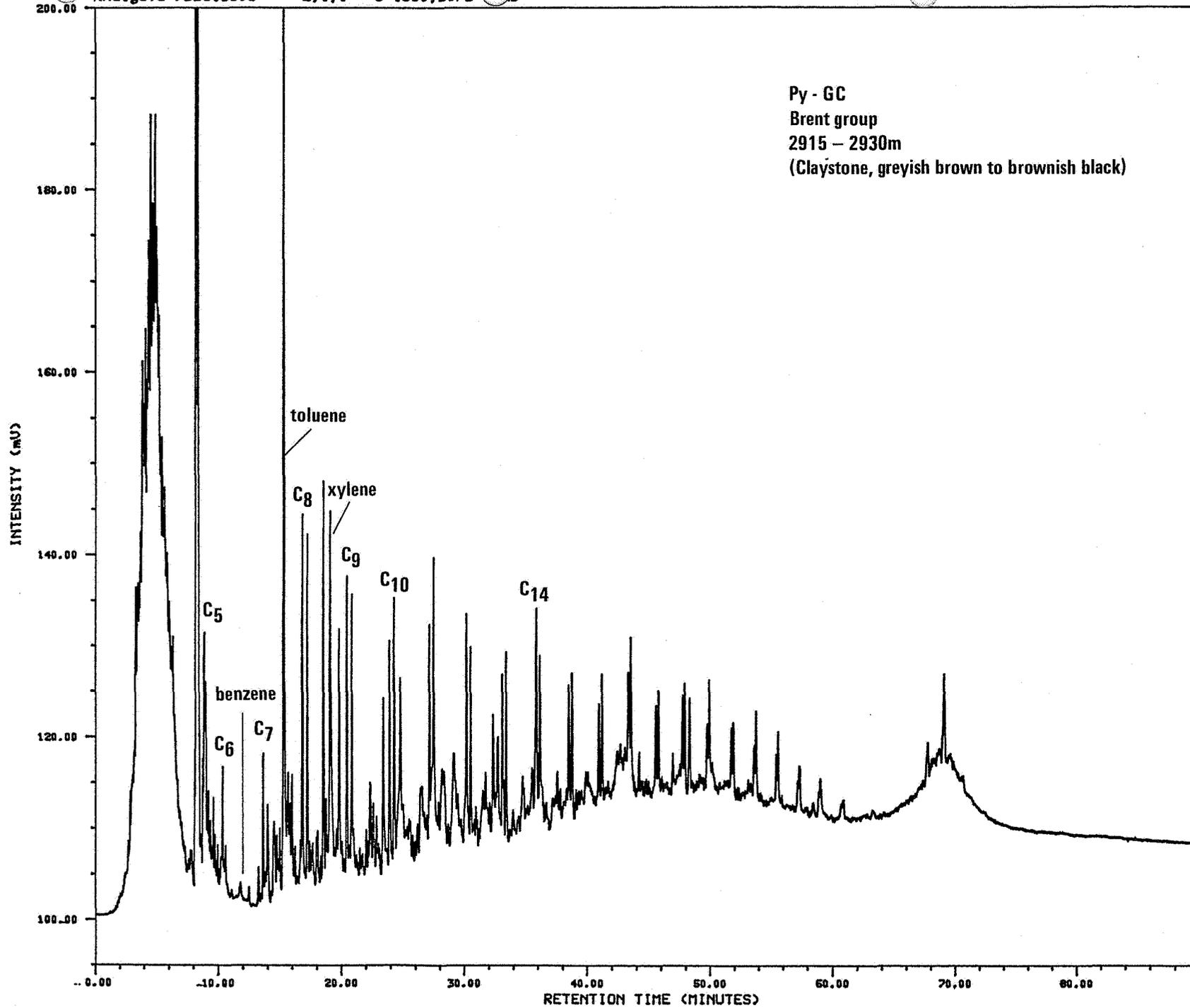


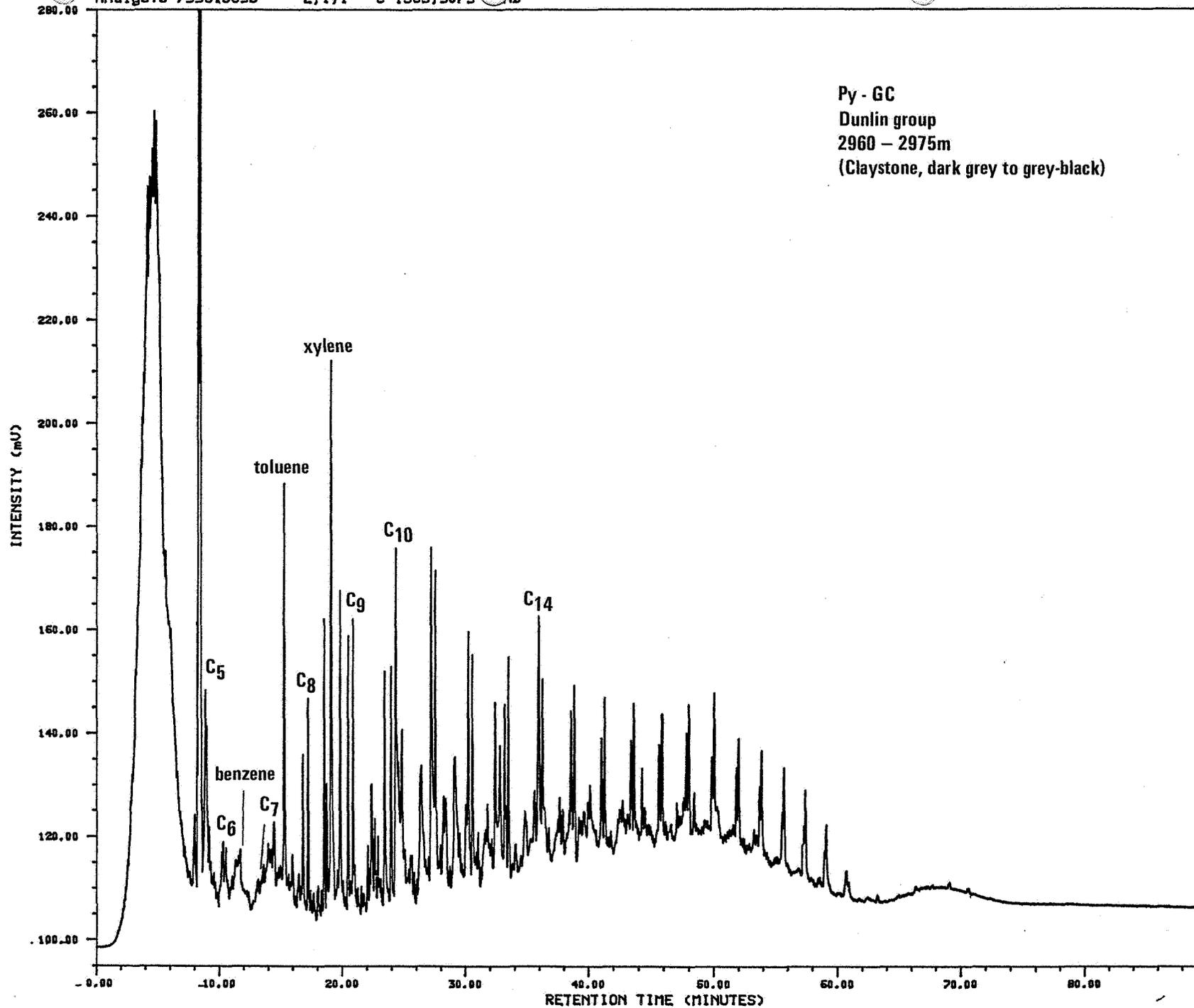




Py - GC
Brent group
2870 - 2885m
(Claystone, grey-black to brown black)

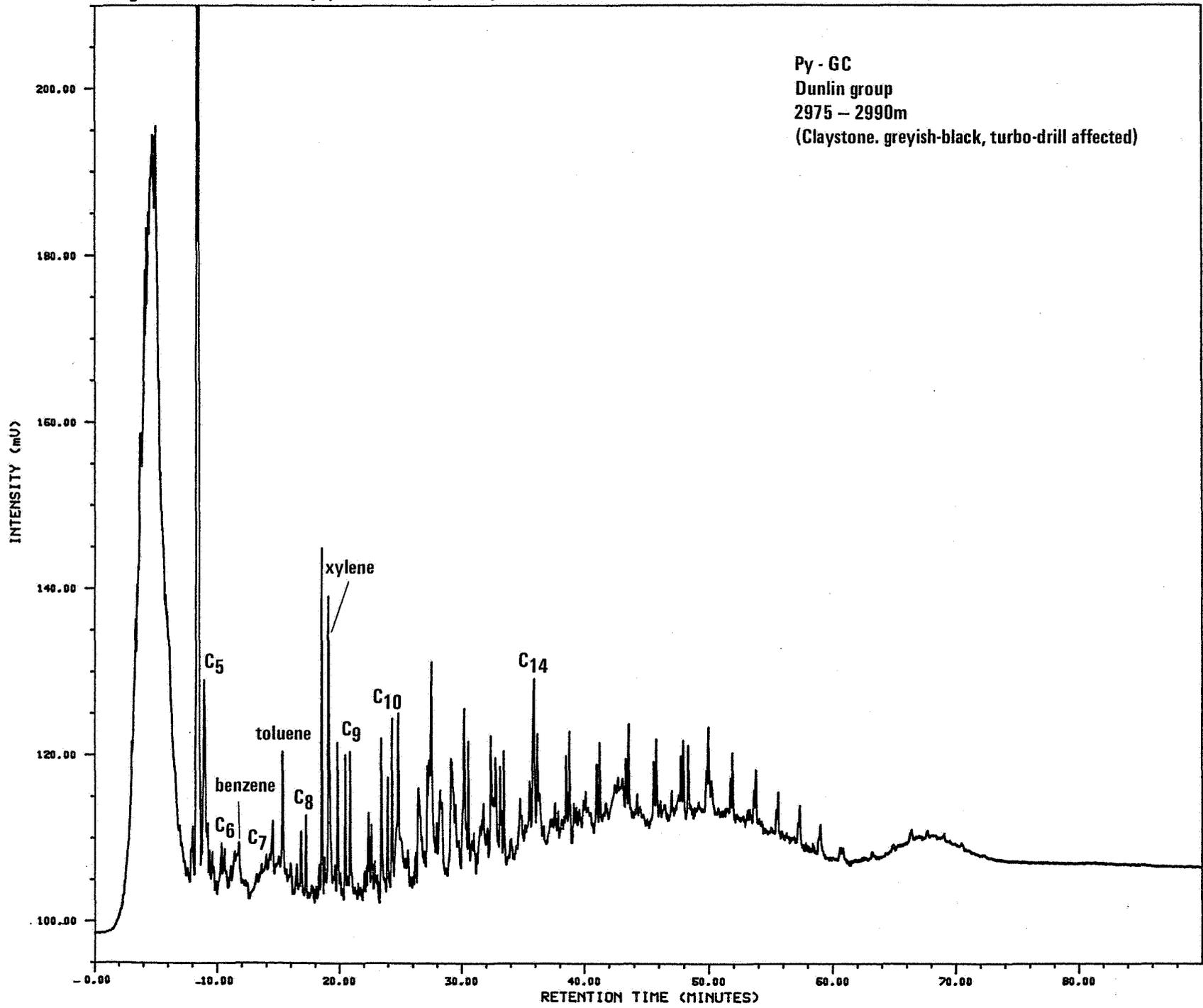
Py - GC
Brent group
2915 - 2930m
(Claystone, greyish brown to brownish black)





Py - GC
Dunlin group
2960 - 2975m
(Claystone, dark grey to grey-black)

Py - GC
Dunlin group
2975 - 2990m
(Claystone, greyish-black, turbo-drill affected)



FIGURES 6-9
OILS AND CORES

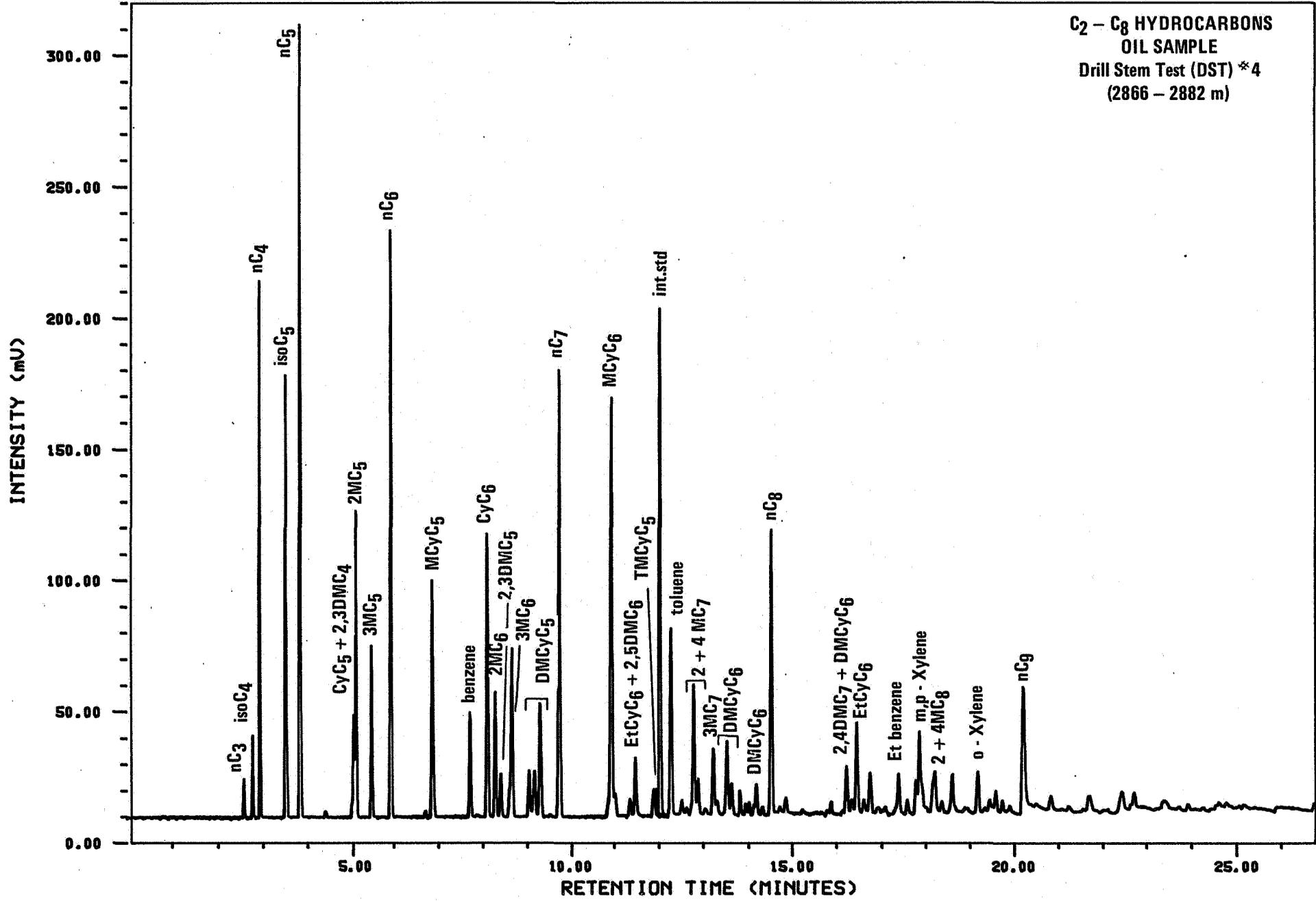
FIGURE 6

C2-C8 HYDROCARBON GAS CHROMATOGRAMS

List of C2-C8 hydrocarbons

C2	ethane
C3	propane
MC3	methyl-propane
nC4	butane
isoC5	iso-pentane
nC5	pentane
2,2DMC4	2,2-dimethyl-butane
CyC5	cyclopentane
2,3DMC4	2,3-dimethyl-butane
2MC5	2-methyl-pentane
3MC5	3-methyl-pentane
nC6	hexane
MCyC5	methyl-cyclopentane
benzene	
CyC6	cyclohexane
2MC6	2-methyl-hexane
2,3DMC5	2,3-dimethyl-pentane
3MC6	3-methyl-hexane
DMCyC5	dimethyl-cyclopentane
nC7	heptane
MCyC6	methyl-cyclohexane
EtCyC5	ethyl-cyclopentane
2,5DMC6	2,5-dimethyl-hexane
2,4DMC6	2,4-dimethyl-hexane
TMCyC5	trimethyl-cyclopentane
toluene	
2MC7	2-methyl-heptane
4MC7	4-methyl-heptane
3MC7	3-methyl-heptane
DMCyC6	dimethyl-cyclohexane
nC8	octane
2,4DMC7	2,4-dimethyl-heptane
EtCyC6	ethyl-cyclohexane
Et benzene	ethyl-benzene
m,p-xylene	meta,para-xylene
2MC8	2-methyloctane
4MC8	4-methyloctane
o-xylene	orto-xylene
int.std.	2,3,4-trimethyl-pentane

C₂ - C₈ HYDROCARBONS
OIL SAMPLE
Drill Stem Test (DST) *4
(2866 - 2882 m)



Analysis 793C1647B

5,1,1 C-1647+INT.STD AD

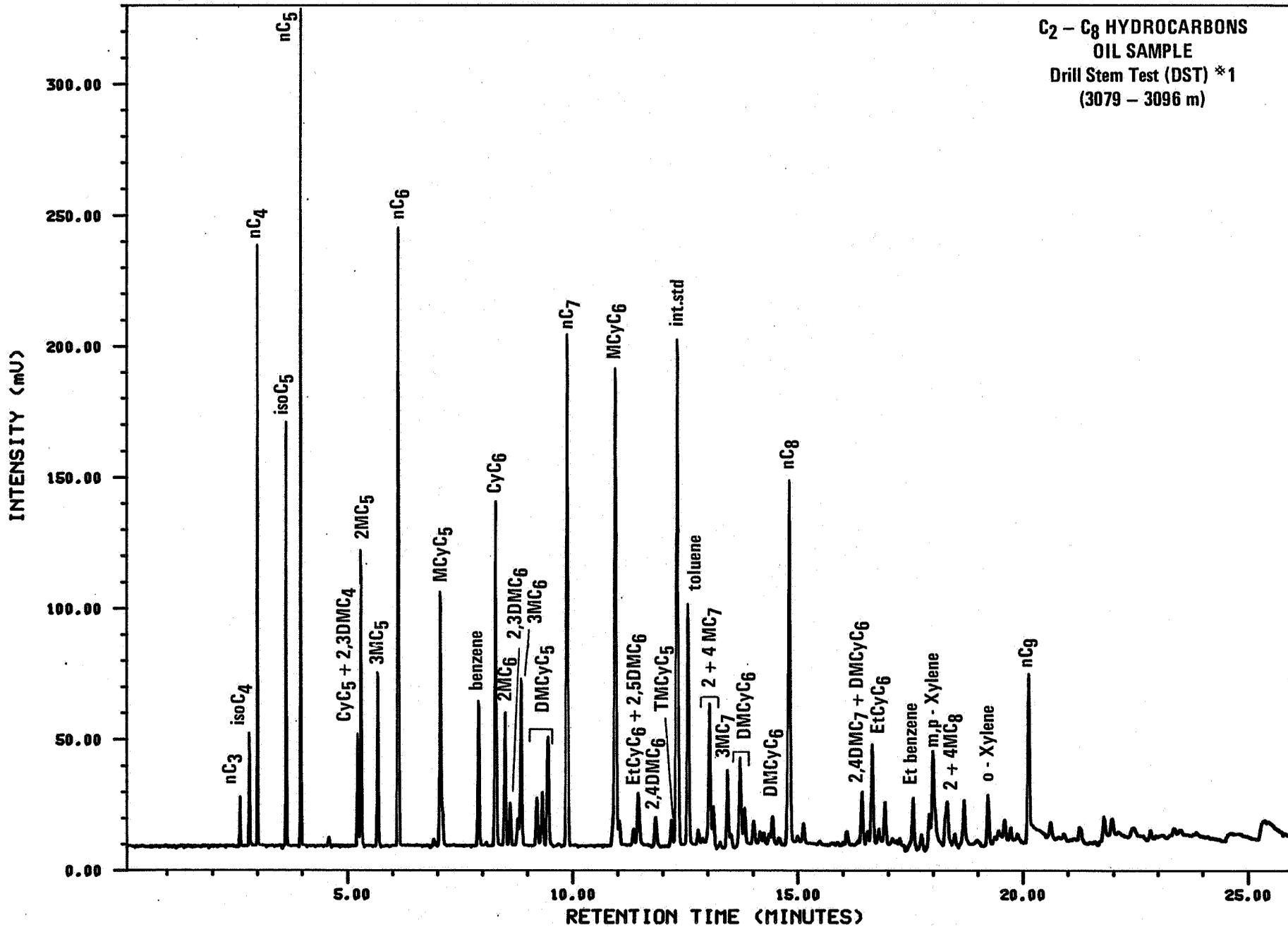
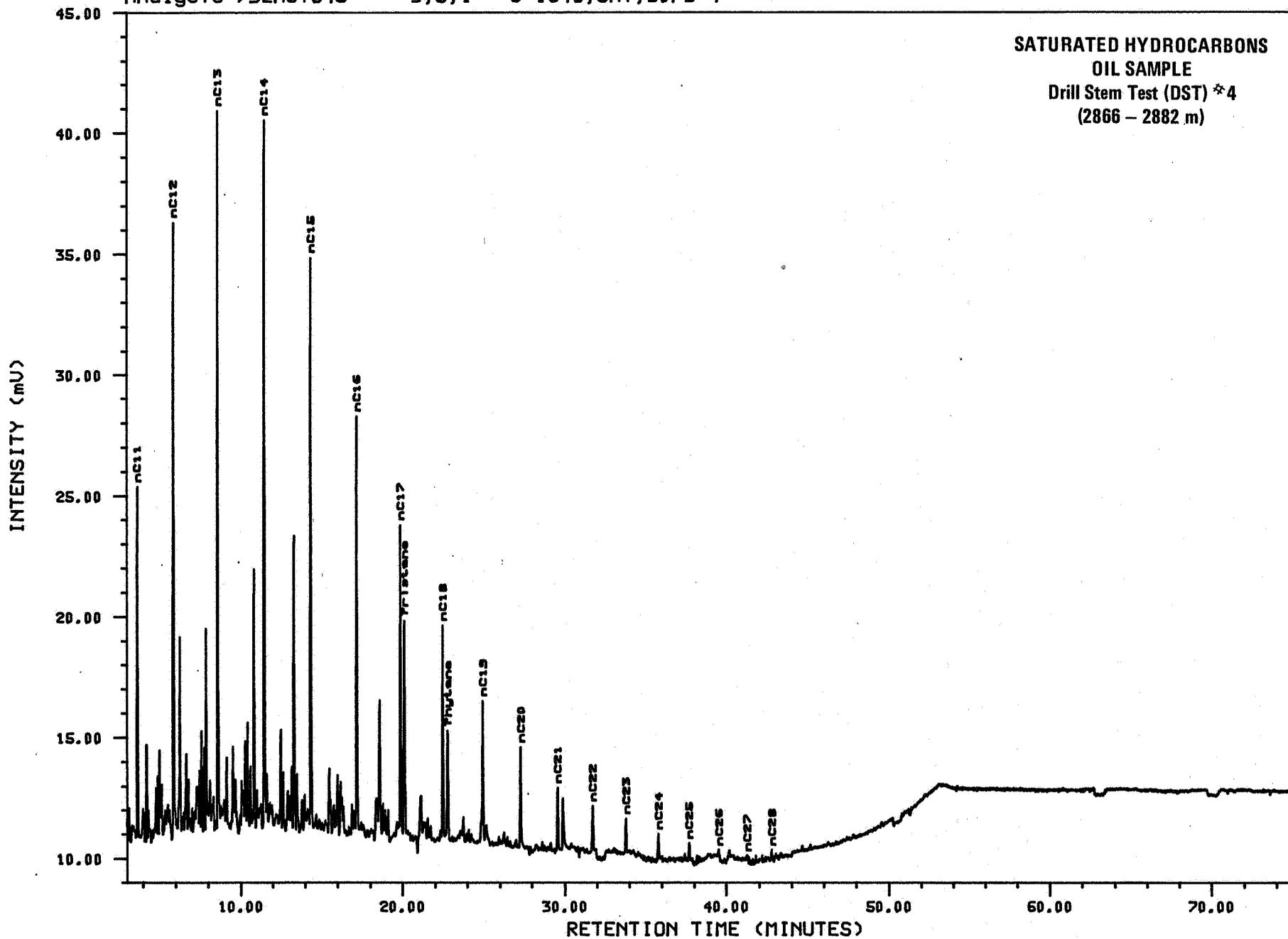


FIGURE 7

SATURATED HYDROCARBON GAS CHROMATOGRAMS

Pr - pristane
Ph - phytane
n-C15 etc. - n-alkanes

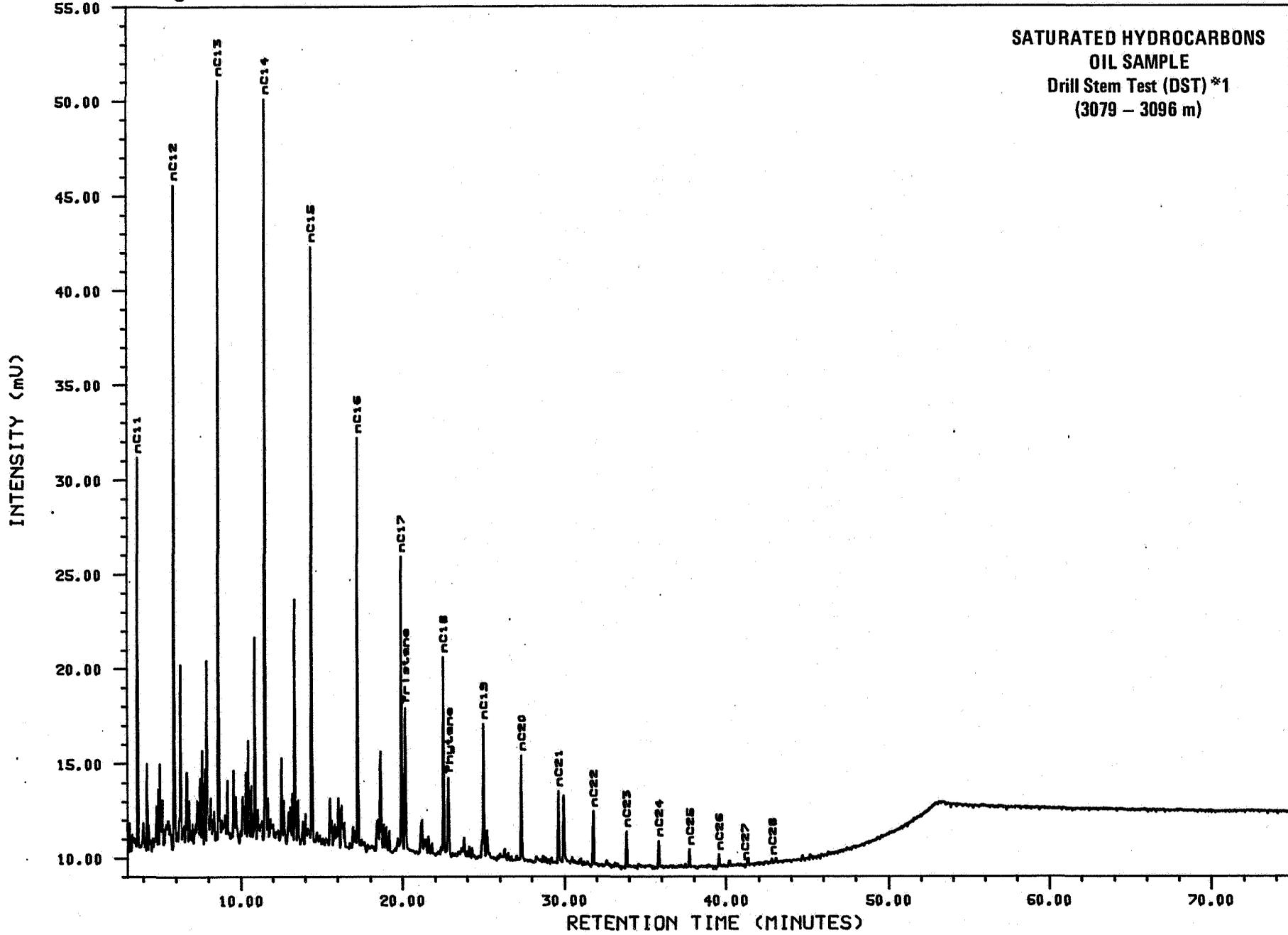


analysis 792AUT04S

3,4,1

C-1647,SAT,30/3-4

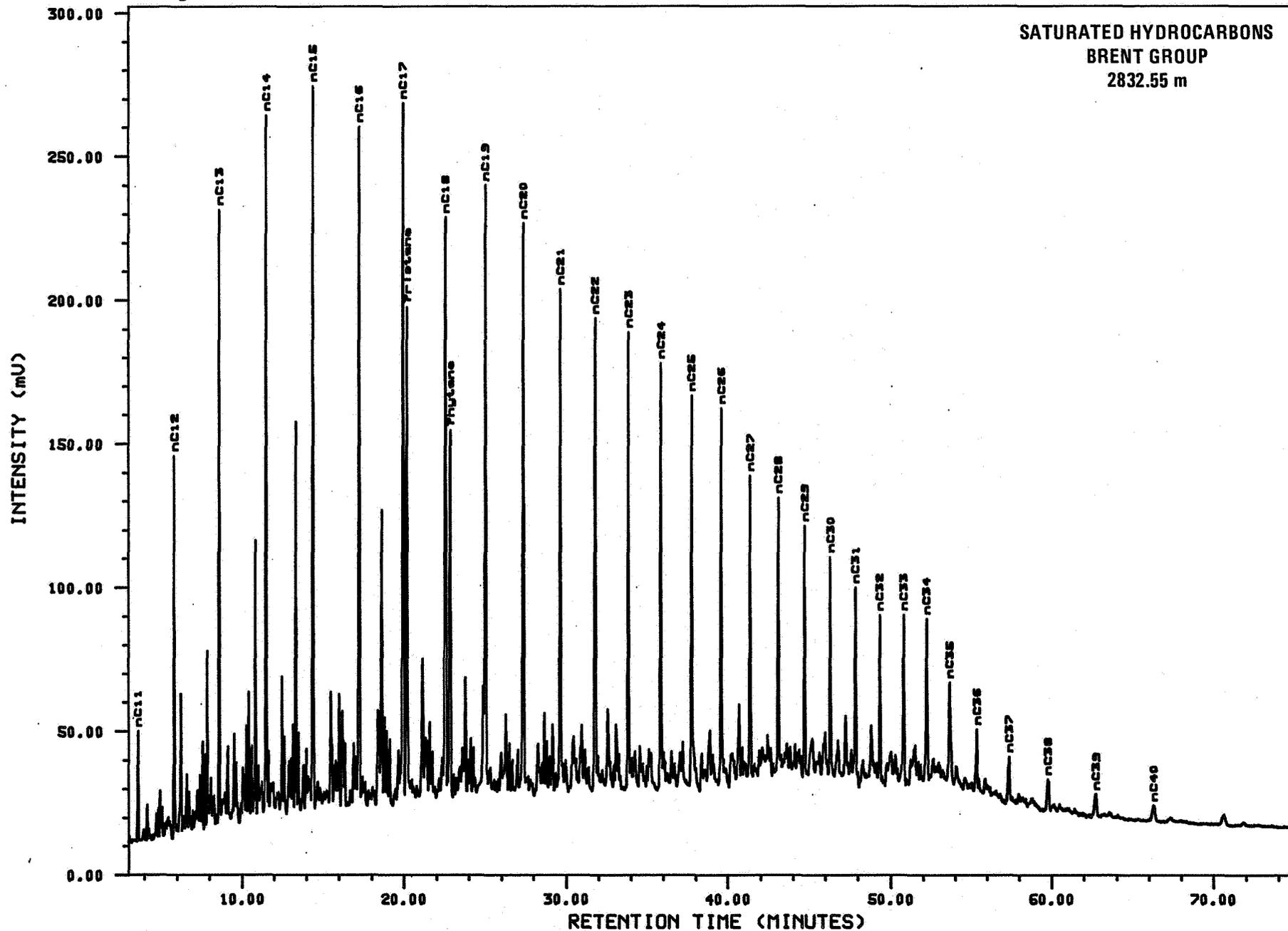
SATURATED HYDROCARBONS
OIL SAMPLE
Drill Stem Test (DST) *1
(3079 - 3096 m)



Analysis 792AUT01

3, 1, 1 C-1623, SAT, 30/3-4

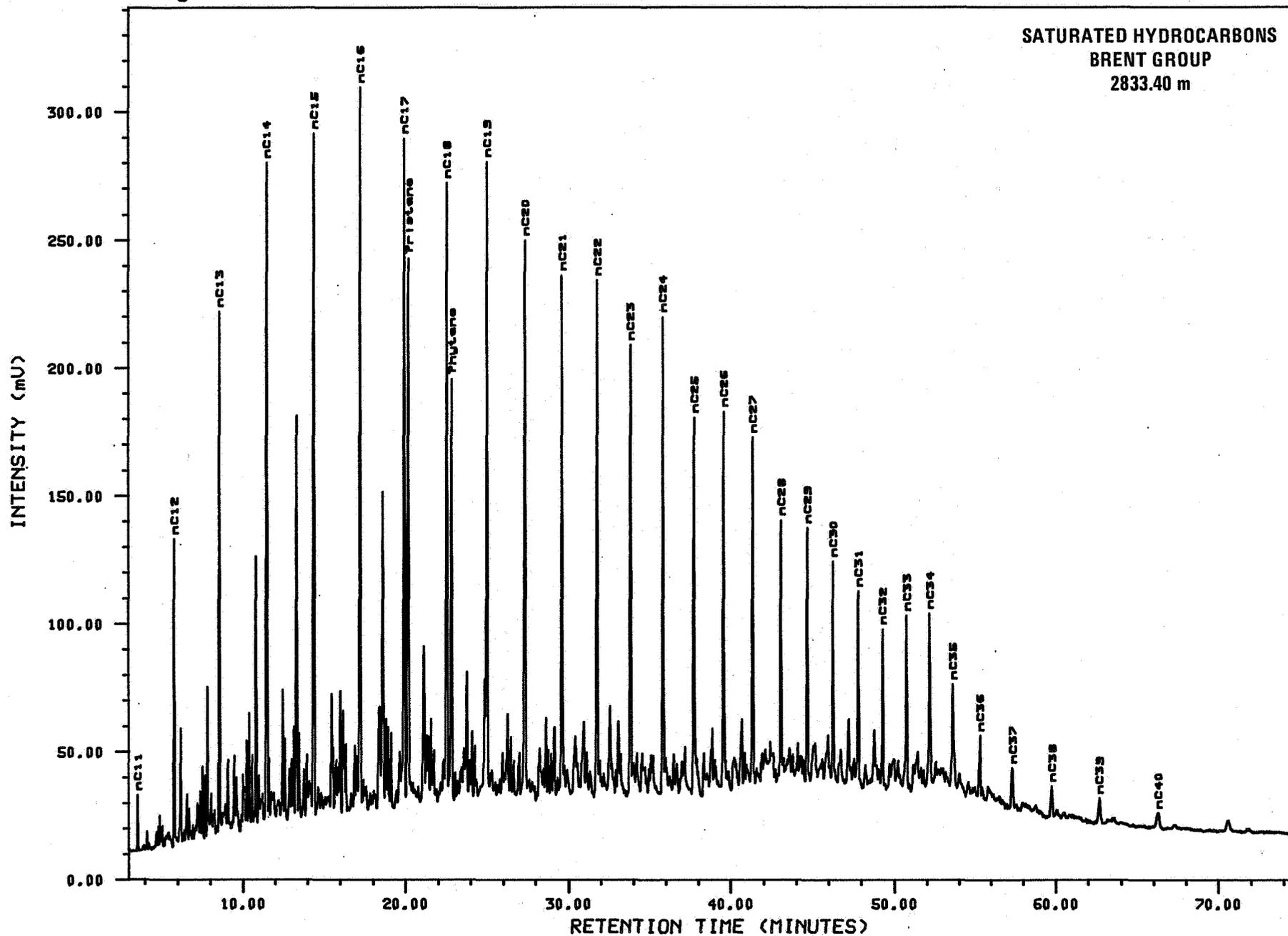
SATURATED HYDROCARBONS
BRENT GROUP
2832.55 m



