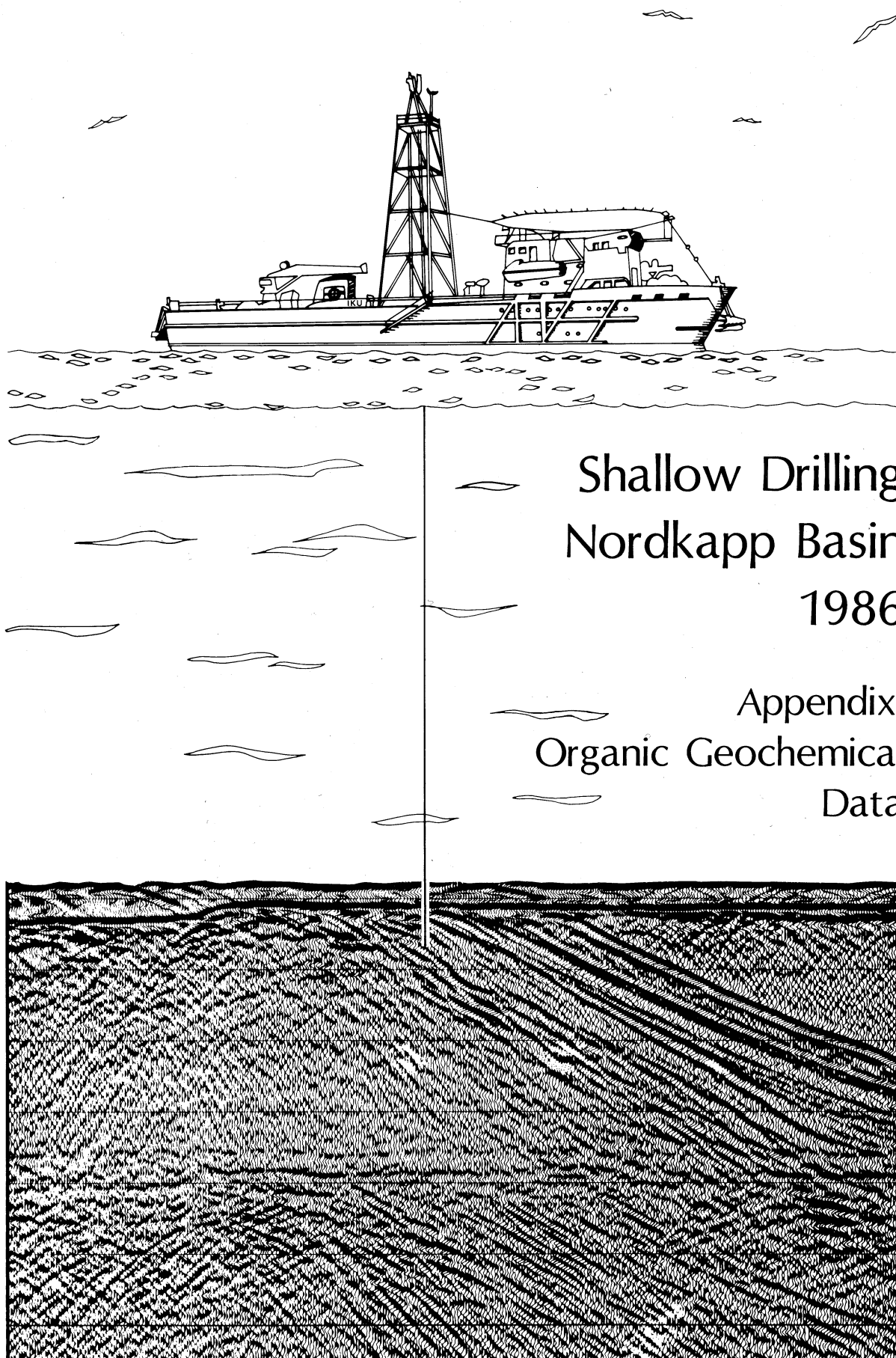




REPORT

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87.027	RESTRICTED

REPORT TITLE: NORDKAPP BASIN SHALLOW DRILLING 1986 Appendix: Organic geochemical Data REPORT NO.: 21.3419.00/04/87
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CLIENT: BP Petroleum Dev. Ltd., Elf Aquitaine Norge a/s, Esso Norge a.s, Mobil Exploration Norway Inc., Norsk Agip A/S, Norsk Hydro a.s, A/S Norske Shell, Statoil				
SUMMARY: This appendix contains: 1) Tables and figures of the geochemical data obtained from the core samples drilled by IKU in the Nordkapp Basin in 1986 (Chapter II). The data are organized core by core, each section having its own table of contents. The text accompanying these data may be found in the main body of the report. 2) Data obtained from the artificial maturation of two core samples using hydrous pyrolysis. These data are accompanied by a descriptive text (Chapter I). 3) A description of the experimental methods (Chapter III).				

KEY WORDS:	
Nordkapp Basin	Source Potential
Barents Sea	Maturation
Organic Geochemistry	Hydrous Pyrolysis

**I. ARTIFICIAL MATURATION OF
CLAYSTONES FROM CORE
7227/8-U-3 USING HYDROUS
PYROLYSIS**

**II. LABORATORY RESULTS
II.1 CORE 7223/3-U-1**

II.2 CORE 7227/8-U-1

II.3 CORE 7227/8-U-3

II.4 CORE 7227/8-U-2

III. ANALYTICAL METHODS

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I. ARTIFICIAL MATURATION OF CLAYSTONES FROM CORE 7227/8-U-3

Two organic-rich samples from core 7227/8-U-3 were selected for hydrous pyrolysis. The first, from the lower part of the Kimmeridgian section at 40.80 m, contains a relatively hydrogen-rich type II-III kerogen according to Rock-Eval data and represents the majority of the samples in this core. The second sample was taken at 51.86 near the base of the core. It is less rich in organic material and contains type III kerogen. This sample represents the lowest source rock quality found in the core.

Fifteen (40.80 m sample) and thirty grams (51.86 m sample) of rock sample were pyrolysed in a bomb in the presence of water at a temperature of 340°C for 72 hours. The pressure was equivalent to the water vapour pressure at this temperature (for experimental see Chapter III). At the end of this artificial maturation, the samples showed similar vitrinite reflectance values of 1.23 (40.80 m) and 1.22 (51.85 m) which indicates that both of them had reached the end of the main oil generation stage.

The sample at 40.80 m yielded only half as much total gas as the sample at 51.86 m yielded. The amount of gaseous hydrocarbons per unit of TOC, however, is about 50% higher for the 40.80 m sample, because this gas contains three times as much hydrocarbons (23.4 vol%) as the gas from the 51.86 m sample (7.67 vol%). The composition of these hydrocarbons is, however, quite similar for both samples (Table A.I.3).

The sample at 40.80 m expelled about fifty times as much pyrolysate per rock weight unit as the sample at 51.86 m yielded. For the TOC-related yield of hydrocarbons the ratio between the two samples is about twenty. The expelled pyrolysates contain a high amount of NSO compounds and remind in their bulk composition of heavy oils. The proportion of aromatic compounds is much higher for the 40.80 m sample compared with the 51.86 m sample (Table A.I.7). This is not unexpected, because the 40.80 m sample contains a higher proportion of marine organic matter.

The aromatic/naphthenic character of the 40.80 m pyrolysate is illustrated by the gas chromatograms of the total oil (Fig. A.I.1) and its C₂-C₈ hydrocarbons fraction (Fig. A.I.2). Paraffinicity index (0.88, paraffin index 1, Thompson 1979) and heptane value (33.6, paraffin index 2, Thompson 1979) however suggest a mature oil. No total oil chromato-

grams could be obtained from the 51.86 m sample because no oil phase floated on the water surface.

The saturated hydrocarbon fractions of both samples show oil-like, unimodal and light-end biased n-alkane distributions with a concentration maximum at nC_{15} (Figure A.I.3). The relative depletion and levelling in the height of the C_{25}^+ n-alkane peaks and the relative increase in peak height of the lighter n-alkanes during hydrous pyrolysis are illustrated in Figure A.I.4.

The gas chromatograms of the aromatic fraction show abundant alkylnaphthalenes, less abundant alkylphenanthrenes and in addition a 'hump' of unresolved 2- and 3-ring compounds. Aromatised steranes and triterpanes can no longer be observed (Fig. A.I.5). The distribution patterns of the alkylnaphthalene and alkylphenanthrene isomers are different from those of the unpyrolysed samples, but do not necessarily reflect the maturity of the samples after pyrolysis. The predominance of 9- and 1-MP over 3- and 2-MP would suggest early or mid-oil window maturity which is in contrast to the vitrinite reflectance values.

The mass chromatograms of the saturated pyrolysate fractions are of insufficient quality, except for the m/z 191 chromatogram of the 51.86 m sample. This differs from the mass chromatogram of the original extract mainly by an increased intensity of trisnorhopane and norhopane (peaks B and C) and by the equilibration of the extended hopane isomers (G/H, J1/J2).

Carbon isotope profiles show that no isotope fractionation has occurred during pyrolysis of the 40.80 m sample, while the respective profiles for the 51.86 m sample indicate an enrichment in heavy carbon for all fractions of the pyrolysate. An explanation for this effect cannot be given.

REFERENCE

THOMPSON, K.F.M., 1979: Light hydrocarbons in subsurface sediments.
Geochim. Cosmochim. Acta, 43, pp. 657-672.

APPENDIX A.I: TABLE OF CONTENTS

Artificial maturation of claystones from core 7227/8-U-3

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- Table A.I.2: Vitrinite reflectance data.
- Table A.I.3: Yield and composition of hydrous pyrolysate gases.
- Table A.I.4: Weight of expelled pyrolysate and chromatographic fractions.
- Table A.I.5: Concentration of expelled pyrolysate and chromatographic fractions normalised to rock weight.
- Table A.I.6: Concentration of expelled pyrolysate and chromatographic fractions normalised to TOC weight
- Table A.I.7: Composition of material expelled pyrolysate.
- Table A.I.8: Tabulation of data from gas chromatograms.
- Table A.I.9: Composition of C₂-C₈ hydrocarbons in expelled pyrolysate.
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- Figure A.I.5: Aromatic hydrocarbon gas chromatograms of expelled pyrolysates.
- Figure A.I.6: Mass chromatograms of terpanes (m/z 191) for expelled pyrolysates.
- Figure A.I.7: Mass chromatograms of steranes (m/z 217 and 218) for expelled pyrolysates.
- Figure A.I.8: Vitrinite reflectance histograms.
- Figure A.I.9: Carbon isotope expelled pyrolysate fraction profiles.

Table A.I.1:

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
	No.		:								S1	
			:									
		m/ft	:	(mg/g ROCK)			(%)	(mg/g TOC)		S1+S2	S1+S2	(C)
I	I	I	I	I	I	I	I	I	I	I	I	I
I	I	I	I	I	I	I	I	I	I	I	I	I
	C 5800	40.80	:	3.25	69.73	1.07	15.07	463	7	72.98	0.04	428
			:									
	C 5801	51.86	:	0.51	2.65	0.61	4.51	59	14	3.16	0.16	427
			:									

DATE : 29 - 1 - 87.

Well Identification: 7227/8-U-3
Reference number: 21.3419.15
(1/1)

Table A.I.2: VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
C 5800	----	40.8	0.29 (30)	G	0.06	1-3
C 5800 HY-PY	----	40.8	1.23 (30)	F	0.16	---
C 5115	----	51.9	0.30 (11) 0.56 (4)	G R	0.05 0.09	1-2,6-7
C 5801 HY-PY	----	51.9	1.22 (4) 0.87 (1) 1.66 (10)	P BP R	0.04 0.00 0.15	---

REL RAT (Reliability Rating): G = Good; F = Fair; P = Poor
S = Stained; R = Reworked;
BP = Bad Particle.

Table A.I.3: Yield and composition of hydrous pyrolysate gases.

	I	Sample C-5800		I	Sample C-5801	
	I	7221/7-U-3, 40.80 m		I	7221/7-U-3, 51.86 m	
Compound	I	ppm of	vol %	I	ppm of	vol %
	I	total gas	of HC	I	total gas	of HC
	I	(v/v)		I	(v/v)	
Nitrogen	I	14914		I	43990	
? RI=155	I	3914		I	3721	
Carbon dio	I	276482		I	223321	
Methane	I	113627	48.47	I	39003	50.92
Ethane	I	66556	28.39	I	20055	26.18
Propane	I	35196	15.01	I	11276	14.72
i-Butane	I	4241	1.81	I	1118	1.46
Butene	I	1919	0.82	I	838	1.09
n-Butane	I	6734	2.87	I	2158	2.82
neo-C5	I	1548	0.66	I	596	0.78
? RI=1417	I	835	0.36	I	288	0.38
? RI=1463	I	264	0.11	I	0	0.00
i-Pentane	I	1300	0.55	I	475	0.62
Pentene ?	I	0	0.00	I	283	0.37
n-Pentane	I	1223	0.52	I	506	0.66
? RI=1505	I	369	0.16	I	0	0.00
? RI=1516	I	320	0.14	I	0	0.00
2,3-diMeC4	I	291	0.12	I	0	0.00

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Table A.I.4:

7227/8-U-3

WEIGHT OF EXPELLED PYROLYSATE AND CHROMATOGRAPHIC FRACTIONS

I			:	Rock						I
I	IKU-No	DEPTH	:	Extr.	EOM	Sat.	Aro.	HC	Non HC	TOC
I			:							I
I		(m)	:	(g)	(mg)	(mg)	(mg)	(mg)	(mg)	(%)
I			:							I
I			:							I
I	C 5800	40.80	:	15.0	376.4	49.6	130.4	180.0	196.4	15.07
I			:							I
I	C 5801	51.86	:	30.0	17.7	3.1	2.5	5.6	12.1	4.51
I			:							I

Project no.: 21.3419.15
 DATE : 21 - 1 - 87.

Table A.I.5:

7227/8-U-3

CONCENTRATION OF EXPELLED PYROLYSATE AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

I			:						I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5800	40.80	:	25093	3307	8693	12000	13093	I
I			:						I
I	C 5801	51.86	:	590	104	84	188	402	I
I			:						I

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 DATE : 21 - 1 - 87.

Table A.I.6:

7227/8-U-3

CONCENTRATION OF EXPELLED PYROLYSATE AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
C 5800	40.80	166.5	21.9	57.7	79.6	86.9
C 5801	51.86	13.1	2.3	1.9	4.2	8.9

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DATE : 21 - 1 - 87.

Table A.I.7:

7227/8-U-3

Composition of expelled pyrolysate.

I	I	I	I	I	I	I	I	I	I	I
	IKU-No.	DEPTH	:	Sat	Aro	HC	SAT	Non HC	HC	
			:	---	---	---	---	---	---	
			:	EOM	EOM	EOM	Aro	EOM	Non HC	
		(m)	:	%	%	%	x 100	%	x 100	
I	I	I	I	I	I	I	I	I	I	I
	C 5800	40.80	:	13.2	34.6	47.8	38.0	52.2	91.6	
	C 5801	51.86	:	17.6	14.2	31.9	123.8	68.1	46.8	
			:							

Table A.I.8:

TABULATION OF DATA FROM THE GAS CHROMATOGRAMS

CLAYSTONE EXTRACTS AND HYDROUS PYROLYSATES FROM CORE 7227/8-U-3

I		DEPTH	:	PRISTANE		PRISTANE		PHYTANE		A		n-C17		I
I	IKU No.		:		A =		B =						CPI	I
I		(m)	:	PHYTANE		n-C17		n-C18		B		n-C27		I
I			:											I
I			:											I
I	C 5104	40.80	:	1.3		5.1		4.0		1.3		1.4	1.7	I
I	C 5800HP	40.80	:	1.9		0.9		0.5		1.7		3.3	1.1	I
I			:											I
I	C 5115	51.86	:	3.5		3.8		1.3		2.9		1.1	1.6	I
I	C 5801HP	51.86	:	3.2		0.8		0.3		2.8		2.8	1.2	I
I			:											I

Table A.I.9: Composition of C₂-C₈ hydrocarbons in expelled pyrolysate.

C5800	area	ug	mg/ml	% of t.oil
isoC3				
nC3	0	.000	.000	.000
iso-C4	0	.000	.000	.000
nC4	0	.000	.000	.000
iso-C5	41447	.237	.792	.088
nC5	30879	.177	.590	.065
CyC5+2,3diMeC4	82480	.473	1.577	.175
2MeC5	130909	.750	2.503	.278
3MeC5	55497	.318	1.061	.117
nC6	238692	1.369	4.564	.507
MeCyC5	255457	1.465	4.884	.542
benzene	177022	1.015	3.384	.376
CyC6	35973	.206	.687	.076
2MeC6	106949	.613	2.044	.227
2,3diMeC5	21734	.124	.415	.046
3MeC6	71154	.408	1.360	.151
DiMeCyC5	201675	1.156	3.856	.428
nC7	270924	1.554	5.180	.575
MeCyC6	97465	.559	1.863	.207
EtCyC5+2,5diMeC6	80532	.461	1.539	.171
2,4diMeC6	22976	.131	.439	.048
triMeCyC5	28792	.165	.550	.061
toluene	225214	1.291	4.306	.478
2+4MeC7	273919	1.571	5.237	.581
3MeC7	63226	.362	1.208	.134
DiMeCyC6	99026	.568	1.893	.210
nC8	198234	1.137	3.790	.421
2,4diMeC7+diMeCyC6	56498	.324	1.080	.120
EtCyC6	87410	.501	1.671	.185
EtBenzene	76697	.439	1.466	.162
m,p-Xylene	283323	1.625	5.417	.601
2+4MeC8	206818	1.186	3.954	.439
o-xylene	91000	.522	1.740	.193
sum		20.719	69.063	7.673

total oil (ug inj.): 270.000

%C2-C8(tot.area)in tot.oil: 12.564%

Corrected replacement of

Table A.I.10: Molecular ratios from sterane and terpane mass chromatograms. Maturity and source characteristic ratios.

Claystone extracts and hydrous pyrolysates from core 7227/8-U-3

IKU-NR.	depth (m)	ab/(ab+ba)	%22S	%20S	%bb	Tm/Ts	C27 rearr. ster.
		hop.	ext. hop	ster.	ster.		
		1)	2)	3)	4)		
		----- maturity-dependent ----- ----- parameters -----					
C5104	40.80	0.79	57.32	23.08	59.38	92.45	85.71
C5800HP	40.80	--	--	--	--	--	--
C5115	51.86	0.73	44.57	5.00	40.64	120.60	52.81
C5801HP	51.86	0.83	61.01	--	--	28.15	--

- 1) $E / (E+F)$ in m/z 191
- 2) $100 * G / (G+H)$ in m/z 191
- 3) $100 * q / (q+t)$ in m/z 217
- 4) $100 * (r+s) / (q+r+s+t)$ in m/z 217
- 5) B / A in m/z 191
- 6) $100 * a / (a+j)$ in m/z 217

Table A.I.11: $\delta^{13}\text{C}$ isotope ratios for expelled pyrolysate fractions.

7227/8-U-3

=====					
Sample	Depth (m)	----- delta 13 C -----			
		SAT	ARO	NSO	ASPH
=====					
C5104	40.80	-29.71	-29.31	-28.73	-28.26
C5800HP	40.80	-29.35	-29.14	-27.42	-27.40

C5115	51.86	-31.02	-27.08	-27.73	-27.81
C5801HP	51.86	-26.43	-26.73	-26.13	-26.89
=====					

Figure A.I.1: Whole oil gas chromatogram of expelled pyrolysate.