Analysis 792AUT01

3,2,1 C-1624,SAT,30/3-4

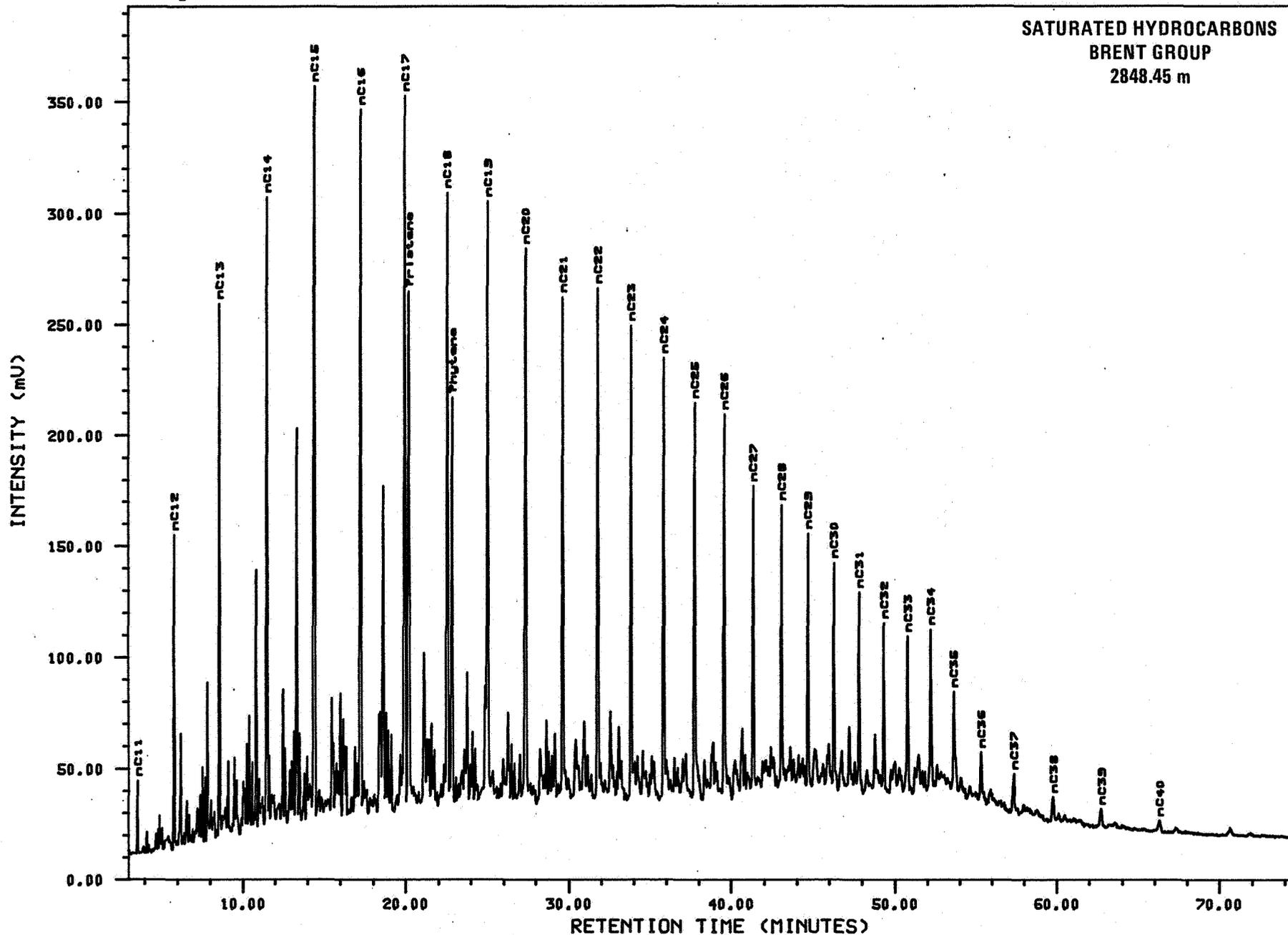
SATURATED HYDROCARBONS
BRENT GROUP
2833.40 m



Analysis 792AUT01

3,3,1 C-1625, SAT, 30/3-4

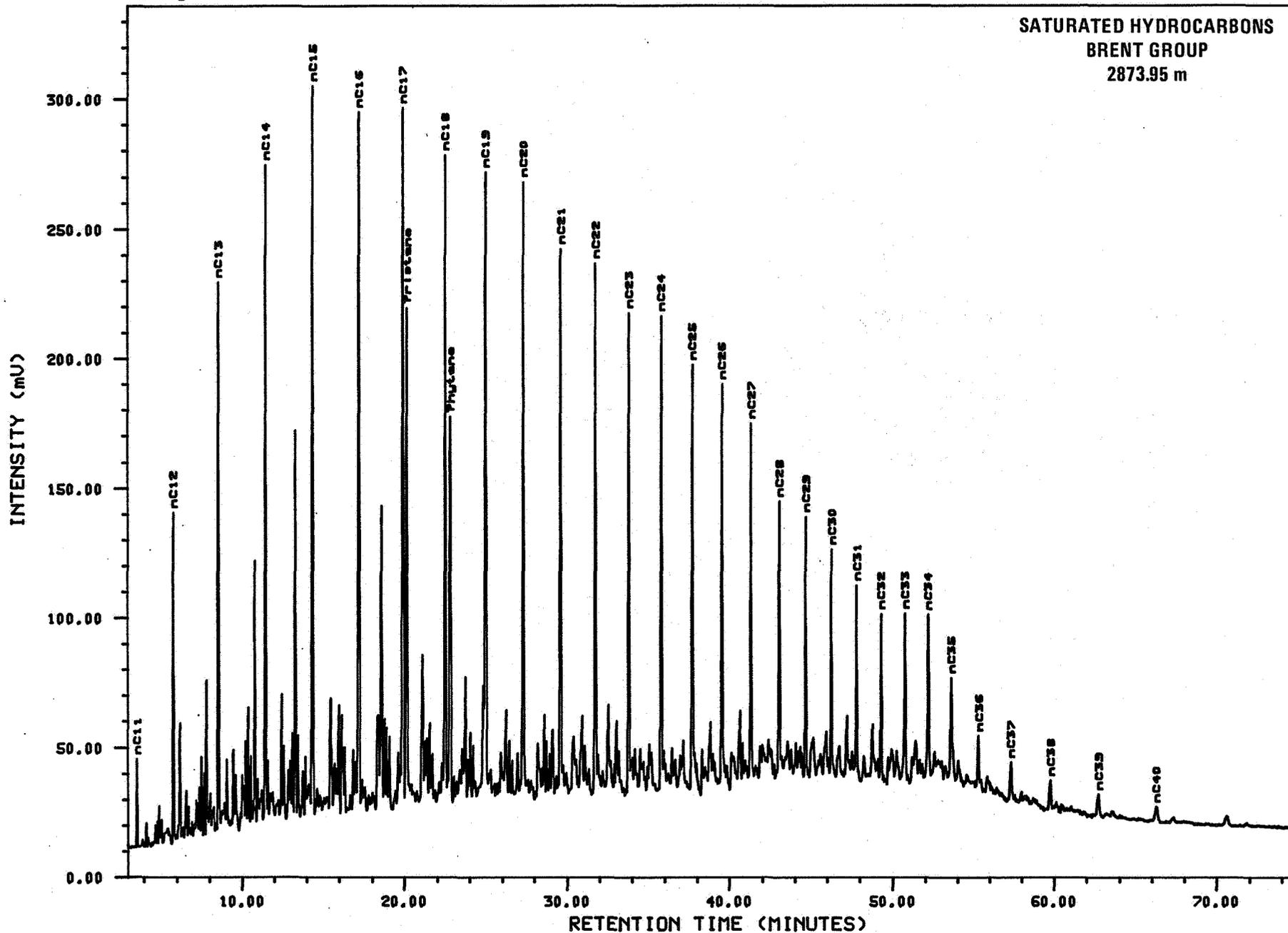
SATURATED HYDROCARBONS
BRENT GROUP
2848.45 m



Analysis 792AUT01

3,4,1 C-1626,SAT,30/3-4

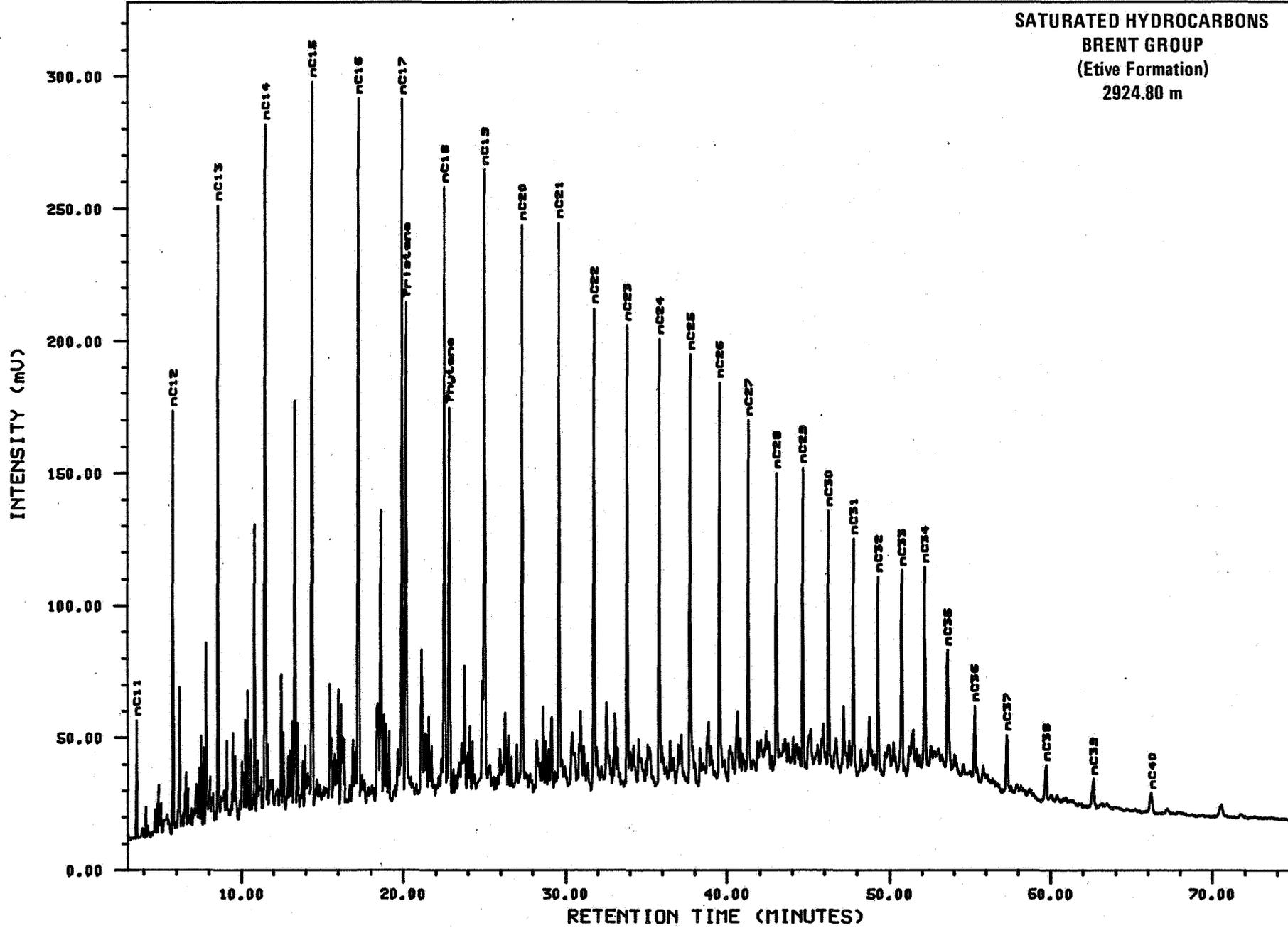
SATURATED HYDROCARBONS
BRENT GROUP
2873.95 m



Analysis 792AUT01

3,5,1 C-1627,SAT,30/3-4

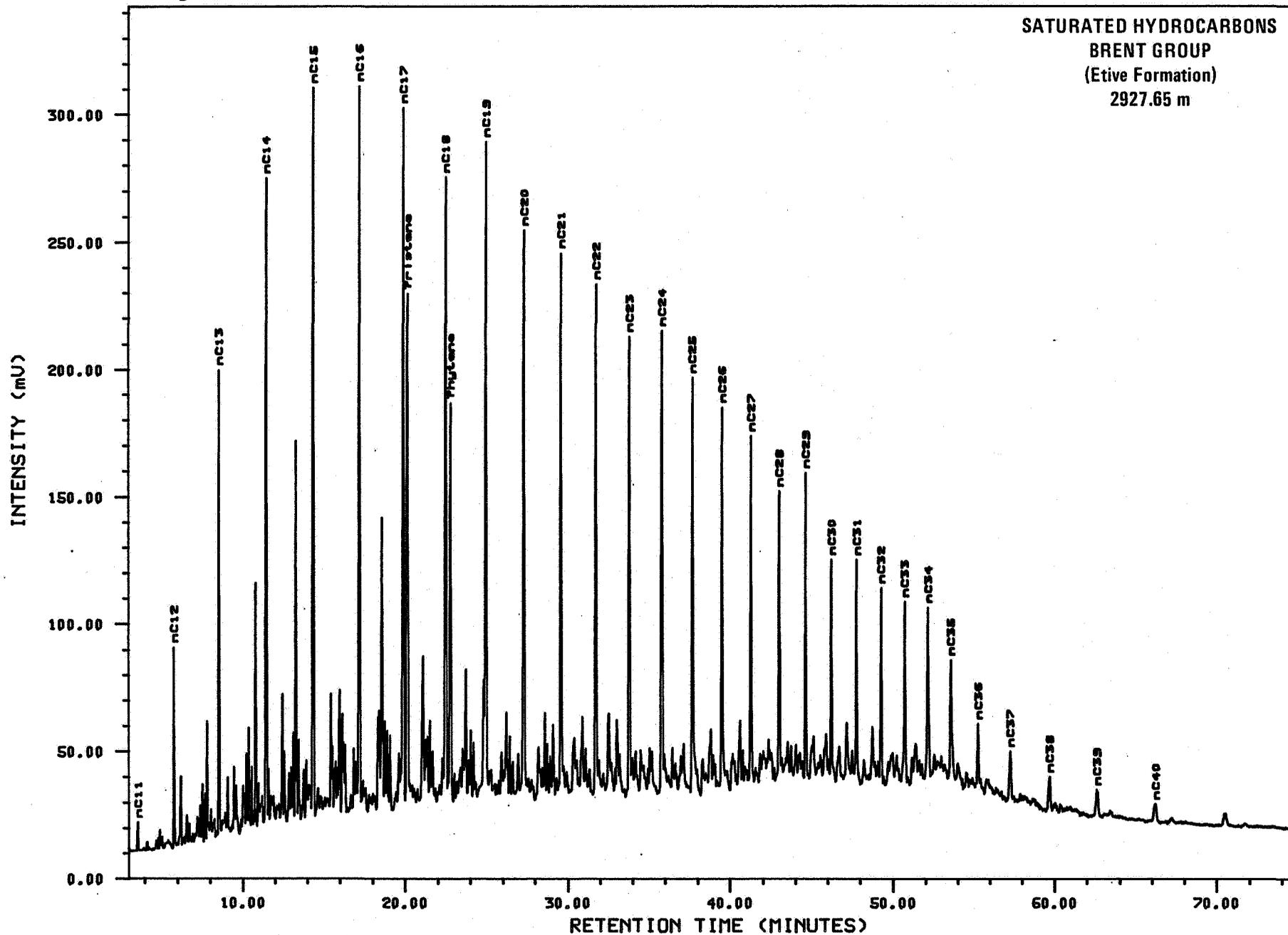
SATURATED HYDROCARBONS
BRENT GROUP
(Etive Formation)
2924.80 m

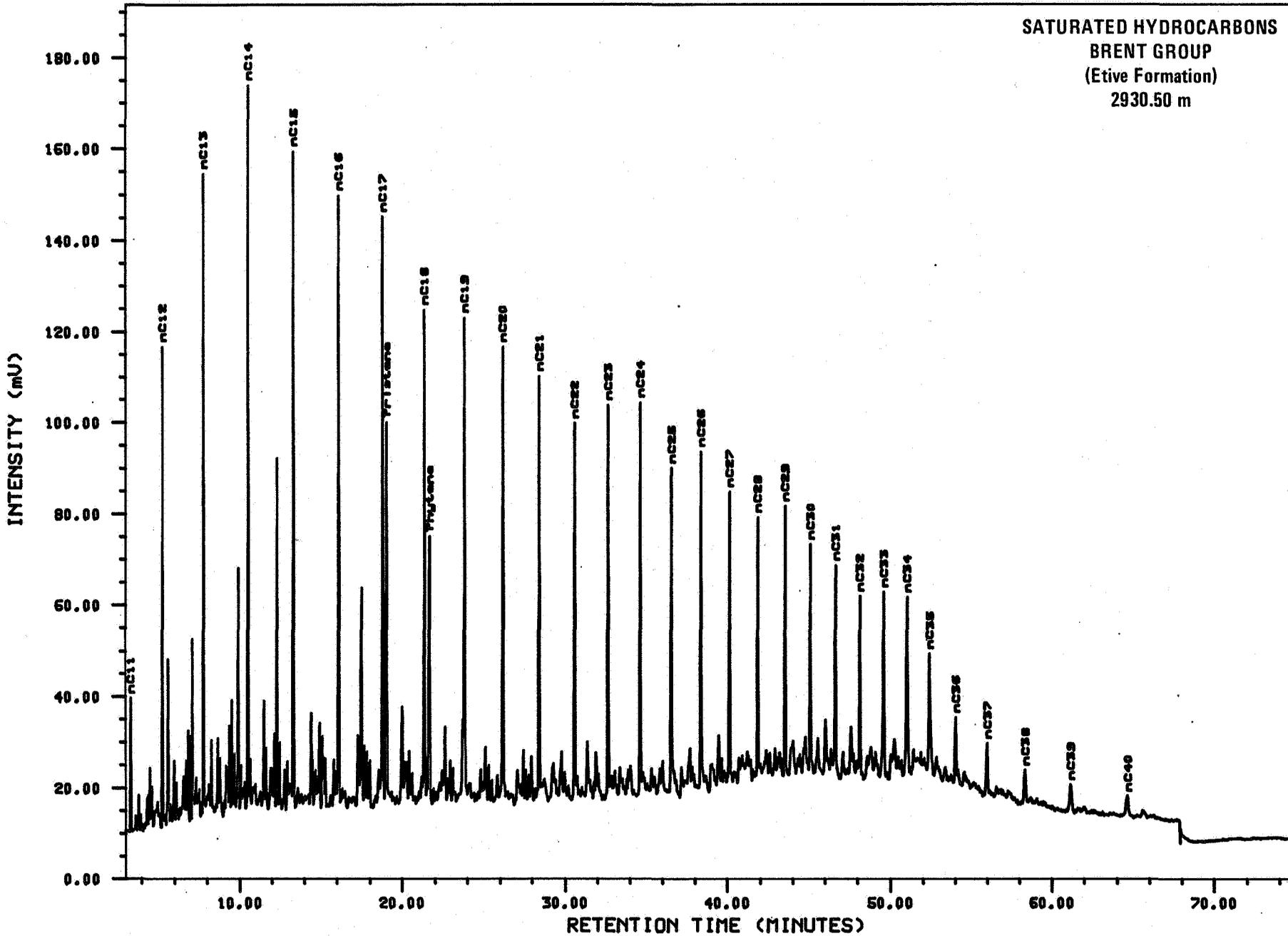


Analysis 792AUT01

3,6,1 C-1628,SAT,30/3-4

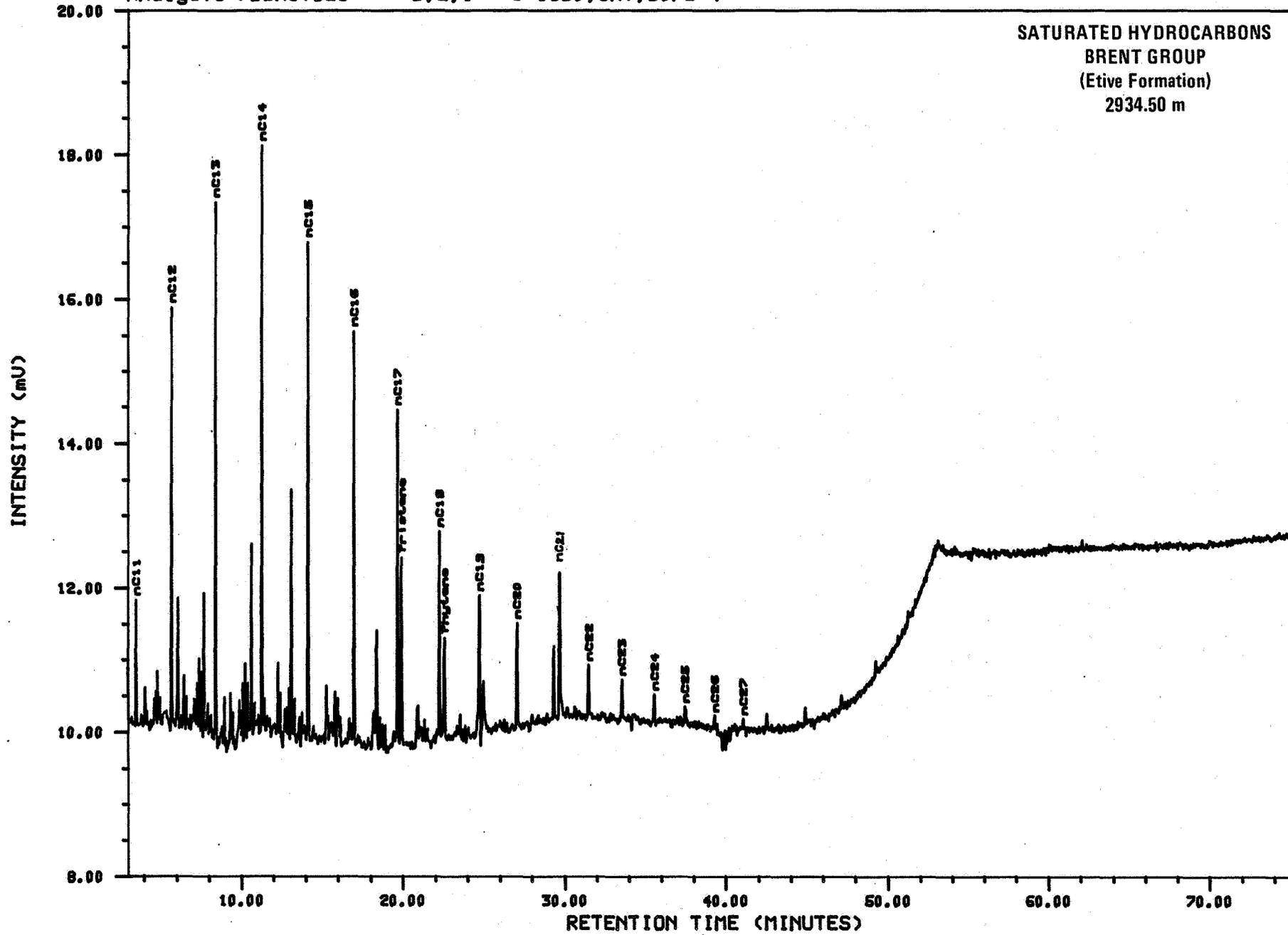
SATURATED HYDROCARBONS
BRENT GROUP
(Etive Formation)
2927.65 m





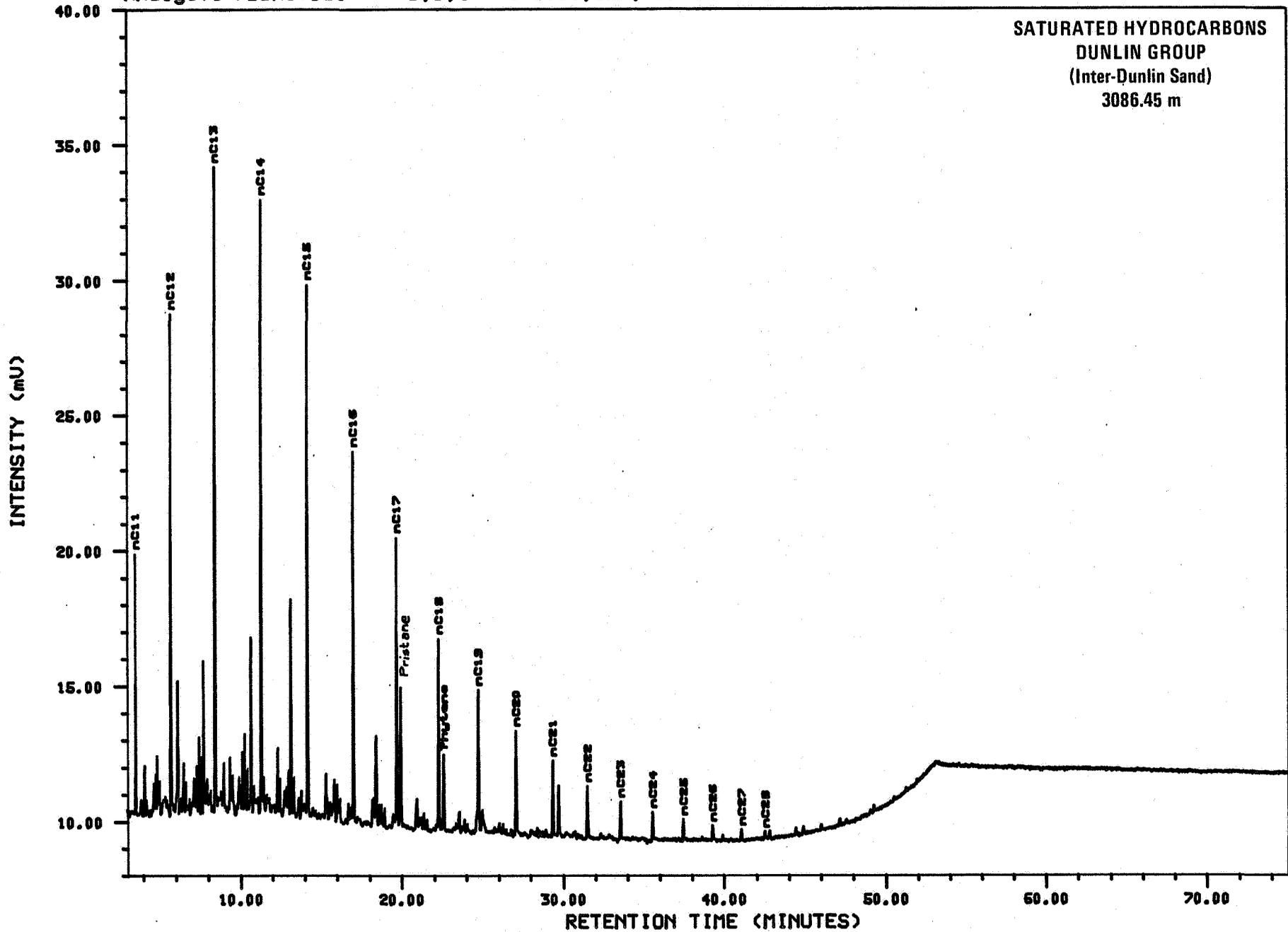
Analysis 793AUT02S 3,2,1 C-1630,SAT,30/3-4

SATURATED HYDROCARBONS
BRENT GROUP
(Etive Formation)
2934.50 m



Analysis 793AUT02S 3,3,1 C-1631, SAT, 30/3-4

SATURATED HYDROCARBONS
DUNLIN GROUP
(Inter-Dunlin Sand)
3086.45 m



Analysis 793AUT02S

3,4,1 C-1632,SAT,30/3-4

SATURATED HYDROCARBONS
DUNLIN GROUP
(Intra-Dunlin Sand)
3088.75 m

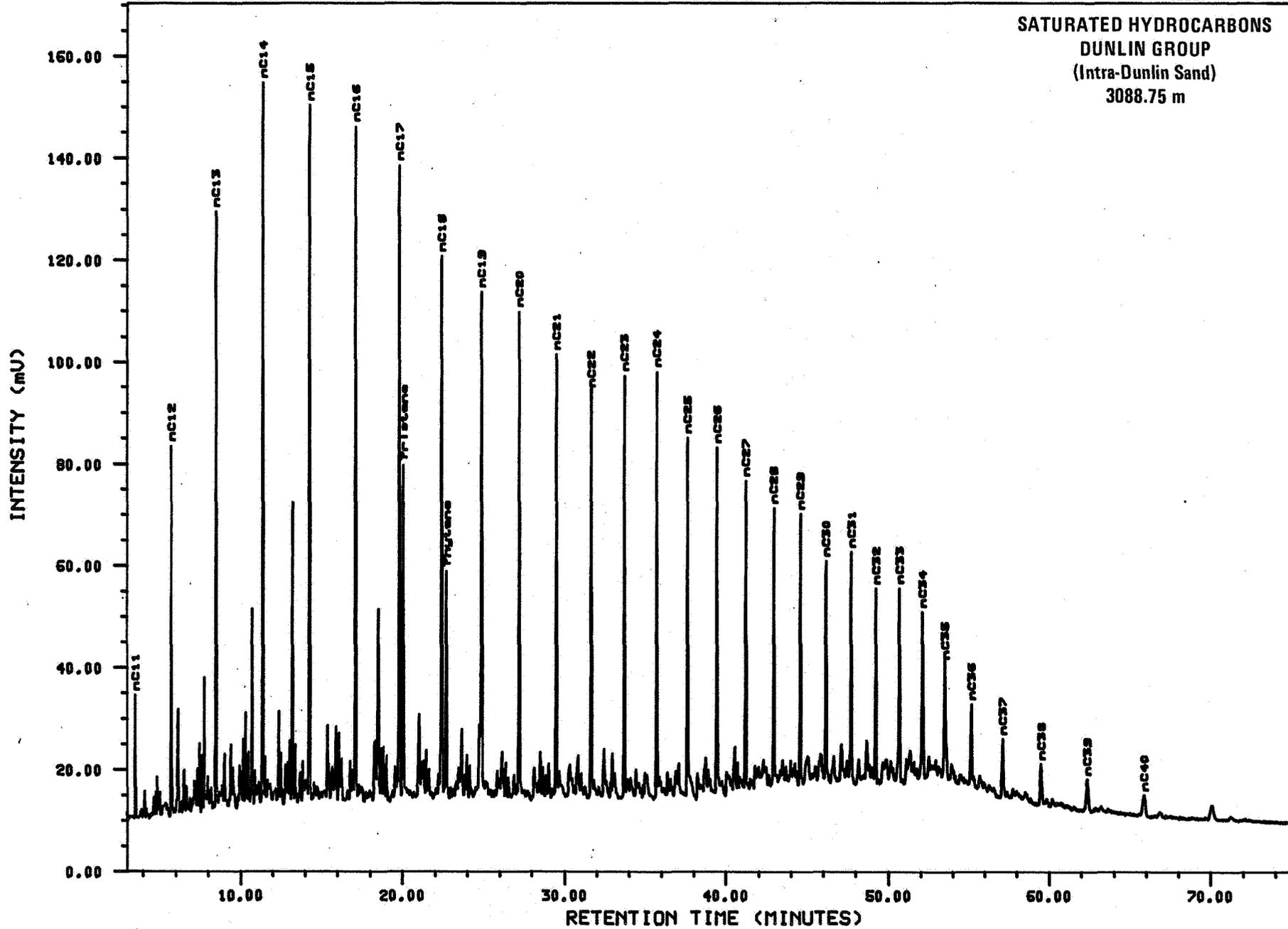


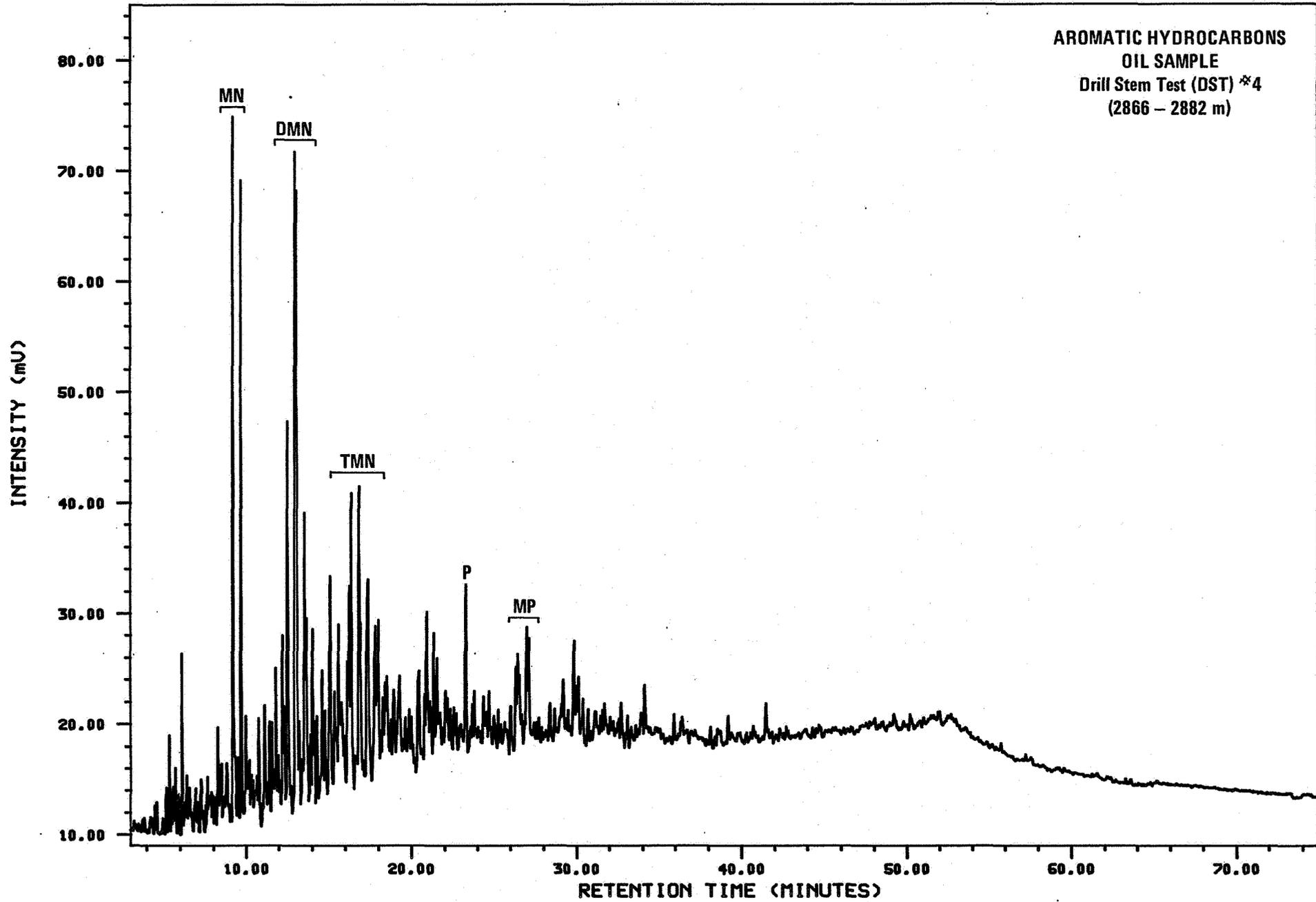
FIGURE 8

AROMATIC HYDROCARBON GAS CHROMATOGRAMS

N,MN,DMN,TMN	- naphthalene and alkylated homologs
P,MP,DMP	- phenanthrene and alkylated homologs

Analysis 792AUT04A 2,5,1 C-1648,ARO,30/3-4

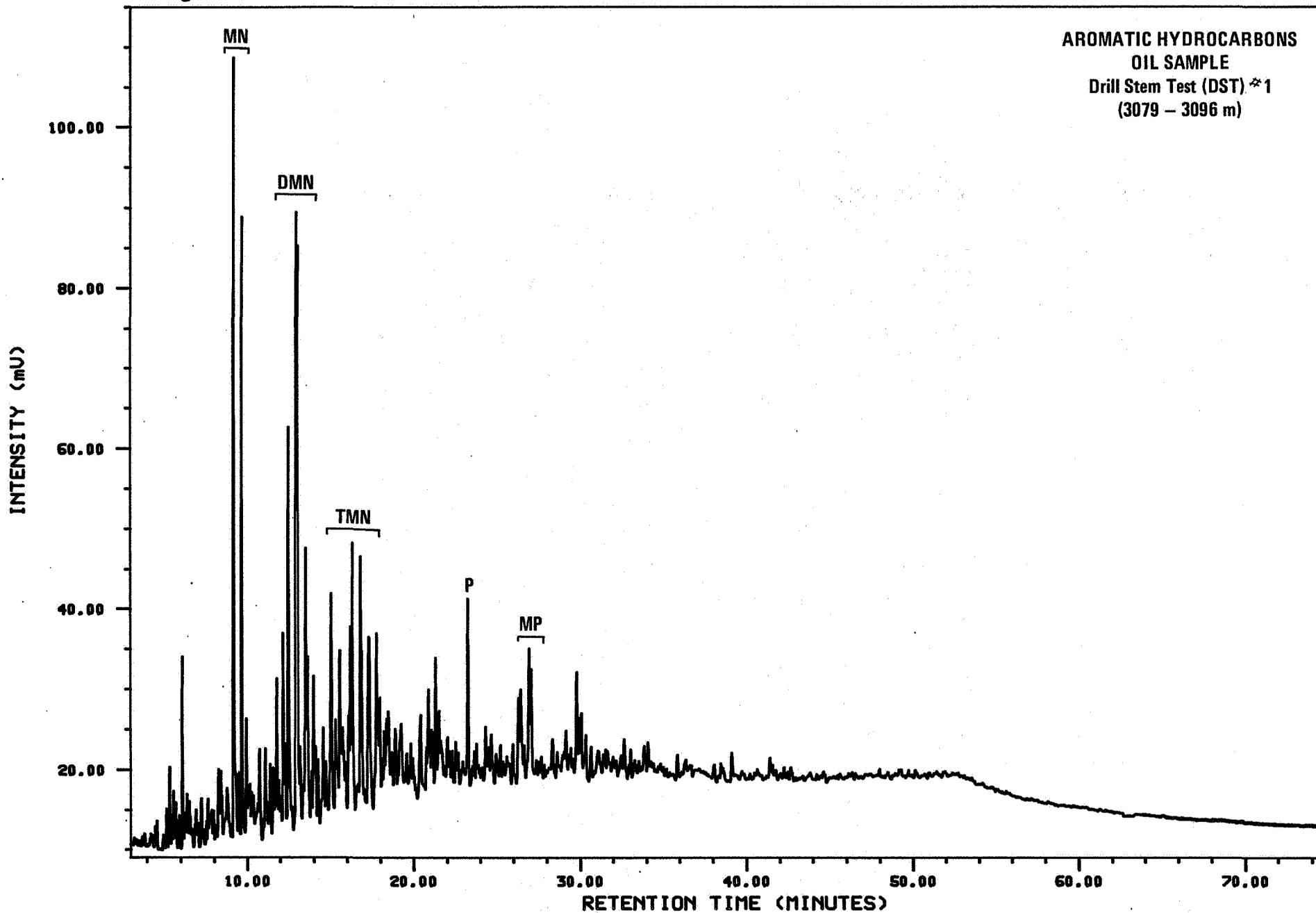
AROMATIC HYDROCARBONS
OIL SAMPLE
Drill Stem Test (DST) *4
(2866 - 2882 m)



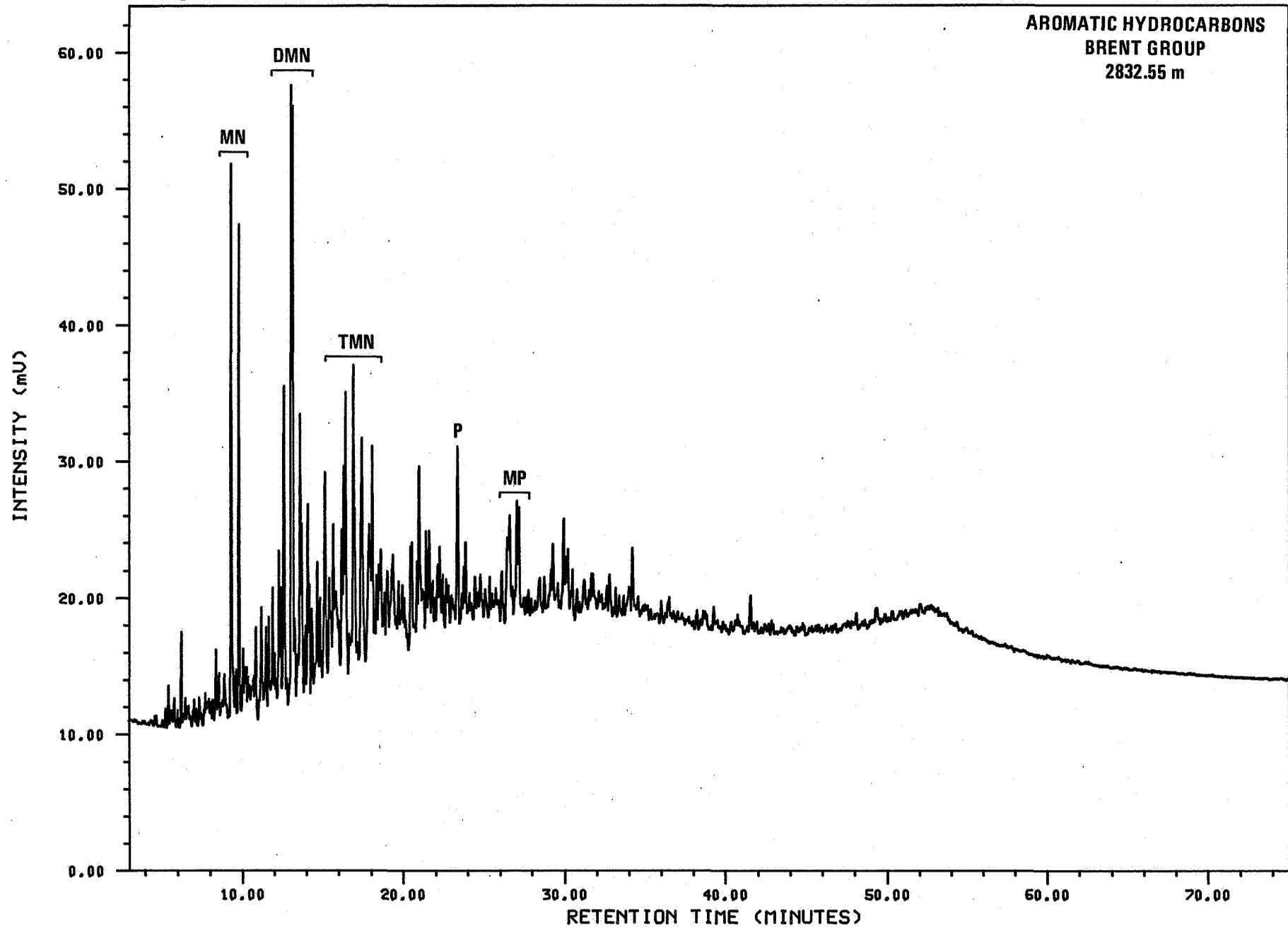
Analysis 792AUT04A

2,4,1 C-1647,ARO,30/3-4

AROMATIC HYDROCARBONS
OIL SAMPLE
Drill Stem Test (DST) *1
(3079 - 3096 m)

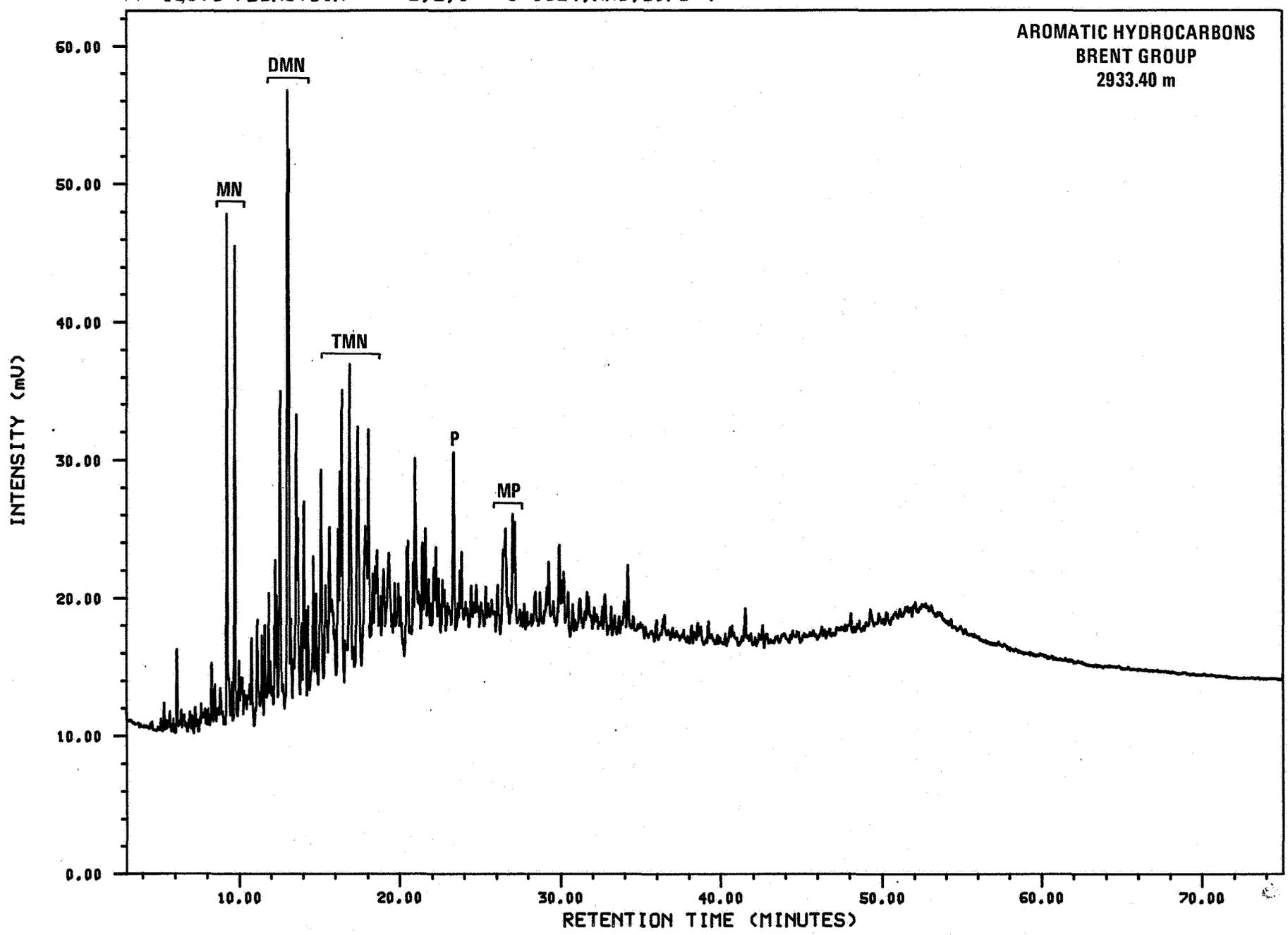


Analysis 793AUT01A 2,1,1 C-1623,ARO,30/3-4,



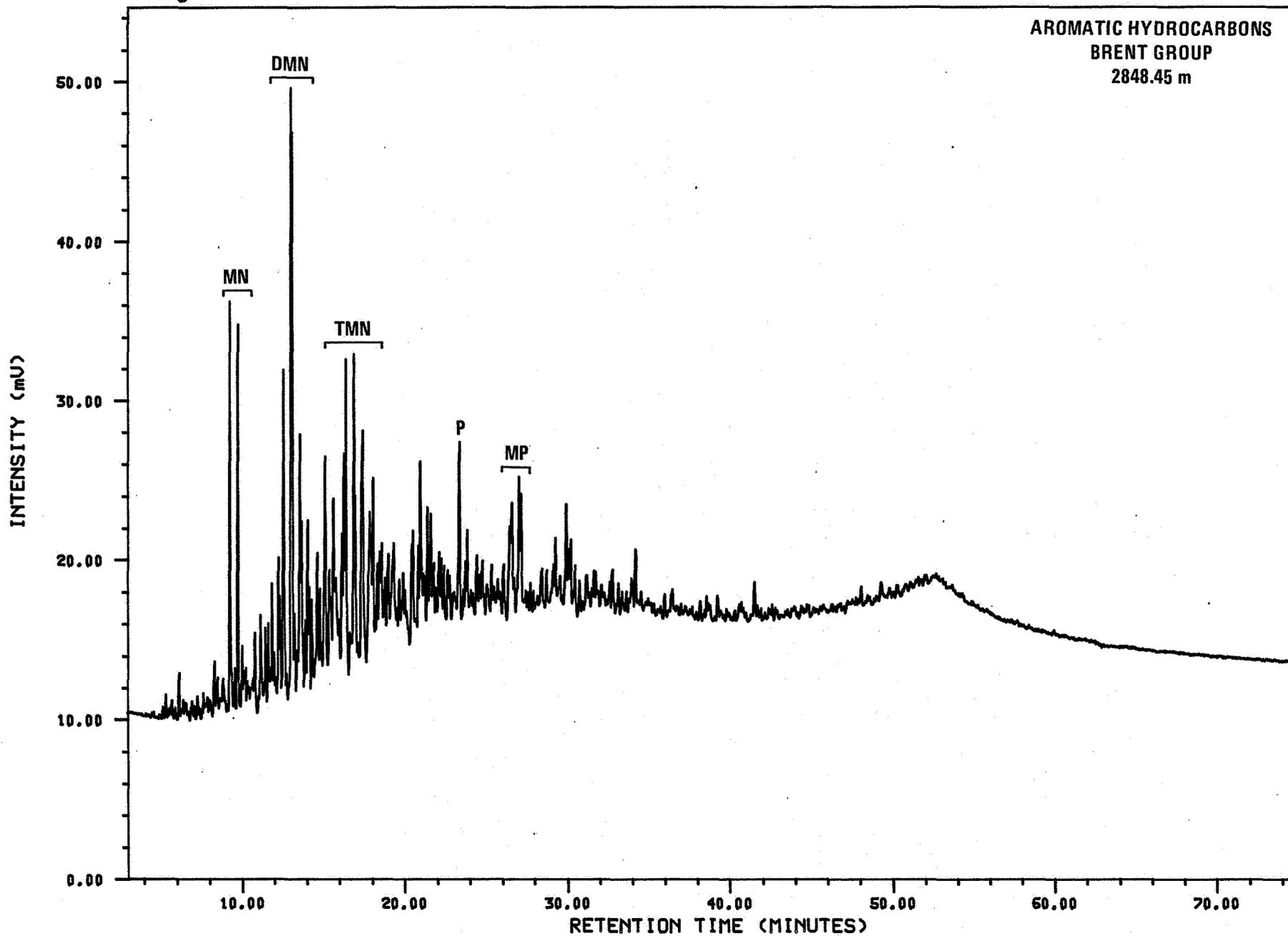
Analysis 793AUT01A 2,2,1 C-1624,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
2933.40 m



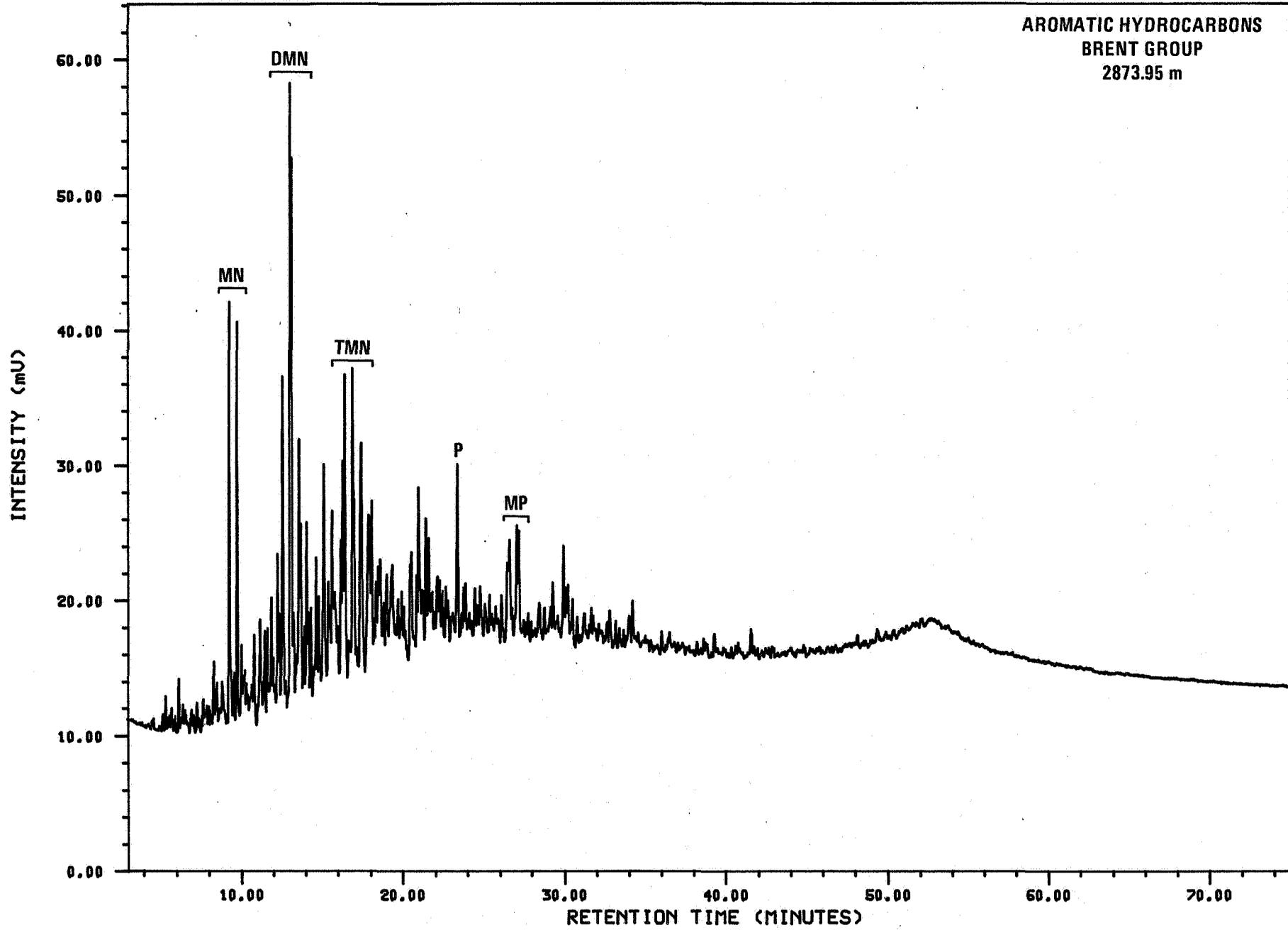
Analysis 793AUT01A 2,3,1 C-1625,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
2848.45 m

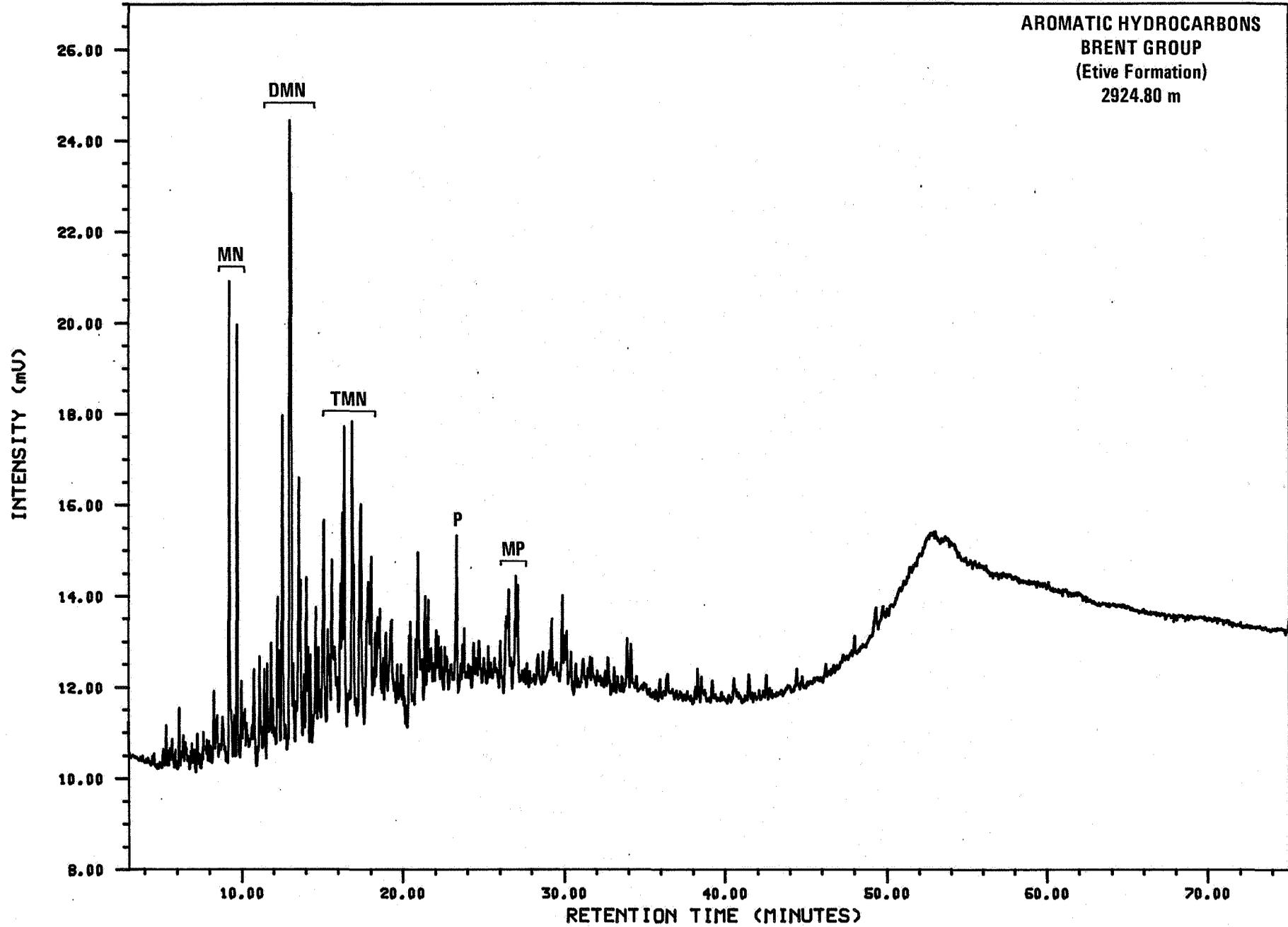


Analysis 793AUT01A 2,4,1 C-1626,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
2873.95 m

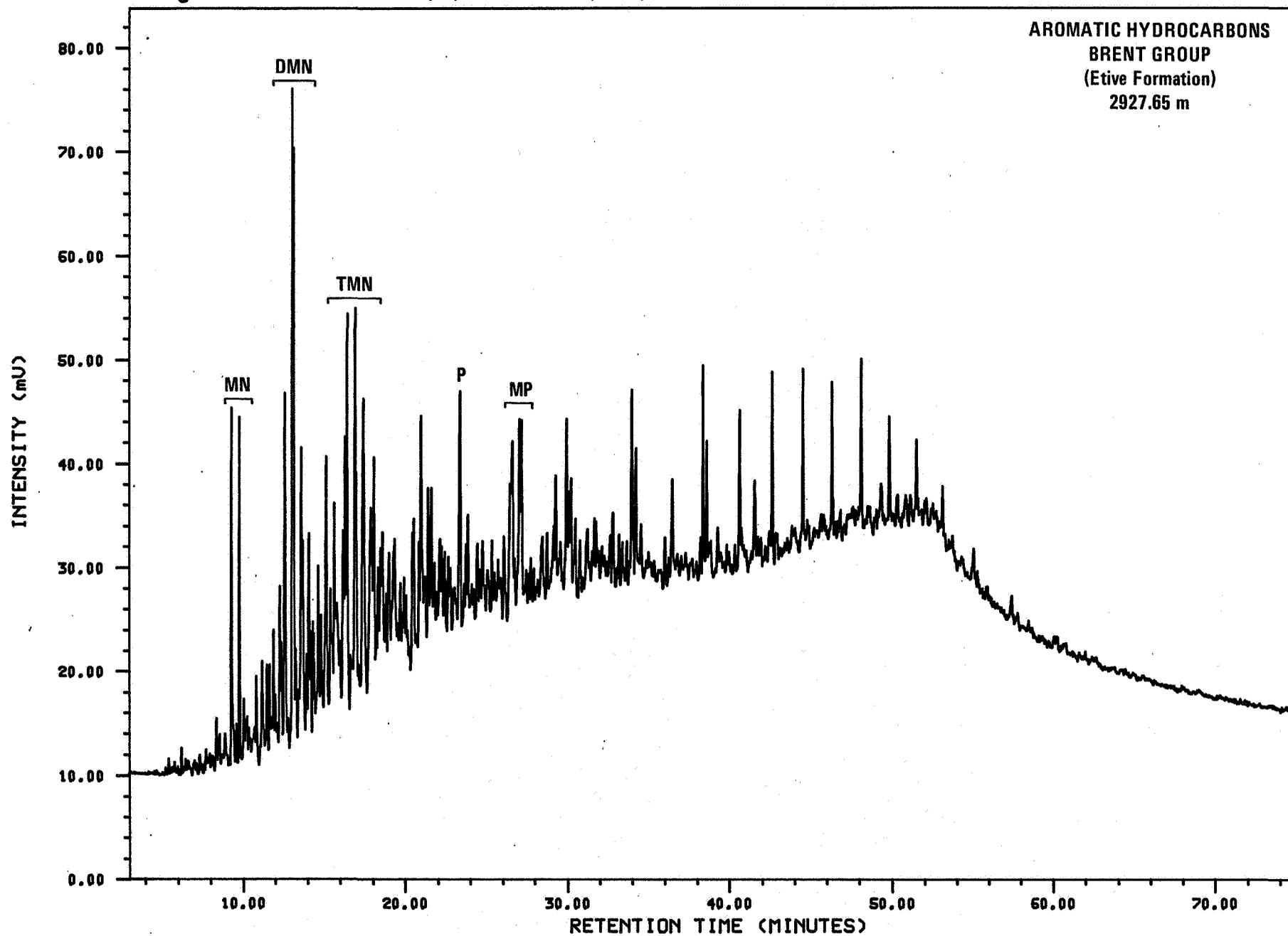


Analysis 793AUT01A 2,5,1 C-1627,ARO,30/3-4



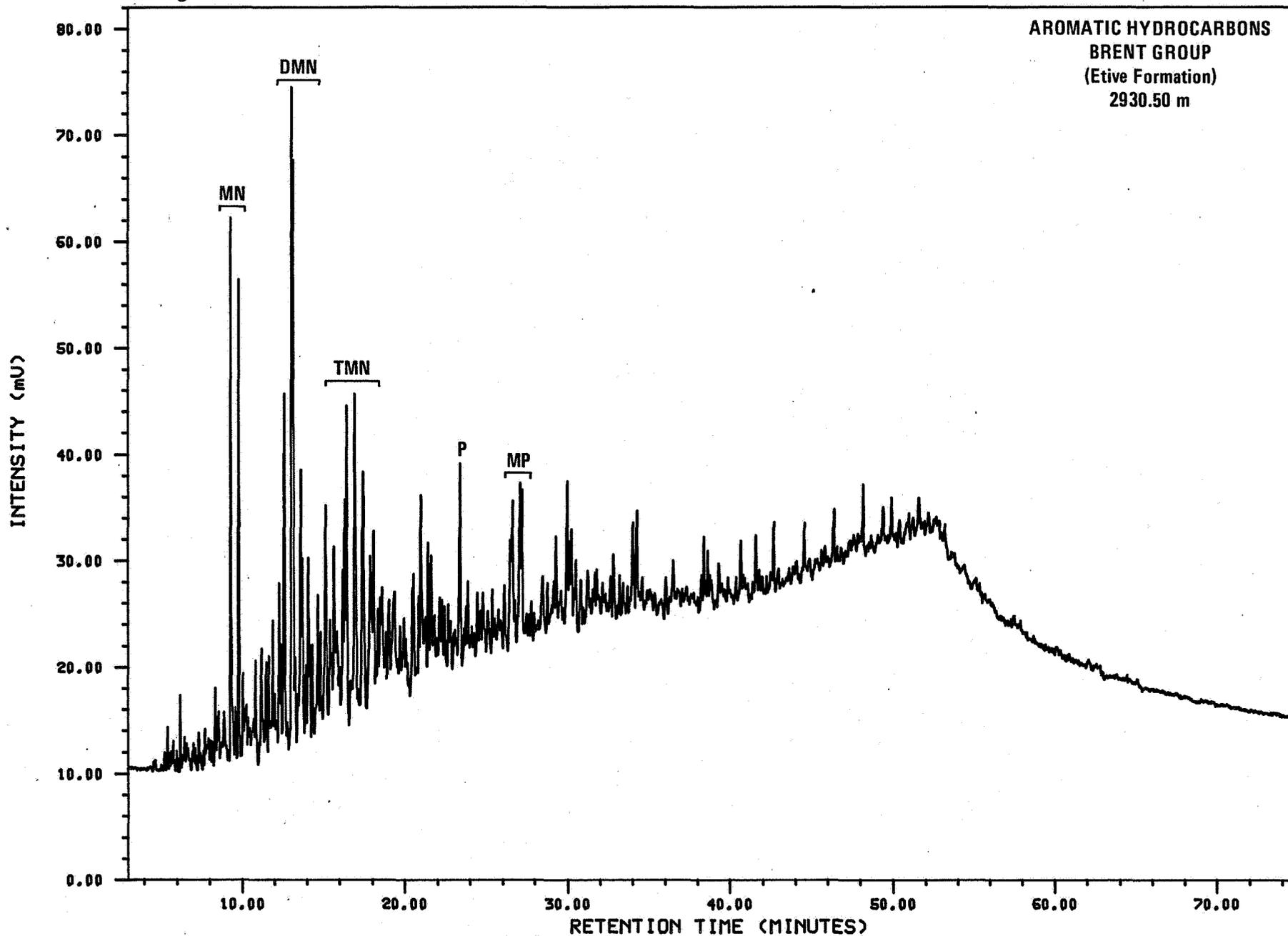
Analysis 793C1628A 2,1,1 C-1628,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
(Etive Formation)
2927.65 m



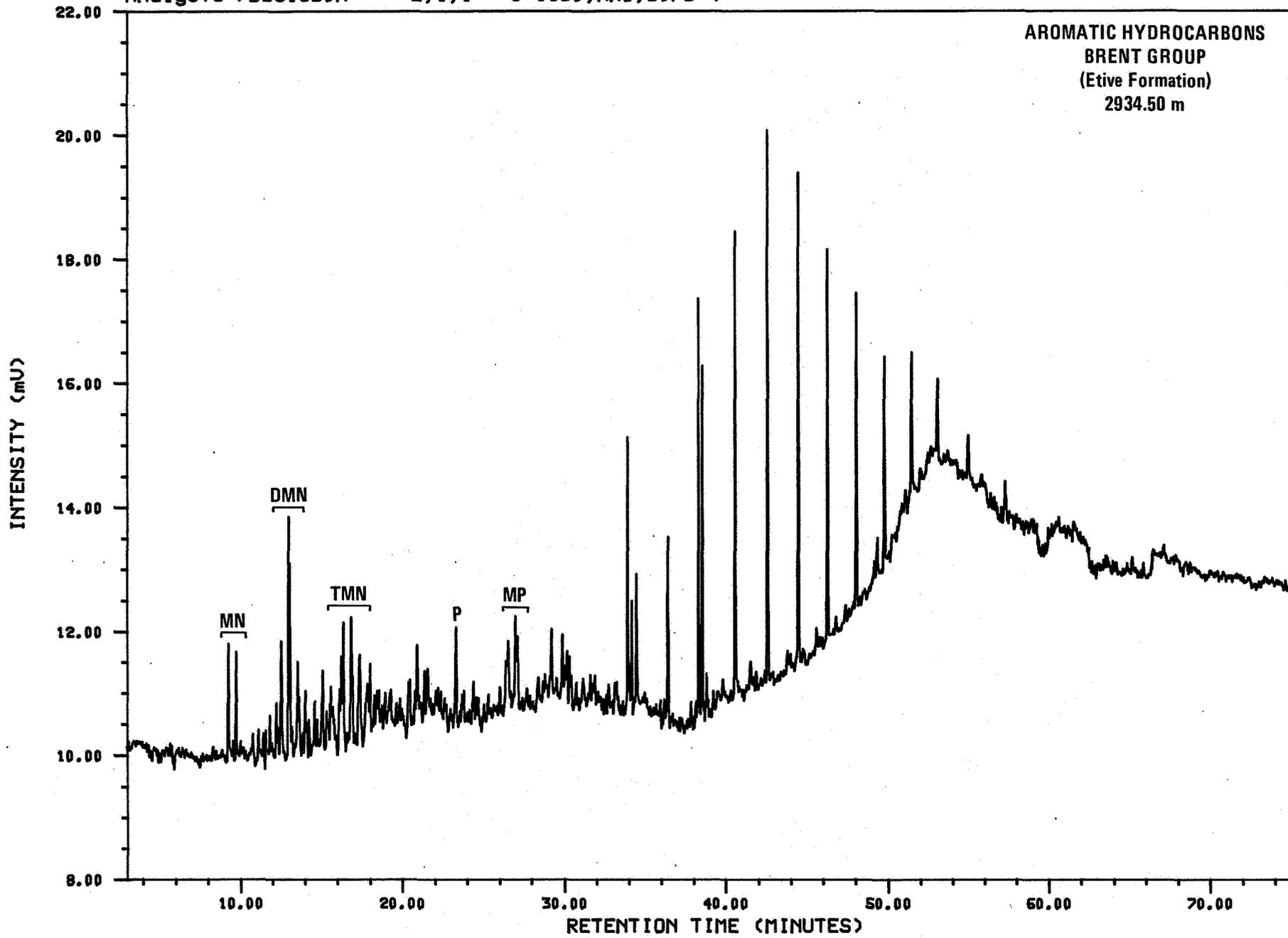
Analysis 793C1629A 2,1,1 C-1629,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
(Etive Formation)
2930.50 m