C ₁₀ etc.	-	n-alkanes
Cy-C ₆	-	cyclohexane
MeCy-C ₆	-	methylcyclohexane
Pr	-	pristane
Ph	-	phytane

Analysis 419C5800T

2,1,1

NORDKAPP,TOT.OIL

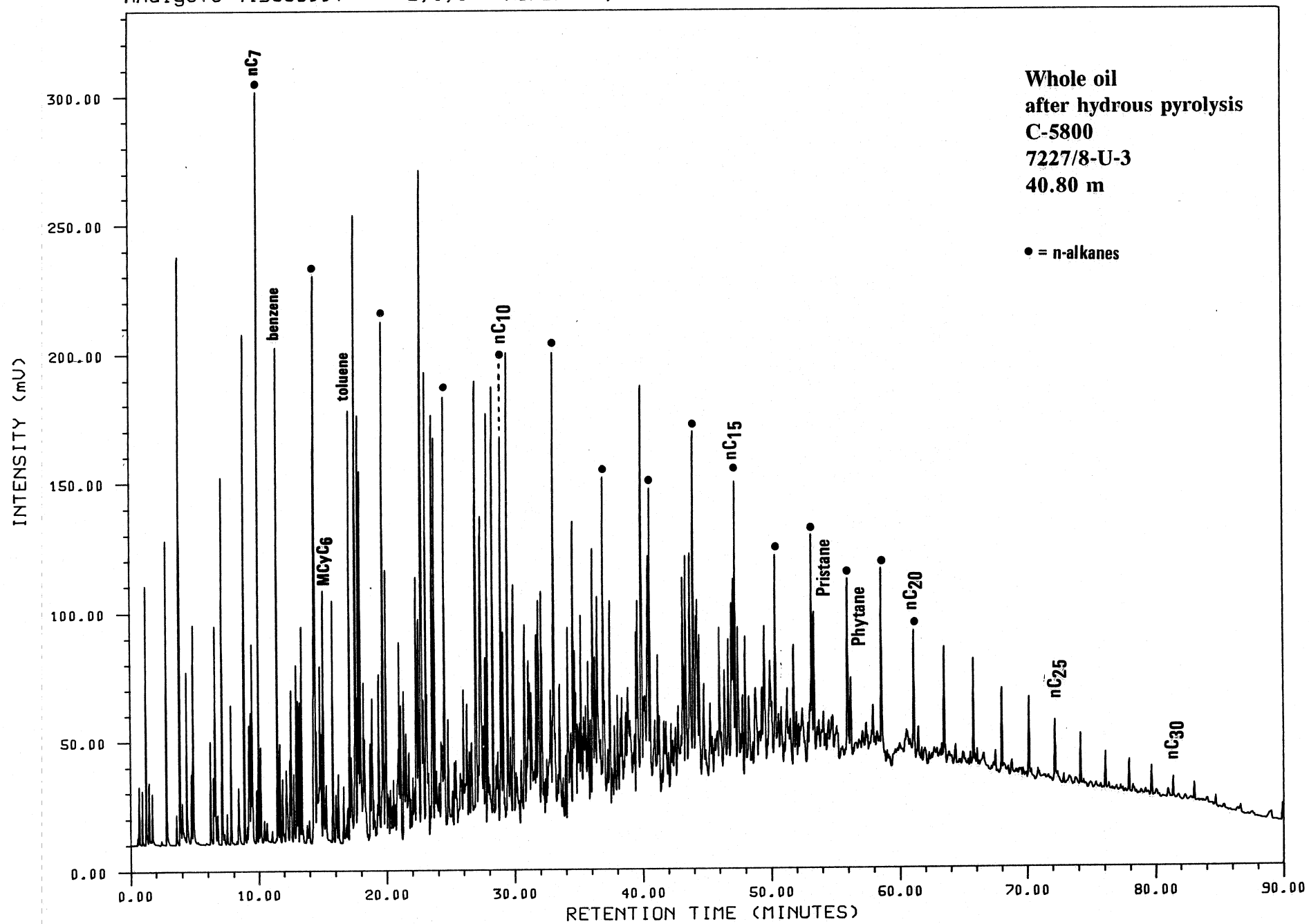


Figure A.I.2: Gas chromatogram of C_2 - C_8 hydrocarbons
of expelled pyrolysates.

Analysis 419C5800

5,1,1 NORDKAPP HY-PY C2-C8

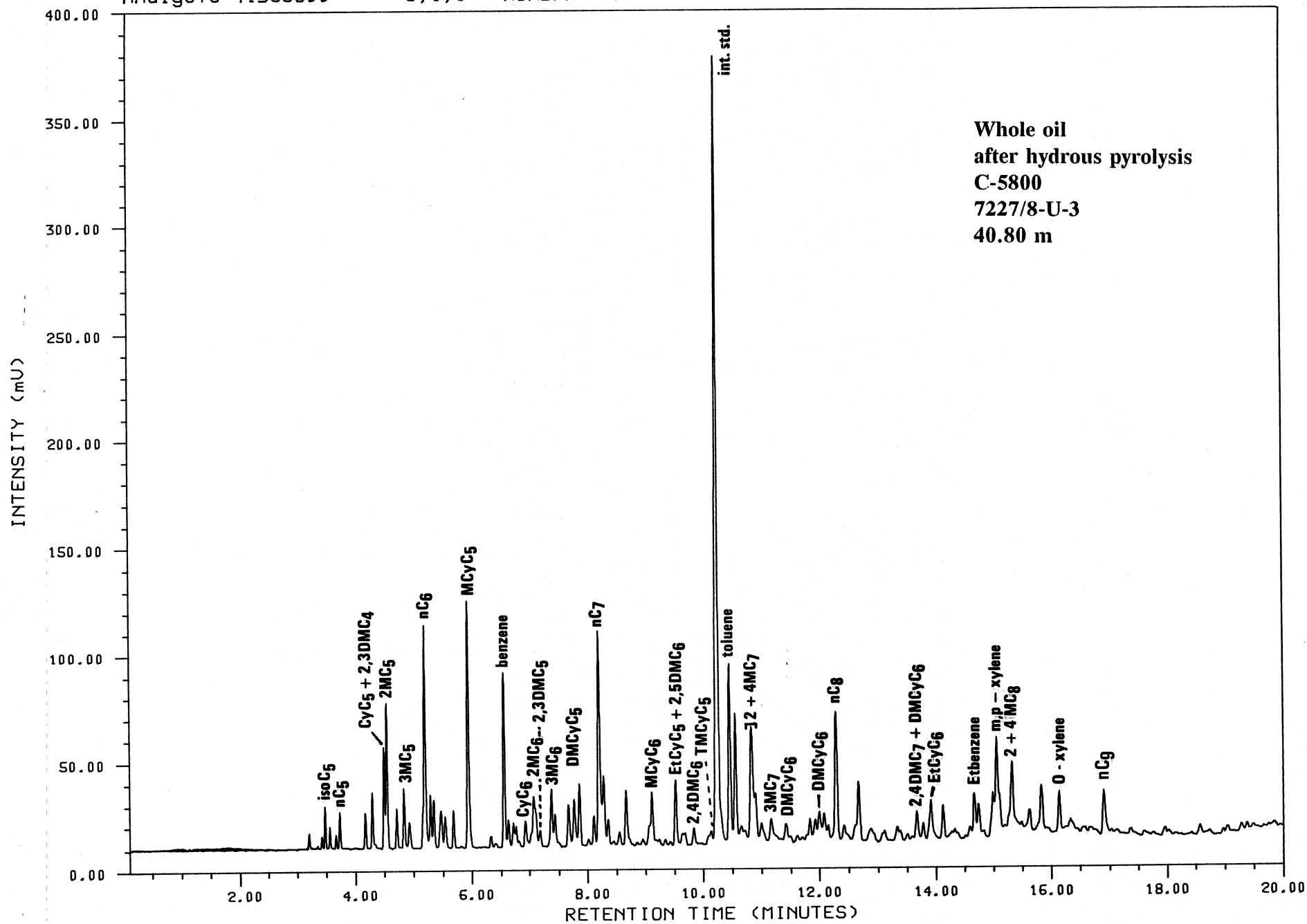
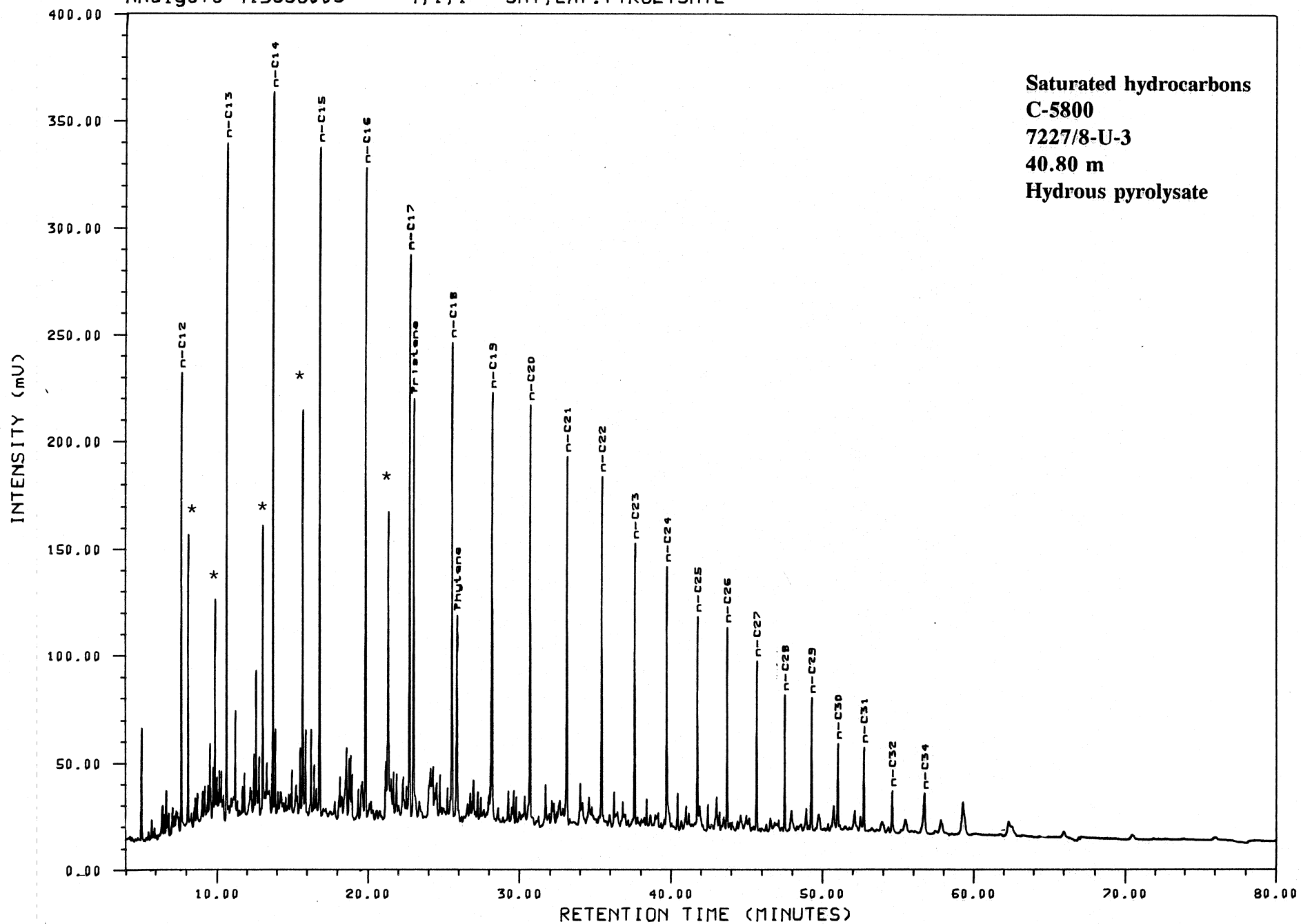


Figure A.I.3: Saturated hydrocarbon gas chromatograms
of expelled pyrolysates.

n-C ₁₅ etc.	- n-alkanes
Pr	- pristane
Ph	- phytane
*	- other acyclic isoprenoids

Analysis 419C5800S

4,1,1 SAT,EXP.PYROLYSATE



Analysis 419C5801S 4,1,1 SAT,EXP.PYROLYSATE

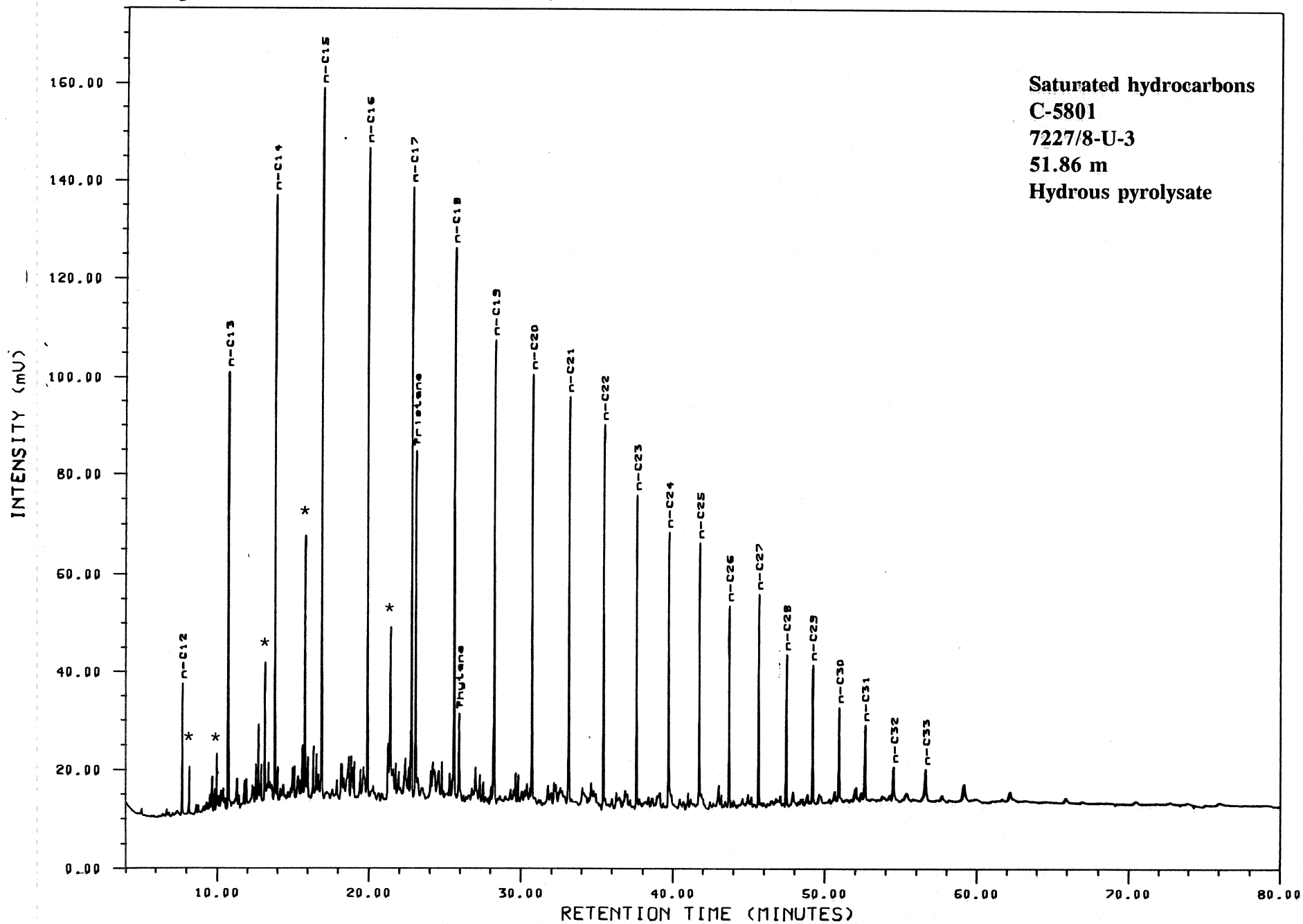
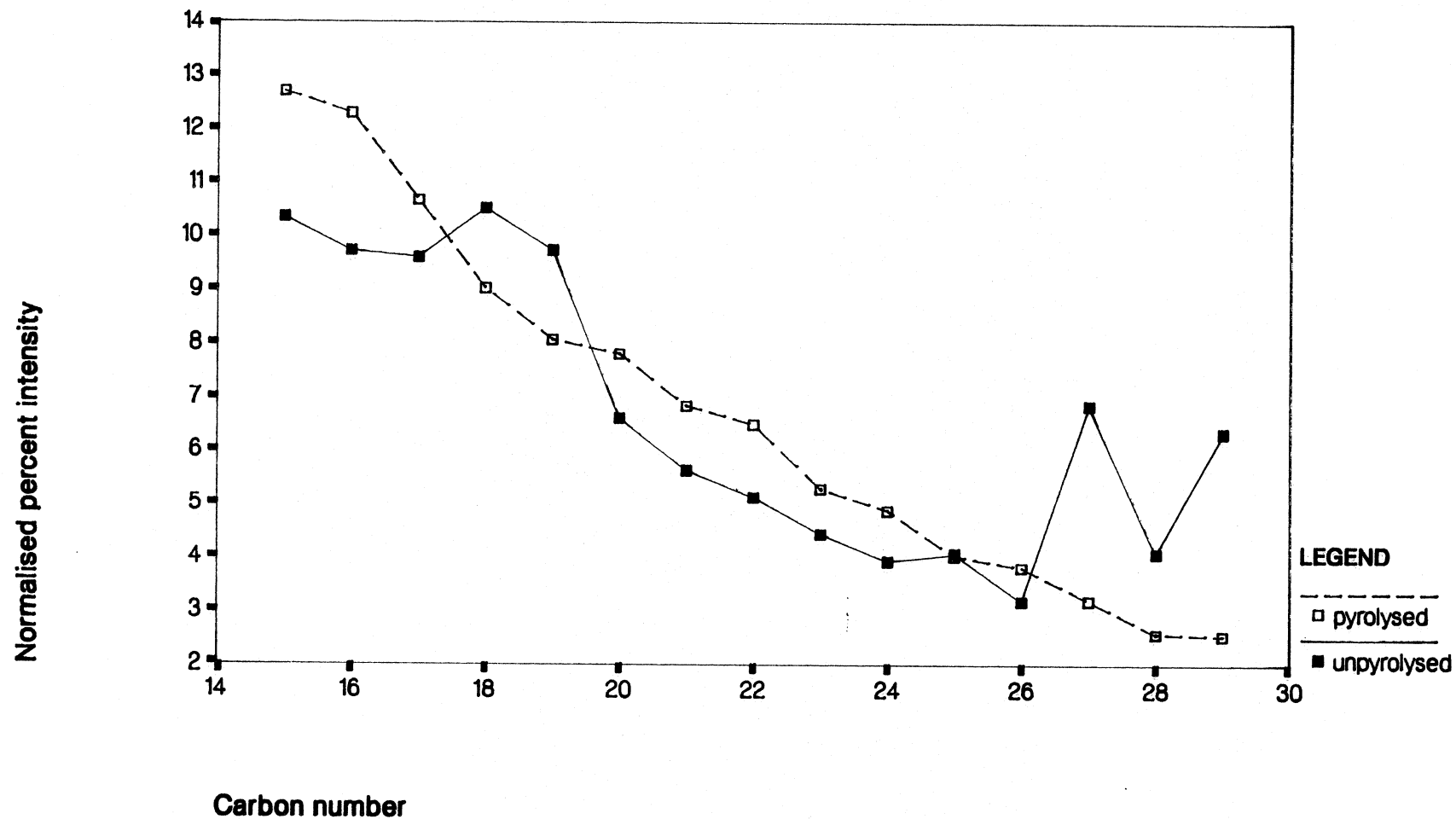


Figure A.I.4: Comparison of n-alkane distribution of sample extracts before hydrous pyrolysis and expelled pyrolysates.

SATURATED HYDROCARBONS BEFORE AND AFTER HYDROUS PYROLYSIS

Core 7227/8-U-3, 40.80 m



SATURATED HYDROCARBONS BEFORE AND AFTER HYDROUS PYROLYSIS

Core 7227/8-U-3, 51.86 m

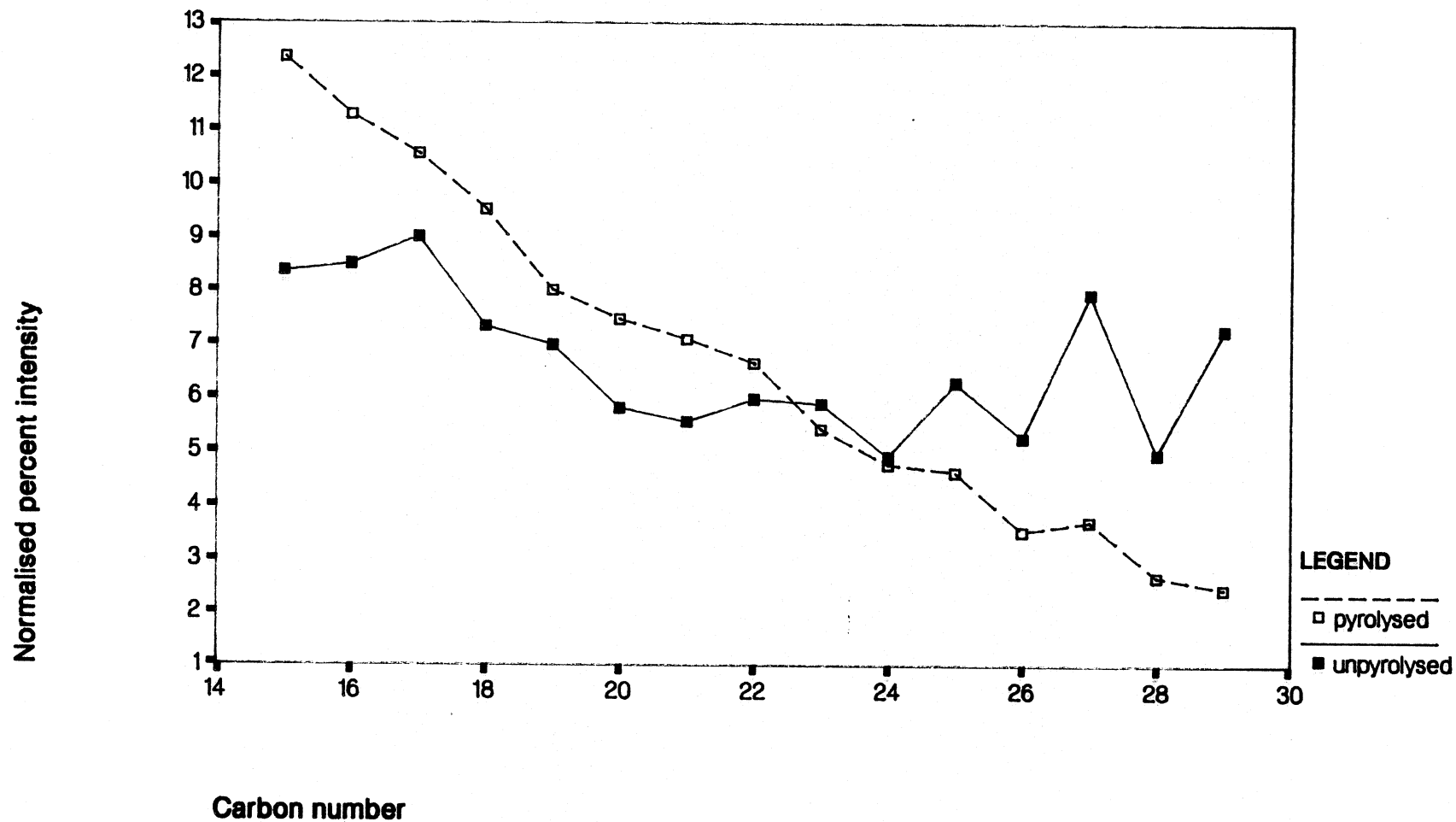


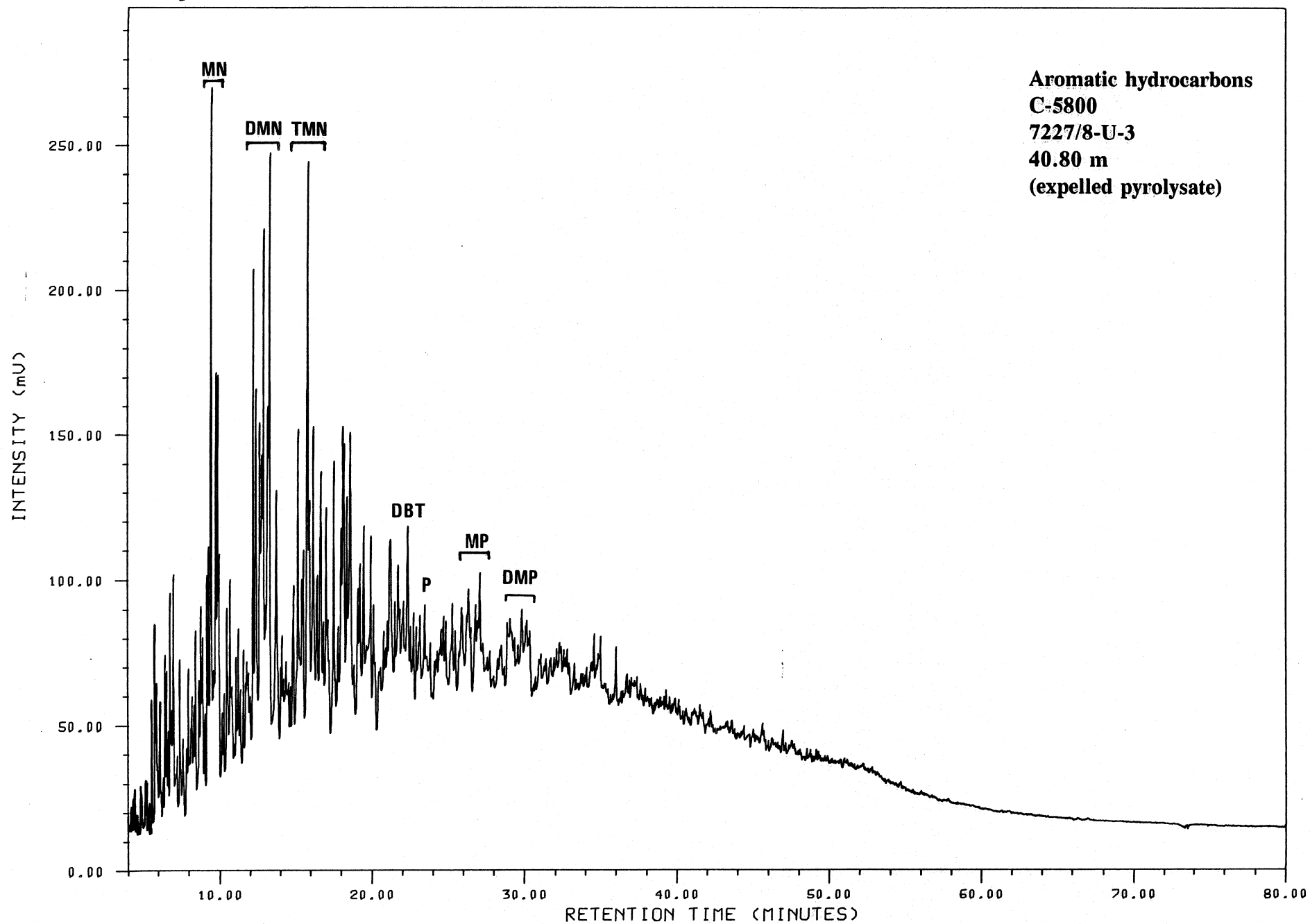
Figure A.I.5: Aromatic hydrocarbon gas chromatograms of expelled pyrolysates.

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

Analysis 419C5800A

4,1,1

ARO,EXP.PYROLYSATE



Analysis 419C5801A 4,1,1 ARO,EXP.PYROLYSATE

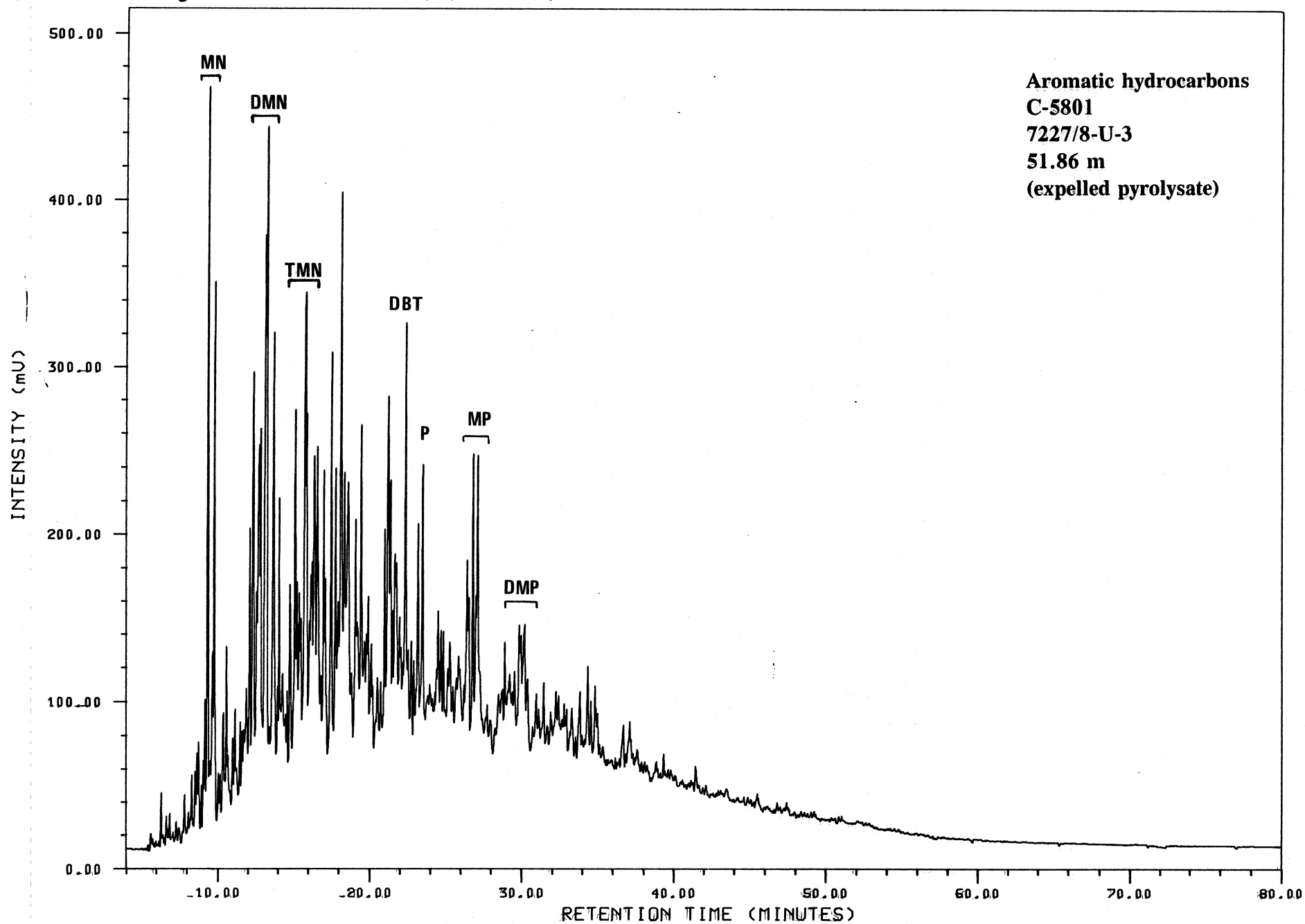
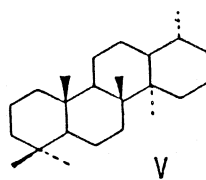
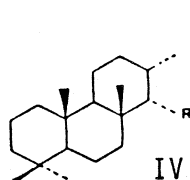
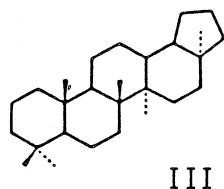
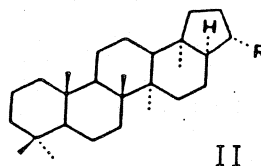
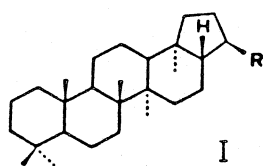


Figure A.I.6:

Mass chromatograms of terpanes (m/z 191) for expelled pyrolysates.

A	T _s , 18 α (H)-trisorneohopane	C ₂₇ H ₄₆	(III)
B	T _m , 17 α (H)-trisnorhopane	C ₂₇ H ₄₆	(I, R=H)
C	17 α (H)-norhopane	C ₂₉ H ₅₀	(I, R=C ₂ H ₅)
D	17 β (H)-normoretane	C ₂₉ H ₅₀	(II, R=C ₂ H ₅)
E	17 α (H)-hopane	C ₃₀ H ₅₂	(I, R=C ₃ H ₇)
F	17 β (H)-moretane	C ₃₀ H ₅₂	(II, R=C ₃ H ₇)
G	17 α (H)-homohopane (22S)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
H	17 α (H)-homohopane (22R)	C ₃₁ H ₅₄	(I, R=C ₄ H ₉)
	+ unknown triterpane (gammacerane?)		
I	17 β (H)-homomoretane	C ₃₁ H ₅₄	(II, R=C ₄ H ₉)
J	17 α (H)-bishomohopane (22S,22R)	C ₃₂ H ₅₆	(I, R=C ₅ H ₁₁)
K	17 α (H)-trishomohopane (22S,22R)	C ₃₃ H ₅₈	(I, R=C ₆ H ₁₃)
L	17 α (H)-tetrakishomohopane (22S,22R)	C ₃₄ H ₆₀	(I, R=C ₇ H ₁₅)
M	17 α (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)



C5800SAT1 20-JAN-87

Sir:Voltage 7070H

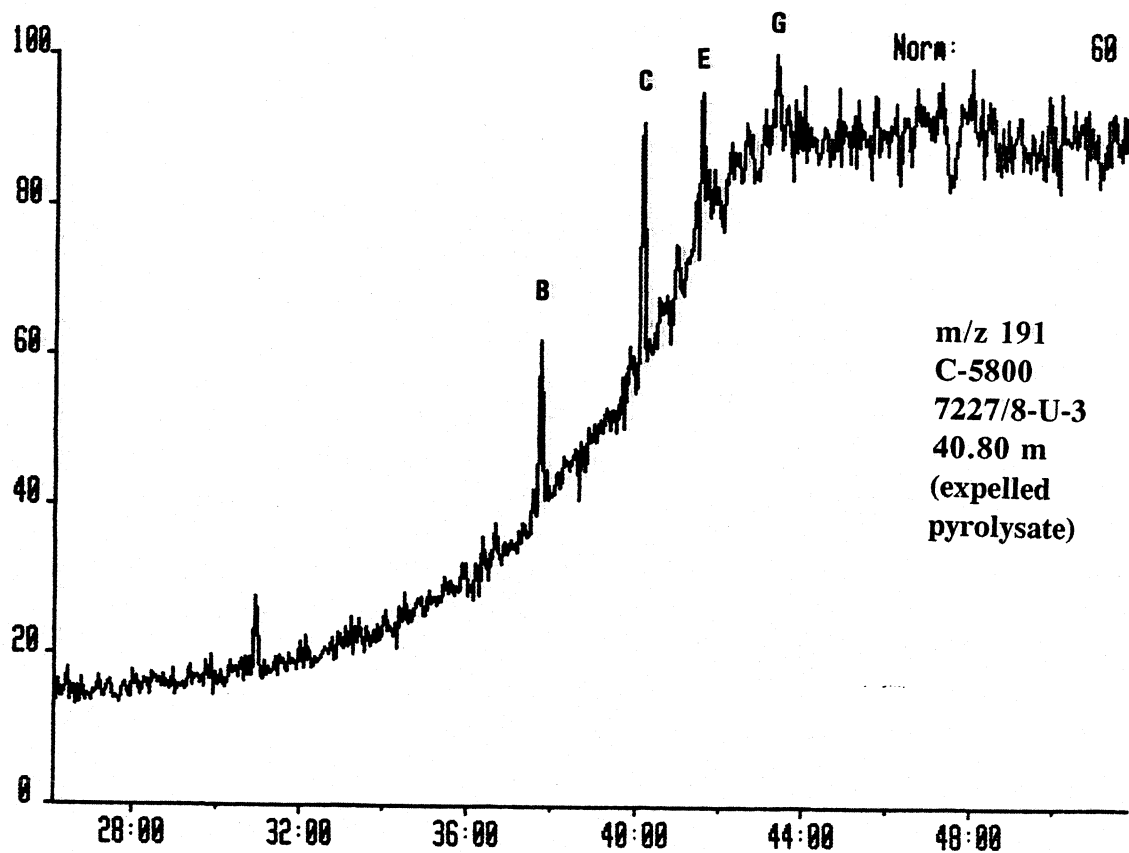
Acnt:IKU

System:TRIT

Sample 1 Injection 1

Group 1 Mass 191.1000

Text:





IKU

SINTEF-GRUPPEN

- 33 -

C5801SAT1 20-JAN-87

Sir: Voltage 7070H

Acnt: IKU

System: TRIT

Sample 1 Injection 1

Group 1 Mass 191.1000

Text:

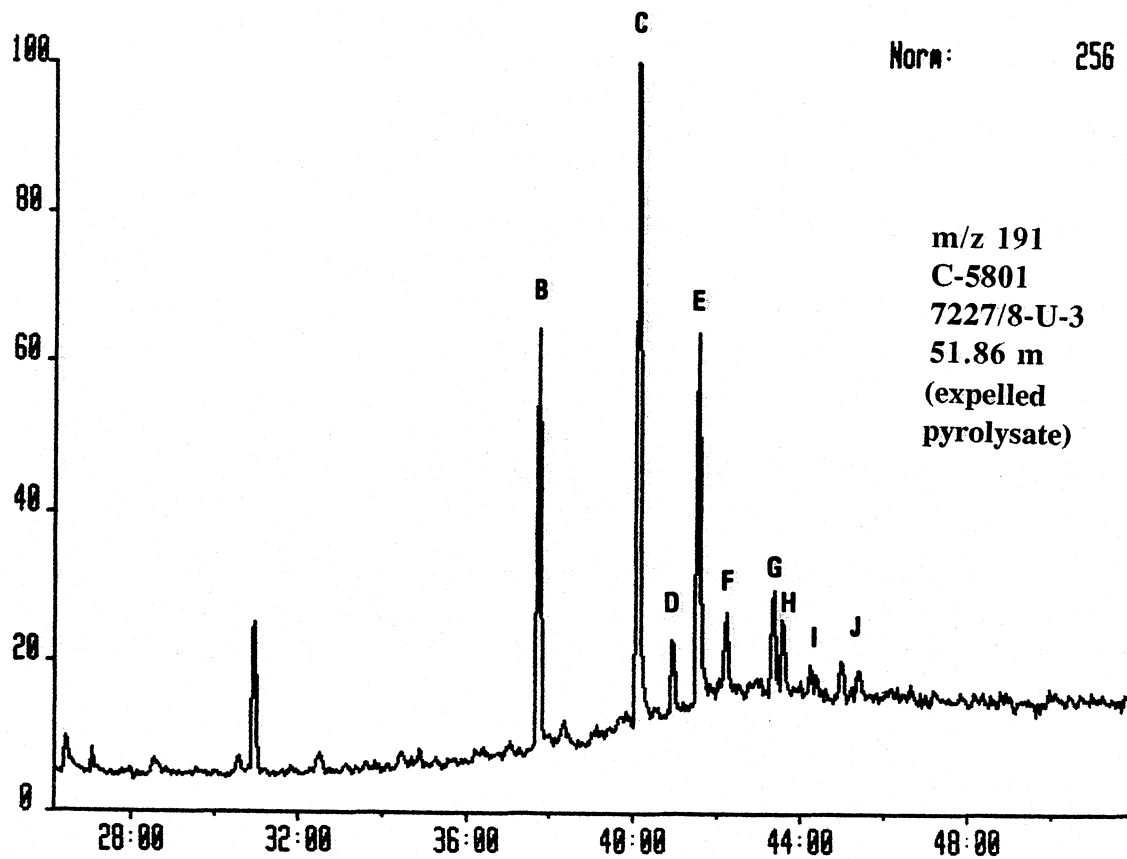
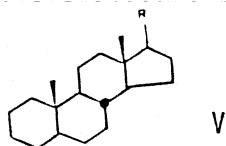
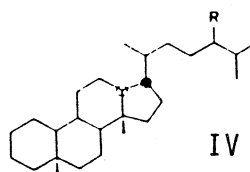
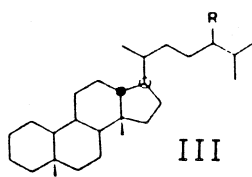
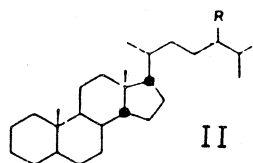
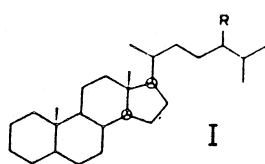


Figure A.I.7:

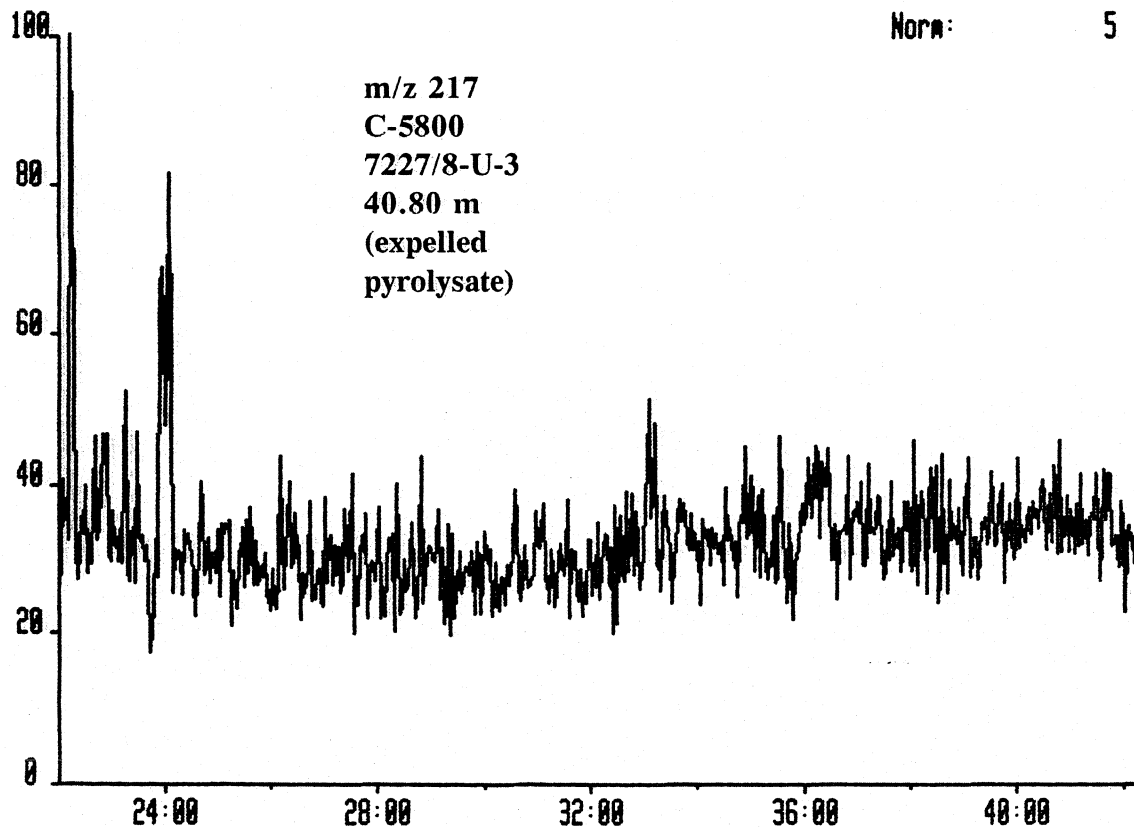
Mass chromatograms of steranes (m/z 217 and 218)
for expelled pyrolysates.