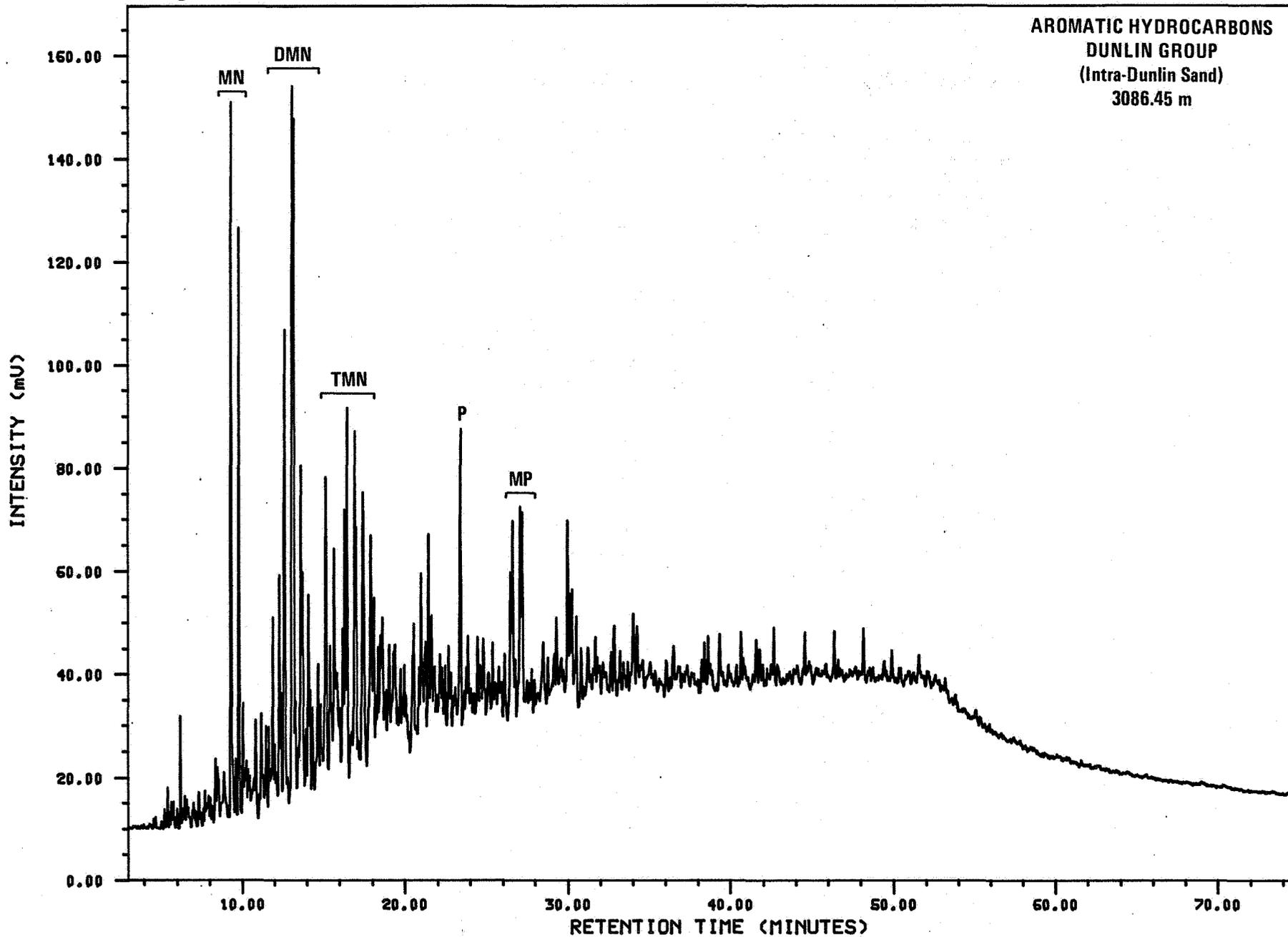
Analysis 793C1630A 2,1,1 C-1630,ARO,30/3-4

AROMATIC HYDROCARBONS
BRENT GROUP
(EIVE FORMATION)
2934.50 m



Analysis 793C1631A 2,1,1 C-1631,ARO,30/3-4

AROMATIC HYDROCARBONS
DUNLIN GROUP
(Intra-Dunlin Sand)
3086.45 m



Analysis 793C1632A 2,1,1 C-1632,ARO,30/3-4

AROMATIC HYDROCARBONS
DUNLIN GROUP
(Intra-Dunlin Sand)
3088.75 m

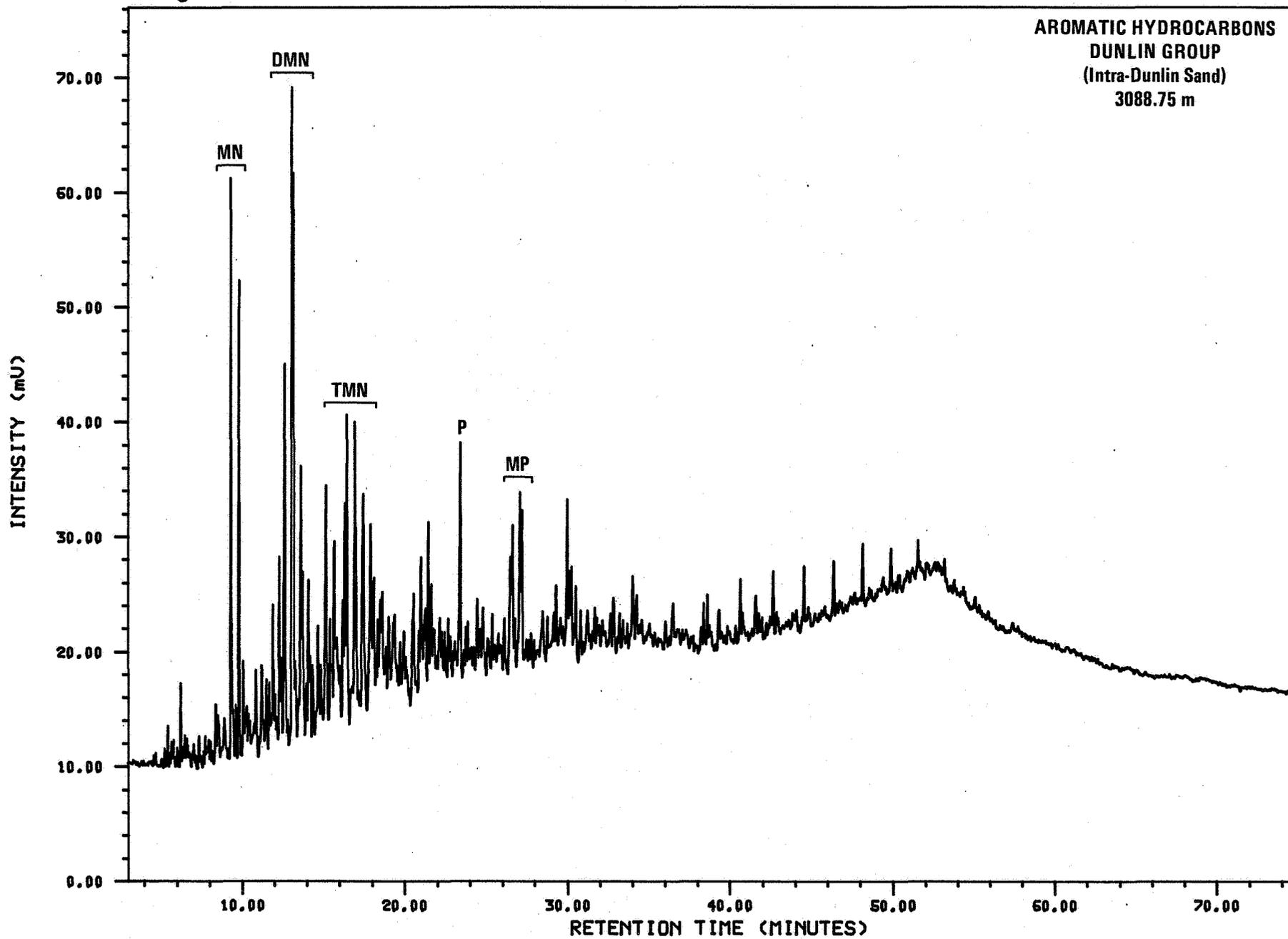
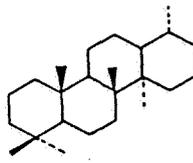
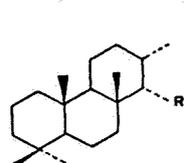
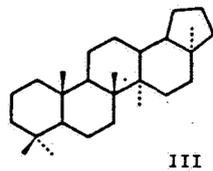
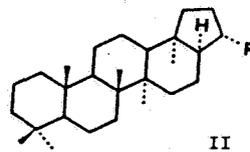
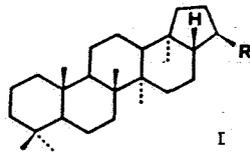


Figure 9a.

Mass chromatograms representing terpanes (m/z 191)

A	T _S , 18α(H)-trisnorneohopane	C ₂₇ H ₄₆	(III)
B	T _m , 17α(H)-trisnorhopane	C ₂₇ H ₄₆	(I, R=H)
C	17α(H)-norhopane	C ₂₉ H ₅₀	(I, R=C ₂ H ₅)
D	17β(H)-normoretane	C ₂₉ H ₅₀	(II, R=C ₂ H ₅)
E	17α(H)-hopane	C ₃₀ H ₅₂	(I, R=C ₃ H ₇)
F	17β(H)-moretane	C ₃₀ H ₅₂	(II, R=C ₃ H ₇)
G	17α(H)-homohopane (22S)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
H	17α(H)-homohopane (22R)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
	+ unknown triterpane (gammacerane?)		
I	17β(H)-homomoretane	C ₃₁ H ₅₄	(II, R=C ₄ H ₉)
J	17α(H)-bishomohopane (22S,22R)	C ₃₂ H ₅₆	(I, R=C ₅ H ₁₁)
K	17α(H)-trishomohopane (22S,22R)	C ₃₃ H ₅₈	(I, R=C ₆ H ₁₃)
L	17α(H)-tetrakishomohopane (22S,22R)	C ₃₄ H ₆₀	(I, R=C ₇ H ₁₅)
M	17α(H)-pentakishomohopane (22S,22R)	C ₃₅ H ₆₂	(I, R=C ₈ H ₁₇)
Z	bisnorhopane	C ₂₈ H ₄₈	
X	unknown triterpane	C ₃₀ H ₅₂	
P	tricyclic terpane	C ₂₃ H ₄₂	(IV, R=C ₄ H ₉)
Q	tricyclic terpane	C ₂₄ H ₄₄	(IV, R=C ₅ H ₁₁)
R	tricyclic terpane (17R,17S)	C ₂₅ H ₄₆	(IV, R=C ₆ H ₁₃)
S	tetracyclic terpane	C ₂₄ H ₄₂	(V)
T	tricyclic terpane (17R,17S)	C ₂₆ H ₄₈	(IV, R=C ₇ H ₁₅)



C1647S

Sir:Voltage - 220 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 12914

Text:  SINTEF-GRUPPEN

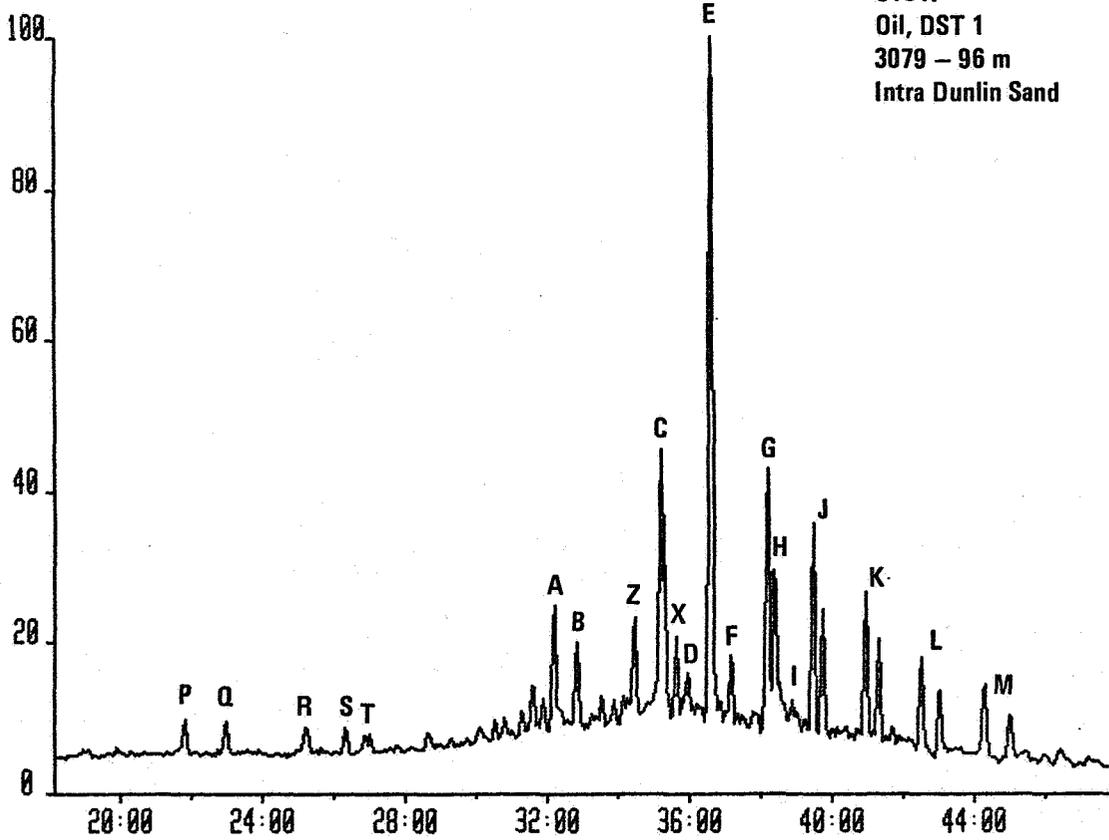
m/z 191

C1647

Oil, DST 1

3079 - 96 m

Intra Dunlin Sand



C1648S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 191.1000

Norm: 5235

Text:  SINTEF-GRUPPEN

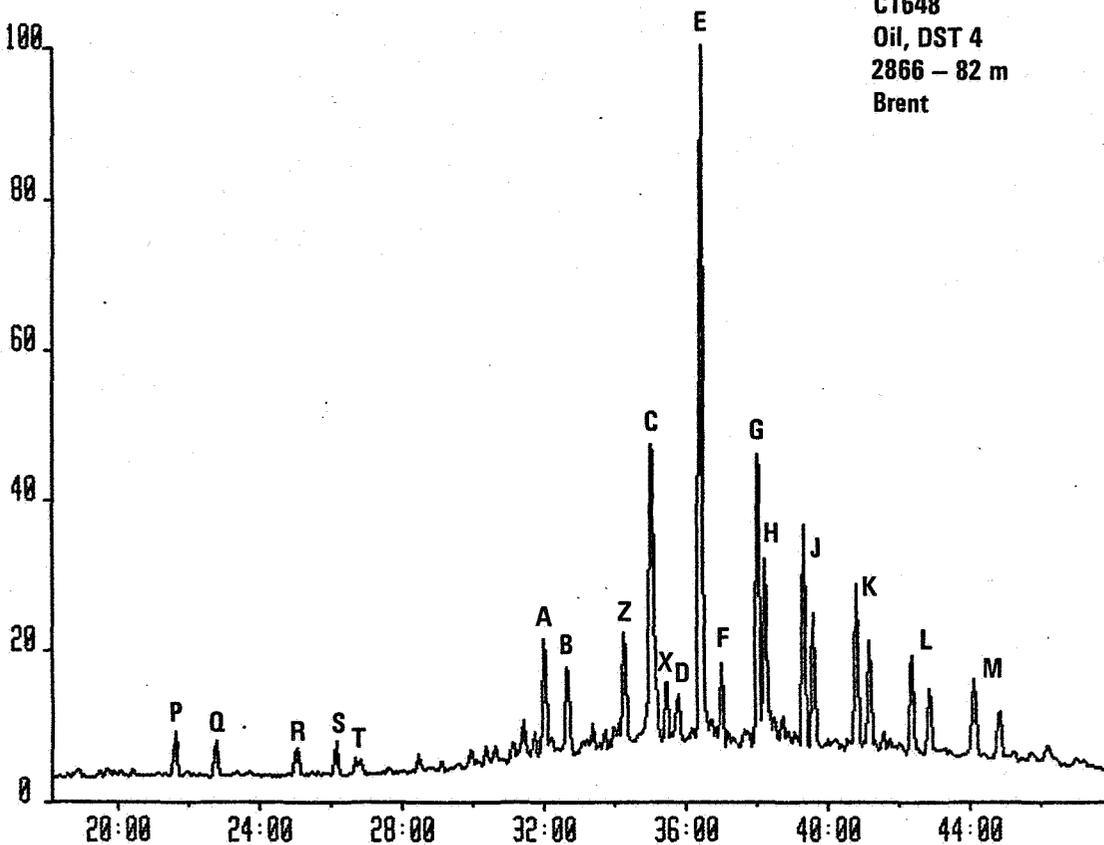
m/z 191

C1648

Oil, DST 4

2866 - 82 m

Brent



C1623S

Sir:Voltage - 221 - Acnt:IKU

System:

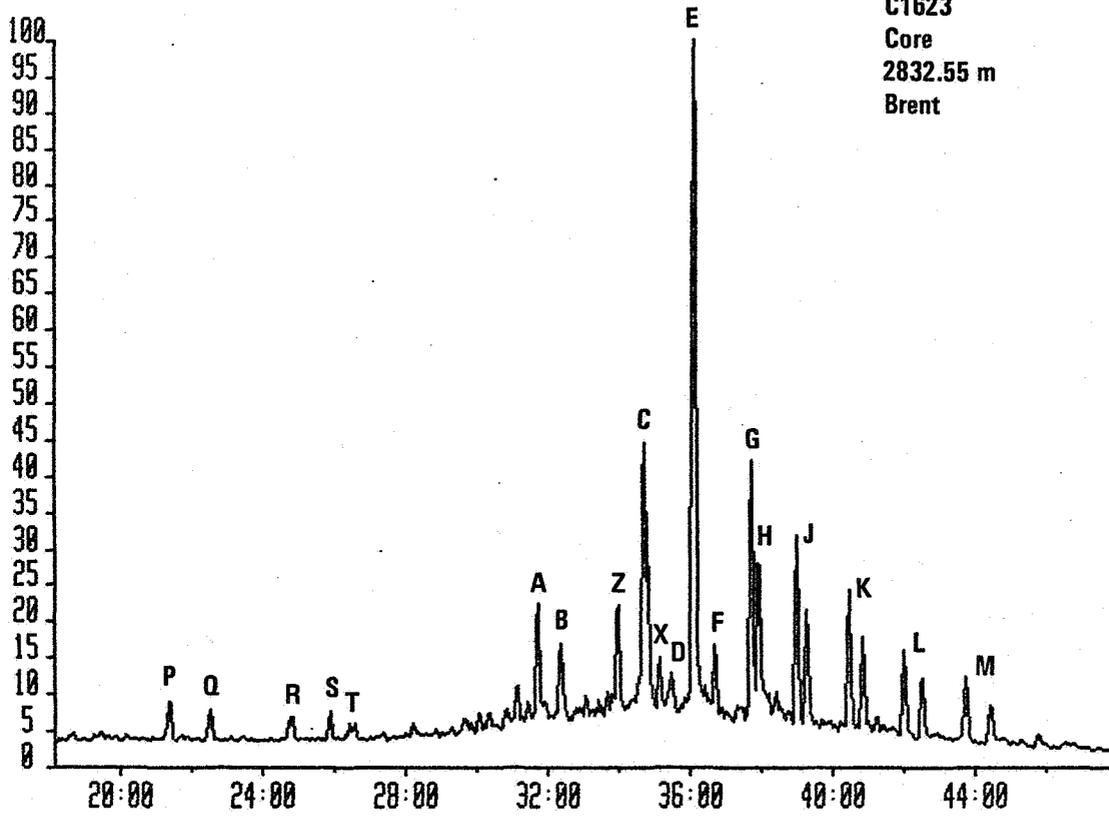
Sample Injektion 1

Group 1 Mass 191.1000

Norm: 7188

Text:  SINTEF-GRUPPEN

m/z 191
C1623
Core
2832.55 m
Brent



C1624S

Sir:Voltage 7070H Acnt:IKU

System:

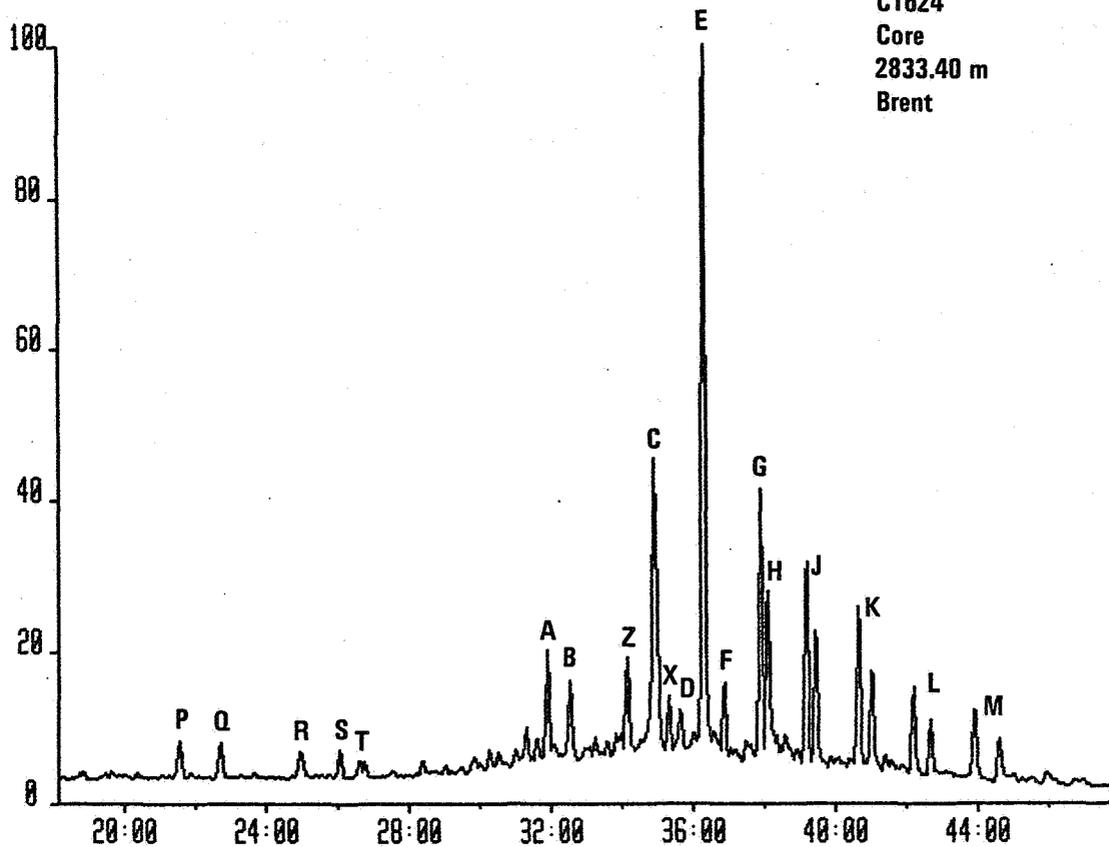
Sample Injektion 1

Group 1 Mass 191.1000

Norm: 6658

Text:  SINTEF-GRUPPEN

m/z 191
C1624
Core
2833.40 m
Brent



C16255

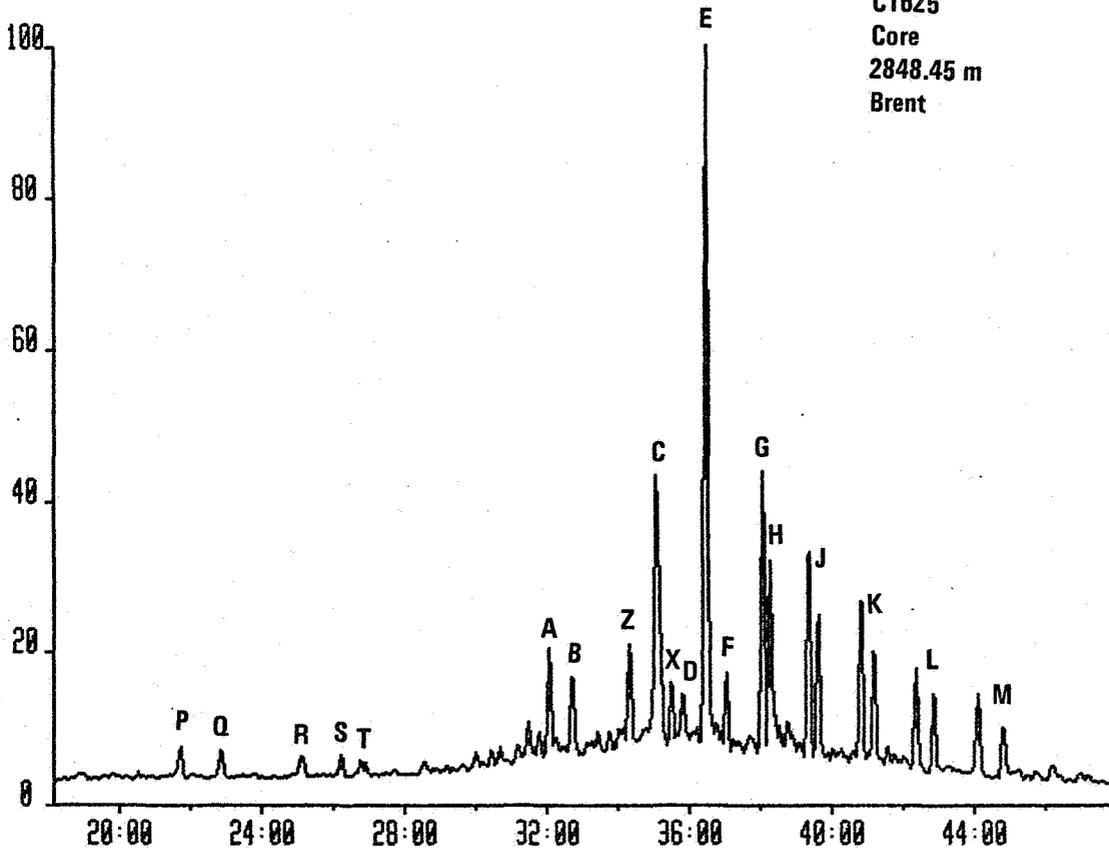
Sir:Voltage - 222 - Acnt:IKU

System:

Sampl. Injection 1 Group 1 Mass 191.1000
Text. SINTEF-GRUPPEN

Norm: 14215

m/z 191
C1625
Core
2848.45 m
Brent



C16265

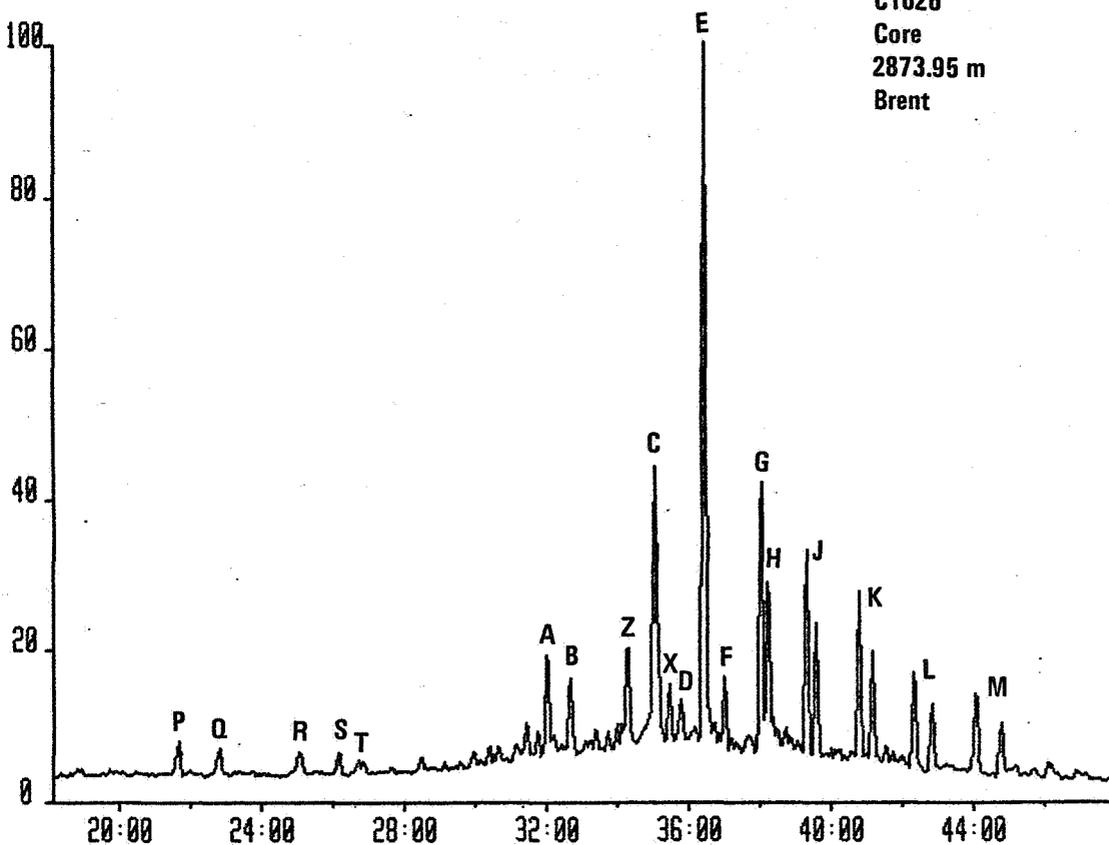
Sir:Voltage 7070H Acnt:IKU

System:

Sampl. Injection 1 Group 1 Mass 191.1000
Text. SINTEF-GRUPPEN

Norm: 11036

m/z 191
C1626
Core
2873.95 m
Brent



C1627S

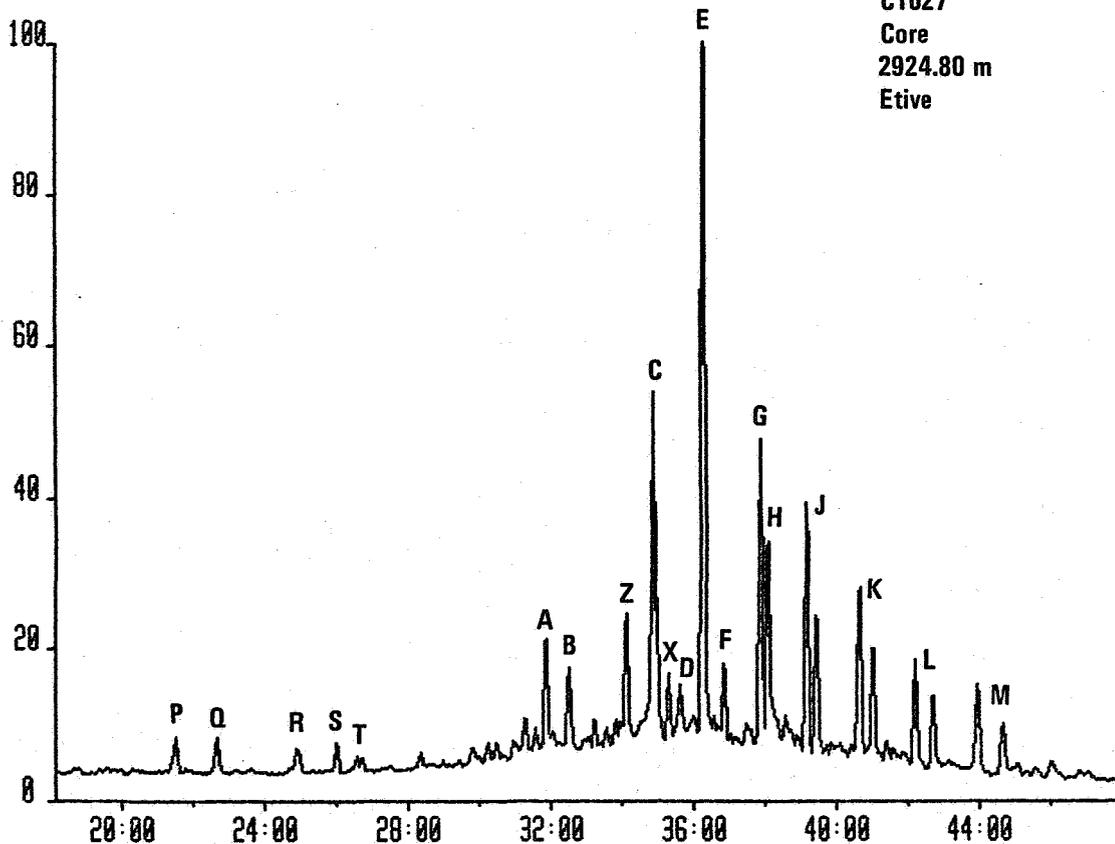
Sir:Voltage - 223 - Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 191.1000
Text 