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 α (H),17 α (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)



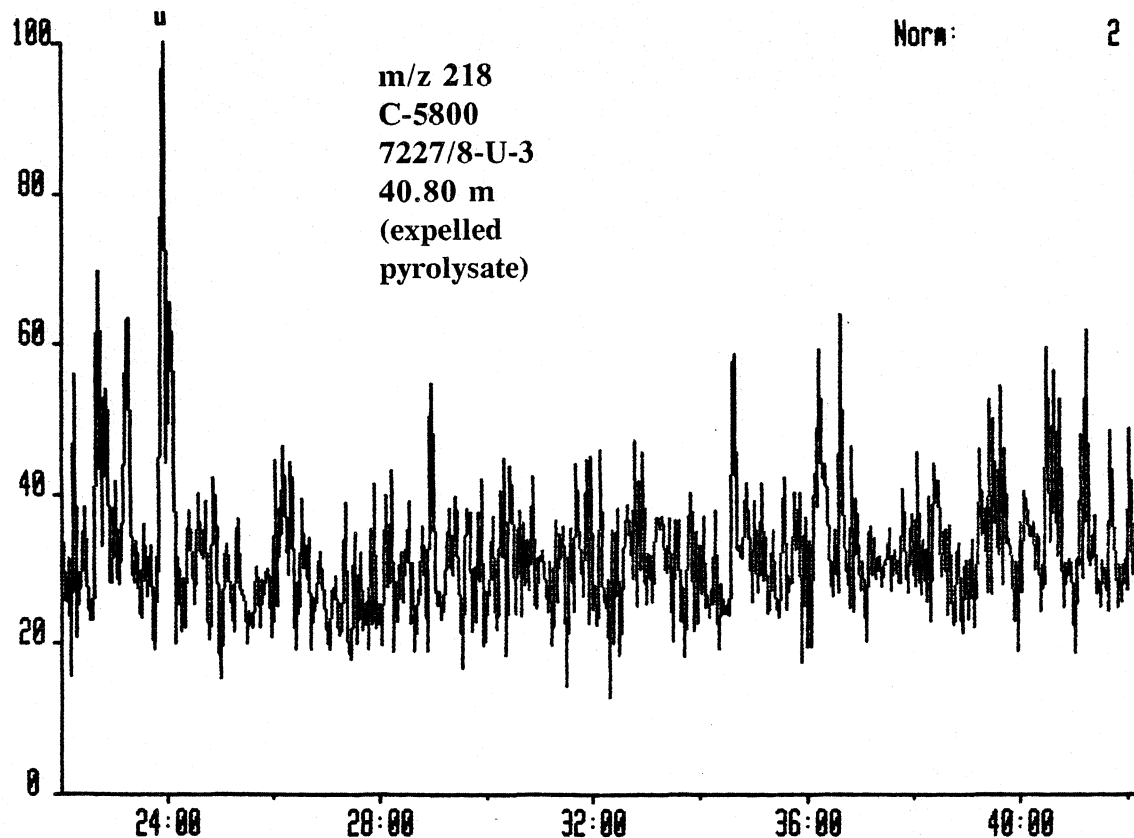
C5800SAT 16-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



C5800SAT 16-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

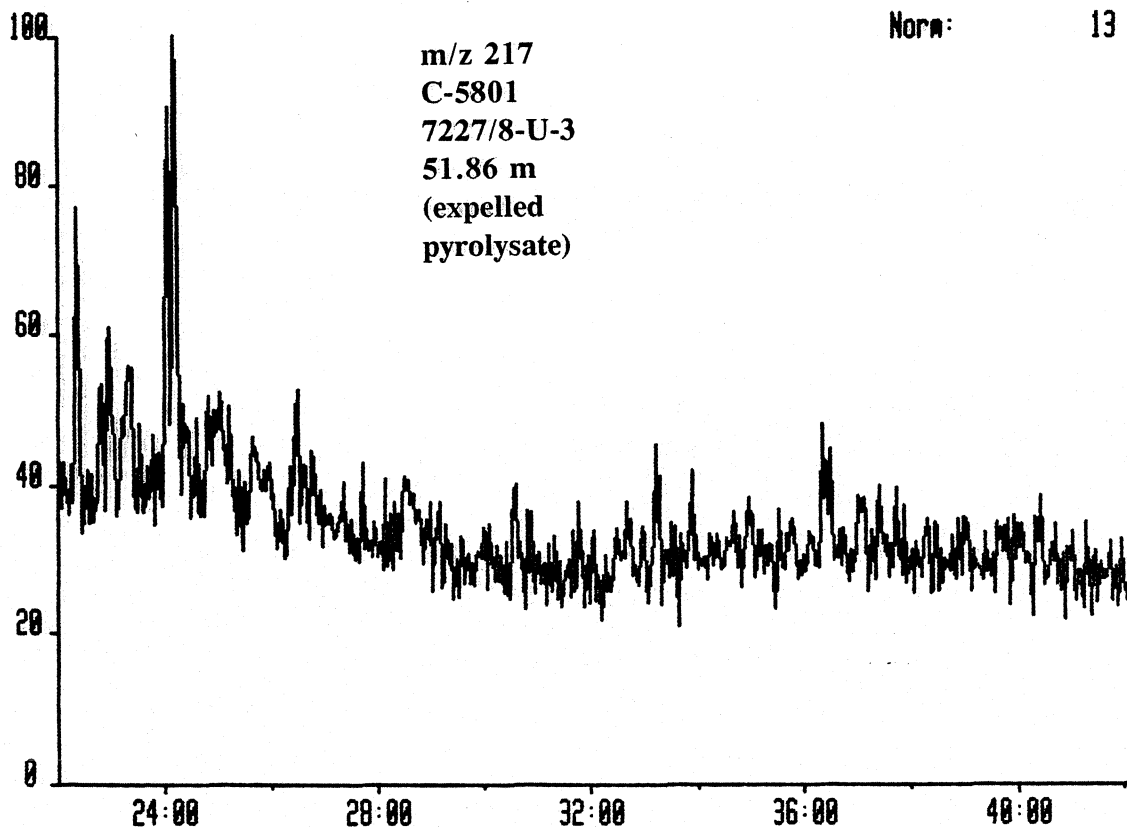
System:TRIT



C5801SAT1 20-JAN-87
Sample 1 Injection 1
Text:

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

System: TRIT



C5801SAT1 20-JAN-87
Sample 1 Injection 1
Text:

Sir: Voltage 7070H Acnt: IKU
Group 1 Mass 218.1000

System: TRIT

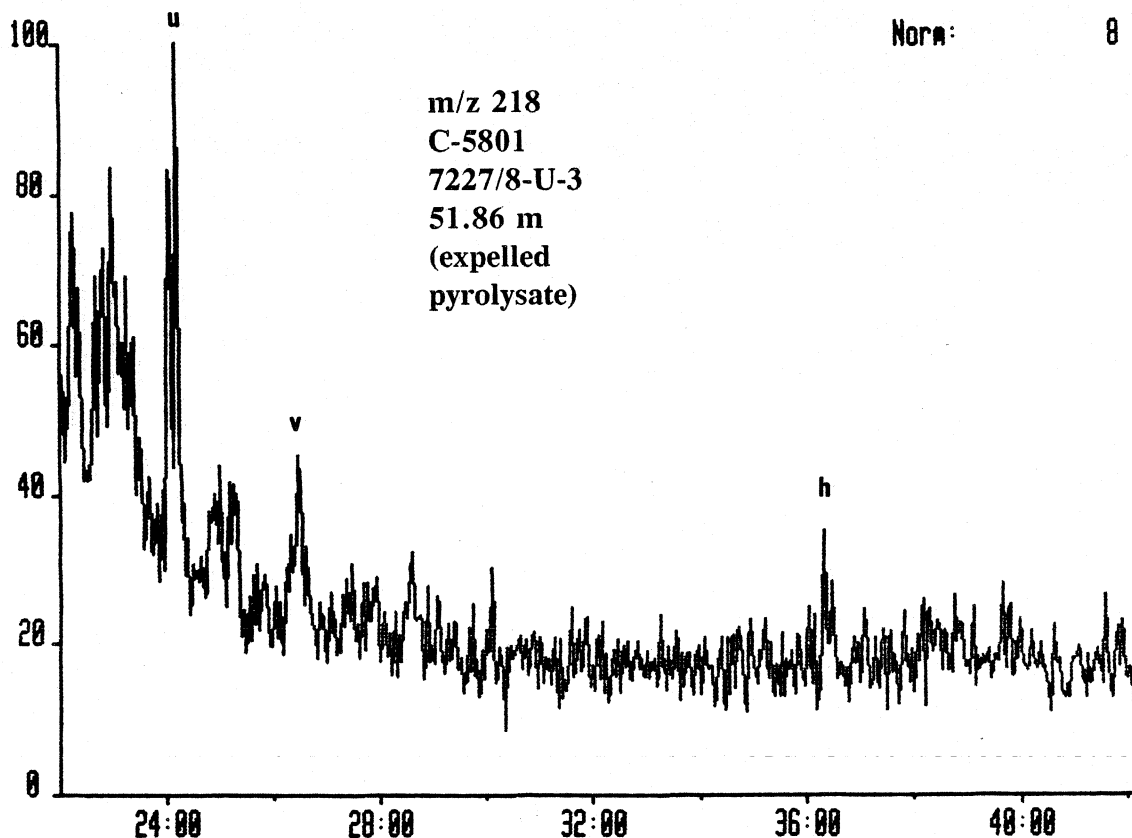


Figure A.I.8: VITRINITE REFLECTANCE HISTOGRAMS

Key: A = Grey-black-brown claystone.
 Upper case letters indicate values included in
 the main population. Lower case letters represent
 values in other populations.

 PP = Statistical data populations
 Y = Main population, not necessarily
 representative of sample maturity.
 N = Other populations.

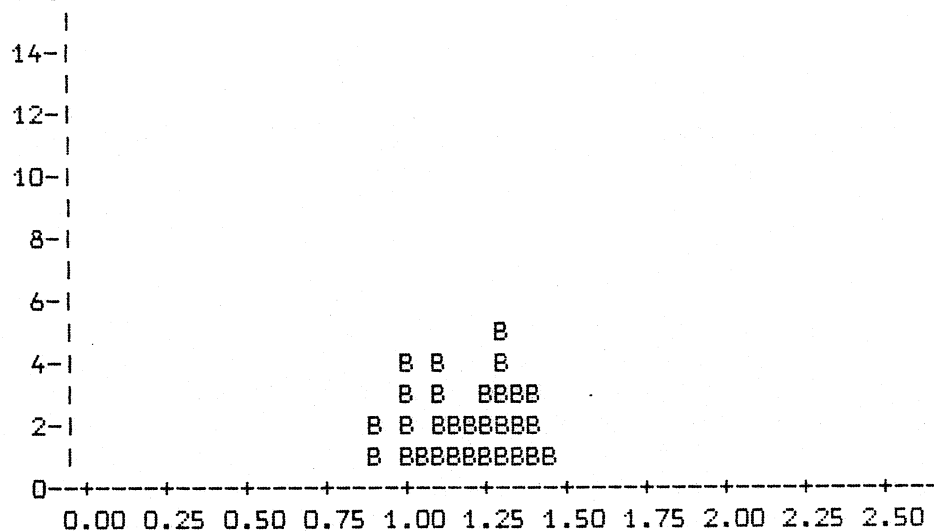
 LOW+ HIGH = Population limits.

 VAL. = Number of measurements in that
 population.

Lithology cross-reference table

A = Clst. gy
 B = Clst. dk gy
 C = Clst. gn
 D = Clst. bn
 E = Clst. rd
 F = Clst. calc.
 G = Clst. carb.
 H = Shale
 I = Sandstone
 J = Limestone
 K = Coal
 L = Lignite
 M = Carbargillite
 N = Siltstone
 O = Bit
 P = X

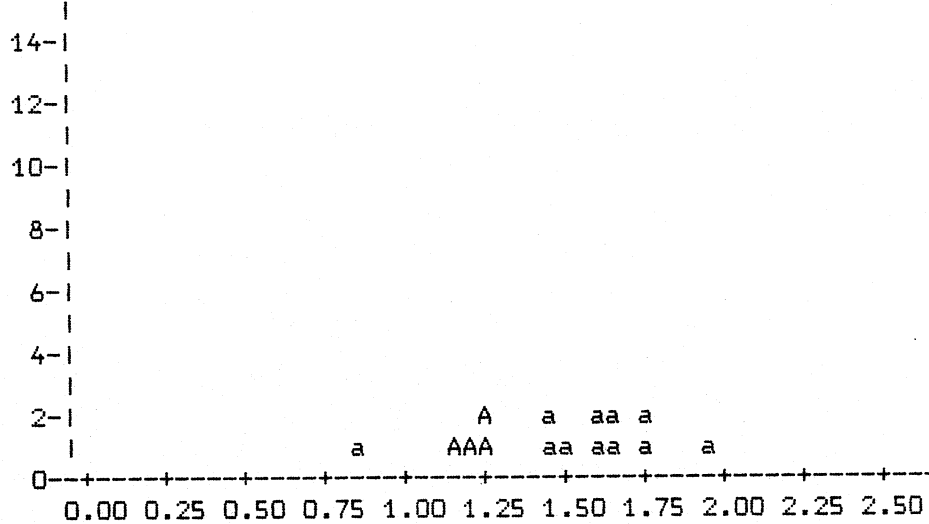
IKU# C5800H 40.8M 7227/8-U-3


 PP LOW HIGH LIT #VAL MEAN STDV
 Y 0.90 1.49 ALL 30 1.23 0.16
 OVERALL 30 1.23 0.16

ORDERED VALUES FOLLOW:

 0.90B 0.92B 1.03B 1.03B 1.04B 1.04B 1.08B 1.13B 1.14B 1.14B 1.14B
 1.16B 1.19B 1.21B 1.22B 1.27B 1.28B 1.29B 1.33B 1.33B 1.33B 1.33B
 1.34B 1.37B 1.38B 1.39B 1.40B 1.43B 1.43B 1.48B

IKU# C5801H 51.9M 7227/8-U-3



	PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	1.17	1.27	ALL	4	1.22	0.04	
N	0.87	0.88	ALL	1	0.87	0.00	
N	1.47	1.98	ALL	10	1.66	0.15	
OVERALL	15	1.49	0.29				

ORDERED VALUES FOLLOW:

 0.87a 1.17A 1.20A 1.25A 1.26A 1.47a 1.48a 1.54a 1.61a 1.63a 1.65a
 1.68a 1.75a 1.78a 1.97a

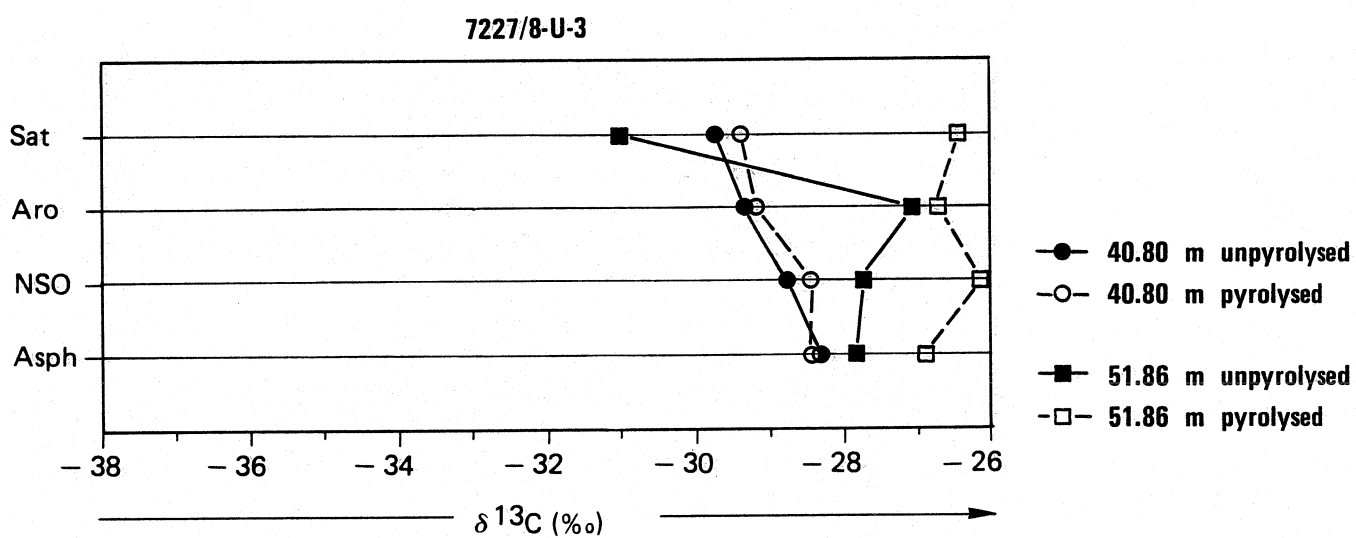


Figure A.I.9: Carbon isotope expelled pyrolysate fraction profiles.

APPENDIX II.1: TABLE OF CONTENTS

Core 7228/3-U-1:

TABLES

Table A.II.1.1a:	Concentration of C_1-C_5 + hydrocarbons in headspace gas.
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Figure A.II.1.2:	Saturated hydrocarbon gas chromatograms.
Figure A.II.1.3:	Aromatic hydrocarbon gas chromatograms.
Figure A.II.1.4:	Mass chromatograms of m/z 191 (terpanes).
Figure A.II.1.5:	Mass chromatograms of m/z 217 and 218 (steranes).
Figure A.II.1.6:	Vitrinite reflectance histograms.
Figure A.II.1.7:	$\delta^{13}C$ isotope profile for extract fractions.

Table A.II.1.1a:

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

[illegible]

Table A.II.1.1b:

[illegible]

Table A.II.1.1c:

[illegible]

Table A.II.1.2:

7228/3-U-1

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 (mg/g TOC)	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)
C 5652	41.10	0.08	0.23	0.60	0.48	48	125	0.31	0.26	434
C 5653	41.90	****	****	****	0.40	*****	****	*****	*****	***
C 5654	42.90	0.01	0.04	0.00	0.25	16	0	0.05	0.20	447
C 5655	44	****	****	****	0.86	*****	****	*****	*****	***
C 5656	45	0.21	0.87	1.13	1.28	68	88	1.08	0.19	440
C 5657	46.40	****	****	****	1.08	*****	****	*****	*****	***
C 5658	47.50	0.21	0.70	1.53	1.03	68	149	0.91	0.23	436
C 5659	48.40	****	****	****	1.18	*****	****	*****	*****	***
C 5660	49.30	0.27	0.56	1.65	0.94	60	176	0.83	0.33	435
C 5661	50.50	****	****	****	1.05	*****	****	*****	*****	***
C 5662	51.60	0.37	8.02	0.40	35.37	23	1	8.39	0.04	426
C 5663	52.70	****	****	****	0.34	*****	****	*****	*****	***
C 5664	53.95	0.14	0.07	0.38	0.28	25	136	0.21	0.67	450
C 5667	55.10	****	****	****	0.73	*****	****	*****	*****	***
C 5665	56.45	0.24	0.46	0.46	0.74	62	62	0.70	0.34	436
C 5666	57.90	****	****	****	0.75	*****	****	*****	*****	***
C 5185	58.79	0.06	9.83	0.49	6.14	160	8	9.89	0.01	448
C 5668	61.72	****	****	****	0.51	*****	****	*****	*****	***
C 5186	64.23	0.02	0.40	0.94	0.56	71	168	0.42	0.05	475
C 5669	64.87	****	****	****	0.98	*****	****	*****	*****	***
C 5670	66.15	****	****	****	0.59	*****	****	*****	*****	***
C 5187	66.38	0.02	0.46	0.38	0.67	69	57	0.48	0.04	435

Table A.II.1.2 cont.

7228/3-U-1

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 (mg/g TOC)	PETROLEUM POTENTIAL S1+S2	PROD. INDEX S1+S2	TEMP. MAX (C)
C 5188	67.40	0.17	2.15	0.30	2.78	77	11	2.32	0.07	432
C 5189	68.86	0.03	0.53	0.96	0.96	55	100	0.56	0.05	431
C 5190	70.81	0.01	0.44	0.87	0.76	58	114	0.45	0.02	435
C 5671	72.02	****	****	****	0.25	*****	****	*****	*****	***
C 5672	73.02	****	****	****	0.25	*****	****	*****	*****	***
C 5673	73.73	****	****	****	0.39	*****	****	*****	*****	***
C 5674	74.78	0.21	0.87	1.07	8.38	10	13	1.08	0.19	437
C 5191	76.05	0.04	1.51	2.10	2.37	64	89	1.55	0.03	438
C 5675	76.60	****	****	****	0.17	*****	****	*****	*****	***
C 5676	78.13	****	****	****	0.56	*****	****	*****	*****	***
C 5192	79.28	0.02	0.57	0.94	0.93	61	101	0.59	0.03	434
C 5193	80.32	0.01	0.81	1.27	1.09	74	117	0.82	0.01	437
C 5677	81.48	****	****	****	0.77	*****	****	*****	*****	***
C 5194	82.31	0.01	0.49	0.96	0.86	57	112	0.50	0.02	435
C 5195	83.04	0.02	0.51	0.62	0.78	65	79	0.53	0.04	438
C 5678	83.85	****	****	****	1.04	*****	****	*****	*****	***
C 5196	85.08	0.01	0.46	0.31	0.76	61	41	0.47	0.02	433
C 5679	85.95	****	****	****	0.92	*****	****	*****	*****	***
C 5680	87	****	****	****	0.95	*****	****	*****	*****	***
C 5197	88.45	0.02	0.36	0.08	0.68	53	12	0.38	0.05	435

Table A.II.1.3: Data from pyrolysis-gas chromatograms.

Core 7228/3-U-1

Sample Nr.	Depth (m)	I I I	TOC (%)	I I I	C1 - -	C2-C5 (a r e a %)	C6-C14 - -	C15+ - -	I I I	(m+p)-xylene/ n-octene (pkht/pkht)
C-5658	47.50	I	1.03	I	8.53	15.40	57.77	14.78	I	0.82
C-5662	51.60	I	35.37	I	19.07	19.64	44.78	16.50	I	2.04
C-5185	58.79	I	6.14	I	2.04	8.12	46.96	42.86	I	0.62
C-5188	67.40	I	2.78	I	13.43	0.31	69.57	16.67	I	1.75
C-5674	74.78	I	8.38	I	19.99	25.81	45.68	8.53	I	1.56

Table A.II.1.4:

 Well Identification: 7228/3-U-1
 Reference number: 21.3419.15
 (1/1)

VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
C 5662	----	51.6	0.31 (28) 0.56 (2)	G R	0.06 0.01	3-4
C 5674	----	74.8	0.40 (23) 0.90 (1)	F R	0.11 0.00	3?
C 5194	----	82.3	0.35 (26) 0.71 (4)	G R	0.08 0.13	2-3

 REL RAT (Reliability Rating): G = Good; F = Fair; P = Poor
 S = Stained; R = Reworked.

Project no.: 21.3419.15
Well ident.: 7228/3-U-1
DATE : 6 - 1 - 87.

Table A.II.1.5:

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

I	I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	: Rock	EOM	Sat.	Aro.	HC	Non HC	TOC	I
I			: Extr.							I
I		(m)	: (g)	(mg)	(mg)	(mg)	(mg)	(mg)	(%)	I
I										I
I	C 5662	51.60	: 44.5	824.7	10.4	127.4	137.8	686.9	25.78	I
I			:							I
I	C 5185	58.79	: 11.9	10.4	0.4	1.2	1.6	8.8	0.82	I
I			:							I
I	C 5188	67.40	: 29.0	16.5	1.1	1.6	2.6	13.9	3.04	I
I			:							I
I	C 5674	74.78	: 49.9	30.4	0.2	1.8	2.0	28.4	1.75	I
I			:							I
I	C 5191	76.05	: 6.9	4.3	0.1	0.6	0.7	3.6	1.07	I
I			:							I
I	C 5196	85.08	: 31.0	13.0	0.2	2.0	2.2	10.8	0.93	I
I			:							I

Project no.: 21.3419.15
 Well ident.: 7228/3-U-1
 DATE : 6 - 1 - 87.

Table A.II.1.6:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

I			:						I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5662	51.60	:	18549	234	2865	3099	15450	I
I			:						I
I	C 5185	58.79	:	876	30	101	131	745	I
I			:						I
I	C 5188	67.40	:	569	37	54	91	478	I
I			:						I
I	C 5674	74.78	:	609	5	36	41	568	I
I			:						I
I	C 5191	76.05	:	626	15	87	102	524	I
I			:						I
I	C 5196	85.08	:	419	6	66	72	347	I
I			:						I

Project no.: 21.3419.15
Well ident.: 7228/3-U-1
DATE : 6 - 1 - 87.

Table A.II.1.7:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

I			:						I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5662	51.60	:	72.0	0.9	11.1	12.0	59.9	I
I			:						I
I	C 5185	58.79	:	106.8	3.7	12.3	16.0	90.8	I
I			:						I
I	C 5188	67.40	:	18.7	1.2	1.8	3.0	15.7	I
I			:						I
I	C 5674	74.78	:	34.8	0.3	2.1	2.3	32.5	I
I			:						I
I	C 5191	76.05	:	58.5	1.4	8.2	9.5	49.0	I
I			:						I
I	C 5196	85.08	:	45.1	0.7	7.1	7.8	37.3	I
I			:						I

Project no.: 21.3419.15
Well ident.: 7228/3-U-1
DATE : 6 - 1 - 87.

Table A.II.1.8:

COMPOSITION OF MATERIAL EXTRACTED FROM THE ROCK

I	I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	:	Sat	Aro	HC	SAT	Non HC	HC	I
I			:	---	---	---	---	---	---	I
I		(m)	:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I			:	%	%	%	x 100	%	x 100	I
I			:							I
I	C 5662	51.60	:	1.3	15.4	16.7	8.2	83.3	20.1	I
I			:							I
I	C 5185	58.79	:	3.5	11.5	15.0	30.0	85.0	17.6	I
I			:							I
I	C 5188	67.40	:	6.5	9.5	16.0	69.2	84.0	19.0	I
I			:							I
I	C 5674	74.78	:	0.8	5.9	6.7	13.3	93.3	7.2	I
I			:							I
I	C 5191	76.05	:	2.3	14.0	16.3	16.7	83.7	19.4	I
I			:							I
I	C 5196	85.08	:	1.5	15.7	17.2	9.8	82.8	20.8	I
I			:							I

Table A.II.1.9:

TABULATION OF DATA FROM THE GAS CHROMATOGRAMS

7228/3-U-1

I		DEPTH	:	PRISTANE	PRISTANE	PHYTANE	A	n-C17		I
I	IKU No.		:		A =	B =			CPI	I
I		(m)	:	PHYTANE	n-C17	n-C18	B	n-C27		I
I			:							I
I			:							I
I	C 5662	51.60	:	5.0	7.2	1.2	5.9	0.2	2.4	I
I			:							I
I	C 5185	58.79	:	0.8	0.9	0.8	1.2	1.0	1.5	I
I			:							I
I	C 5188	67.40	:	3.3	2.8	0.8	3.4	0.2	1.4	I
I			:							I
I	C 5674	74.78	:	2.2	1.7	0.7	2.5	1.1	1.4	I
I			:							I
I	C 5191	76.05	:	1.3	1.0	0.5	1.9	1.0	1.3	I
I			:							I
I	C 5196	85.08	:	1.6	1.5	0.7	2.1	0.3	1.2	I
I			:							I

Corrected replacement of

Table A.II.1.10: Molecular ratios from sterane and terpane mass chromatograms. Maturity and source characteristic ratios.

7228/3-U-1							
IKU-NR.	depth (m)	ab/(ab+ba)	%22S	%20S	%bb	Tm/Ts	C27 rearr.
		hop.	ext. hop	ster.	ster.		ster.
		1)	2)	3)	4)	5)	6)
		----- maturity-dependent -----				maturity- and	
		----- parameters -----				source-dependent	
C5662	51.60	0.71	16.88	6.03	34.12	13.47	50.00
C5191	76.05	--	--	--	--	--	--

- 1) $E / (E+F)$ in m/z 191
- 2) $100 * G / (G+H)$ in m/z 191
- 3) $100 * q / (q+t)$ in m/z 217
- 4) $100 * (r+s) / (q+r+s+t)$ in m/z 217
- 5) B / A in m/z 191
- 6) $100 * a / (a+j)$ in m/z 217

Table A.II.1.11:

a)

7228/3-U-1

Gas yields of the hydrocarbons C1-C7 of adsorbed gas of core samples (ug/kg rock)

IKU No.	Depth (m)	C1	C2	C3	iC4	nC4	2,2-DMC3	C5+
C5124	46.79	268.1	33.2	17.0	6.1	7.2	.	.
C5125	51.49	17.9	7.4	8.4	1.0	1.2	.	.
C5127	63.54	387.9	51.9	26.6	20.3	17.5	7.3	.
C5129	84.97	184.9	17.4	15.4	7.6	8.9	.	.

. = value missing, undefined, or below detection limit

b)

7228/3-U-1

Gas ratios (v/v) and isotope ratios of the hydrocarbons C1 to C7 of adsorbed gas of core samples.

IKU No.	Depth (m)	C1/ (C2+C3)	100*C1/ (C1+C2 +C3+iC4 +nC4)	100* (iC4/nC4)	d13C1 (0/00 PDB)	d13C2 (0/00 PDB)	dD C1 (0/00 SMOW)
C5124	46.79	11.33	90.74	79.96	-46.5	-33.7	.
C5125	51.49	2.58	70.36	78.65	-29.5	.	.
C5127	63.54	10.48	89.09	109.48	-49.3	.	.
C5129	84.97	12.55	90.54	80.60	-47.3	-34.5	.

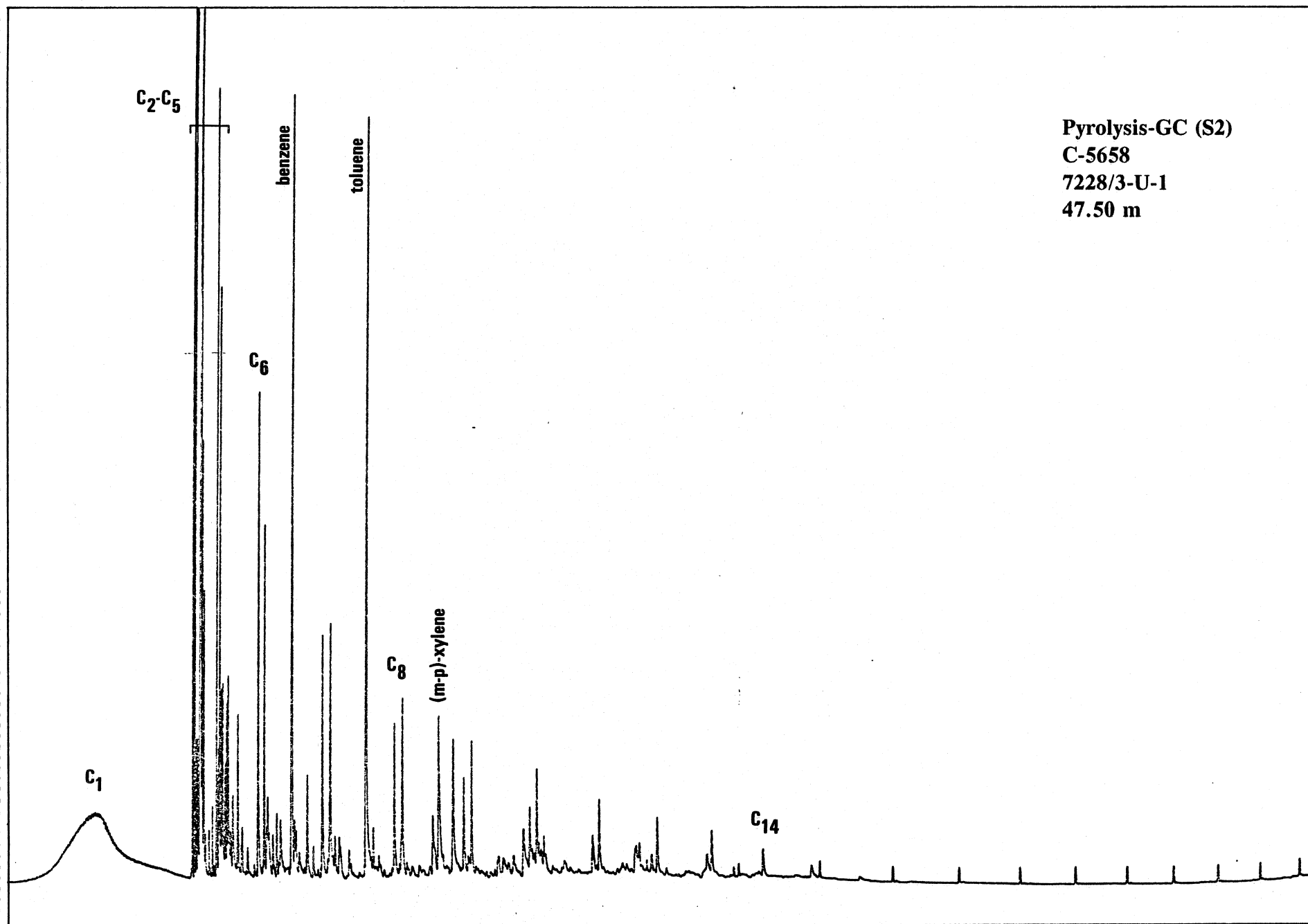
. = value missing, undefined, or below detection limit

Table A.II.1.12: $\delta^{13}\text{C}$ isotope ratios for extract fractions.

7228/3-U-1

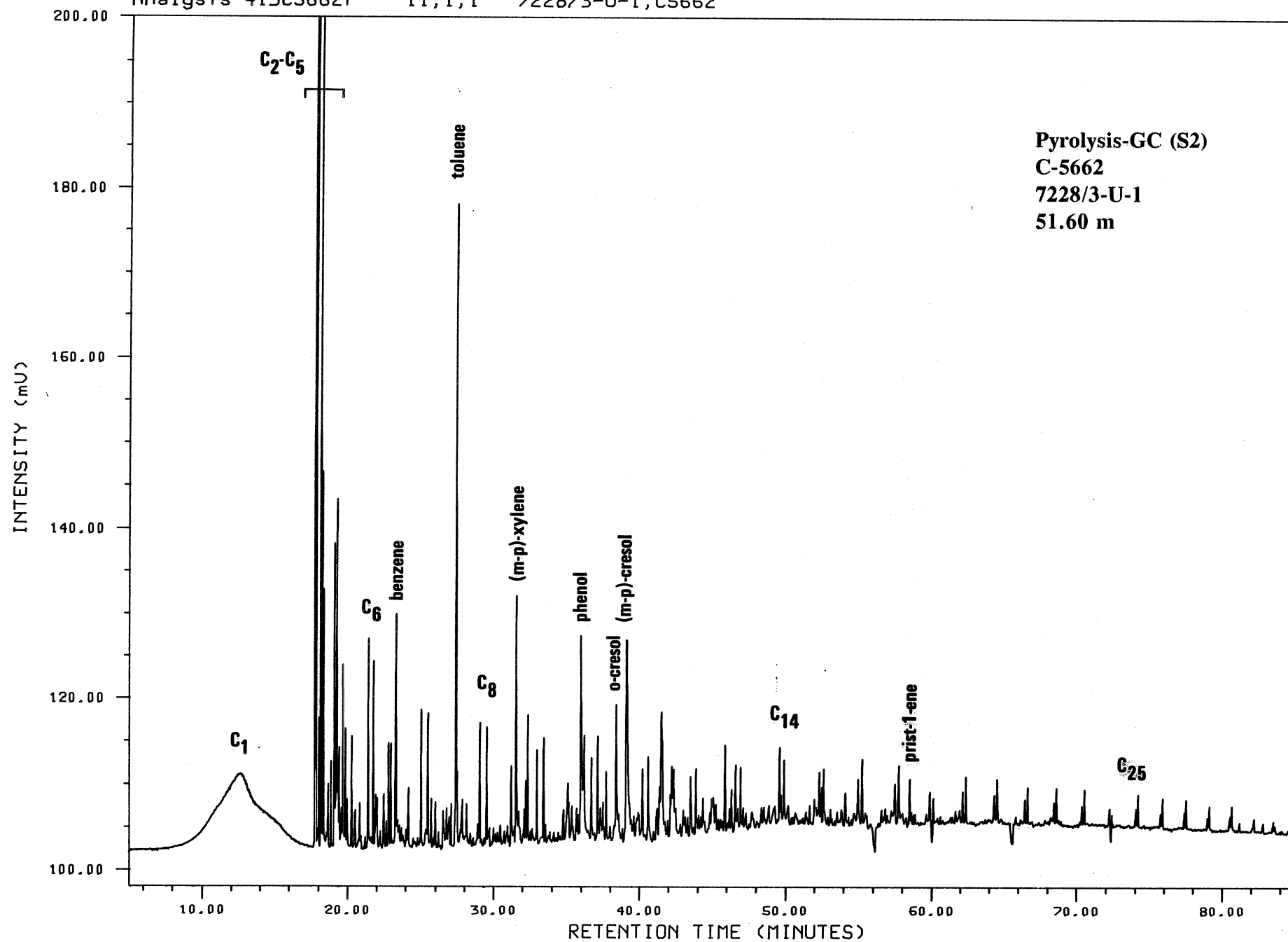
=====					
Sample	Depth (m)	----- delta 13 C -----			
		SAT	ARO	NSO	ASPH
=====					
C5662	51.60	-32.73	-30.21	-28.02	-29.68
C5188	67.40	-33.12	-28.99	-29.29	-28.63
=====					

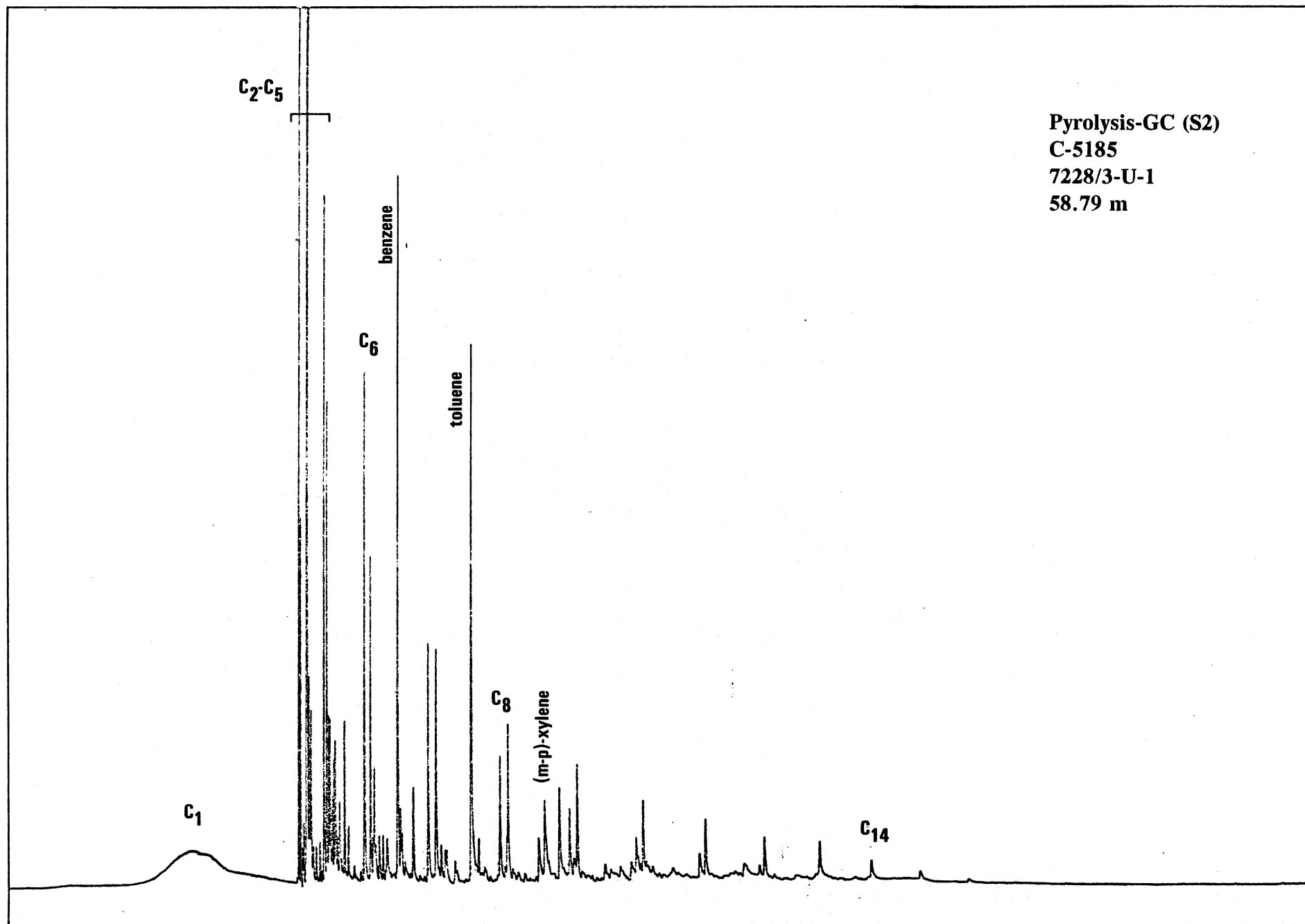
Figure A.II.1.1: Pyrolysis-gas chromatograms (S2 peak).