Norm: 9152

m/z 191
C1627
Core
2924.80 m
Etive



C1628S

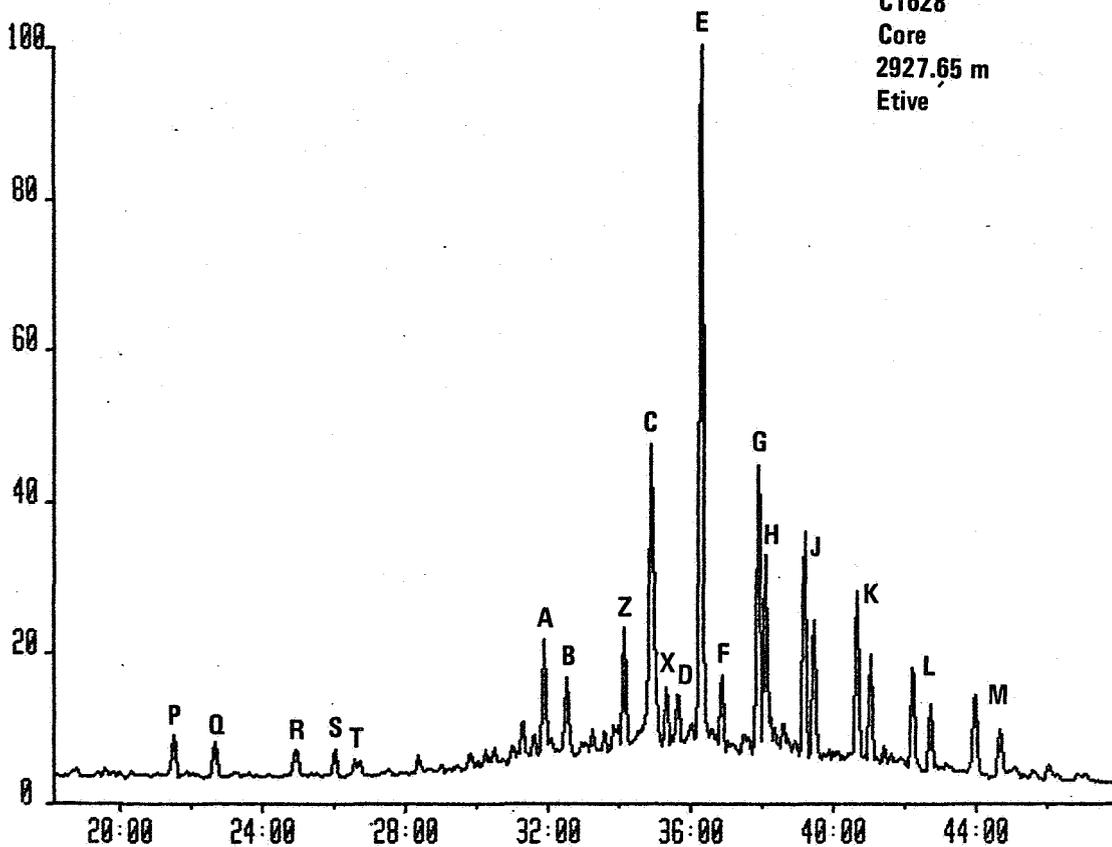
Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 191.1000
Text 

Norm: 7272

m/z 191
C1628
Core
2927.65 m
Etive





IKU

SINTEF-GRUPPEN

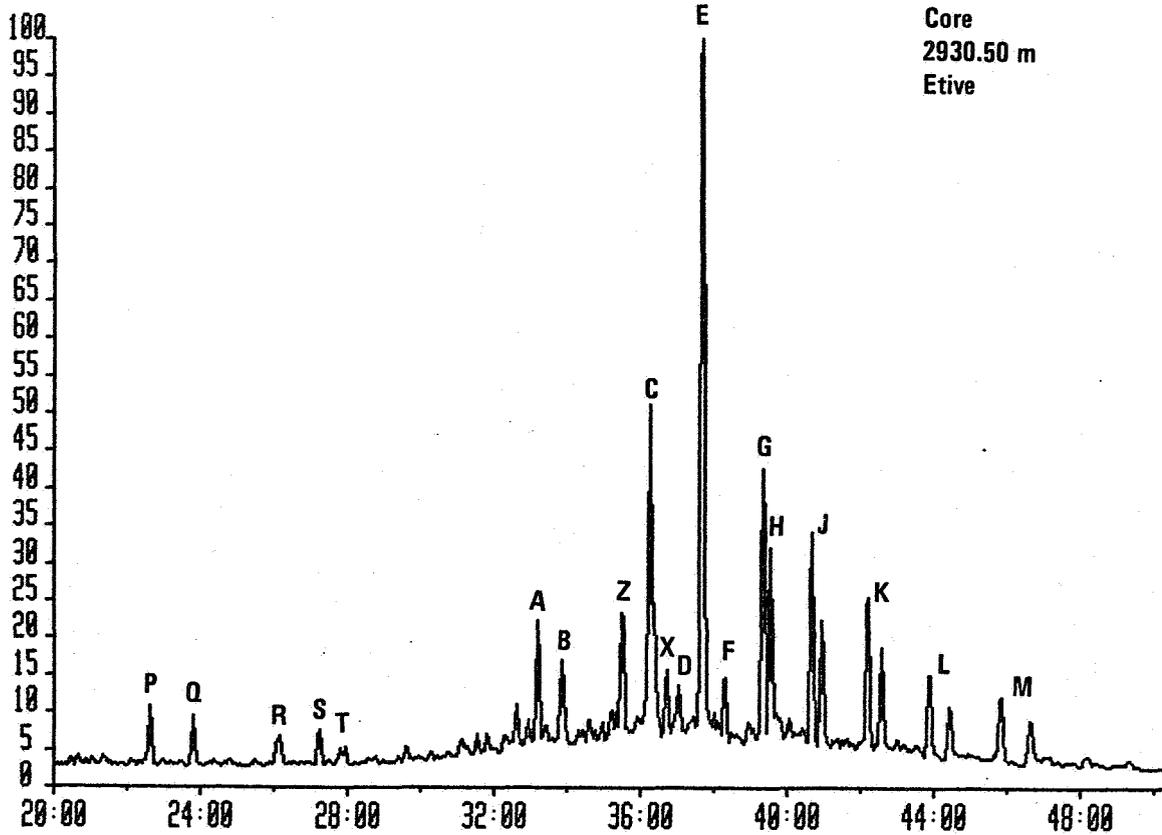
C1629
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

Srv:Voltage 7070H

Acnt:IKU

System:

Norm: 1789
m/z 191
C1629
Core
2930.50 m
Etive



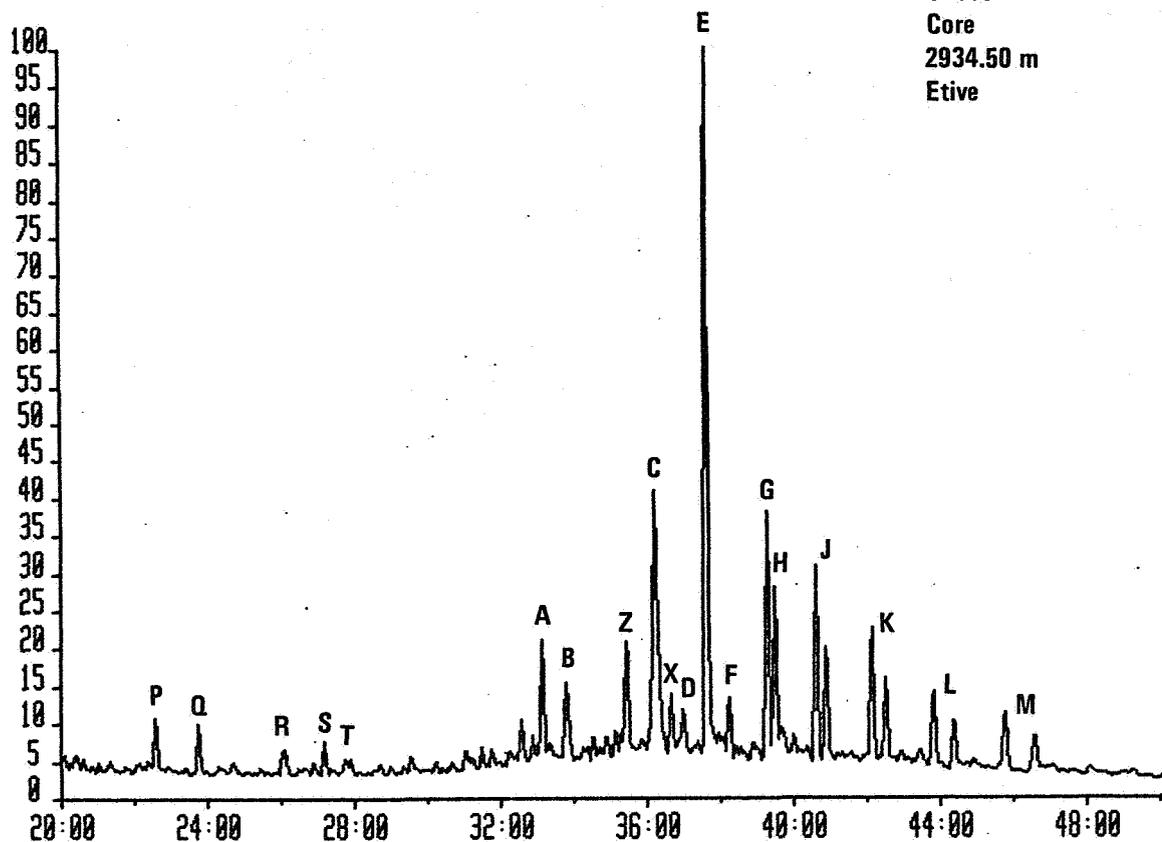
C1630
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

Srv:Voltage 7070H

Acnt:IKU

System:

Norm: 1144
m/z 191
C1630
Core
2934.50 m
Etive

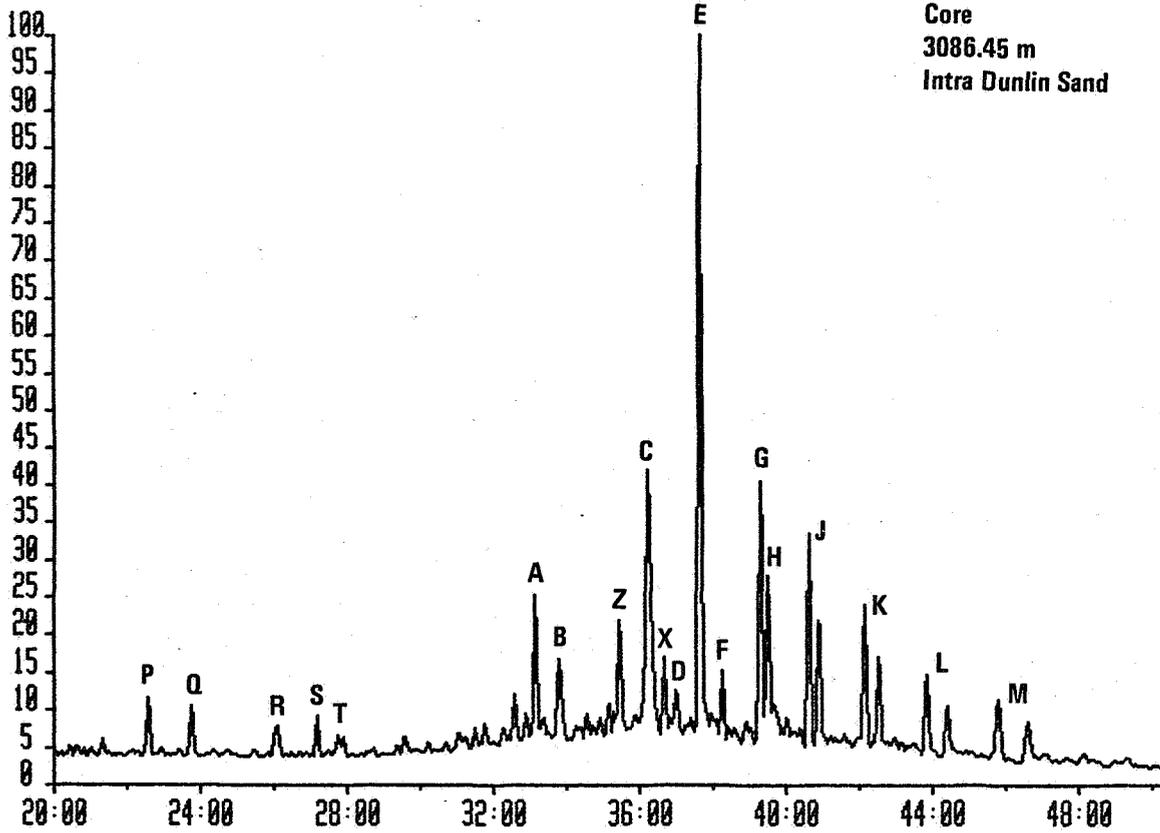




IKU
SINTEF-GRUPPEN

C1631
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:
Norm: 1794
m/z 191
C1631
Core
3086.45 m
Intra Dunlin Sand



C1632
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:
Norm: 1389
m/z 191
C1632
Core
3088.75 m
Intra Dunlin Sand

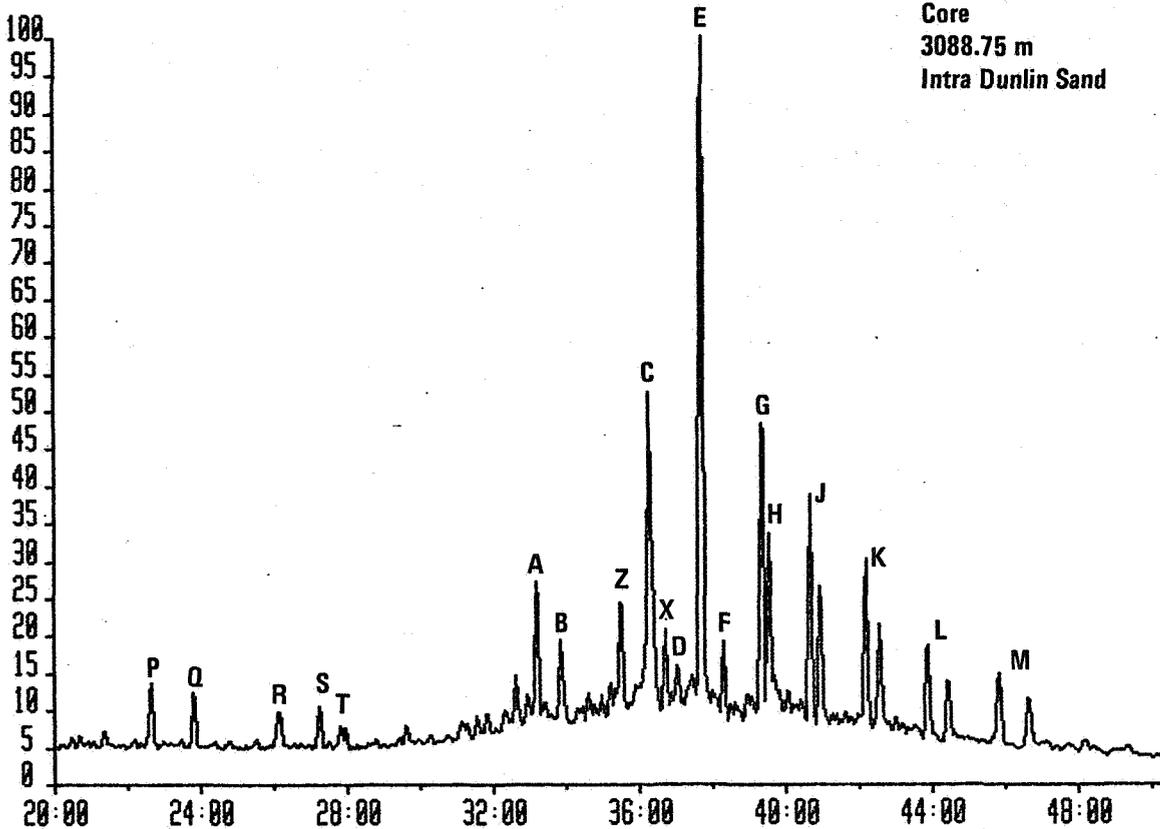
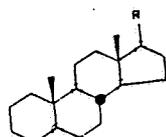
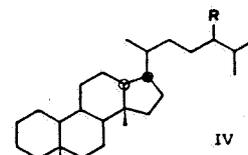
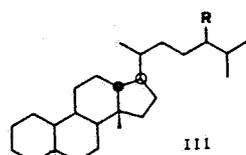
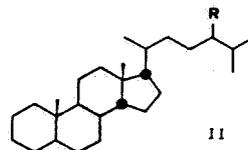
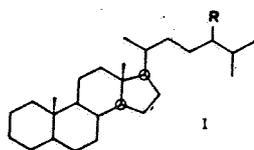


Figure 9b.

Mass chromatograms representing steranes (m/z 217 and 218)

a	13 β (H),17 α (H)-diasterane (20S)	C ₂₇ H ₄₈	(III,R=H)
b	13 β (H),17 α (H)-diasterane (20R)	C ₂₇ H ₄₈	(III,R=H)
c	13 α (H),17 β (H)-diasterane (20S)	C ₂₇ H ₄₈	(IV,R=H)
d	13 α (H),17 β (H)-diasterane (20R)	C ₂₇ H ₄₈	(IV,R=H)
e	13 β (H),17 α (H)-diasterane (20S)	C ₂₈ H ₅₀	(III,R=CH ₃)
f	13 β (H),17 α (H)-diasterane (20R)	C ₂₈ H ₅₀	(III,R=CH ₃)
g	13 α (H),17 β (H)-diasterane (20S)	C ₂₈ H ₅₀	(IV,R=CH ₃)
	+ 14 α (H),17 α (H)-sterane (20S)	C ₂₇ H ₄₈	(I,R=H)
h	13 β (H),17 α (H)-diasterane (20S)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
	+ 14 β (H),17 β (H)-sterane (20R)	C ₂₇ H ₄₈	(II,R=H)
i	14 β (H),17 β (H)-sterane (20S)	C ₂₇ H ₄₈	(II,R=H)
	+ 13 α (H),17 β (H)-diasterane (20R)	C ₂₈ H ₅₀	(IV,R=CH ₃)
j	14 α (H),17 α (H)-sterane (20R)	C ₂₇ H ₄₈	(I,R=H)
k	13 β (H),17 α (H)-diasterane (20R)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
l	13 α (H),17 β (H)-diasterane (20S)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
m	14 α (H),17 α (H)-sterane (20S)	C ₂₈ H ₅₀	(I,R=CH ₃)
n	13 α (H),17 β (H)-diasterane (20R)	C ₂₉ H ₅₂	(III,R=C ₂ H ₅)
	+ 14 β (H),17 β (H)-sterane (20R)	C ₂₈ H ₅₀	(II,R=CH ₃)
o	14 β (H),17 β (H)-sterane (20S)	C ₂₈ H ₅₀	(II,R=CH ₃)
p	14 α (H),17 α (H)-sterane (20R)	C ₂₈ H ₅₀	(I,R=CH ₃)
q	14 α (H),17 α (H)-sterane (20S)	C ₂₉ H ₅₂	(I,R=C ₂ H ₅)
r	14 β (H),17 β (H)-sterane (20R)	C ₂₉ H ₅₂	(II,R=C ₂ H ₅)
	+ unknown sterane		
s	14 β (H),17 β (H)-sterane (20S)	C ₂₉ H ₅₂	(II,R=C ₂ H ₅)
t	14 β (H),17 β (H)-sterane (20R)	C ₂₉ H ₅₂	(I,R=C ₂ H ₅)
u	5 α (H)-sterane	C ₂₁ H ₃₆	(V,R=C ₂ H ₅)
v	5 α (H)-sterane	C ₂₂ H ₃₈	(IV,R=C ₃ H ₇)



C1648S

Sampl
Text



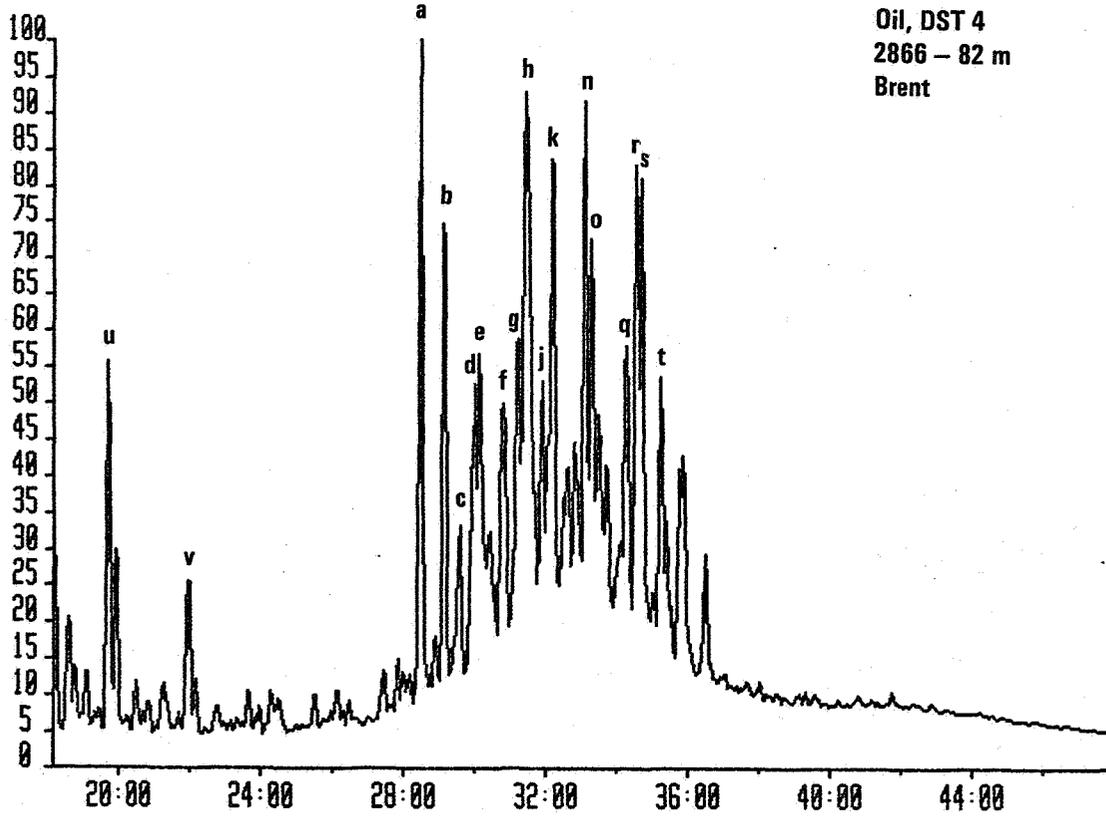
Injection 1

SINTEF-GRUPPEN

Sir: Voltage - 227 - Acnt: IKU
Group 1 Mass 217.1000

System:

Norm: 915
m/z 217
C1648
Oil, DST 4
2866 - 82 m
Brent



C1647S

Sampl
Text



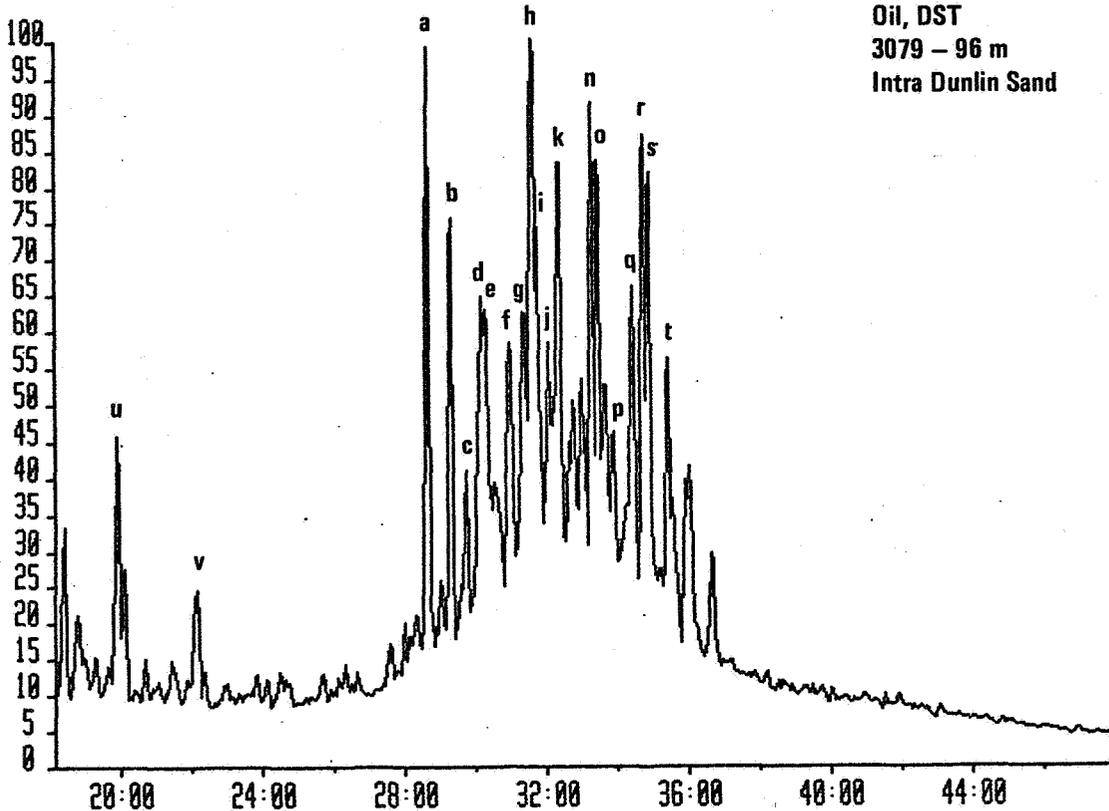
Injection 1

SINTEF-GRUPPEN

Sir: Voltage 7070H Acnt: IKU
Group 1 Mass 217.1000

System:

Norm: 2478
m/z 217
C1647
Oil, DST
3079 - 96 m
Intra Dunlin Sand



C1623S

Sir: Voltage - 228 - Acnt: IKU

System:

Sampl Injection 1

Group 1 Mass 217.1000

Norm: 1259

Text  SINTEF GRUPPEN

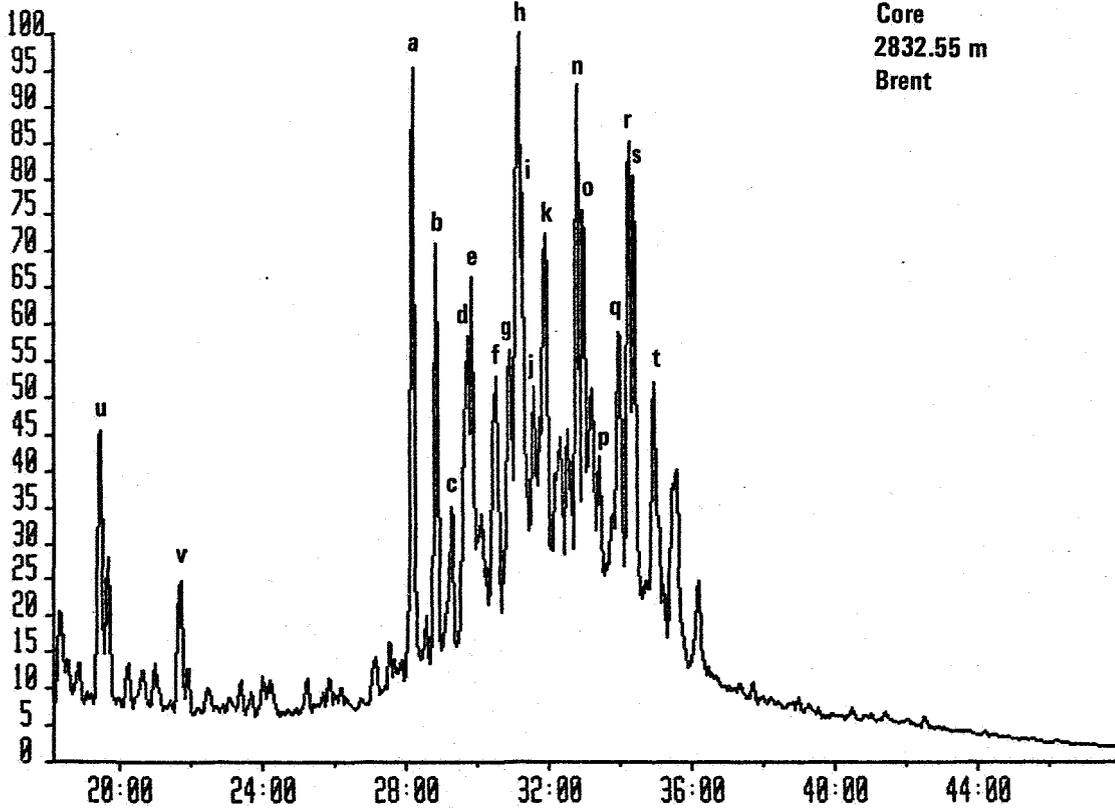
m/z 217

C1623

Core

2832.55 m

Brent



C1624S

Sir: Voltage 7070H Acnt: IKU

System:

Sampl Injection 1

Group 1 Mass 217.1000

Norm: 1187

Text  SINTEF GRUPPEN

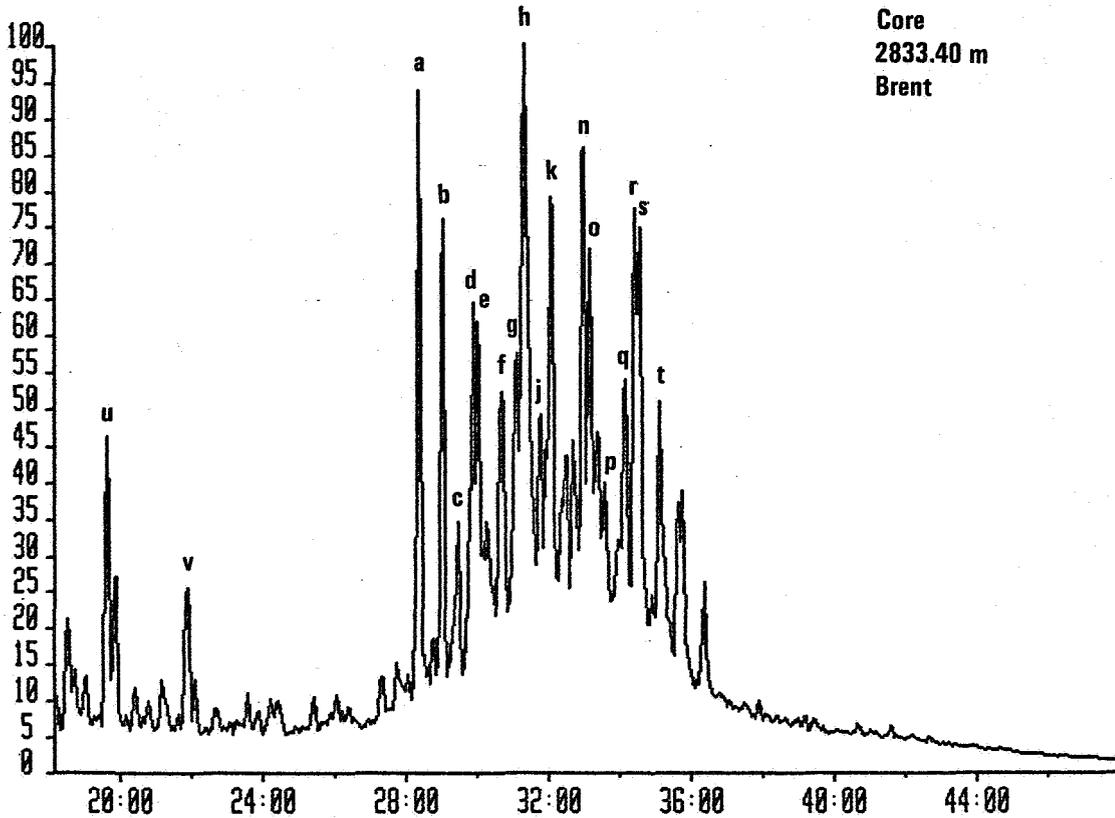
m/z 217

C1624

Core

2833.40 m

Brent



C1625S

Sir: Voltage - 229 - Acnt: IKU

System:

Sampl Injektion 1

Group 1 Mass 217.1000

Norm: 2224

Text  SINTEF-GRUPPEN

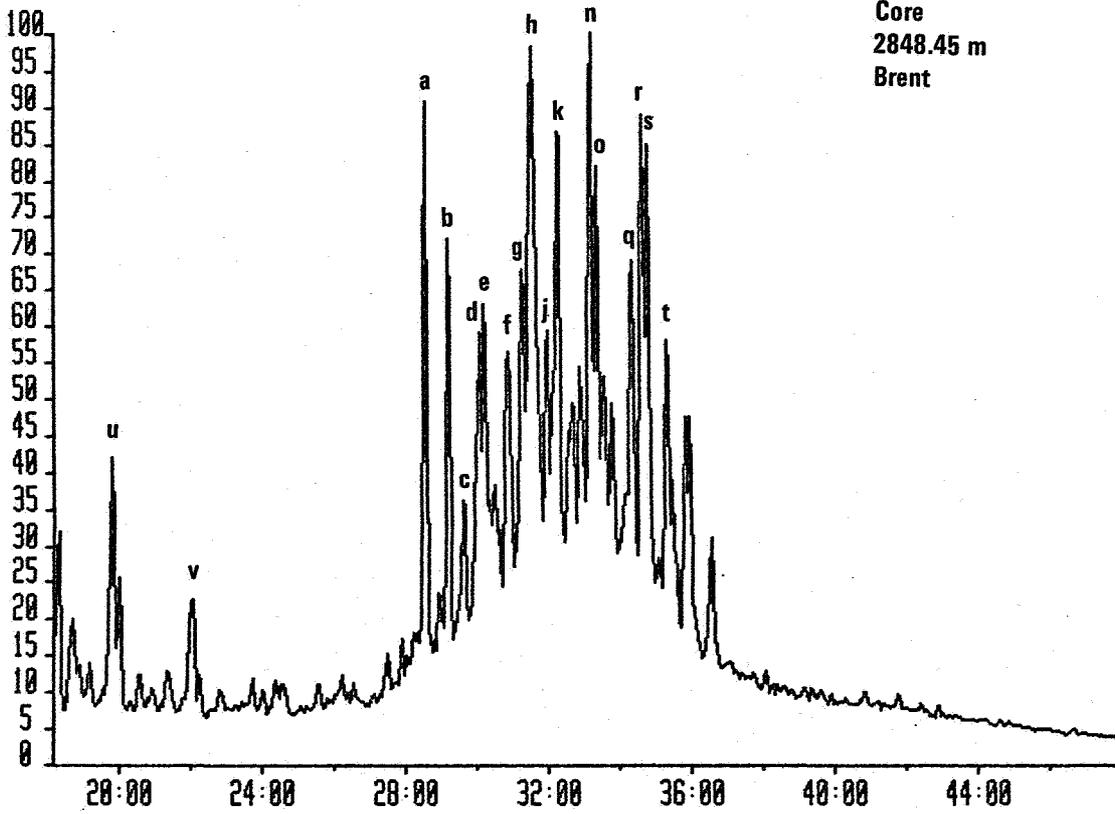
m/z 217

C1625

Core

2848.45 m

Brent



C1626S

Sir: Voltage 7070H Acnt: IKU

System:

Sampl Injektion 1

Group 1 Mass 217.1000

Norm: 1747

Text  SINTEF-GRUPPEN

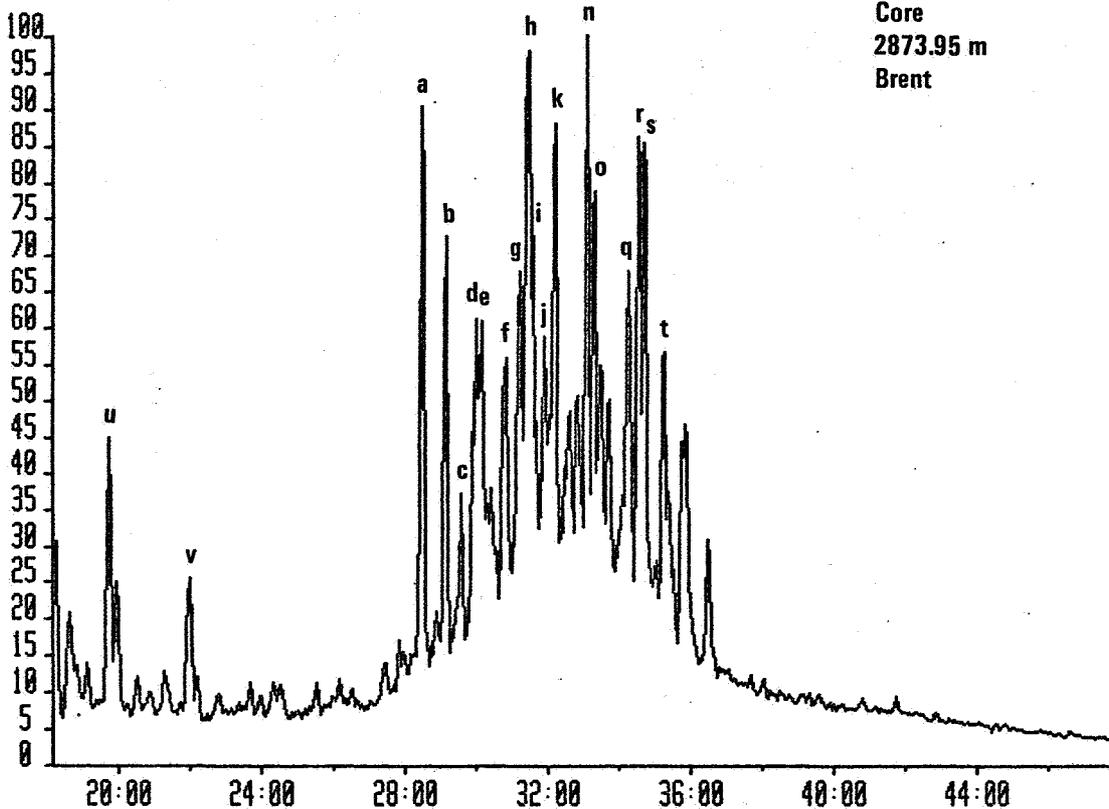
m/z 217

C1626

Core

2873.95 m

Brent



C1627S

Sir: Voltage - 230 - Acnt: IKU

System:

Sampl Injection 1
Text  IKU
SINTEF GRUPPEN

Group 1 Mass 217.1000

Norm: 1540

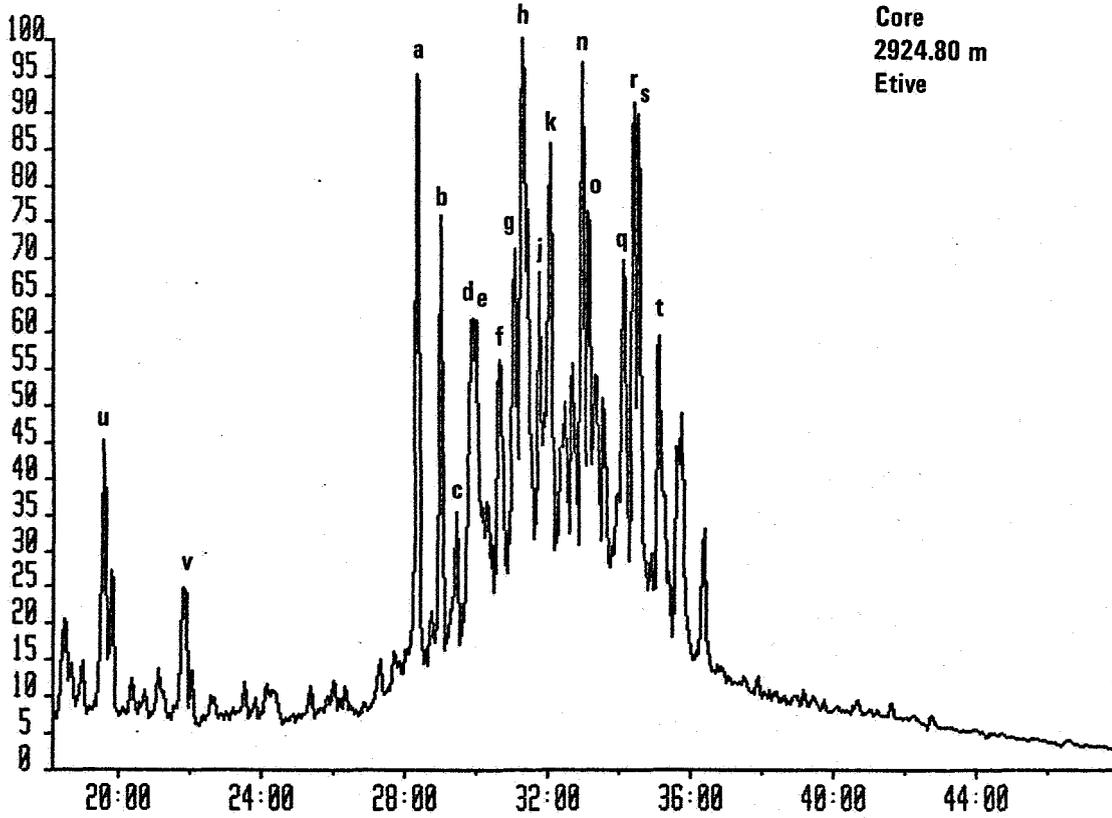
m/z 217

C1627

Core

2924.80 m

Etive



C1628S

Sir: Voltage 7070H Acnt: IKU

System:

Sampl Injection 1
Text  IKU
SINTEF GRUPPEN

Group 1 Mass 217.1000

Norm: 1239

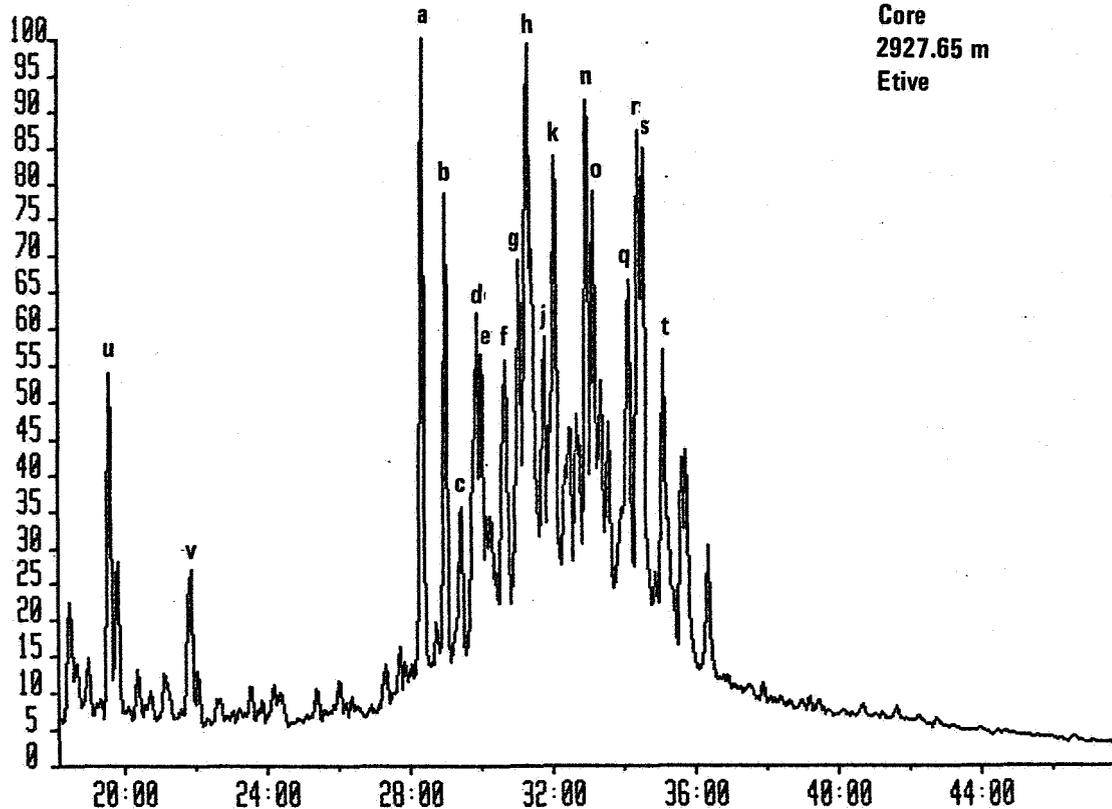
m/z 217

C1628

Core

2927.65 m

Etive



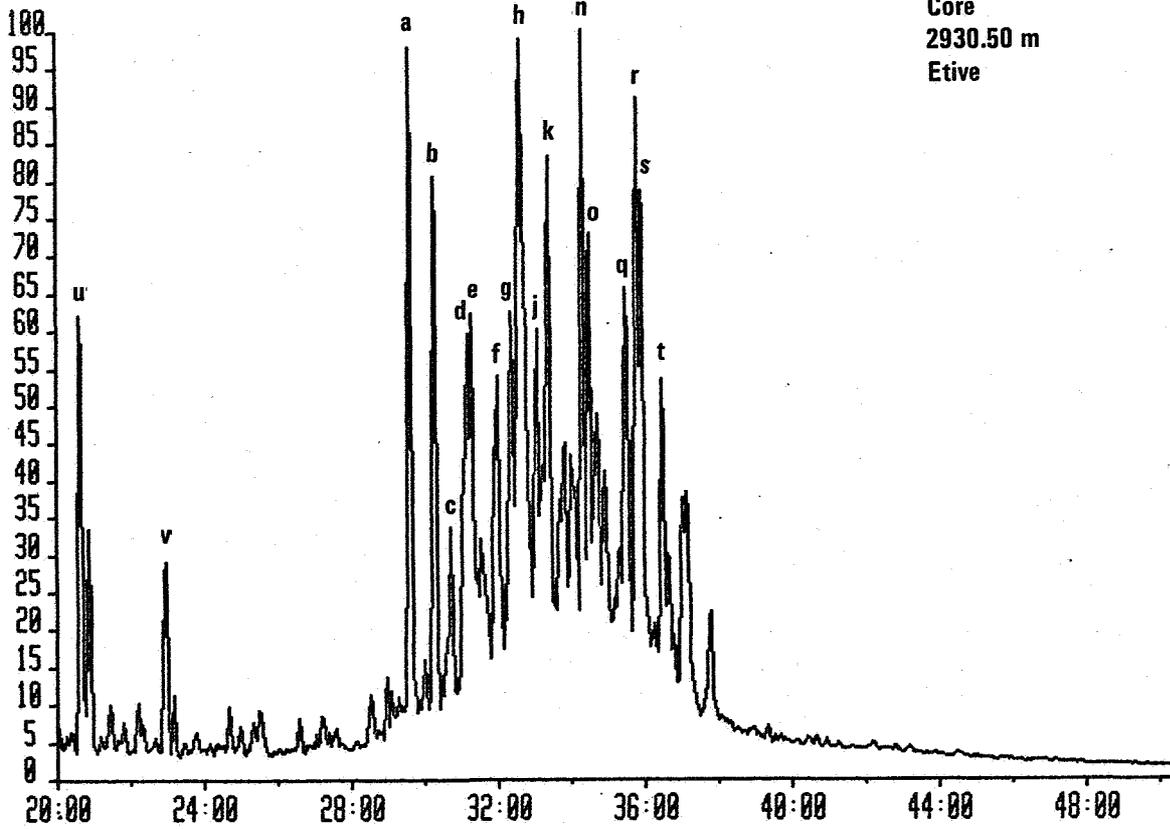


IKU

SINTEF-GRUPPEN

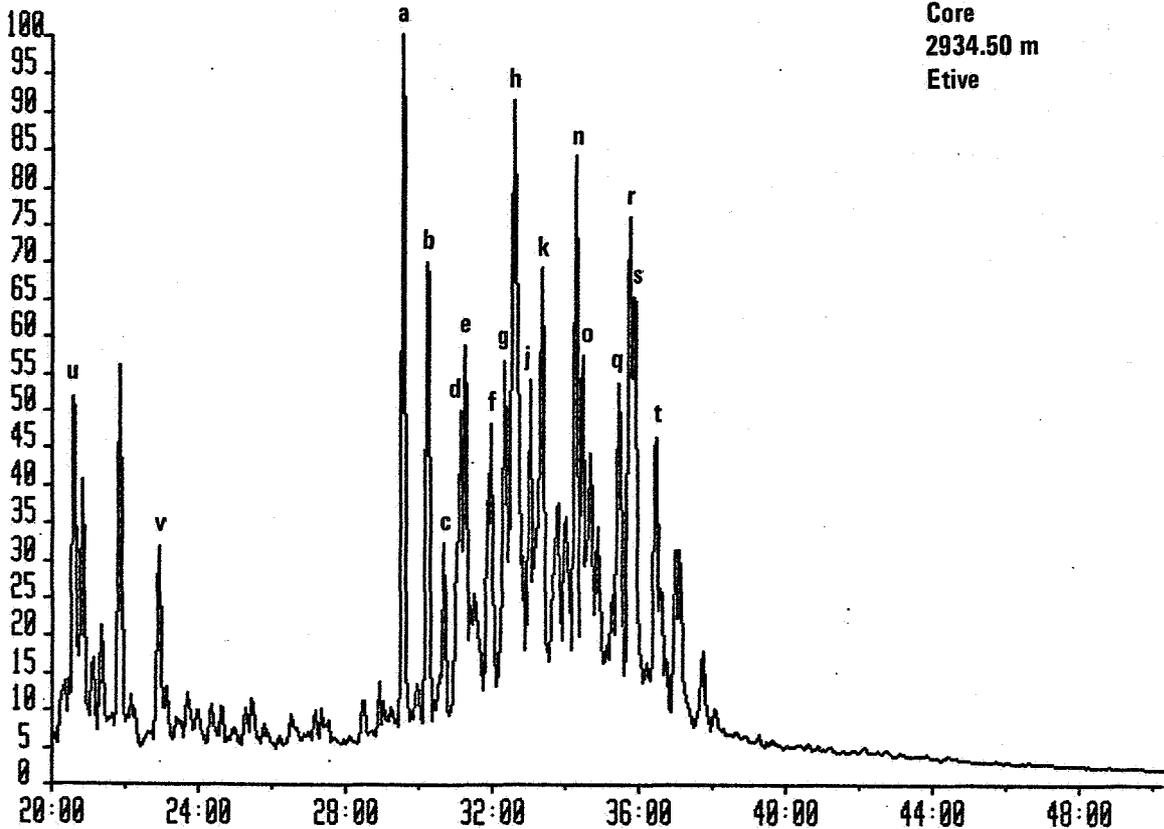
C1629
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:
Norm: 317
m/z 217
C1629
Core
2930.50 m
Etive



C1630
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

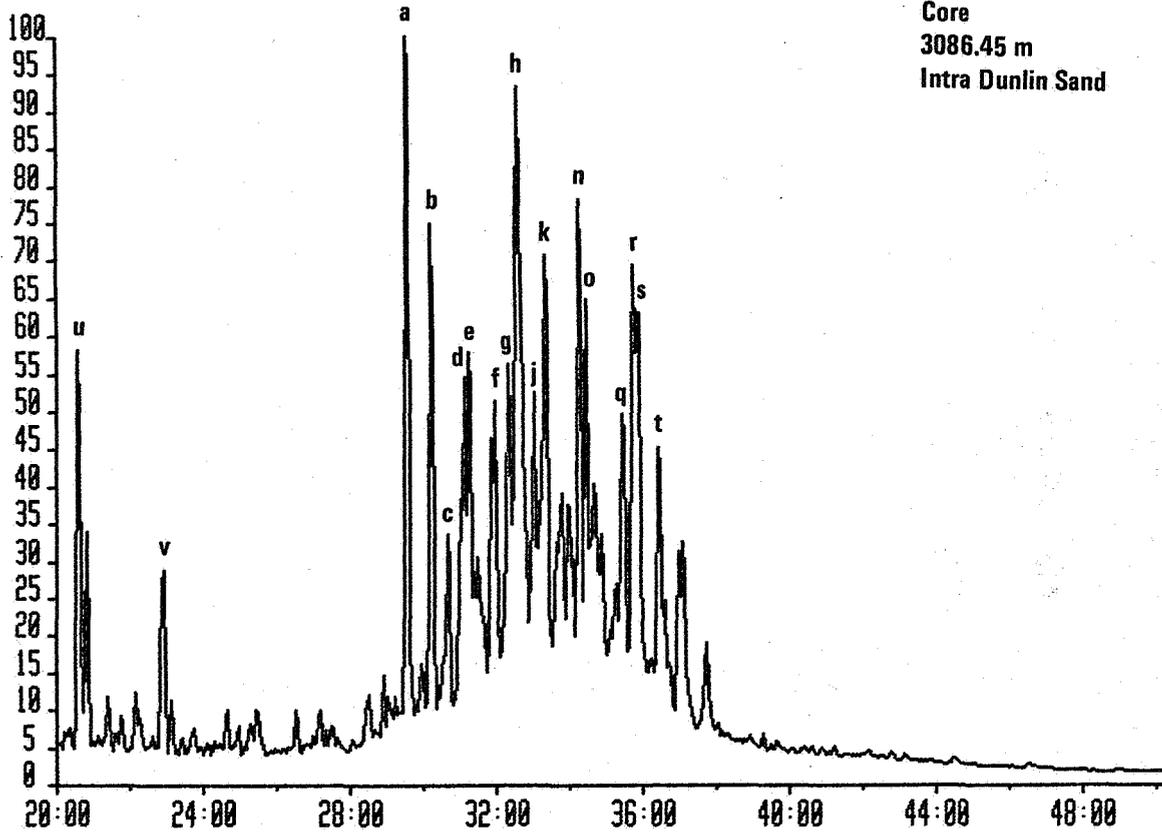
System:
Norm: 215
m/z 217
C1630
Core
2934.50 m
Etive





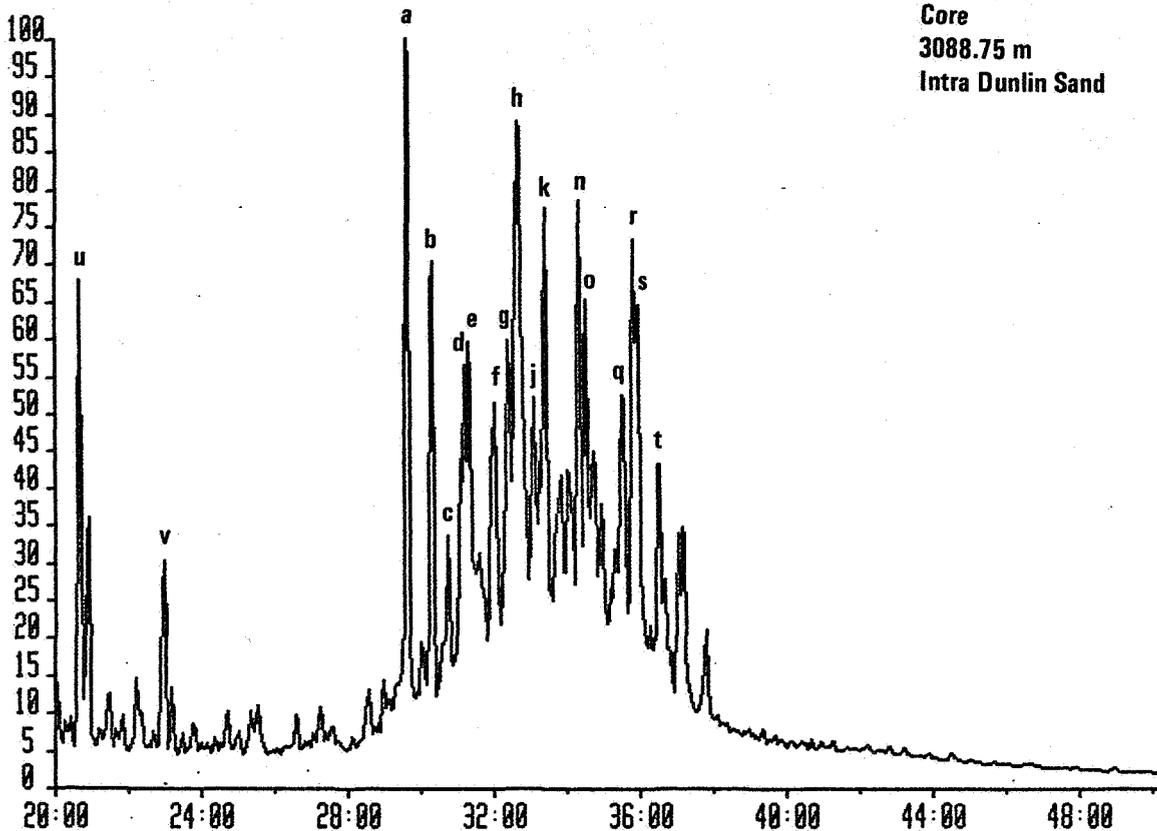
C1631
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:
Norm: 369
m/z 217
C1631
Core
3086.45 m
Intra Dunlin Sand



C1632
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:
Norm: 326
m/z 217
C1632
Core
3088.75 m
Intra Dunlin Sand



C1647S

Sir:Voltage - 233 - Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 218.1000
Text  SINTEF-GRUPPEN

Norm: 2511

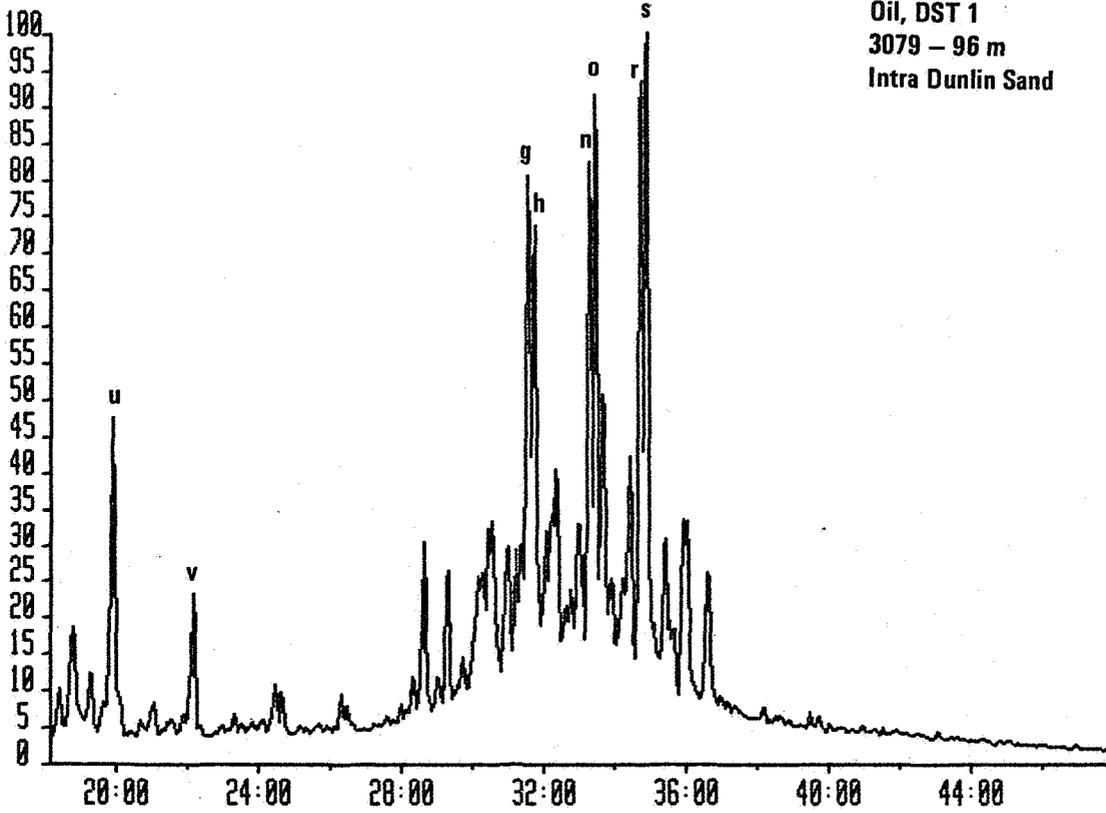
m/z 218

C1647

Oil, DST 1

3079 - 96 m

Intra Dunlin Sand



C1648S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1 Group 1 Mass 218.1000
Text  SINTEF-GRUPPEN

Norm: 946

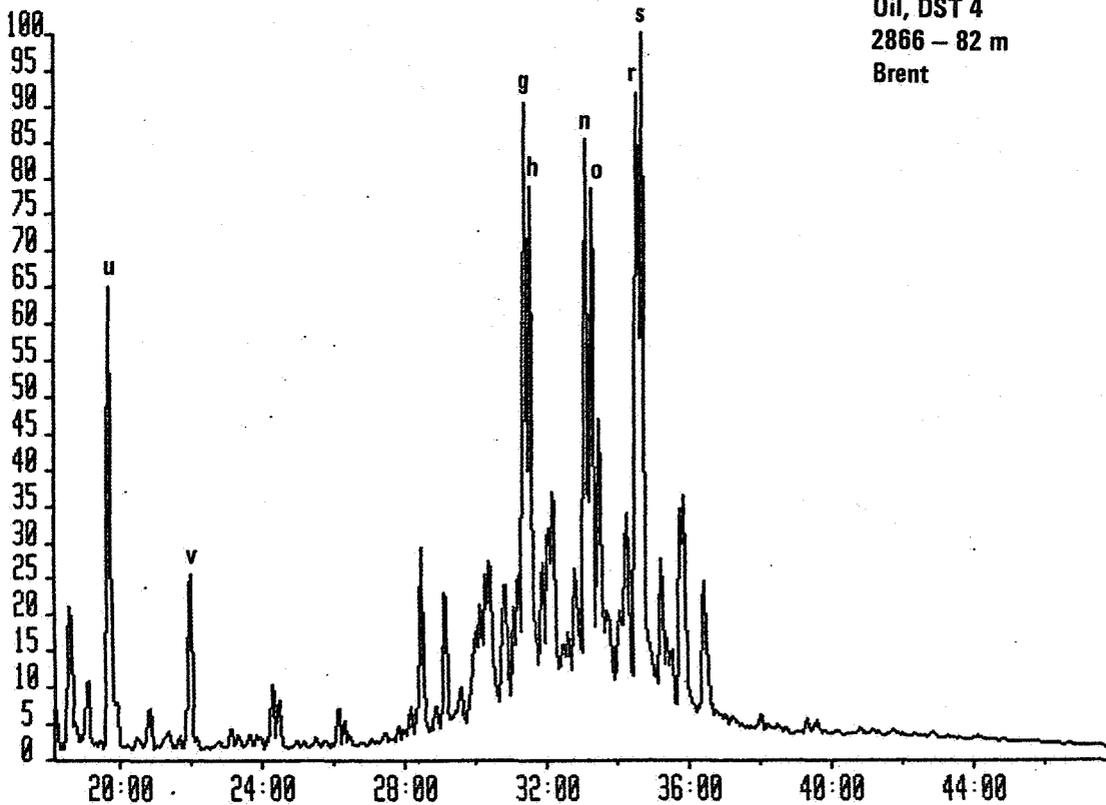
m/z 218

C1648

Oil, DST 4

2866 - 82 m

Brent



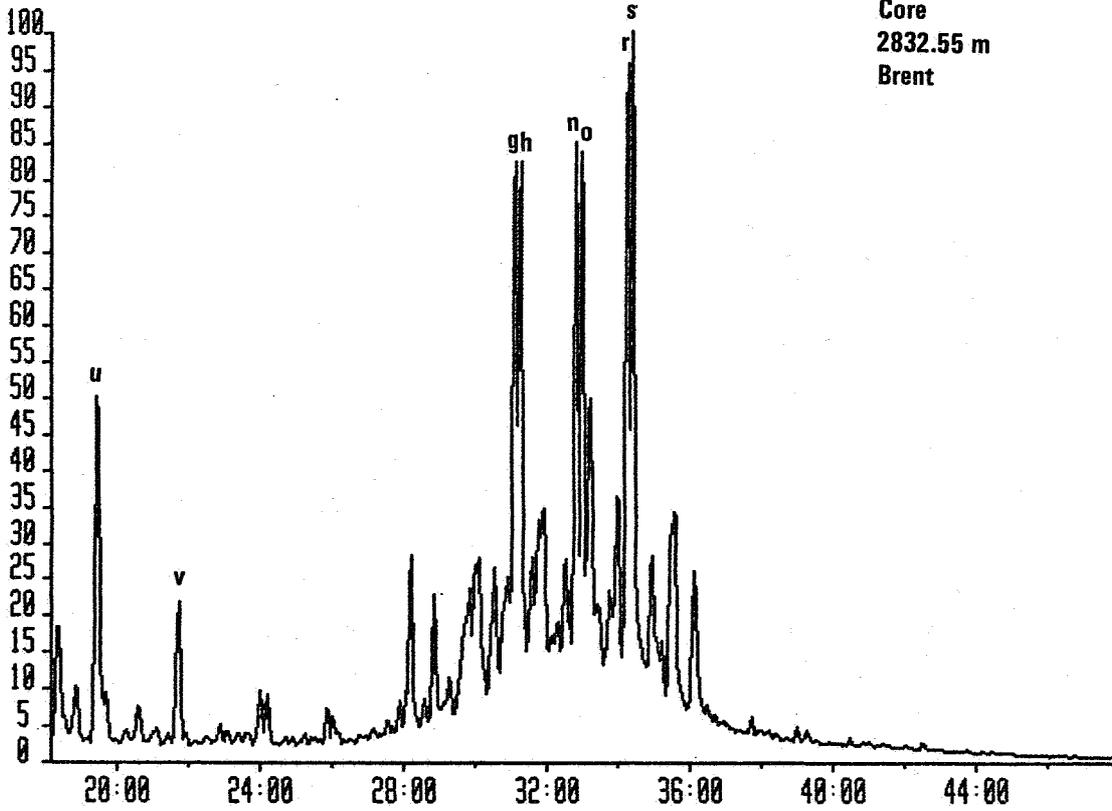
C1623S

Sir: Voltage - 234 - Acnt: IKU

System:

Sampl Injektion 1 Group 1 Mass 218.1000
Text  SINTEF-GRUPPEN

Norm: 1263
m/z 218
C1623
Core
2832.55 m
Brent



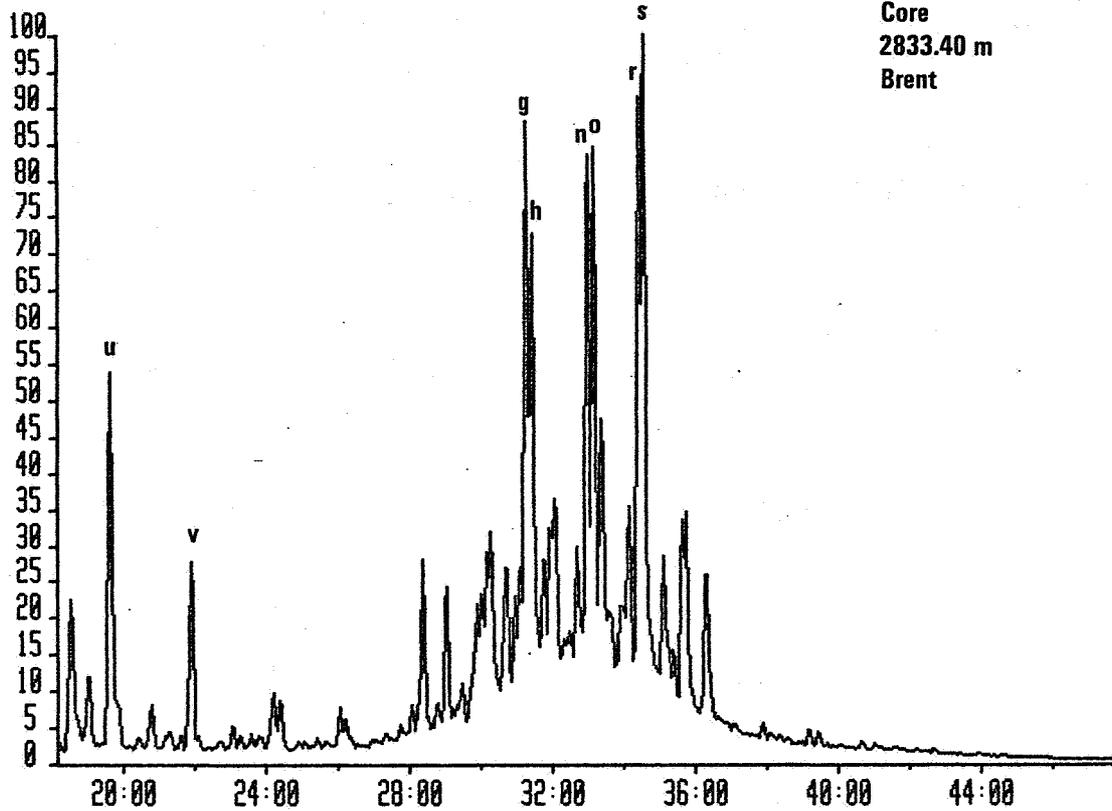
C1624S

Sir: Voltage 7070H Acnt: IKU

System:

Sampl Injektion 1 Group 1 Mass 218.1000
Text  SINTEF-GRUPPEN

Norm: 1119
m/z 218
C1624
Core
2833.40 m
Brent



C16255

Sir:Voltage - 235 - Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 218.1000