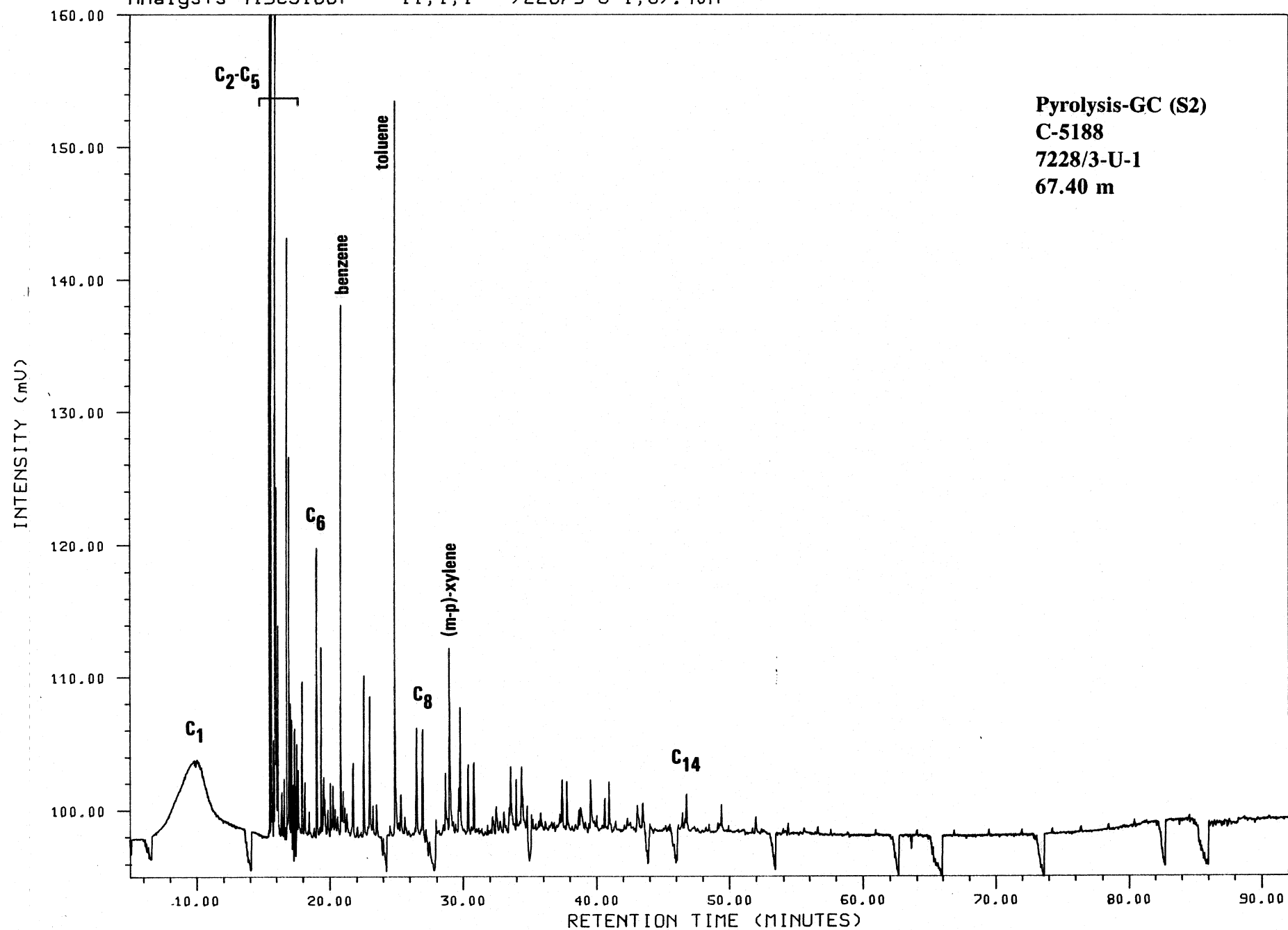
Pyrolysis-GC (S2)
C-5658
7228/3-U-1
47.50 m

Analysis 419C5662P 11,1,1 7228/3-U-1,C5662





Analysis 419C5188P 11,1,1 7228/3-U-1,67.40M



Analysis 419C5674P 11,1,1 7228/3-U-1,74.78M

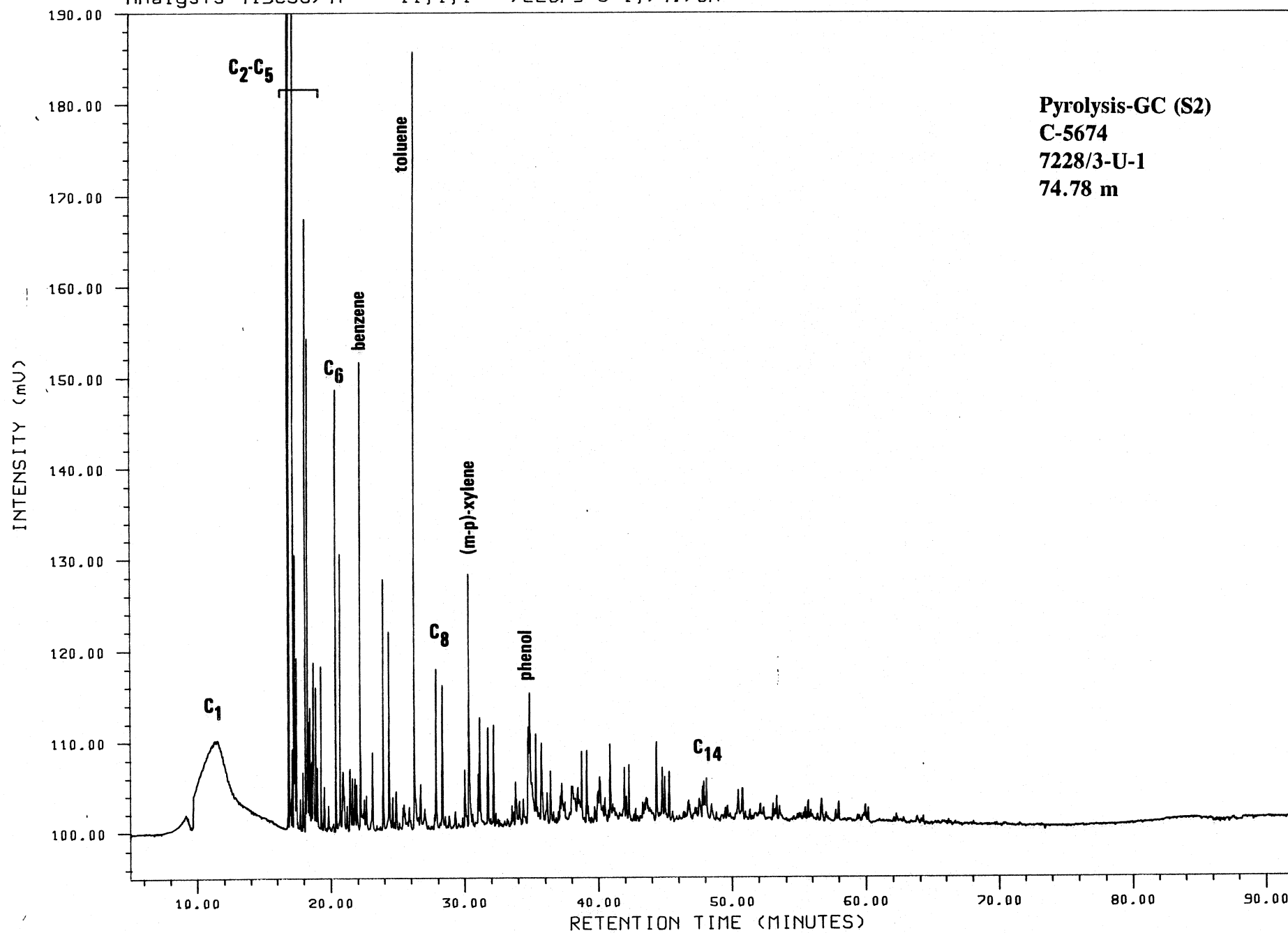
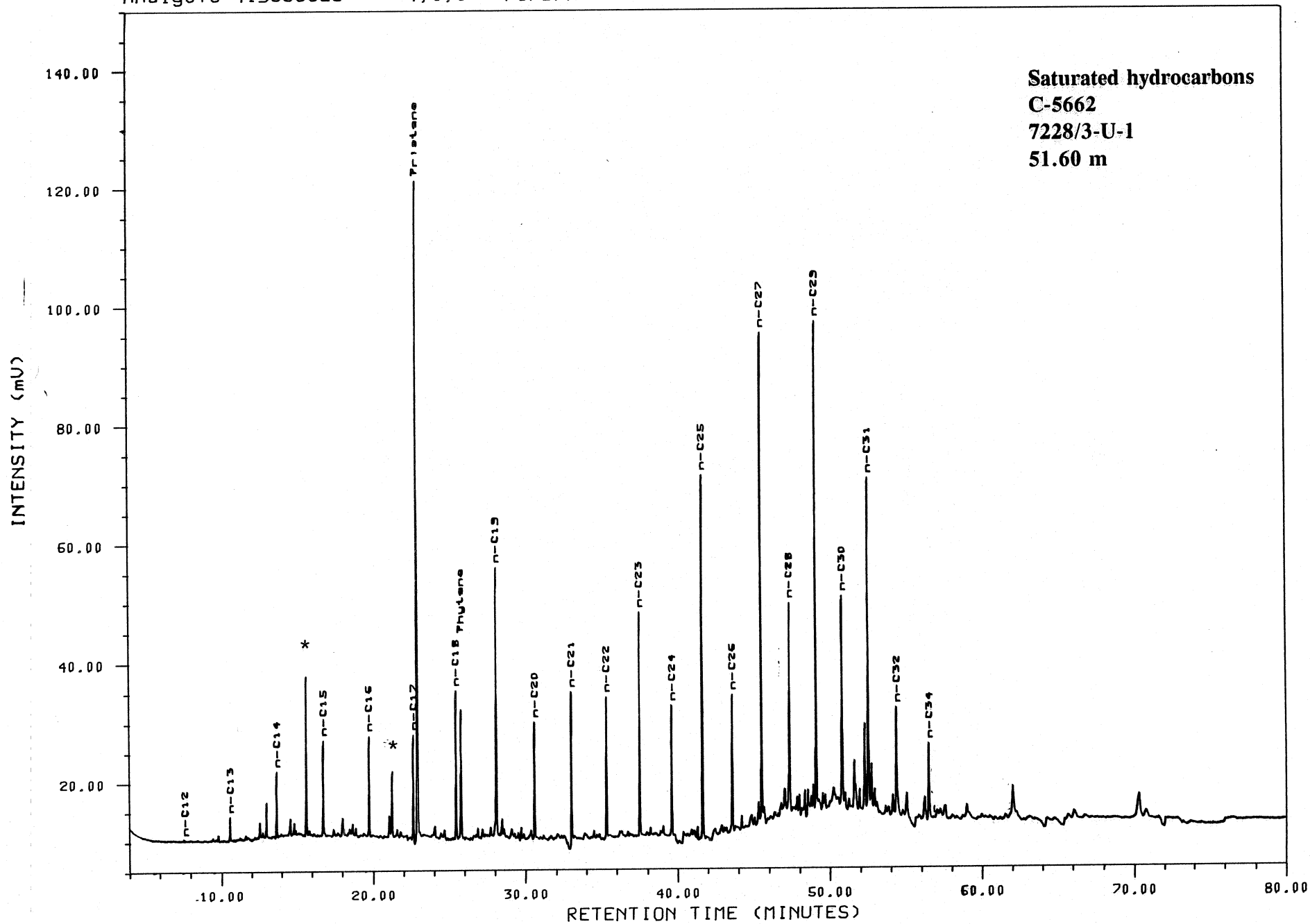


Figure A.II.1.2: Saturated hydrocarbon gas chromatograms.