Norm: 2404

Text  SINTEF GRUPPEN

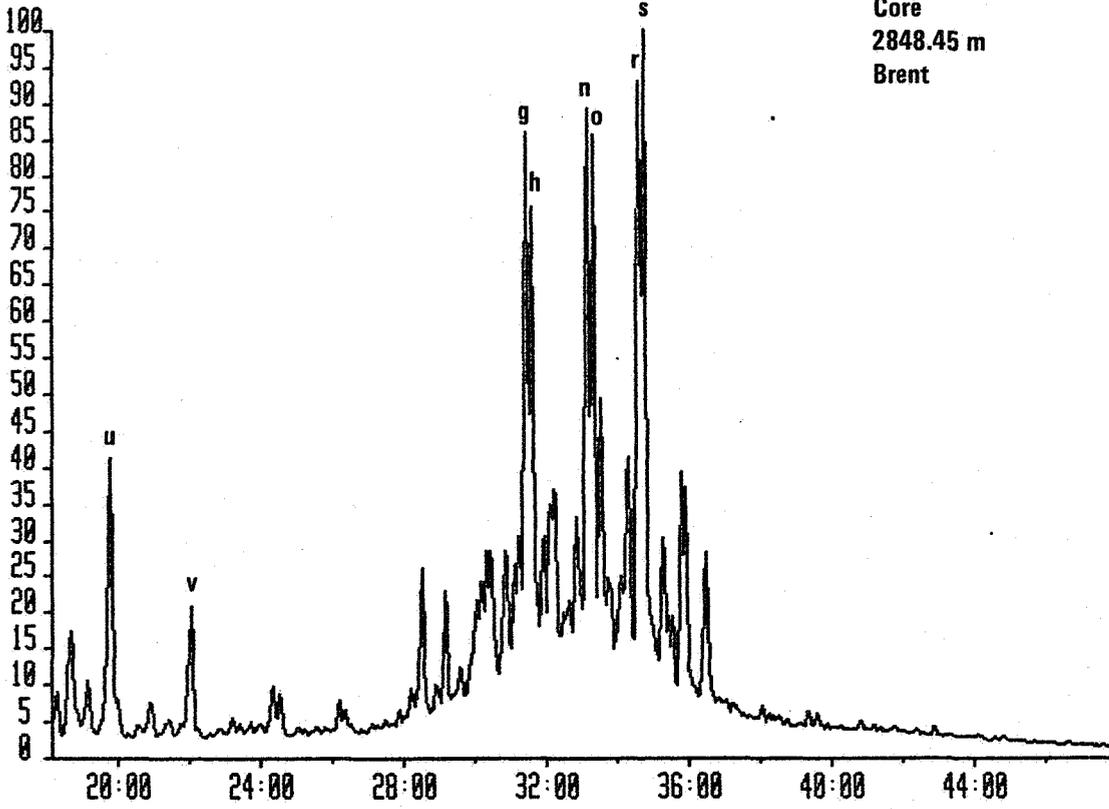
m/z 218

C1625

Core

2848.45 m

Brent



C16265

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1

Group 1 Mass 218.1000

Norm: 1898

Text  SINTEF GRUPPEN

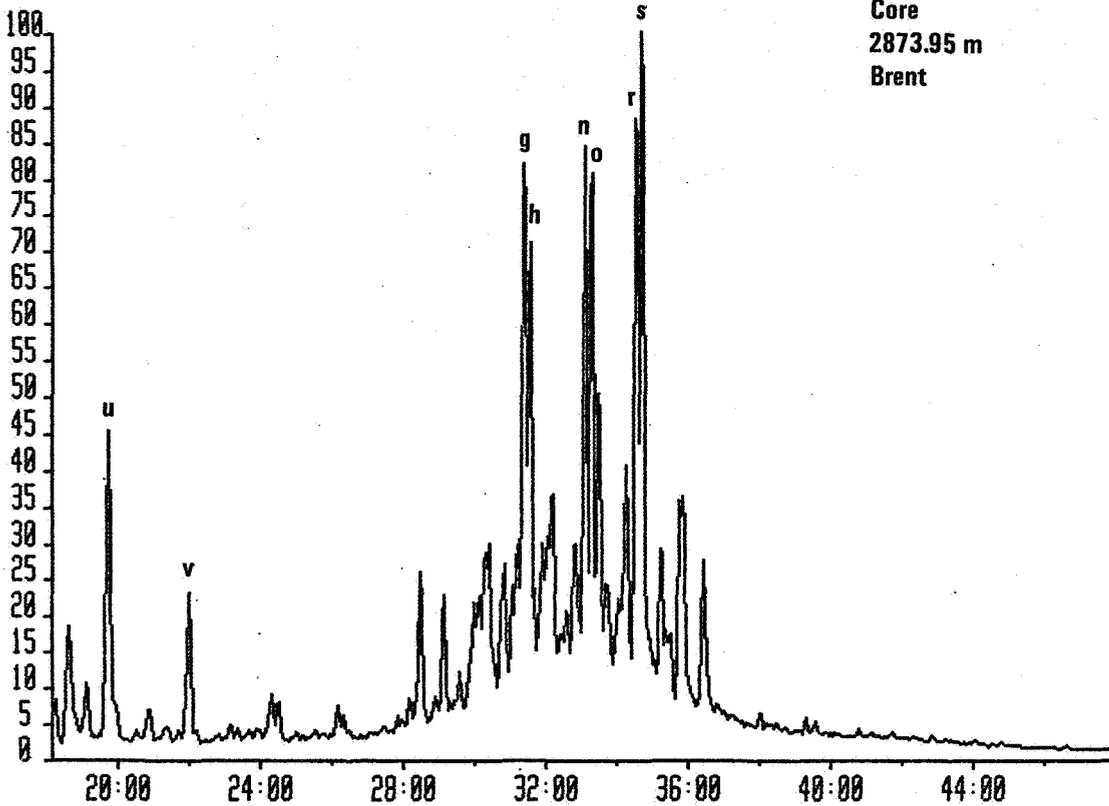
m/z 218

C1626

Core

2873.95 m

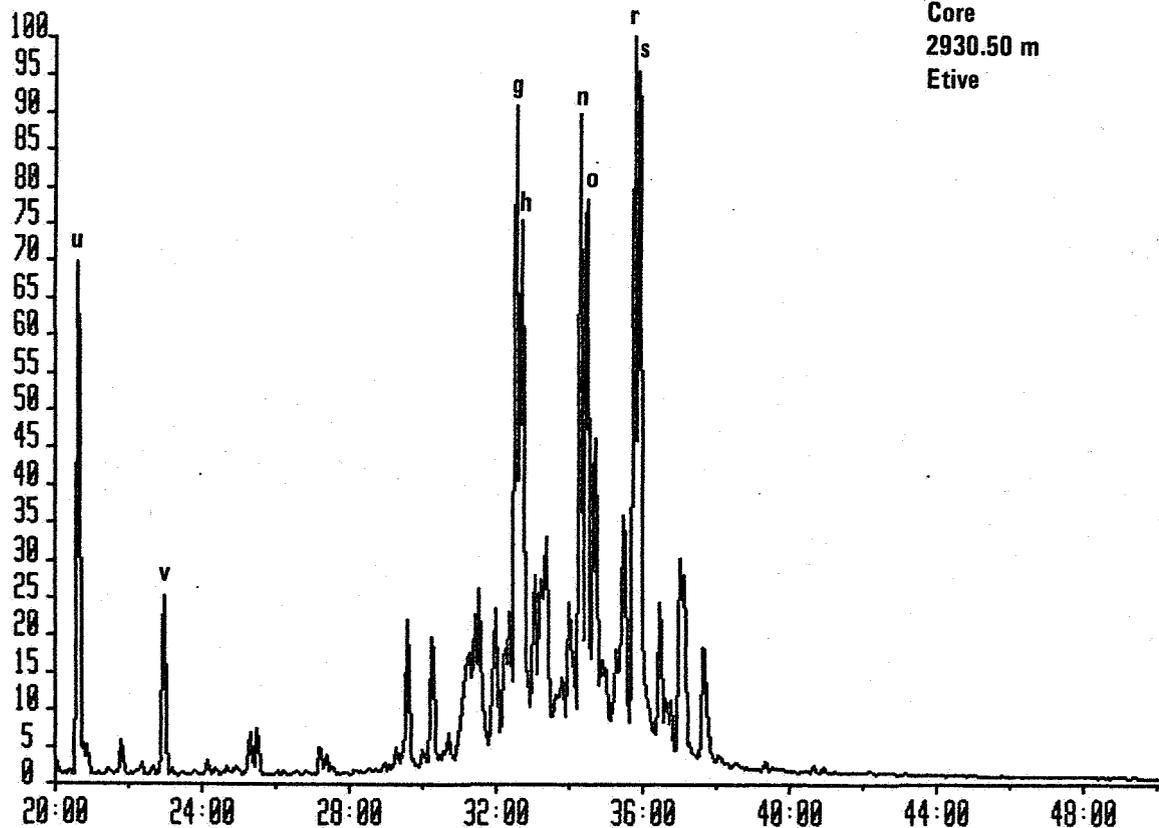
Brent





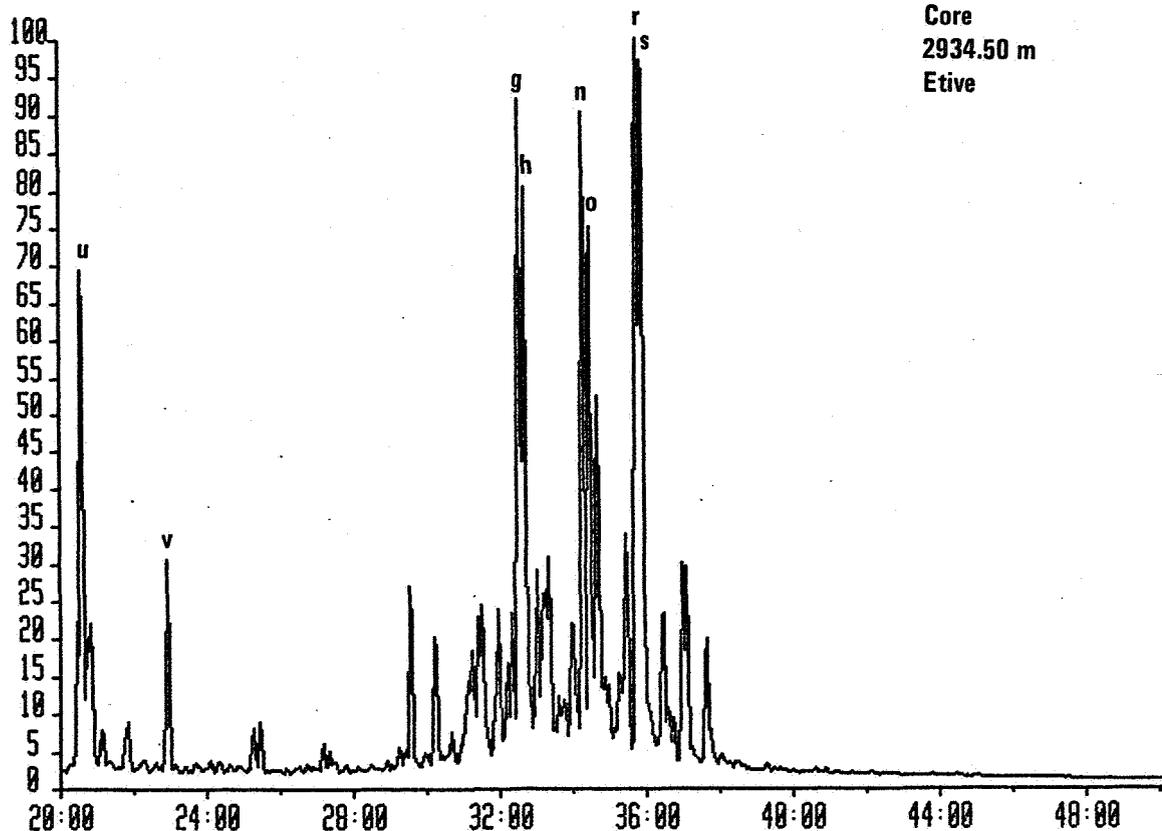
C1629
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:
Norm: 300
m/z 218
C1629
Core
2930.50 m
Etive



C1630
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:
Norm: 201
m/z 218
C1630
Core
2934.50 m
Etive



C1627S

Sir:Voltage - 237 - Acnt:IKU

System:

Sampl Injection 1
Text  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

Norm: 1763

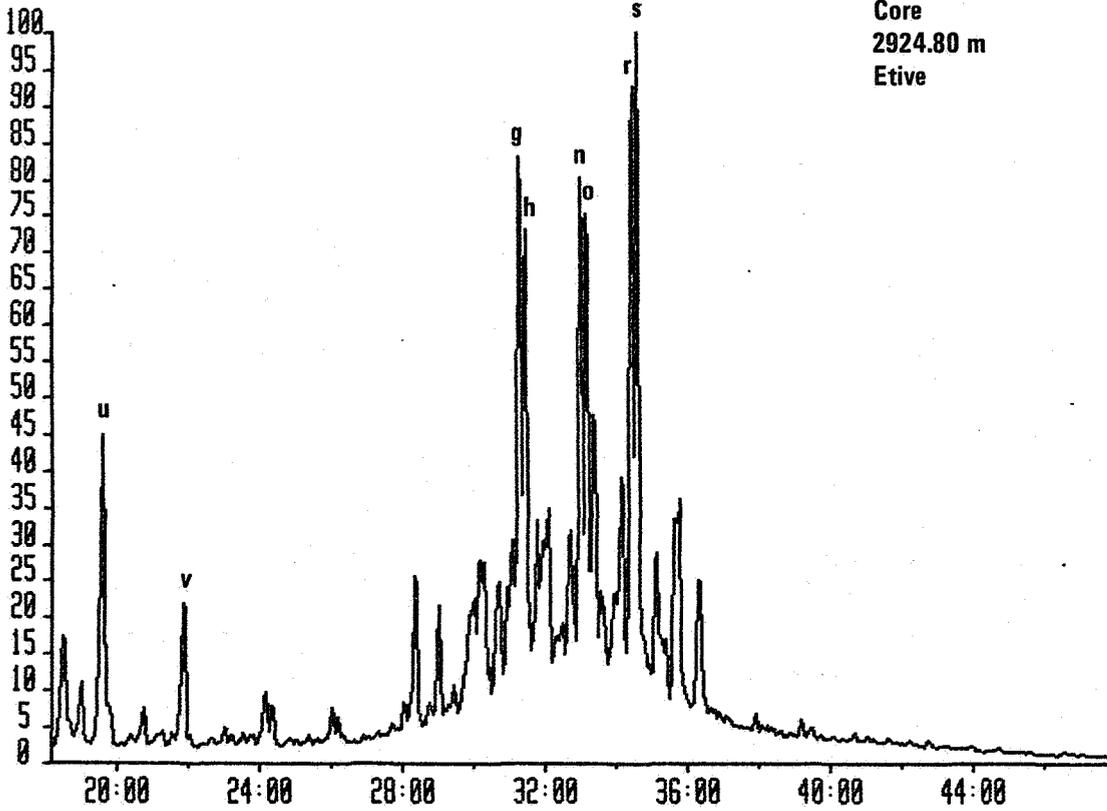
m/z 218

C1627

Core

2924.80 m

Etive



C1628S

Sir:Voltage 7070H Acnt:IKU

System:

Sampl Injection 1
Text  IKU
SINTEF-GRUPPEN

Group 1 Mass 218.1000

Norm: 1359

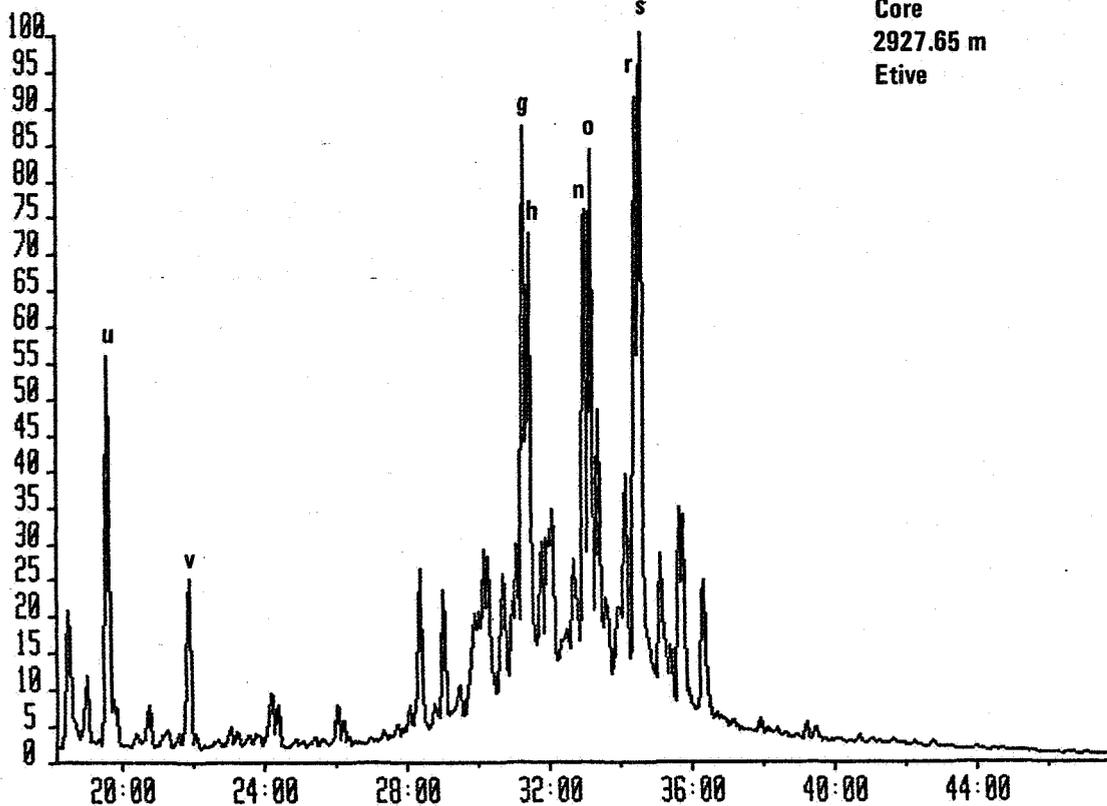
m/z 218

C1628

Core

2927.65 m

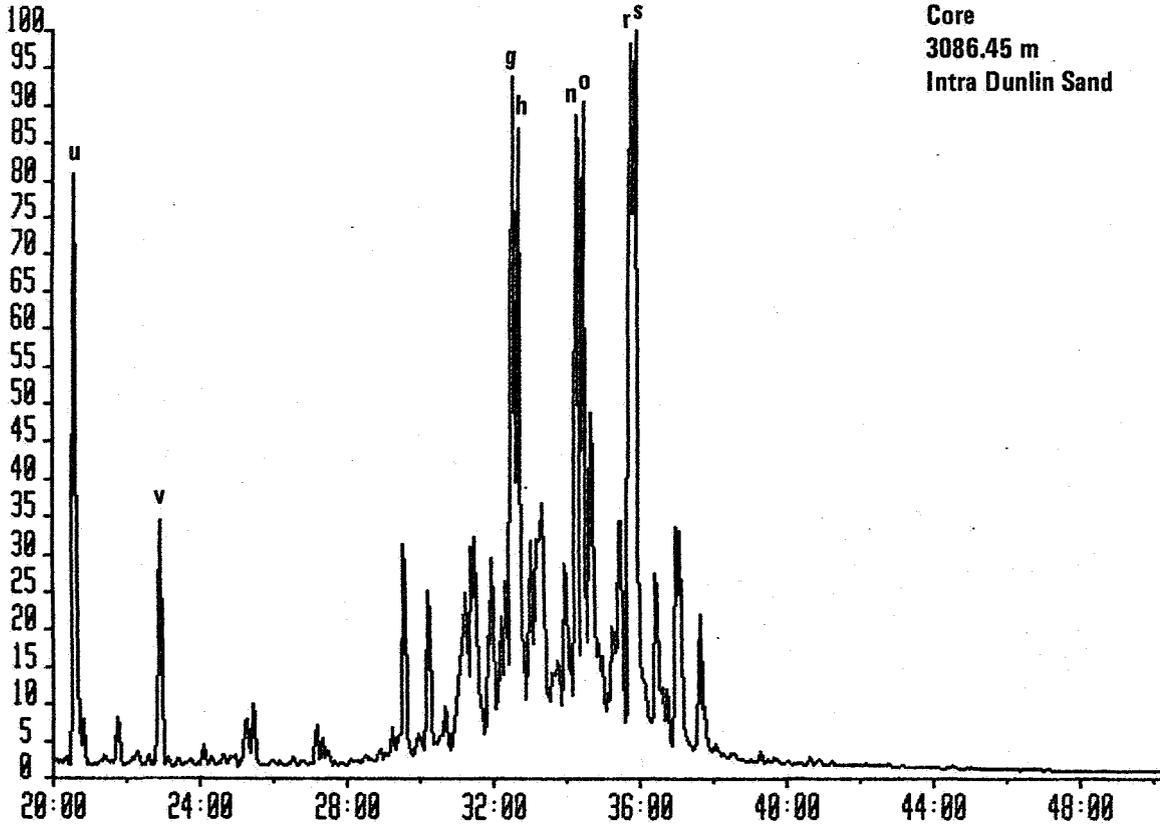
Etive





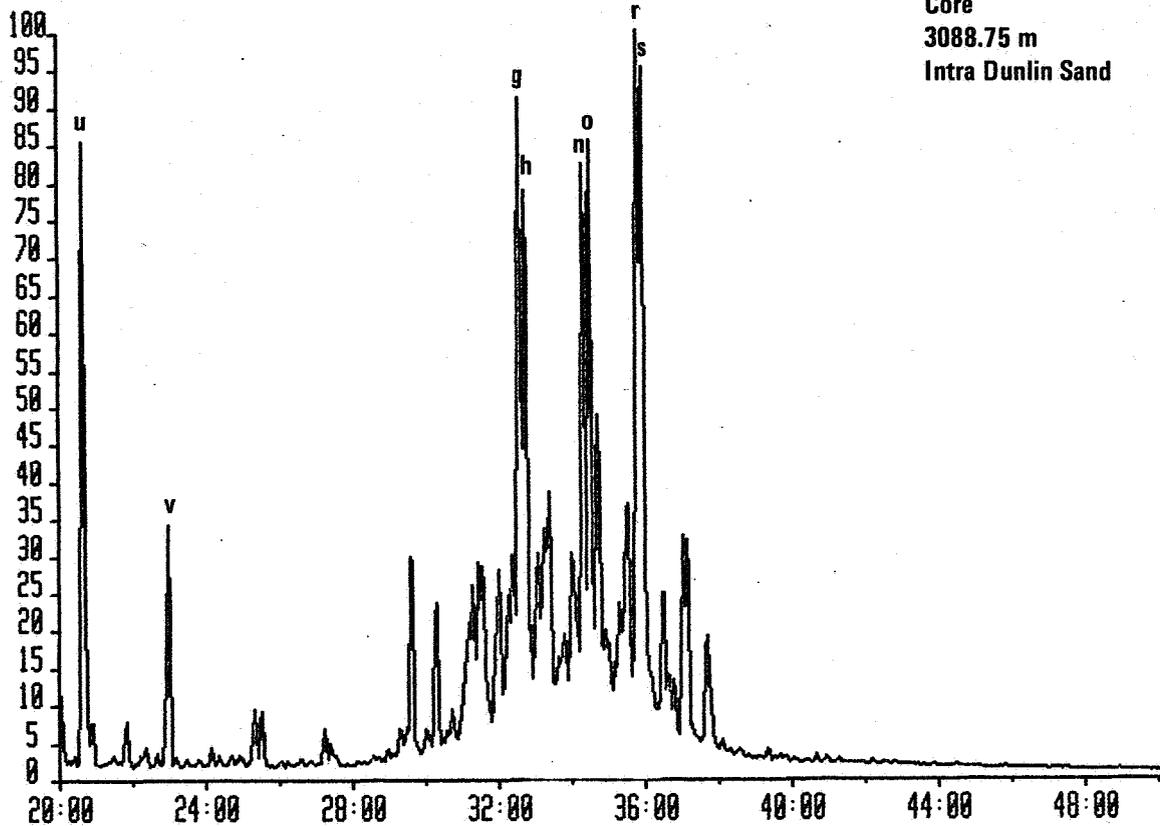
C1631 Sir: Voltage 7070H Acnt: IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:
Norm: 324
m/z 218
C1631
Core
3086.45 m
Intra Dunlin Sand



C1632 Sir: Voltage 7070H Acnt: IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:
Norm: 290
m/z 218
C1632
Core
3088.75 m
Intra Dunlin Sand



APPENDICES

APPENDIX 1

Molecular ratios from terpane and sterane mass chromatograms applied as maturity and source characteristic parameters

Geochemical fossils or biological marker components are characteristic of the type of organic matter present at the time the sediments were deposited. The biological isomers of these components undergo changes due to increased maturity in particular, but also to a certain degree caused by migration and weathering processes.

Source characteristic parameters

In the m/z 191 mass chromatograms which represent the terpanes, the hopanes and moretanes are the major components in most extracts and oils. Of the hopanes the C₂₇ and C₂₉-C₃₅ homologs are ubiquitous, while the C₂₈ bisnorhopane is believed to be typical of certain types of source rocks. This is also the case for the component, probably gamma-cerane, sometimes seen to coelute with the 22S isomer of the C₃₁ 17 α (H)-hopanes (H). In the sterane mass chromatograms, m/z 217 and m/z 218, the molecular weight distribution of the C₂₇-C₂₉ regular steranes is believed to be representative of the original input of organic matter. The highest molecular weight compounds, the C₂₉ steranes, represent organic matter of terrestrial origin, while the lower molecular weight analogs originate from more marine type environments.

Maturity dependant parameters

The biological isomers of the hopanes, the 17 β (H), 21 β (H)-hopanes, undergo structural changes during the maturation process. The isomerisation reactions are thought to be produced via the 17 β (H), 21 α (H)-hopanes (moretanes) to the most stable 17 α (H), 21 β (H)-hopanes. At equilibrium 100% of the 17 α (H)-hopanes are seen. The ratio $\alpha\beta/\alpha\beta+\beta\alpha$ is used to describe this reaction. In the extended hopanes ($\geq C_{31}$), the thermally stable S configurations at C-22 become increasingly more abundant as compared to the biologically preferred R configurations at increased maturity level. The equilibrium ratio is approximately 60% of the 22S configuration. Another ratio that is known to change with maturity is the Tm/Ts (Seifert et al., 1978) of the C₂₇ hopanes. The maturable 18 α (H)-trisnorneohopane (Tm) is reduced in intensity relative to the more stable 17 α (H)-trisnorneohopane (Ts), causing the Tm/Ts to decrease at increased

maturity. This ratio is also believed to be source dependant, and this should be born in mind when applying the ratio for maturity comparison. The amount of tricyclic terpanes is also to a certain extent seen to be maturity dependant.

Two isomerisation reactions taking place in the steranes are most commonly applied for maturity assignments from the m/z 217 mass chromatograms. The biologically preferred $14\alpha(H)$, $17\alpha(H)$ -isomers of the regular steranes is transformed to the thermally stable $14\beta(H)$, $17\beta(H)$ -steranes, the % $\beta\beta$ approaching 75% at equilibrium. An equilibrium concentration of 50% is seen of the stable S configuration at C-20 as opposed to the 100% of the biological 20R epimer (Mackenzie et al., 1980). The abundance of rearranged steranes increased with increasing maturity.

One of the reactions taking place at an early stage of diagenesis is the aromatisation of steranes, leading to the formation of mono- and tri-aromatic analogs. This process is measured as the abundance of tri-aromatic relative to mono-aromatic compounds (% tri/tri + mono) in the m/z 231 and 253 mass chromatograms, respectively. In addition the degree of side chain cracking, as % $C_{20}/C_{26, 27}$ and % $C_{21}/C_{28,29}$ respectively, is applied. These cracking processes are also taking place during early diagenesis, and are used for maturity assignment together with the previously mentioned ratios.

Migration and weathering

The effect on the geochemical fossils of migration and weathering, is less apparent than the maturity induced changes. Migration is believed to cause an increase in the relative amounts of rearranged and $14\beta(H)$, $17\beta(H)$ regular steranes (Seifert and Moldowan, 1978, 1981). Severe biological alteration leads to the formation of desmethyl-hopanes (Seifert and Moldowan, 1979).

APPENDIX II

Background data from GC analysis of saturated hydrocarbons
Cuttings samples.

CUTTINGS

SwAnalysis:3 793C1620S,1,10w
 Created at 14:58 on 15/Aug/85

Page 1

***** MULTICHROM 5000/R SX *****

Channel:3 Title: HP-5730 Date 14/ 8/85 Time 13:56
 Analysis:793C1620S Sample Name:C-1620,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	J.00	Identity	Type
9	5.139	8854	24327	0.217	n-C12	FO
19	7.571	20696	60226	0.538	n-C13	0
34	10.285	36860	118154	1.056	n-C14	LO
44	13.091	42380	138827	1.241	n-C15	LO
56	15.848	40675	135917	1.215	n-C16	LO
68	18.531	33884	127695	1.141	n-C17	0
69	18.787	43544	204881	1.831	Pristane	0
80	21.101	27586	103860	0.928	n-C18	0
81	21.405	15409	93207	0.833	Phytane	OM
90	23.560	25266	108960	0.974	n-C19	0
99	25.896	21081	92656	0.828	n-C20	0
108	28.163	22752	100488	0.838	n-C21	0
115	30.317	20326	111613	0.937	n-C22	FOM
124	32.381	29108	112492	1.005	n-C23	FO
132	34.355	32938	133260	1.131	n-C24	FO
141	36.285	40289	179399	1.603	n-C25	0
147	38.120	33018	190606	1.703	n-C26	OM
153	39.928	69569	305207	2.728	n-C27	0
160	41.624	47851	259920	2.323	n-C28	0
166	43.309	109901	478280	4.274	n-C29	0
172	44.867	30962	134828	1.205	n-C30	LO
178	46.440	107245	544773	4.859	n-C31	OM
181	47.576	32244	189988	1.638	n-C32	0
186	49.352	55564	261911	2.341	n-C33	LO
190	50.728	11297	75157	0.672	n-C34	OM
196	52.099	21707	129898	1.131	n-C35	LO
198	53.656	3040	23973	0.214	n-C36	0

Total 1953154 11189590 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC



CUTTINGS

SwAnalysis:3 793C1521S,1,10w
Created at 09:25 on 20/Aug/85

***** MULTICHROM 5000/RX *****

Channel:3 Title: HP-5730 Date 13/ 8/85 Time 10:18
Analysis:793C1521S Sample Name:C-1521,30/3-4,SAT,TV
Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
1	5.163	5137	13748	0.045	n-C12	
12	7.603	45871	132216	0.436	n-C13	M
28	10.355	145852	529720	1.745	n-C14	O
42	13.171	220869	918383	3.026	n-C15	LO
55	15.944	250443	1147112	3.779	n-C16	O
68	18.627	232131	1100015	3.624	n-C17	O
69	18.893	247925	1593509	5.250	Pristane	O
80	21.192	194424	911917	3.004	n-C18	O
82	21.480	109015	601570	1.932	Phytane	O
95	23.651	166911	772041	2.543	n-C19	O
105	25.987	133996	609251	2.007	n-C20	O
115	28.240	108726	441259	1.454	n-C21	FO
122	30.389	87789	397735	1.310	n-C22	FOM
131	32.440	80465	324030	1.058	n-C23	FO
140	34.413	64427	267390	0.831	n-C24	O
147	36.328	63892	288231	0.950	n-C25	O
156	38.173	54138	317128	1.045	n-C26	M
162	39.971	58159	278747	0.918	n-C27	O
170	41.693	52116	213004	0.702	n-C28	LO
177	43.355	94732	456589	1.504	n-C29	
182	44.813	49674	430757	1.419	n-C30	LO
188	46.440	55820	242531	0.739	n-C31	O
193	47.928	29821	226416	0.746	n-C32	O
199	49.368	27498	169479	0.558	n-C33	LO
205	50.776	17862	143917	0.474	n-C34	OM
211	52.141	16038	172279	0.538	n-C35	O
214	53.717	6330	40209	0.132	n-C36	FOM

Total 5327455 30353620 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
Method: TB Calibration: TB Type: UC

CUTTINGS

SwAnalysis:3 793C1555S,1,10w
 Created at 13:34 on 15/Aug/85

Page 1

***** MULTICHROM 5000/R SX *****

Channel:3 Title: HP-5730 Date 15/ 8/85 Time 12:13
 Analysis:793C1555S Sample Name:C-1555,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
1	13.099	1403	5604	0.234	n-C15	
6	15.848	7927	25931	1.351	n-C16	LO
14	18.523	15809	53486	2.807	n-C17	
15	18.749	7928	40597	2.131	Pristane	FO
22	21.091	18903	70485	3.639	n-C18	O
23	21.389	6264	35230	1.849	Phytane	LO
30	23.547	14444	49527	2.539	n-C19	
37	25.885	13899	53865	2.827	n-C20	LO
44	28.141	11361	40405	2.121	n-C21	
49	30.301	10419	46171	2.423	n-C22	FO
53	32.357	9674	41807	2.134	n-C23	FO
58	34.323	9632	38389	2.015	n-C24	O
62	36.240	11234	51373	2.636	n-C25	O
66	38.067	11099	48578	2.530	n-C26	LO
68	39.840	13496	49882	2.618	n-C27	OM
73	41.539	12086	50504	2.651	n-C28	O
78	43.192	16202	65161	3.420	n-C29	
81	44.787	11189	42670	2.240	n-C30	LO
87	46.328	14102	58784	3.035	n-C31	O
93	47.832	7420	43395	2.278	n-C32	LOM
96	49.275	8747	41560	2.131	n-C33	M
100	50.683	5577	25899	1.359	n-C34	M
104	52.056	4419	28577	1.500	n-C35	O
107	53.616	2137	11671	0.613	n-C36	M
Total		385557	1905280	100.000		

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

Channel:3 Title: HP-5730 Date 13/ 8/85 Time 12:24
 Analysis:793C1570S Sample Name:C-1570,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
11	5.181	26369	70848	0.138	n-C12	FO
24	7.651	96792	284035	0.755	n-C13	O
39	10.408	197919	704485	1.872	n-C14	FO
52	13.256	274187	1255681	3.336	n-C15	O
63	16.045	316609	1575997	4.137	n-C16	OM
75	18.728	298175	1617210	4.237	n-C17	OM
76	18.979	245117	1628618	4.327	Pristane	OM
87	21.309	264848	1461288	3.833	n-C18	O
88	21.571	119484	648467	1.723	Phytane	LO
99	23.763	251663	1284593	3.413	n-C19	O
111	26.093	219923	1179033	3.133	n-C20	OM
122	28.352	191326	855093	2.272	n-C21	FO
129	30.499	156549	844506	2.244	n-C22	FOM
136	32.563	142297	667367	1.773	n-C23	FO
144	34.531	127541	586698	1.559	n-C24	FO
150	36.451	132271	736661	1.957	n-C25	O
154	38.285	134637	677873	1.801	n-C26	O
161	40.061	137765	665938	1.739	n-C27	FOM
167	41.757	119987	618417	1.643	n-C28	FOM
172	43.421	133935	631691	1.678	n-C29	FO
180	45.000	93252	427880	1.137	n-C30	LO
184	46.531	96716	503044	1.337	n-C31	LOM
189	48.019	62519	302418	0.804	n-C32	O
196	49.475	73384	416109	1.106	n-C33	OM
201	50.867	56629	354429	0.942	n-C34	OM
207	52.232	44123	359467	0.955	n-C35	O
210	53.848	30664	203506	0.541	n-C36	LO

Total 6707993 37636990 100.000

Sample Type: SR Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

5wAnalysis:3 793C1574S,1,10w
 Created at 08:53 on 20/Aug/85

Page 1

***** MULTICHROM 5000/RSX *****

Channel:3 Title: HP-5730 Date 14/ 8/85 Time 9:10
 Analysis:793C1574S Sample Name:C-1574,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
2	5.109	1357	6560	0.332	n-C12	0
8	7.557	3723	10367	0.525	n-C13	0
15	10.280	4765	15792	0.800	n-C14	FO
24	13.077	5746	19149	0.970	n-C15	
29	15.840	5803	18792	0.952	n-C16	
35	18.523	6057	20312	1.029	n-C17	
36	18.755	22367	115786	5.853	Pristane	0
41	21.080	6125	20964	1.032	n-C18	LO
42	21.384	2681	14317	0.725	Phytane	
49	23.539	6271	24663	1.249	n-C19	0
53	25.899	6567	26119	1.323	n-C20	
56	28.139	7658	29495	1.443	n-C21	
58	30.293	10452	55974	2.834	n-C22	OM
60	32.357	12640	48698	2.436	n-C23	
63	34.336	16294	60959	3.037	n-C24	
65	36.245	25140	95473	4.834	n-C25	0
70	38.077	21921	78286	3.934	n-C26	
73	39.861	40858	155174	7.857	n-C27	
76	41.557	20917	104673	5.300	n-C28	FOM
80	43.213	41739	138111	6.933	n-C29	
86	44.803	17610	66241	3.334	n-C30	LO
92	46.355	30954	132643	6.717	n-C31	LO
97	47.837	7616	34345	1.739	n-C32	0
102	49.283	8258	42608	2.158	n-C33	M
108	50.696	2198	10954	0.555	n-C34	FOM
113	52.069	1385	9525	0.432	n-C35	FOM
115	53.632	530	2779	0.141	n-C36	0

Total 460921 1974877 100.000

Sample Type: SR Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

SwAnalysis:3 793C1577S,1,10w
 Created at 13:22 on 15/Aug/85

Page 1

***** MULTICHROM 5000/RSX *****

Channel:3 Title: HP-5730 Date 14/ 8/85 Time 10:50
 Analysis:793C1577S Sample Name:C-1577,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
5	7.587	755	4107	0.019	n-C13	0
17	10.301	4793	28873	0.131	n-C14	FO
28	13.101	25701	89083	0.405	n-C15	LO
38	15.875	56888	204204	0.927	n-C16	0
50	18.557	81533	325301	1.477	n-C17	OM
51	18.819	104911	560763	2.546	Pristane	0
62	21.136	99387	351993	1.538	n-C18	
63	21.416	32381	164218	0.746	Phytane	
74	23.587	104209	403916	1.834	n-C19	LO
82	25.939	106757	447833	2.033	n-C20	0
93	28.200	109351	467888	2.125	n-C21	0
99	30.352	116340	488732	2.219	n-C22	FOM
106	32.429	127175	629856	2.830	n-C23	FO
113	34.413	136437	626772	2.846	n-C24	0
116	36.339	170619	842989	3.828	n-C25	FO
125	38.173	140313	747259	3.333	n-C26	0
130	39.976	169307	995920	4.522	n-C27	0
138	41.661	125084	728165	3.306	n-C28	0
144	43.325	145486	889525	4.039	n-C29	0
151	44.904	95739	588014	2.670	n-C30	0
155	46.451	111152	675199	3.036	n-C31	OM
160	47.917	61970	280618	1.274	n-C32	0
167	49.368	56827	360512	1.637	n-C33	LOM
171	50.760	40675	233321	1.059	n-C34	FOM
176	52.131	32202	195971	0.830	n-C35	LO
180	53.704	20059	119265	0.542	n-C36	FO

Total 3539725 22022870 100.000

Sample Type: SR Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

5wAnalysis:3 793C1583S,1,10w
 Created at 13:55 on 15/Aug/85

Page 1

***** MULTICHROM 5000/RX *****

Channel:3 Title: HP-5730 Date 14/ 8/85 Time 15:40
 Analysis:793C1583S Sample Name:C-1583,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	0.00	Identity	Type
1	10.405	121	280	0.038	n-C14	
4	13.147	373	1613	0.049	n-C15	0
9	15.901	4261	14522	0.437	n-C16	LO
13	18.584	13734	50166	1.539	n-C17	0
14	18.819	13536	70642	2.125	Pristane	LO
18	21.163	23237	82367	2.478	n-C18	
19	21.445	8253	43540	1.310	Phytane	0
27	23.624	30092	105859	3.135	n-C19	0
35	25.981	29634	114488	3.444	n-C20	LO
41	28.235	29692	111177	3.345	n-C21	FO
47	30.395	29146	122613	3.639	n-C22	0
51	32.464	30817	118384	3.531	n-C23	
55	34.448	28864	117108	3.523	n-C24	FO
62	36.349	34029	140182	4.217	n-C25	0
70	38.192	25716	111585	3.357	n-C26	0
75	39.968	30500	114202	3.436	n-C27	
82	41.672	20452	87360	2.628	n-C28	0
88	43.331	24511	103225	3.105	n-C29	LO
94	44.923	14972	60685	1.826	n-C30	
99	46.461	19407	86638	2.606	n-C31	LO
105	47.944	9279	43010	1.234	n-C32	0
111	49.400	9792	56961	1.714	n-C33	LO
116	50.797	6541	45757	1.377	n-C34	OM
118	51.581	1892	15210	0.458	n-C35	LO
122	53.741	2468	22844	0.637	n-C36	OM

Total 650753 3324031 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

SwAnalysis:3 793C1584S,1,10w
 Created at 12:31 on 15/Aug/85

Page 1

***** MULTICHRM 5000/RSX *****

Channel:3 Title: HP-5730 Date 15/ 8/85 Time 10:33
 Analysis:793C1584S Sample Name:C-1584,30/3-4,TV
 Sample 1 Injection 1

PK.#	R/T	Height	Area	J.00	Identity	Type
7	5.115	22539	59912	0.193	n-C12	FO
20	7.555	81578	234916	0.758	n-C13	LO
33	10.291	152109	542639	1.751	n-C14	FO
44	13.112	199155	797696	2.574	n-C15	0
58	15.891	213743	938118	3.027	n-C16	0
71	18.568	203290	918324	2.953	n-C17	0
72	18.803	130913	783430	2.528	Pristane	0
84	21.139	179286	860004	2.775	n-C18	0
85	21.405	75536	407963	1.316	Phytane	LO
95	23.597	167979	768232	2.479	n-C19	0
106	25.944	140115	753521	2.432	n-C20	LO
115	28.189	131569	568812	1.836	n-C21	0
123	30.344	116386	521026	1.631	n-C22	FO
134	32.413	120002	496125	1.601	n-C23	0
144	34.403	114219	495843	1.600	n-C24	0
151	36.323	119667	834950	2.634	n-C25	0
159	38.157	105689	744825	2.403	n-C26	0
166	39.949	113807	829956	2.678	n-C27	0
173	41.640	95739	1027316	3.315	n-C28	OM
178	43.299	98547	540864	1.745	n-C29	0
185	44.872	64854	393275	1.239	n-C30	0
188	46.411	55595	244704	0.730	n-C31	0
194	47.891	35940	164342	0.530	n-C32	0
201	49.331	35670	186792	0.603	n-C33	0
206	50.728	27487	202597	0.654	n-C34	OM
210	52.083	19685	158831	0.513	n-C35	LOM
212	53.640	8903	48761	0.157	n-C36	FOM

Total 5023893 30989310 100.000

Sample Type: SR Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

CUTTINGS

5wAnalysis:3 793C1587S,1,10w
 Created at 10:25 on 16/Aug/85

Page 1

***** MULTICHROM 5000/RX *****

Channel:3 Title: HP-5730 Date 13/ 8/85 Time 14:25
 Analysis:793C1587S Sample Name:C-1587,30/3-4,TY
 Sample 1 Injection 1

PK. #	R/T	Height	Area	0.00	Identity	Type
12	5.181	50204	129406	0.614	n-C12	
24	7.645	122276	380019	1.803	n-C13	0
39	10.403	212110	852822	4.046	n-C14	0
52	13.208	189327	752165	3.558	n-C15	0
64	15.965	167506	664904	3.154	n-C16	0
78	18.648	158121	673346	3.135	n-C17	0
79	18.888	108191	662237	3.142	Pristane	0
89	21.219	148431	628119	2.930	n-C18	0
91	21.496	58269	321788	1.527	Phytane	LO
102	23.677	143106	600113	2.847	n-C19	0
112	26.024	130059	549221	2.636	n-C20	FOM
122	28.275	115241	479947	2.277	n-C21	0
128	30.437	95739	418357	1.935	n-C22	FO
137	32.499	99005	402420	1.909	n-C23	0
146	34.483	83761	361629	1.716	n-C24	FO
154	36.403	86324	484078	2.237	n-C25	LO
159	38.227	71782	390235	1.851	n-C26	0
164	40.008	79747	339398	1.610	n-C27	0
172	41.715	60654	351859	1.639	n-C28	OM
178	43.373	67021	289657	1.374	n-C29	0
185	44.952	44883	217483	1.032	n-C30	LO
190	46.493	48537	221092	1.049	n-C31	LO
195	47.987	29184	120408	0.571	n-C32	0
199	49.427	29047	196276	0.931	n-C33	OM
204	50.851	21634	140721	0.638	n-C34	LOM
208	52.221	16728	113576	0.539	n-C35	LO
210	53.811	8191	66167	0.314	n-C36	0

Total 4106625 21078160 100.000

Sample Type: SR Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: TB Calibration: TB Type: UC

APPENDIX III

Background data from GC analysis of saturated hydrocarbons
Oils and core samples.

OILS

SwAnalysis:3 792AUT04S,4,10w
 Created at 15:11 on 08/Aug/85

Page 1

***** MULTICHROM 5000/R SX *****

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Channel:3 Title: HP-5730 Date 10/ 7/85 Time 18:18
 Analysis:792AUT04S Sample Name:C-1647,SAT,30/3-4
 Sample 4 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
4	3.651	20749	49047	3.220	nC11	
19	5.917	35010	99077	6.504	nC12	0
40	8.637	40045	123809	8.127	nC13	
57	11.533	38928	124512	8.174	nC14	
75	14.429	31458	105135	6.902	nC15	
93	17.235	21535	75198	4.936	nC16	0
106	19.944	15431	55696	3.656	nC17	M
107	20.179	7525	39271	2.578	Pristane	
119	22.520	10344	37077	2.434	nC18	
121	22.829	4006	20586	1.351	Phytane	0
132	24.984	6625	24172	1.537	nC19	
138	27.355	5576	21288	1.337	nC20	0
145	29.611	3879	14748	0.938	nC21	0
152	31.781	2929	11690	0.737	nC22	0
161	33.832	1993	8275	0.543	nC23	
167	35.808	1492	6306	0.414	nC24	0
175	37.712	975	3802	0.250	nC25	
177	39.552	700	2893	0.130	nC26	
182	41.125	134	313	0.021	nC27	

Total 443189 1523360 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 4
 Method: AUTO Calibration: AUTO Type: UC

OILS

5wAnalysis:3 792AUT04S,5,10w
 Created at 15:41 on 08/Aug/85

Page 1

***** MULTICHRDM 5000/RSX *****

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Channel:3 Title: HP-5730 Date 11/ 7/85 Time 8:45
 Analysis:792AUT04S Sample Name:C-1648,SAT,30/3-4
 Sample 5 Injection 1

PK.f	R/T	Height	Area	P	Identity	Type
4	3.656	14872	40029	2.933	nC11	OM
19	5.896	25400	71797	5.339	nC12	0
39	8.605	29600	90192	6.745	nC13	
56	11.496	29039	93476	6.930	nC14	M
72	14.381	23557	82653	6.131	nC15	
87	17.208	17160	62832	4.639	nC16	
99	19.907	12686	46702	3.433	nC17	
100	20.136	8868	43262	3.235	Pristane	0
110	22.493	8750	31049	2.322	nC18	
111	22.789	4434	23087	1.727	Phytane	0
119	24.957	5398	18585	1.330	nC19	
127	27.323	4189	17783	1.330	nC20	0
131	29.573	2667	10833	0.810	nC21	
137	31.749	2063	11630	0.870	nC22	OM
142	33.813	1464	5724	0.428	nC23	M
148	35.803	1172	5192	0.338	nC24	OM
155	37.699	791	3850	0.238	nC25	M
160	39.565	412	1258	0.034	nC26	
164	41.264	221	389	0.029	nC27	

Total 375085 1337204 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 5
 Method: AUTO Calibration: AUTO Type: UC

CORES

SwAnalysis:3 793AUT01,1,10w
 Created at 13:13 on 24/Jul/85

***** MULTICHROM 5000/RSX *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 15:26
 Analysis:792AUT01 Sample Name:C-1623,SAT,30/3-4
 Sample 1 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
4	3.592	38584	91003	0.304	nC11	O
17	5.853	132500	403622	1.350	nC12	
33	8.595	212324	707059	2.354	nC13	
51	11.512	240310	941425	3.148	nC14	M
67	14.429	249313	1045346	3.435	nC15	M
82	17.256	232055	1030837	3.447	nC16	
98	19.971	238342	1008553	3.372	nC17	
99	20.216	169062	974652	3.259	Pristane	O
111	22.563	195859	913771	3.055	nC18	
112	22.851	125099	708853	2.370	Phytane	O
122	25.032	194790	743372	2.436	nC19	O
134	27.395	195553	945577	3.132	nC20	M
145	29.651	168467	749855	2.507	nC21	
152	31.816	160181	752080	2.515	nC22	M
161	33.875	155558	699070	2.337	nC23	
169	35.859	144418	674328	2.255	nC24	
176	37.768	137154	841205	2.813	nC25	O
182	39.613	131127	718922	2.404	nC26	O
187	41.373	105094	490118	1.639	nC27	OM
192	43.080	93283	381170	1.274	nC28	
201	44.733	87514	393912	1.317	nC29	O
207	46.323	76573	362211	1.211	nC30	O
212	47.880	67463	338348	1.131	nC31	OM
219	49.357	57579	254878	0.852	nC32	O
223	50.824	58574	335403	1.121	nC33	M
228	52.237	56171	356897	1.133	nC34	M
233	53.667	34891	281352	0.941	nC35	OM
236	55.352	22069	163269	0.546	nC36	OM
240	57.357	15962	129083	0.432	nC37	OM
243	59.757	10798	85156	0.235	nC38	OM
249	62.723	8019	82007	0.274	nC39	OM
254	66.269	5759	80703	0.270	nC40	M

Total 6387433 29908230 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
 Method: AUTO Calibration: AUTO Type: UC

CORES

5wAnalysis:3 793AUT01,2,10w
 Created at 13:13 on 24/Jul/85

***** MULTICHROM 5000/RX *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 16:57
 Analysis:792AUT01 Sample Name:C-1624,SAT,30/3-4
 Sample 2 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
3	3.576	22226	49432	0.143	nC11	
13	5.837	120155	354857	1.028	nC12	
28	8.595	202298	711804	2.032	nC13	
45	11.523	254837	1048083	3.036	nC14	
61	14.451	265336	1265492	3.635	nC15	
76	17.277	277544	1259396	3.648	nC16	
90	19.992	254715	1228600	3.559	nC17	
91	20.243	209836	1182402	3.425	Pristane	0
102	22.579	234237	1110272	3.216	nC18	
103	22.872	162058	863313	2.501	Phytane	
114	25.048	230071	901819	2.612	nC19	
125	27.405	216490	1204782	3.430	nC20	OM
135	29.661	200436	978633	2.835	nC21	OM
141	31.829	196347	895807	2.535	nC22	M
150	33.891	171153	813574	2.356	nC23	
156	35.869	181423	781306	2.233	nC24	
163	37.773	147439	960890	2.733	nC25	0
169	39.613	146295	704811	2.041	nC26	0
176	41.387	135277	562672	1.630	nC27	OM
181	43.091	99860	482937	1.339	nC28	
189	44.744	99631	452514	1.311	nC29	0
195	46.328	85973	398858	1.155	nC30	0
198	47.875	75215	344794	0.939	nC31	OM
204	49.357	60966	277742	0.804	nC32	0
209	50.808	68211	390231	1.130	nC33	OM
213	52.221	67265	405808	1.175	nC34	M
218	53.651	40366	304501	0.832	nC35	M
222	55.331	24324	175013	0.507	nC36	0
226	57.341	16057	144413	0.418	nC37	0
229	59.776	12061	92477	0.238	nC38	OM
235	62.696	10174	93692	0.271	nC39	OM
239	66.291	6035	80937	0.234	nC40	M

Total 7099592 34525580 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 2
 Method: AUTO Calibration: AUTO Type: UC

CORES

SwAnalysis:3 793AUT01,3,10w
 Created at 13:14 on 24/Jul/85

Page 1

***** MULTICHROM 5000/RX *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 18:27
 Analysis:792AUT01 Sample Name:C-1625,SAT,30/3-4
 Sample 3 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
2	3.571	33182	76912	0.131	nC11	O
15	5.837	141778	429953	1.035	nC12	
31	8.600	238158	871878	2.130	nC13	
48	11.539	279558	1284386	3.132	nC14	M
65	14.467	326924	1522569	3.772	nC15	M
80	17.299	311420	1526058	3.731	nC16	M
93	20.016	314839	1487005	3.634	nC17	M
94	20.259	228560	1361190	3.372	Pristane	O
105	22.600	267106	1352416	3.351	nC18	
106	22.893	179958	979569	2.427	Phytane	
116	25.069	250320	1122464	2.731	nC19	M
126	27.432	247055	1447564	3.536	nC20	OM
137	29.683	222655	1186409	2.939	nC21	O
143	31.843	223814	1076501	2.637	nC22	M
151	33.912	206311	968205	2.339	nC23	
159	35.891	191738	935641	2.318	nC24	
167	37.795	178310	1123558	2.734	nC25	O
173	39.619	168361	821840	2.036	nC26	O
180	41.384	134896	641092	1.538	nC27	O
186	43.091	125954	613440	1.520	nC28	OM
193	44.744	113975	537944	1.333	nC29	
199	46.344	101279	478521	1.136	nC30	O
203	47.885	88705	433856	1.075	nC31	OM
207	49.368	75032	338144	0.838	nC32	O
211	50.829	70622	442897	1.037	nC33	OM
216	52.232	72117	468189	1.150	nC34	M
220	53.677	44665	329296	0.816	nC35	OM
225	55.347	20471	128621	0.319	nC36	M
230	57.389	17549	129120	0.320	nC37	
236	59.800	10551	84400	0.209	nC38	M
241	62.744	8196	76738	0.130	nC39	OM
245	66.312	5017	59165	0.147	nC40	M

Total 8148315 40361480 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 3
 Method: AUTO Calibration: AUTO Type: UC

CORES

SwAnalysis:3 793AUT01,4,10w
 Created at 13:33 on 24/Jul/85

Page 1

***** MULTICHROM 5000/R5X *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 19:58
 Analysis:792AUT01 Sample Name:C-1626,SAT,30/3-4
 Sample 4 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
2	3.565	34178	75067	0.219	nC11	0
15	5.827	127602	393474	1.146	nC12	
31	8.584	210309	750607	2.136	nC13	
49	11.512	250198	1053447	3.038	nC14	
66	14.429	278826	1230537	3.534	nC15	
80	17.251	264604	1237329	3.604	nC16	
94	19.971	263749	1227601	3.575	nC17	M
95	20.216	190014	1192374	3.473	Pristane	0
107	22.552	242050	1120509	3.233	nC18	
108	22.851	145425	791470	2.305	Phytane	0
120	25.027	222410	918819	2.676	nC19	
132	27.384	234649	1193926	3.477	nC20	0
142	29.645	203290	935979	2.726	nC21	M
151	31.805	199399	947590	2.730	nC22	M
159	33.875	180278	877146	2.555	nC23	
166	35.848	177867	837468	2.439	nC24	
174	37.768	164485	1018294	2.936	nC25	0
180	39.597	155069	878508	2.559	nC26	0
186	41.368	137322	599034	1.745	nC27	0
193	43.080	102622	461388	1.344	nC28	M
202	44.728	101431	481321	1.402	nC29	0
210	46.328	87850	413689	1.205	nC30	0
214	47.859	71568	295725	0.851	nC31	0
221	49.357	64320	294897	0.859	nC32	
225	50.808	64762	371867	1.033	nC33	OM
229	52.227	62794	411702	1.139	nC34	M
235	53.661	39534	314767	0.917	nC35	OM
238	55.352	21119	188659	0.549	nC36	OM
241	57.352	14641	118536	0.345	nC37	M
246	59.795	11344	88457	0.258	nC38	M
251	62.741	8822	78974	0.230	nC39	OM
256	66.280	5925	82921	0.241	nC40	M

Total 7160256 34336690 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 4
 Method: AUTO Calibration: AUTO Type: UC

CORES

SwAnalysis:3 793AUT01,5,10w
 Created at 13:42 on 24/Jul/85

Page 1

***** MULTICHROM 5000/R SX *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 21:29
 Analysis:792AUT01 Sample Name:C-1627,SAT,30/3-4
 Sample 5 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
2	3.571	44921	96439	0.233	nC11	
14	5.837	159647	472890	1.336	nC12	
30	8.600	231032	821077	2.407	nC13	
46	11.533	256363	1095280	3.210	nC14	
62	14.456	272783	1238463	3.630	nC15	
76	17.283	261796	1202253	3.524	nC16	
90	19.992	258683	1160311	3.401	nC17	
91	20.248	184261	1055270	3.093	Pristane	O
103	22.589	222578	1055058	3.093	nC18	
104	22.877	142755	757084	2.219	Phytane	O
115	25.059	217924	885354	2.535	nC19	O
128	27.416	210294	1078703	3.132	nC20	M
138	29.661	207761	890391	2.610	nC21	
146	31.832	176021	897809	2.632	nC22	M
153	33.880	169993	832325	2.440	nC23	
163	35.869	162959	786686	2.306	nC24	
170	37.773	162867	961809	2.819	nC25	O
177	39.597	150247	844211	2.475	nC26	O
184	41.360	131829	567149	1.632	nC27	O
191	43.064	110602	528793	1.530	nC28	OM
198	44.707	114753	496937	1.457	nC29	
205	46.301	97067	434316	1.273	nC30	O
211	47.848	85363	350094	1.026	nC31	O
215	49.341	74101	343374	1.006	nC32	O
219	50.787	76711	399813	1.172	nC33	M
225	52.195	75810	429534	1.259	nC34	M
228	53.635	45390	329901	0.937	nC35	O
232	55.309	28288	202655	0.534	nC36	O
236	57.304	21551	151378	0.444	nC37	M
241	59.747	13342	107670	0.316	nC38	M
246	62.669	11194	106134	0.311	nC39	OM
249	66.227	7688	84596	0.248	nC40	

Total 7200596 34116400 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 5
 Method: AUTO Calibration: AUTO Type: UC

CORES

5wAnalysis:3 793AUT01,6,10w
 Created at 13:46 on 24/Jul/85

***** MULTICHROM 5000/R SX *****

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Channel:3 Title: HP-5730 Date 19/ 7/85 Time 22:59
 Analysis:792AUT01 Sample Name:C-1628,SAT,30/3-4
 Sample 6 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
2	3.568	11458	26144	0.076	nC11	
15	5.821	78908	232314	0.677	nC12	
32	8.563	182491	625191	1.822	nC13	
50	11.496	251175	1018114	2.936	nC14	M
64	14.419	283648	1255355	3.638	nC15	
77	17.245	279985	1287759	3.732	nC16	
92	19.949	268571	1273391	3.710	nC17	
93	20.195	197720	1135961	3.310	Pristane	O
104	22.536	237502	1160530	3.331	nC18	
105	22.824	152704	819592	2.338	Phytane	
116	25.011	240386	974153	2.838	nC19	
127	27.373	219496	1180862	3.440	nC20	M
140	29.629	210111	1037377	3.022	nC21	O
147	31.795	195340	946645	2.758	nC22	M
154	33.864	174068	854918	2.431	nC23	
162	35.845	175456	822154	2.335	nC24	M
170	37.736	163645	1022849	2.930	nC25	OM
177	39.576	149774	869437	2.533	nC26	O
184	41.341	136117	602942	1.757	nC27	O
191	43.048	112418	552056	1.608	nC28	OM
199	44.696	120994	498907	1.454	nC29	OM
206	46.296	86690	452576	1.319	nC30	O
210	47.832	86767	402789	1.174	nC31	OM
215	49.320	76390	335405	0.977	nC32	O
219	50.765	71095	412574	1.202	nC33	OM
224	52.189	67097	437705	1.275	nC34	M
227	53.613	47236	335799	0.978	nC35	OM
232	55.293	23828	129804	0.378	nC36	
237	57.283	19540	163545	0.476	nC37	OM
243	59.715	13915	175609	0.512	nC38	OM
247	62.616	10788	100955	0.234	nC39	OM
254	66.195	6896	78053	0.227	nC40	O

Total 7051898 34322700 100.000

Sample Type: ST Scale Factor: 1.000 Bottle: 6
 Method: AUTO Calibration: AUTO Type: UC



CORES

5wAnalysis:3 793C1629S,1,10w
Created at 16:31 on 31/Jul/85

***** MULTICHROM 5000/RX *****

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Channel:3 Title: HP-5730 Date 24/ 7/85 Time 12: 9
Analysis:793C1629S Sample Name:C-1629,SAT,30/3-4
Sample 1 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
2	3.336	29371	60264	0.403	nC11	
12	5.309	105307	264934	1.770	nC12	
28	7.800	140222	427094	2.854	nC13	
44	10.552	157099	516787	3.453	nC14	
61	13.373	143136	548222	3.633	nC15	
77	16.147	132149	507756	3.333	nC16	
92	18.829	126335	472995	3.131	nC17	
93	19.069	82708	432972	2.833	Pristane	0
105	21.405	106086	420737	2.812	nC18	
107	21.699	57377	305414	2.041	Phytane	
118	23.864	96808	327963	2.132	nC19	0
127	26.219	98425	409570	2.737	nC20	0
140	28.467	91162	345980	2.312	nC21	
148	30.632	81350	350025	2.339	nC22	
156	32.696	84340	323707	2.133	nC23	M
166	34.675	84661	327730	2.130	nC24	M
171	36.589	71766	404938	2.706	nC25	0
176	38.419	73552	320624	2.143	nC26	0
184	40.195	63511	263510	1.731	nC27	
191	41.896	56396	235913	1.576	nC28	0
199	43.555	59555	239800	1.602	nC29	
203	45.152	50079	215075	1.437	nC30	0
208	46.696	44413	169626	1.134	nC31	0
212	48.173	39641	170700	1.141	nC32	0
216	49.629	41007	214712	1.435	nC33	M
221	51.053	38840	234890	1.570	nC34	M
225	52.440	26418	181796	1.215	nC35	0
229	54.067	14842	109187	0.730	nC36	OM
233	56.024	11710	91682	0.613	nC37	0
237	58.360	7467	56780	0.379	nC38	M
241	61.181	6021	52923	0.354	nC39	OM
247	64.637	4560	49134	0.328	nC40	0

Total 3544315 14964730 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 1
Method: AUTO Calibration: AUTO Type: UC

CORES

5wAnalysis:3 793AUT02S,2,10w
 Created at 17:41 on 31/Jul/85

Page 1

***** MULTICHROM 5000/RX *****

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Channel:3 Title: HP-5730 Date 23/ 7/85 Time 10:39
 Analysis:793AUT02S Sample Name:C-1630,SAT,30/3-4
 Sample 2 Injection 1

PK.#	R/T	Height	Area		P Identity	Type
1	3.509	1759	4167	1.310	nC11	
11	5.712	5875	16945	5.327	nC12	
21	8.400	7483	23222	7.300	nC13	0
31	11.285	8111	25367	7.974	nC14	
41	14.176	6932	24654	7.750	nC15	
47	16.987	5702	19279	6.030	nC16	0
51	19.685	4615	14815	4.657	nC17	
52	19.928	2615	13152	4.134	Pristane	0
55	22.267	2869	10262	3.226	nC18	
56	22.565	1406	7532	2.338	Phytane	
61	24.739	1783	6040	1.839	nC19	
63	27.083	1515	7267	2.234	nC20	
64	29.333	1053	3886	1.222	nC21	
65	31.520	755	3424	1.076	nC22	
66	33.579	559	2116	0.635	nC23	
67	35.568	419	1871	0.538	nC24	
68	37.472	229	1076	0.338	nC25	
69	39.339	213	1449	0.436	nC26	
71	41.088	158	760	0.239	nC27	0

Total 86605 318131 100.000

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 2
 Method: AUTO Calibration: AUTO Type: UC

CORES

5wAnalysis:3 793AUT02S,4,10w
 Created at 17:01 on 31/Jul/85

Page 1

***** MULTICHROM 5000/R SX *****

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Channel:3 Title: HP-5730 Date 23/ 7/85 Time 14:55
 Analysis:793AUT02S Sample Name:C-1632,SAT,30/3-4
 Sample 4 Injection 1

PK.#	R/T	Height	Area	P	Identity	Type
1	3.520	24183	49427	0.376	nC11	0
11	5.757	72758	206277	1.571	nC12	
27	8.488	116813	366817	2.734	nC13	
43	11.403	140588	478428	3.644	nC14	
58	14.317	135705	511426	3.835	nC15	
71	17.133	131066	490214	3.734	nC16	
84	19.851	122597	453992	3.458	nC17	
85	20.083	64549	322750	2.458	Pristane	
97	22.435	104895	400994	3.054	nC18	
99	22.728	43605	222990	1.638	Phytane	
110	24.904	92260	324936	2.475	nC19	0
122	27.256	94717	385388	2.935	nC20	0
130	29.520	85607	320671	2.442	nC21	M
136	31.683	80007	323432	2.453	nC22	M
142	33.747	81853	303039	2.308	nC23	
150	35.739	82784	302357	2.303	nC24	
157	37.640	70729	363800	2.771	nC25	0
163	39.480	67570	286870	2.135	nC26	0
168	41.256	60631	244612	1.833	nC27	0
176	42.957	54378	228478	1.740	nC28	0
184	44.611	53466	227670	1.734	nC29	0
191	46.221	43372	199847	1.522	nC30	0
195	47.768	44814	186819	1.423	nC31	OM
199	49.267	37844	157784	1.202	nC32	0
204	50.712	38474	200369	1.526	nC33	OM
208	52.120	32702	198193	1.510	nC34	M
213	53.528	23946	158196	1.205	nC35	OM
217	55.176	16160	94565	0.720	nC36	0
222	57.133	11599	85530	0.651	nC37	
226	59.507	8291	84383	0.643	nC38	OM
229	62.379	6402	61698	0.470	nC39	OM
233	65.843	4260	56500	0.430	nC40	M
Total		3035607	13128990	100.000		

Sample Type: SA Scale Factor: 1.000 Amount: 1.000 Bottle: 4
 Method: AUTO Calibration: AUTO Type: UC

APPENDIX IV

 DISCUSSION OF THE $\delta^{13}\text{C}$ ISOTOPE DATA FOR SELECTED CUTTINGS SAMPLES

The $\delta^{13}\text{C}$ isotope data for selected cuttings samples are shown in table 10. Problems were encountered obtaining isotope data from some of the cuttings extracts due to insufficient sample. $\delta^{13}\text{C}$ isotope data were obtained on those kerogens which were analysed by pyrolysis-gas chromatography.

Post Paleocene (950-2027m): The two samples from this unit at 1700m and 2015-30m show a slight decrease with depth in the $\delta^{13}\text{C}$ ratio of the saturate fraction and a marked decrease in the $\delta^{13}\text{C}$ ratio of the isolated kerogens. The value for the 2015-30m sample was obtained on a very small sample quantity and may not be wholly reliable. Tissot and Welte (1984) observe that in the North Sea, humic kerogens are often less depleted in ^{13}C than marine kerogens, the reverse of what is usually seen. This would agree with the Py-GC data which, together with the $\delta^{13}\text{C}$ data, suggests a decrease in the humic input with depth, although it should also be noted that there is a significant difference between the $\delta^{13}\text{C}$ saturates and the $\delta^{13}\text{C}$ kerogen for the 1700m sample, which may suggest that the extractable organic matter in this sample is not of indigenous origin (Schoell, 1982).

Cretaceous (2265-2780m): One cuttings sample at 2750-65m was analysed from this unit and has $\delta^{13}\text{C}$ ratios of -29.00/00 for the saturate fraction and -27.90/00 for the aromatic fraction. The $\delta^{13}\text{C}$ ratio of the saturated fraction is similar to that for the lowermost of the two Tertiary samples, although these samples are separated by about 700m.

Brent group (2795-2950m): Four samples at 2810-25m, 2825-40m, 2870-85m and 2915-30m were examined from the Brent group. $\delta^{13}\text{C}$ values were obtained for the kerogen from all four samples, but $\delta^{13}\text{C}$ values were obtained for the extracted material in only one sample due to a lack of sample at 2870-85m and 2915-30m. The $\delta^{13}\text{C}$ data for the kerogen isolates show a decrease with depth from -28.00/00 to -25.30/00. This decrease is matched by a decrease in the percentages of woody/coaly kerogen in the upper three samples, based on visual observations. The $\delta^{13}\text{C}$ value for the 2810-25m saturate fraction is similar to those seen at 2750-65m and 2015-30m, and to the core extracts and oil.

Dunlin group (2950-3233m): Of the three samples from this group, $\delta^{13}\text{C}$ data was obtained on isolated kerogens at 2960-75m and 2975-90m, and on saturated/aromatic fractions at 2975-90m and 3020-35m (no data were obtained from the aromatics fraction of the 2975-90m sample due to poor sample recovery). All of these samples are from the turbo-drilled zone and were analysed to observe any turbo-drill effects. No data were obtained from the extractable matter at 2960-75m.

The $\delta^{13}\text{C}$ data for the kerogen isolates continue the trend described from the samples of the Brent group, although it is not known to what extent this is due to the turbo-drilling. No kerogen data were obtained for the lowest sample due to problems separating the probably caved coal and the claystone in this sample. The $\delta^{13}\text{C}$ data for the saturate fractions are slightly lower than those observed in the cores and oils, although this may be partly due to turbo-drilling effects. The $\delta^{13}\text{C}$ value for the aromatic hydrocarbons at 3020-35m is significantly lower than those for the cores and oils and may reflect the marked loss of low-molecular weight aromatic compounds shown in the gas chromatogram of this sample.

References

- SCHOELL, M., 1982: Applications of isotope analysis to petroleum and natural gas research. Spectra, Sept. 1982, pp.31-41.
- TISSOT, B. and WELTE, D., 1984: Petroleum formation and occurrence (2nd Ed.), Springer-Verlag.

APPENDIX V

DISCUSSION OF PYROLYSIS-GAS CHROMATOGRAPHY DATA

Isolated kerogen from a total of eight selected cuttings samples was analysed using pyrolysis-gas chromatography. Semi-quantitative data were calculated, together with the (m+p)-xylene/n-octene ratio of Larter (1982). Consideration of the semi-quantitative data suggests that these data are not wholly reliable and, therefore, will not be further referred to in this discussion.

Post Paleocene (950-2027m): Two samples at 1650-1700m and 2015-2030m were analysed. The upper sample has a generally poorer development of alkene/alkane peaks. Both pyro-chromatograms show a relatively prominent unidentified peak and a prominent hump of unresolved high molecular weight compounds. The relatively good development of alkane/-alkene peaks and a low xylene/octene ratio of 0.34 in the 2015-2030m sample may reflect the bacterial/fungal debris described as being present in this sample (page 21). The generally poor peak development in the 1650-1700m sample suggests a fairly degraded kerogen, which is supported by a relatively high oxygen index of 191mg/g (table 5).

Brent group (2795-2950m): Four samples were analysed at 2810-25m, 2825-40m, 2875-85m and 2915-2930m, the first two samples being coals. The pyro-chromatograms of the two coals show well-developed alkane/-alkene homologies suggesting the presence of significant amounts of liptinitic material, especially so in the case of the 2810-25m sample. Xylene/octene ratios of 2.03 (2810-25m) and 3.31 (2825-40m) suggest a mostly higher plant input to the coals as might be expected, but suggest less higher plant input to the former sample. The pyro-chromatogram of the 2870-85m claystone is somewhat similar to that of the upper coal, but a xylene/octene ratio of 3.17 suggests a slightly more hydrogen-poor kerogen type, as is suggested by hydrogen index and oxygen index data (table 5). The remaining sample from the Brent group (2915-2930m) has a xylene/octene ratio of 0.94, suggesting a mixed kerogen type with less terrestrial input than was seen in the other Brent group samples. This difference is not so apparent from the pyro-chromatogram in which the most distinguishing feature is a very prominent toluene peak. In conclusion, it might be said that the pyro-chromatograms of the Brent group samples tend to suggest a more mixed type II/III kero-

gen than is suggested by the Rock-Eval data, but which agrees with the visual kerogen data.

Dunlin group (2950-3233m): The remaining two samples at 2960-75m and 2975-90m are from the Dunlin group, and according to supplied well-data, may have been affected by turbo-drilling, This is probably most evident in the lower sample which has a pyro-chromatogram with an appearance suggesting a poor type III kerogen, in contradiction to the hydrogen index of 228mg/g. The appearance of this pyro-chromatogram suggests that the high hydrogen index of this sample may be due to hydrocarbon contamination. The pyro-chromatogram of the 2960-75m sample shows a better development of aromatic components relative to aliphatic components, suggesting a type III kerogen of better preservation than that in the lower sample.

References

LARTER, S.R., 1982: Application of analytical pyrolysis techniques to kerogen characterisation and fossil fuel exploration/exploitation. In: Analytical Pyrolysis, techniques and applications (Ed. K.J.Voorhees), pp.212-276. Butterworths.