n-C ₁₅ etc.	- n-alkanes
Pr	- pristane
Ph	- phytane
*	- other acyclic isoprenoids

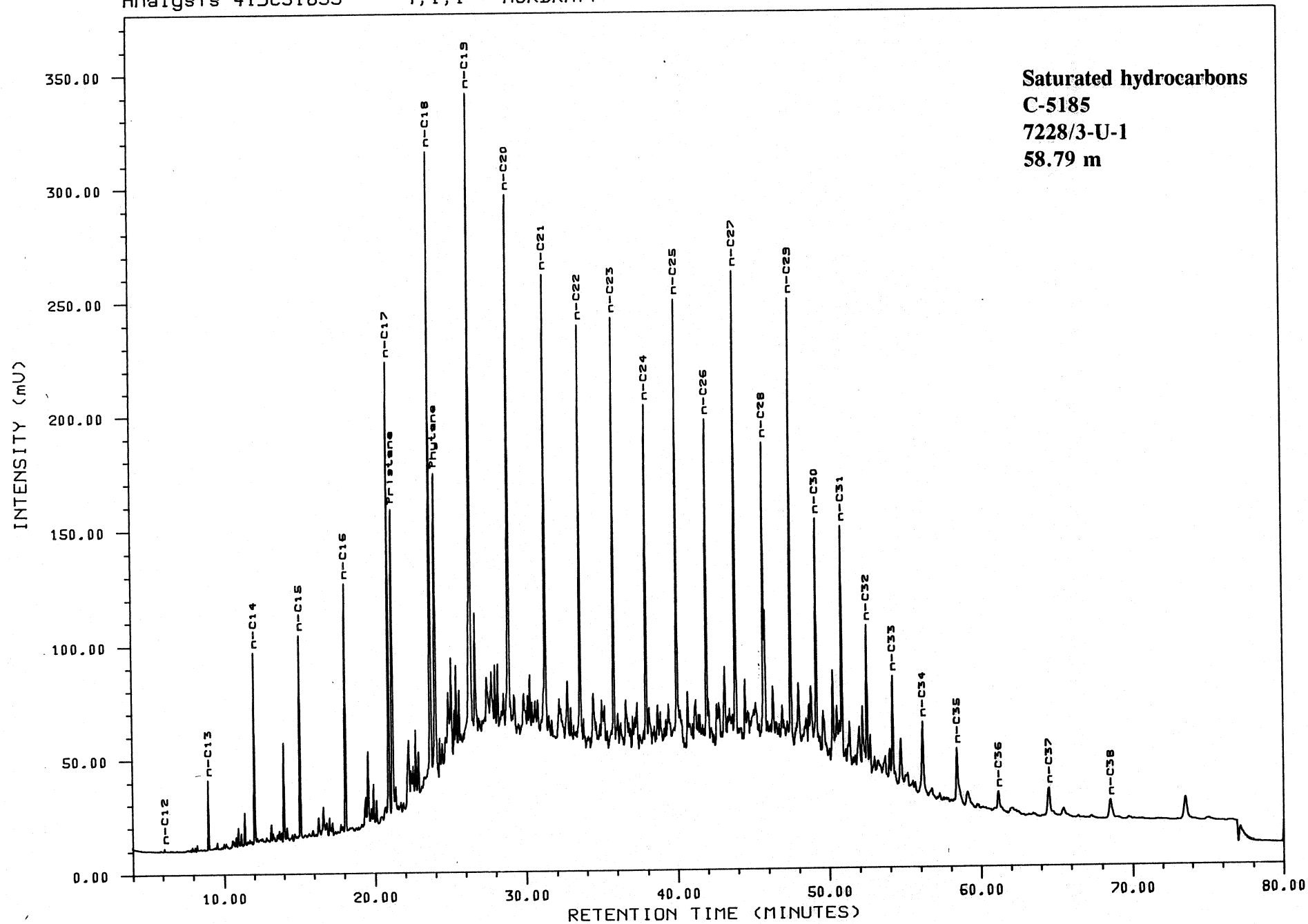
Analysis 419C5662S 4,1,1 NORDKAPP



Analysis 419C5185S

4,1,1

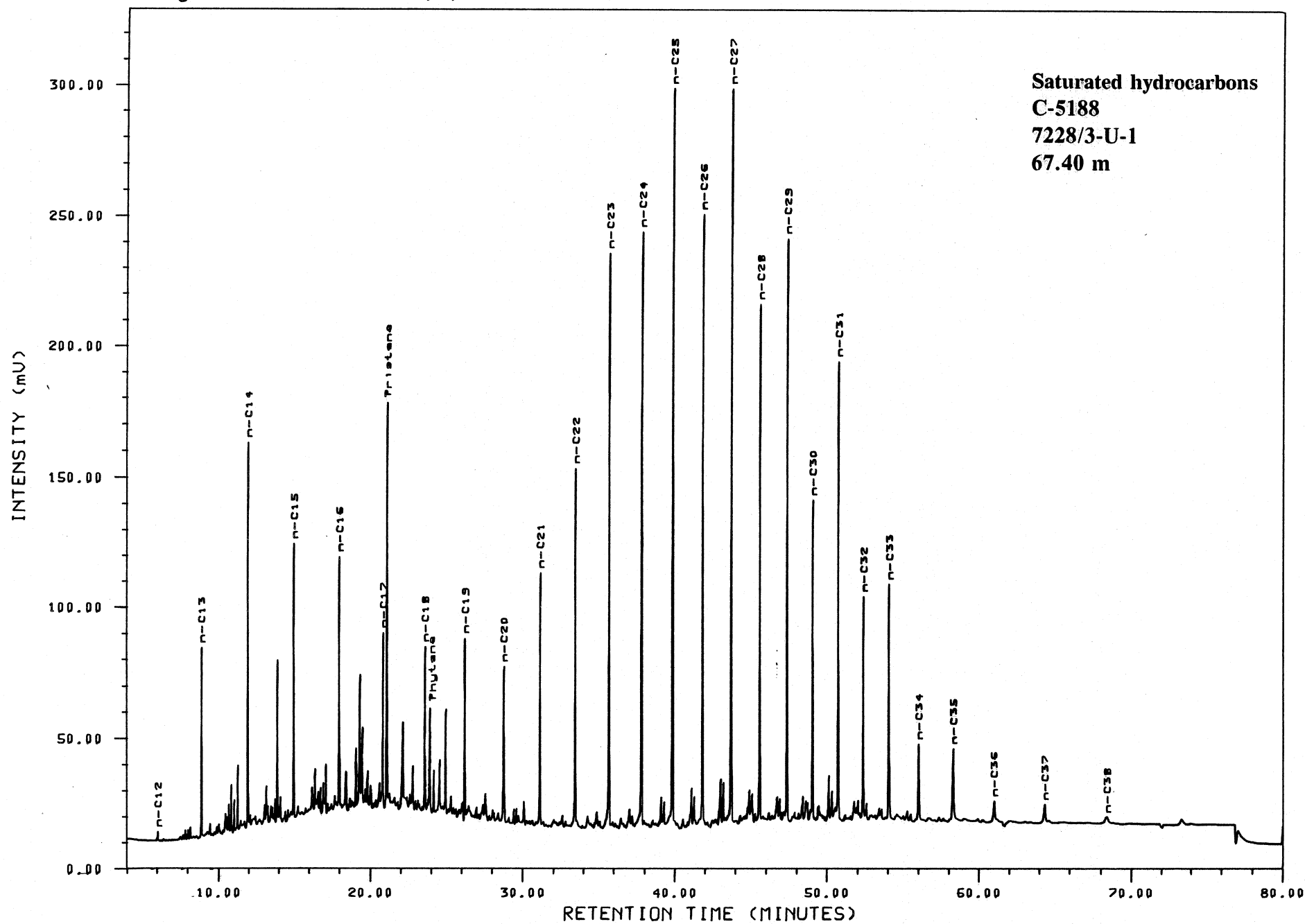
NORDKAPP



Analysis 419C5188S

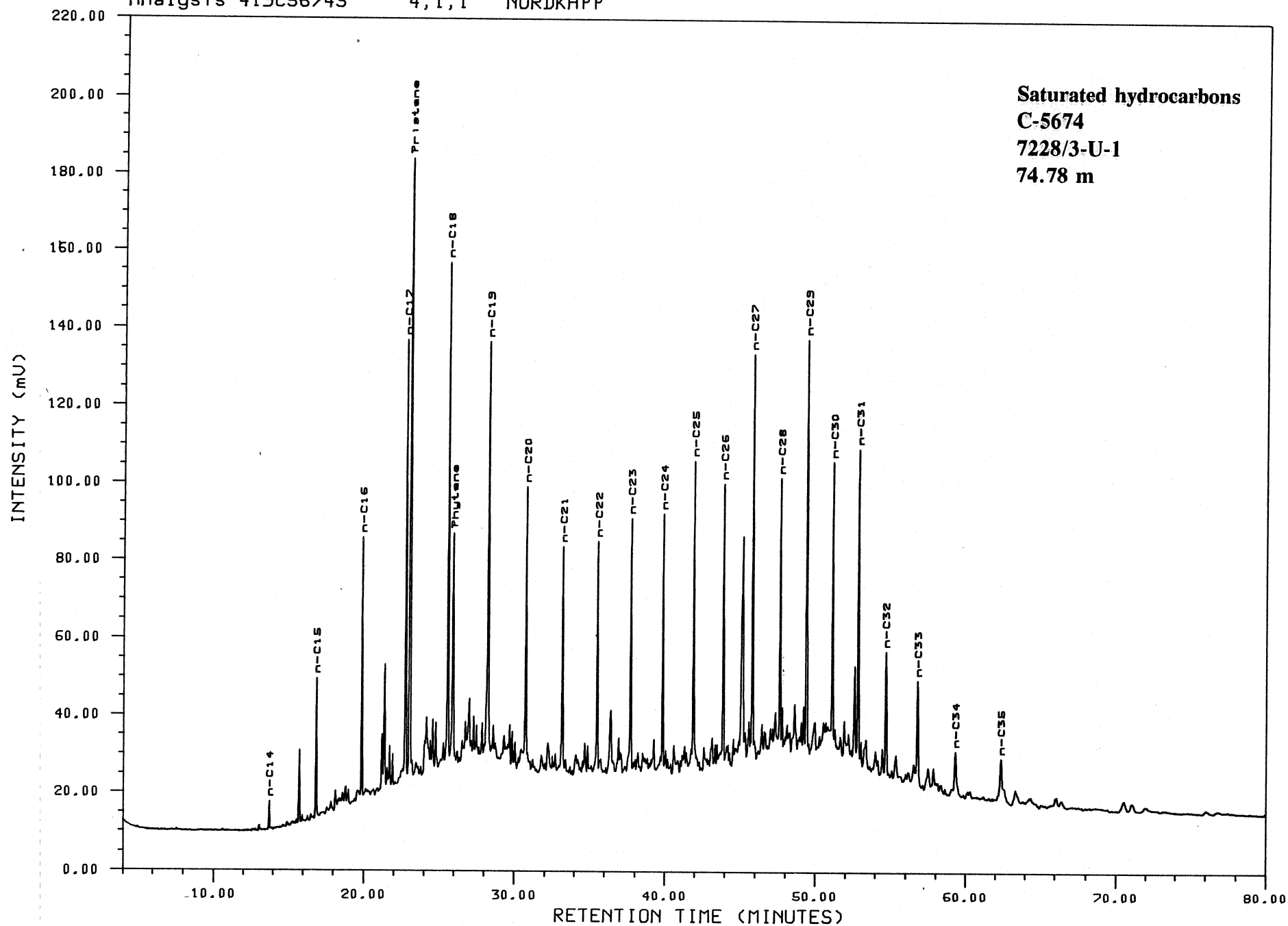
4,1,1

NORDKAPP



Analysis 419C5674S

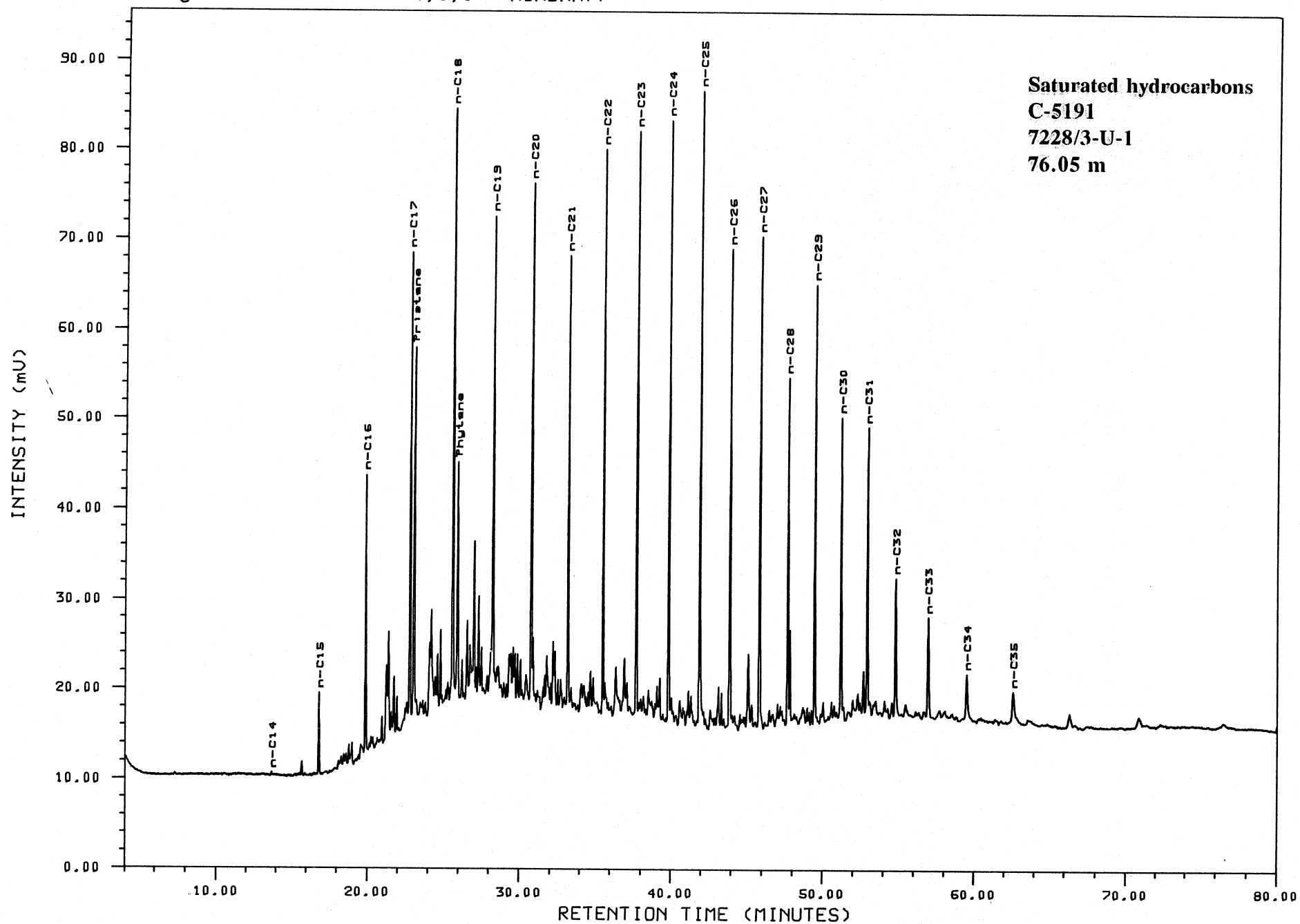
4,1,1 NORDKAPP



Analysis 419C5191S

4,1,1

NORDKAPP



Analysis 419C5196S

4,1,1

NORDKAPP

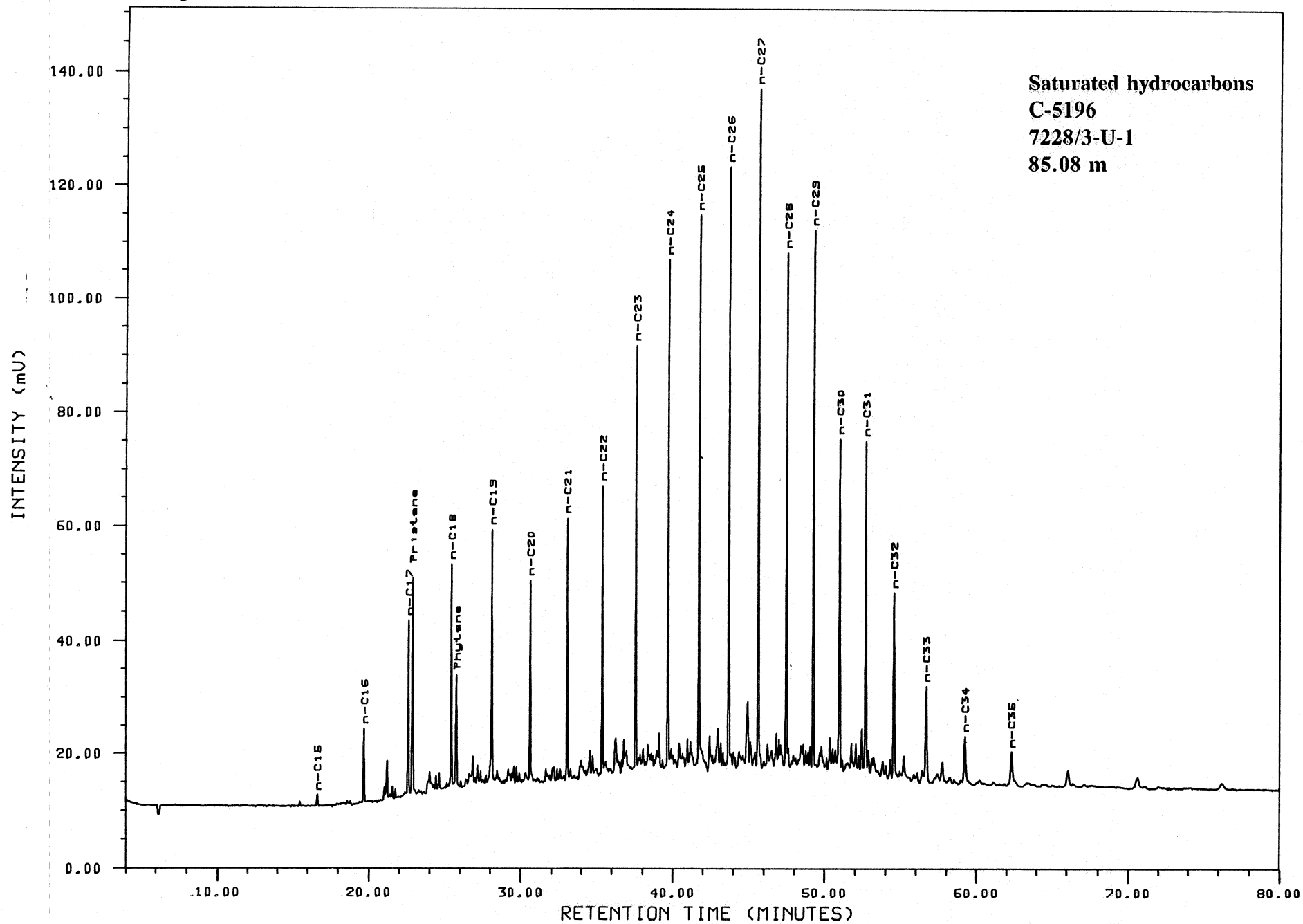


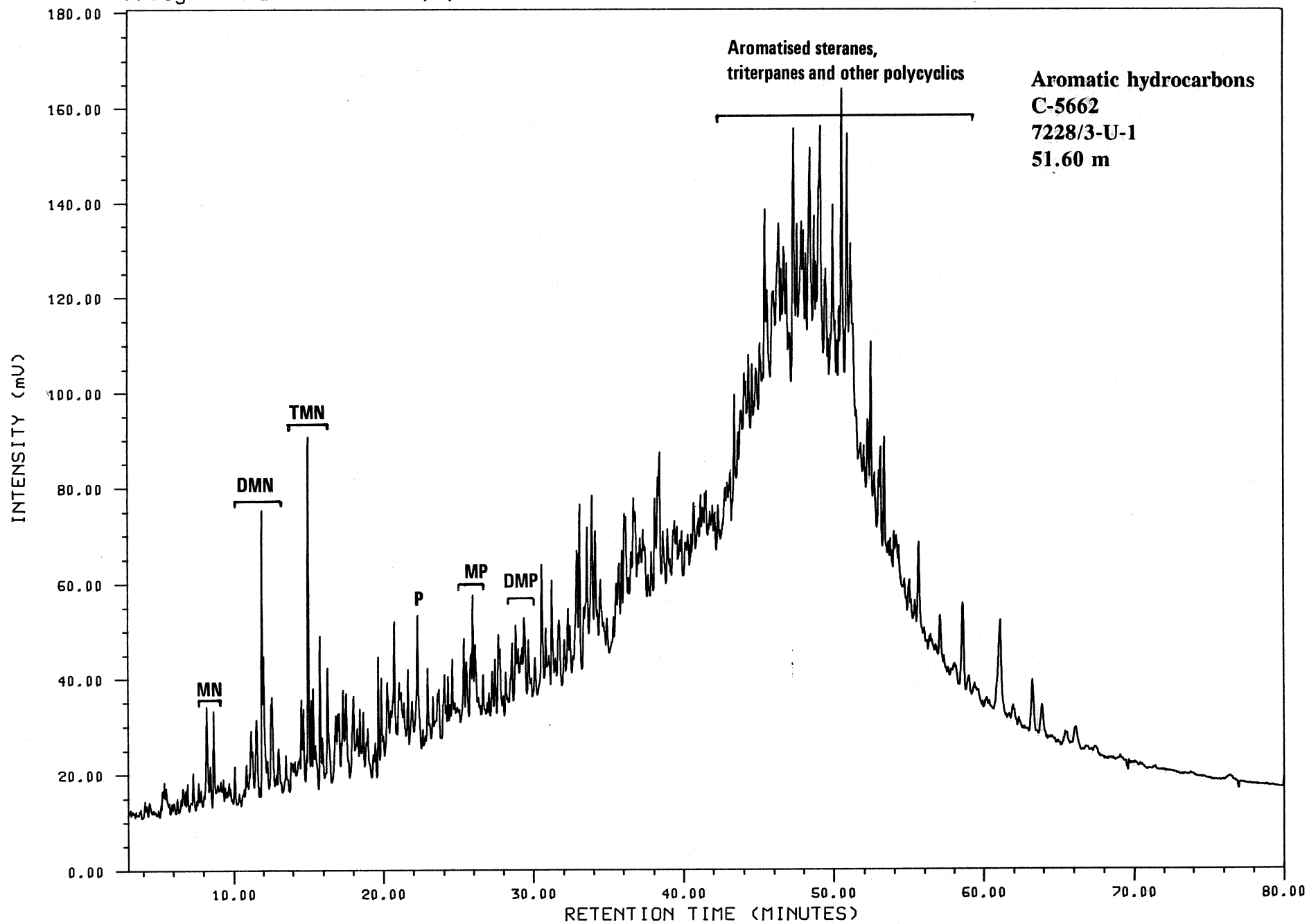
Figure A.II.1.3: Aromatic hydrocarbon gas chromatograms.

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

Analysis 419C5662A

2,1,1

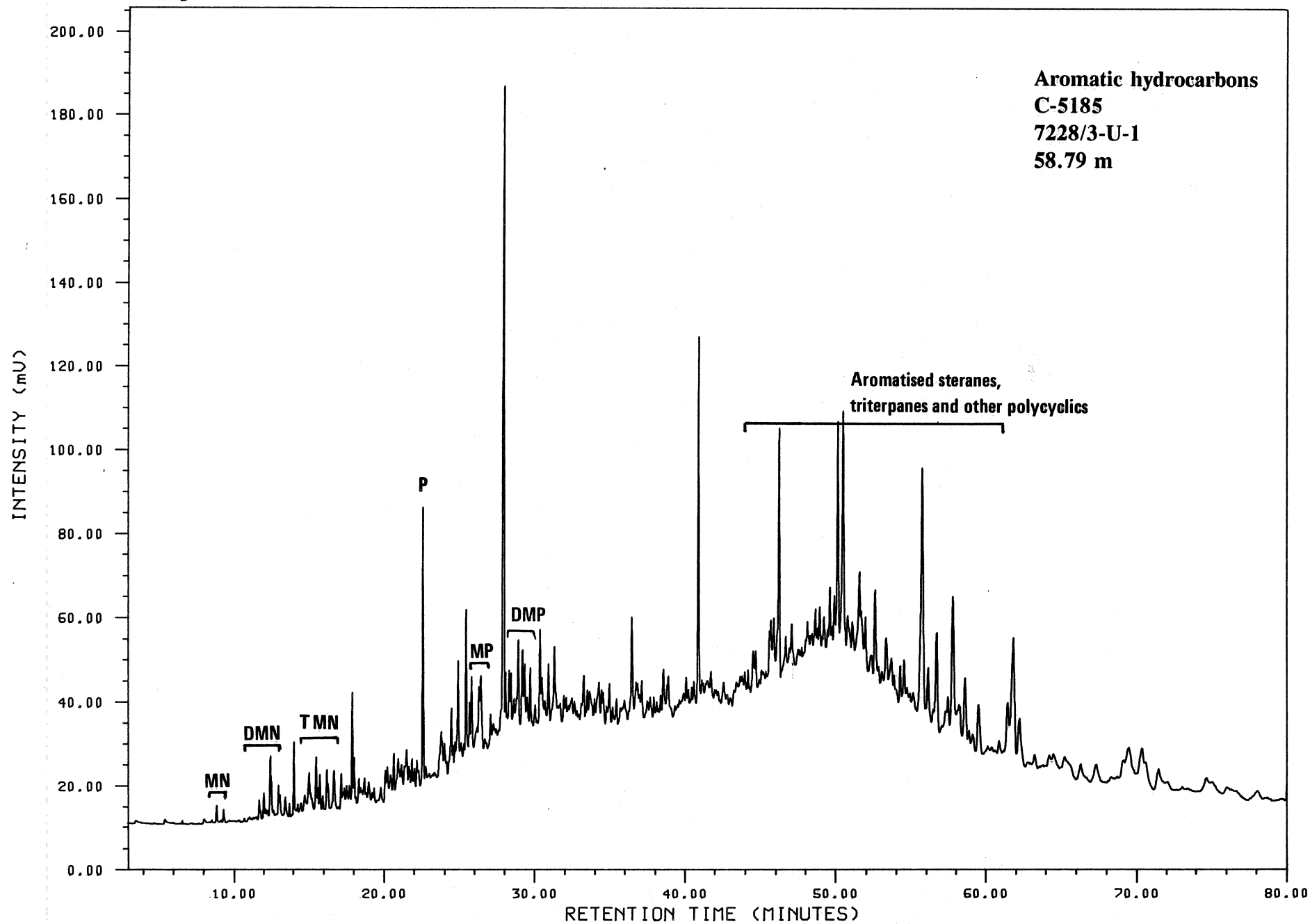
NORDKAPP



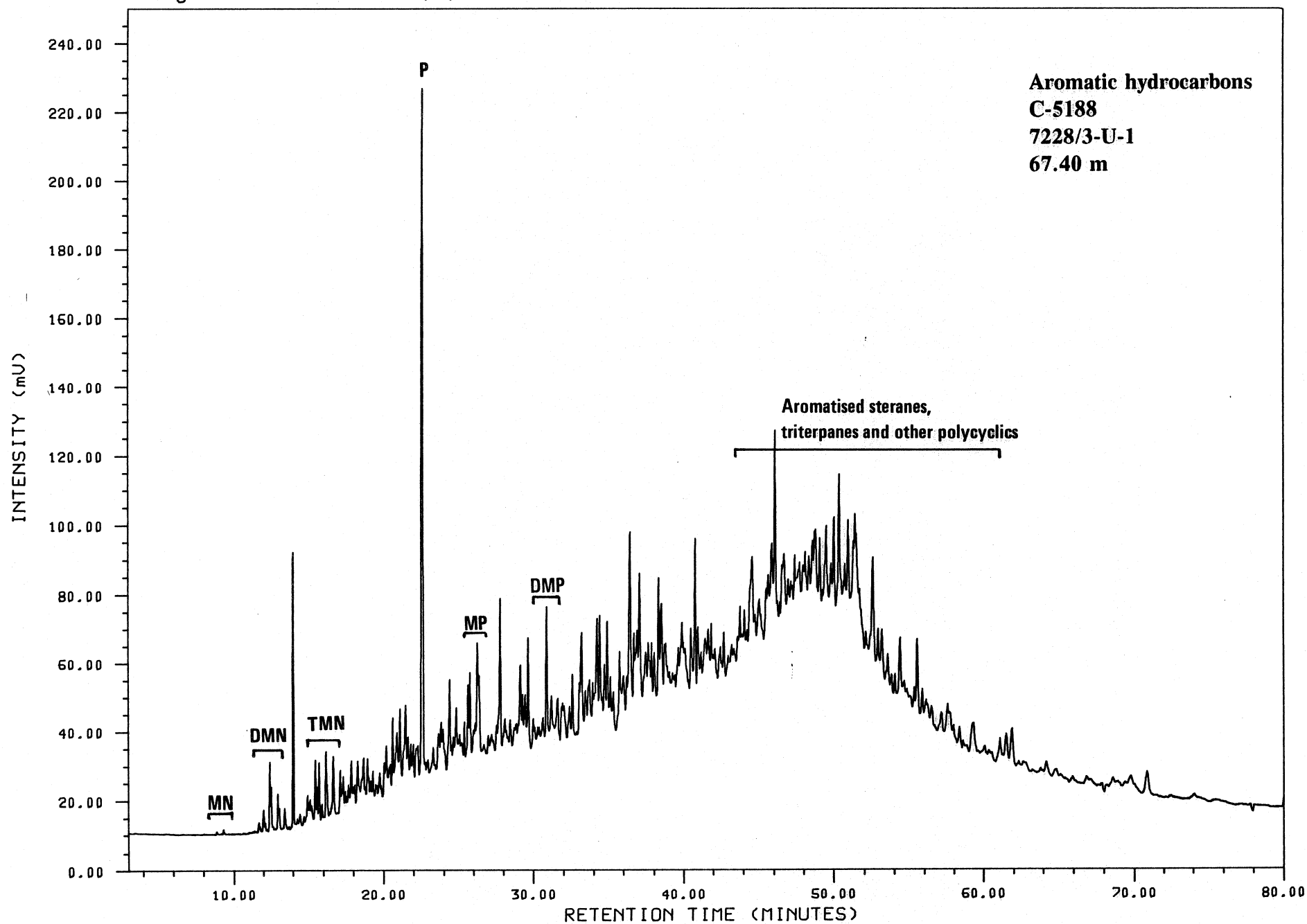
Analysis 419C5185A

2,1,1

NORDKAPP



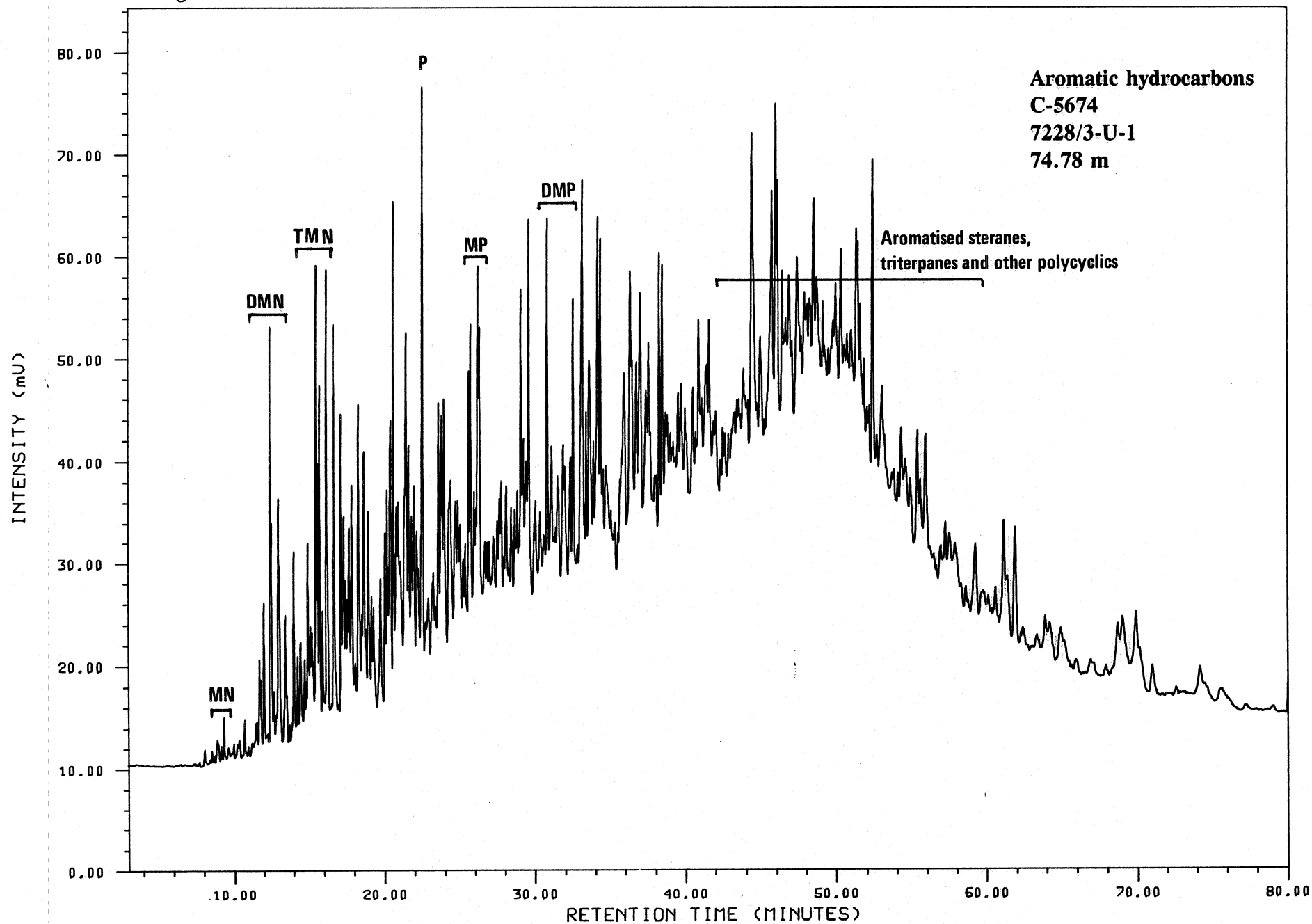
Analysis 419C5188A 2,1,1 NORDKAPP



Analysis 419C5674A

2,1,1

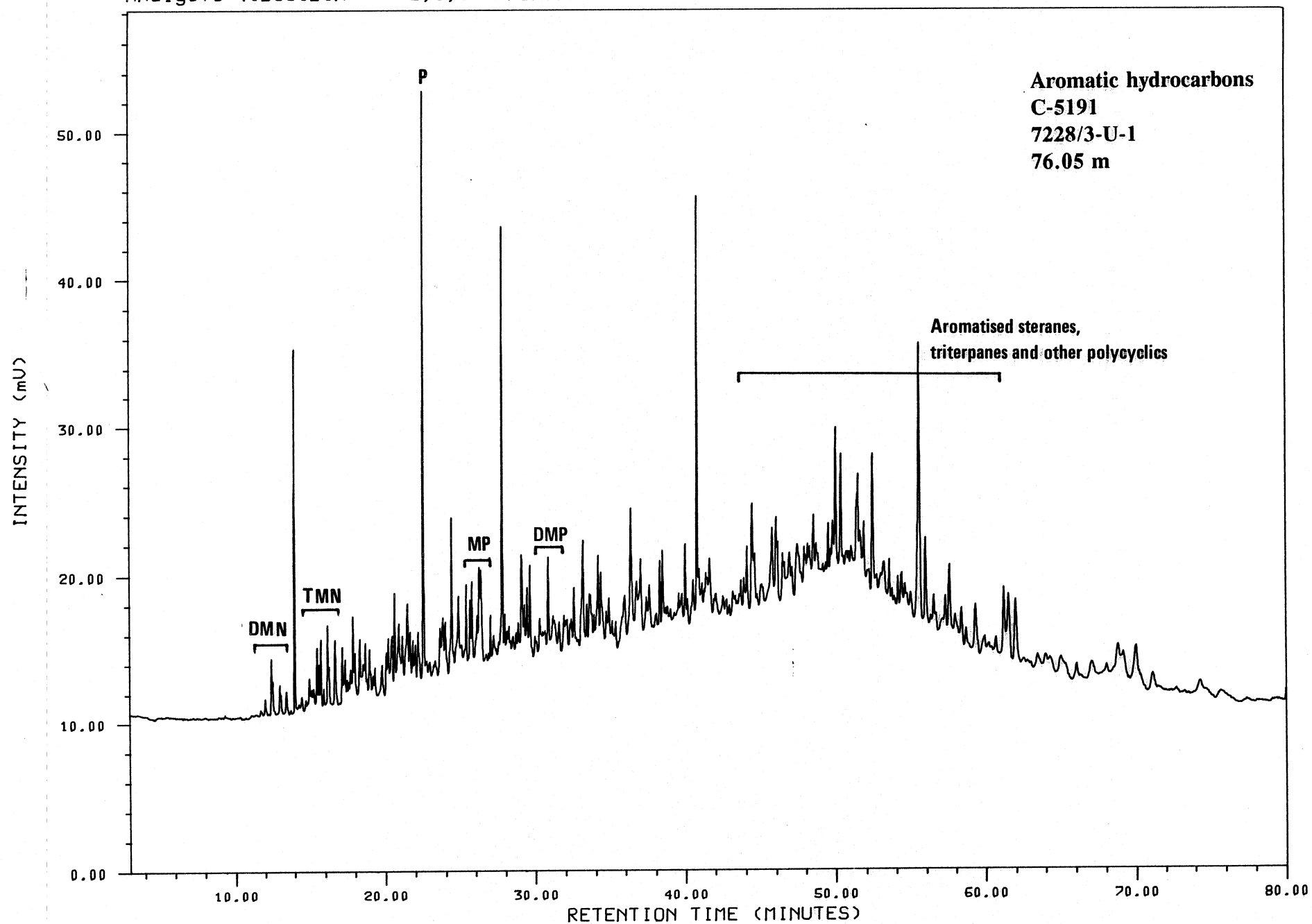
NORDKAPP



Analysis 419C5191A

2,1,1

NORDKAPP



Analysis 419C5196A

2,1,1 NORDKAPP

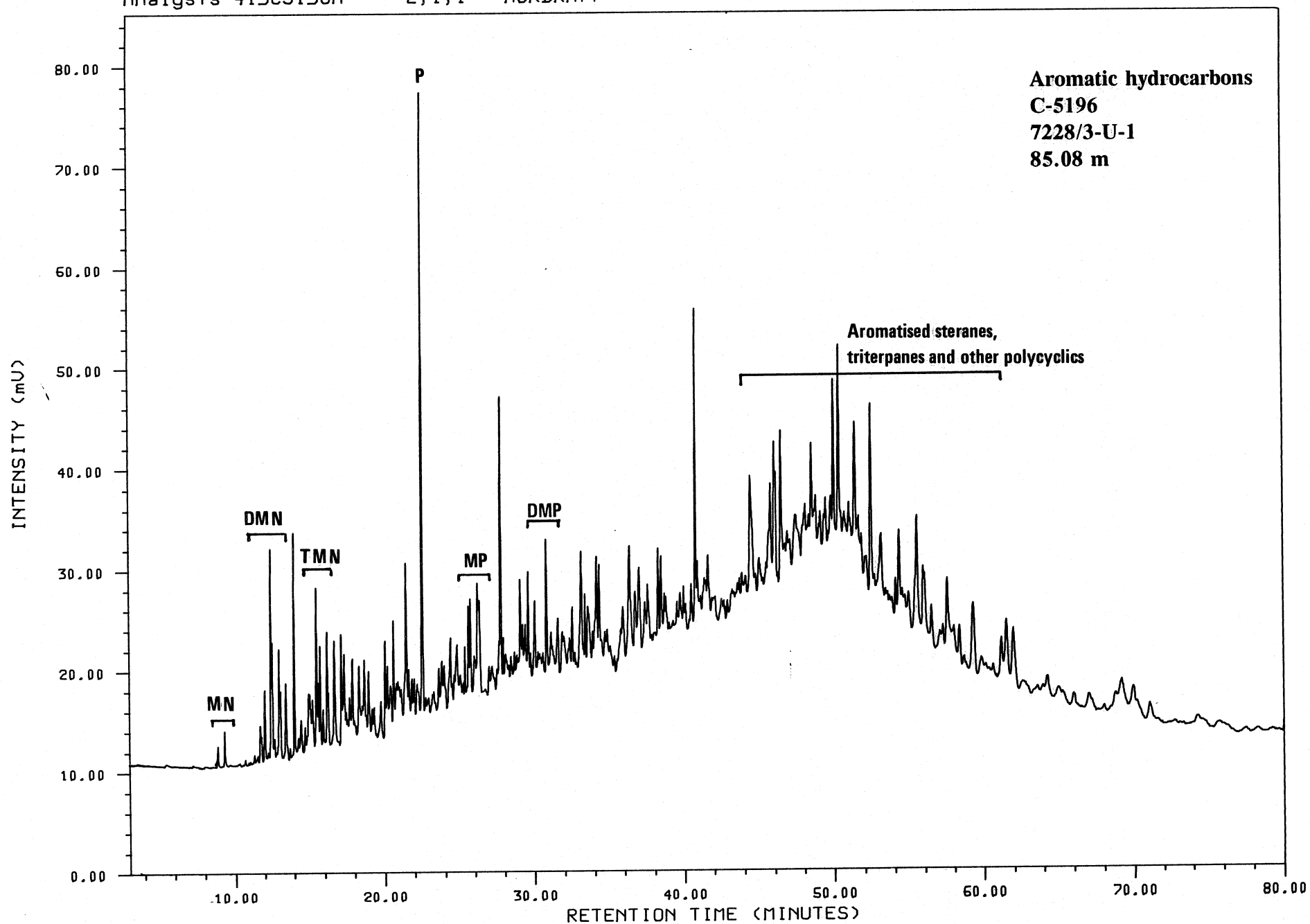
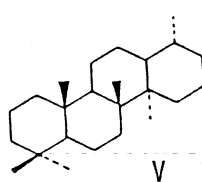
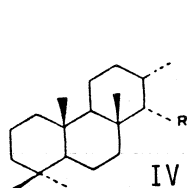
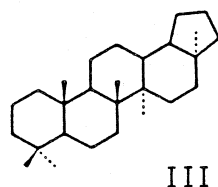
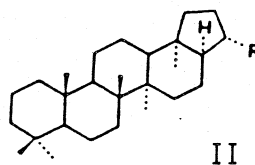
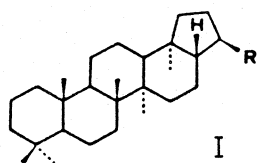


Figure A.II.1.4:

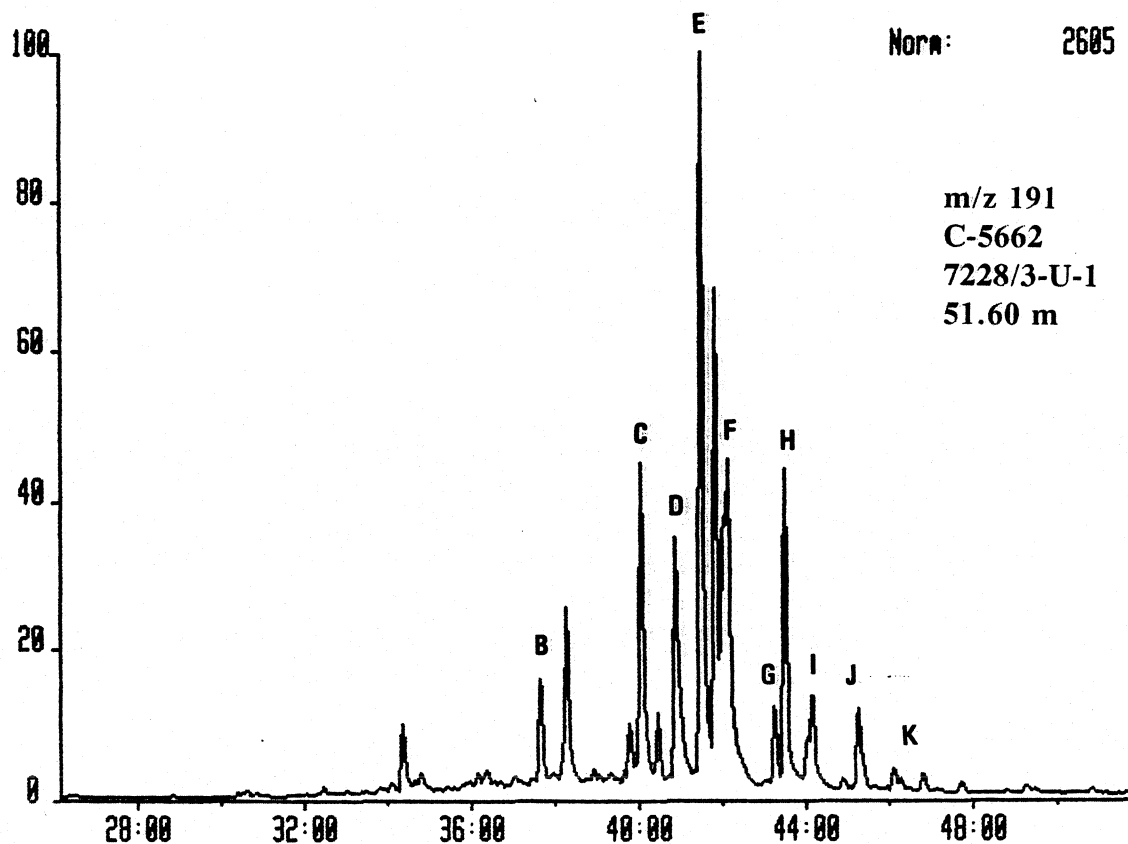
Mass chromatograms of terpanes (m/z 191)

A	T _s , 18α(H)-trisorneohopane	C ₂₇ H ₄₆	(III)
B	T _m , 17α(H)-trisorhopane	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	bisorhopane	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)



C5662SAT 15-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:TRIT



C5191SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:TRIT

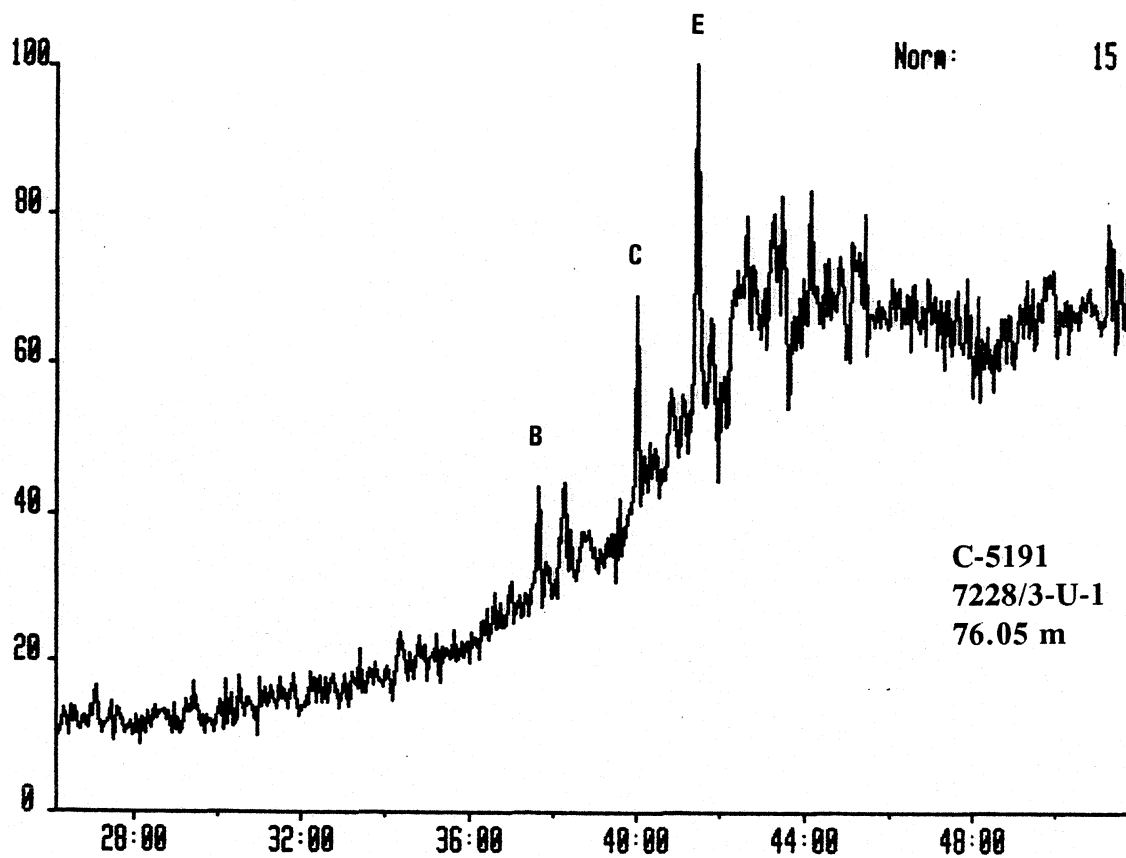
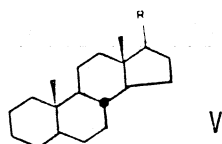
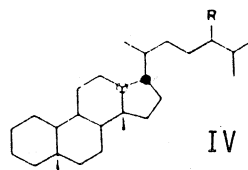
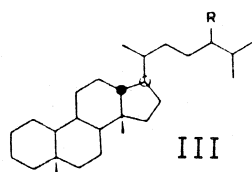
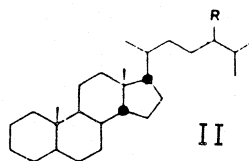
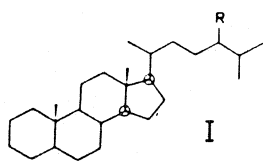


Figure A.II.1.5:

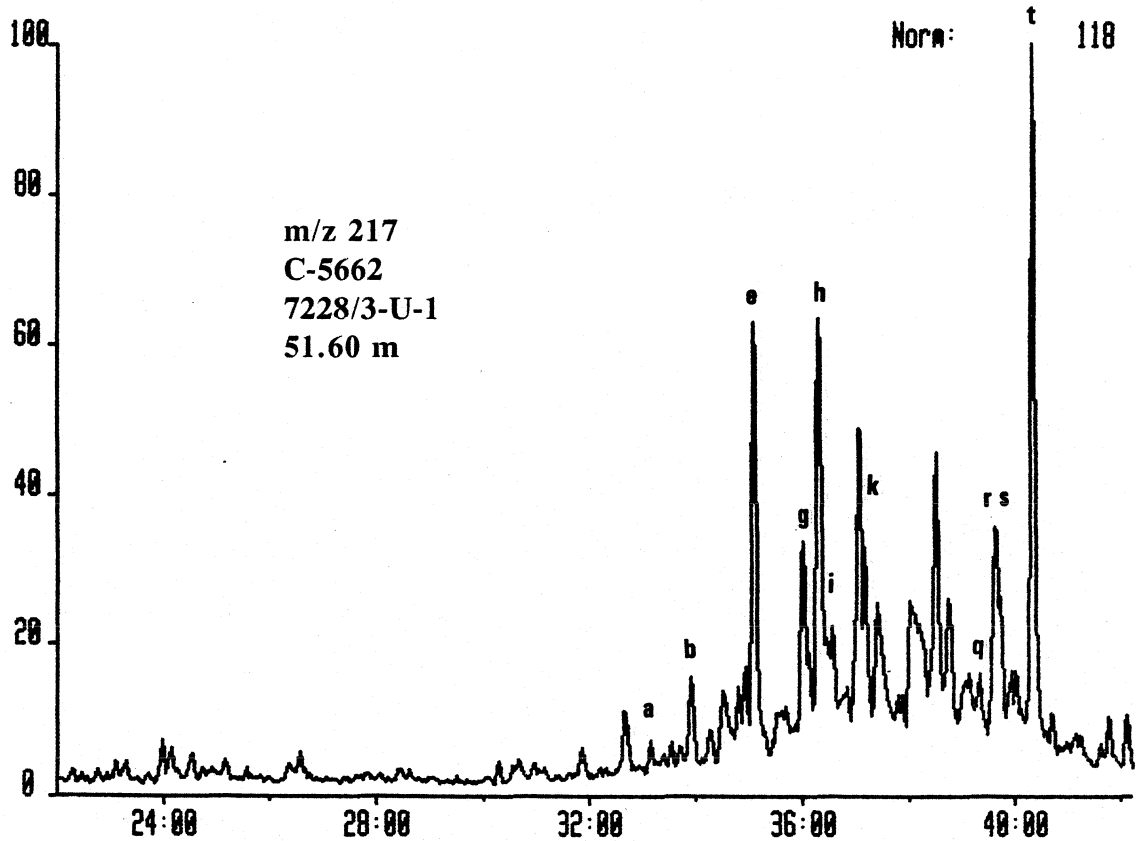
Mass chromatograms of steranes (m/z 217 and 218)
for expelled pyrolysates.

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 α (H),17 α (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)



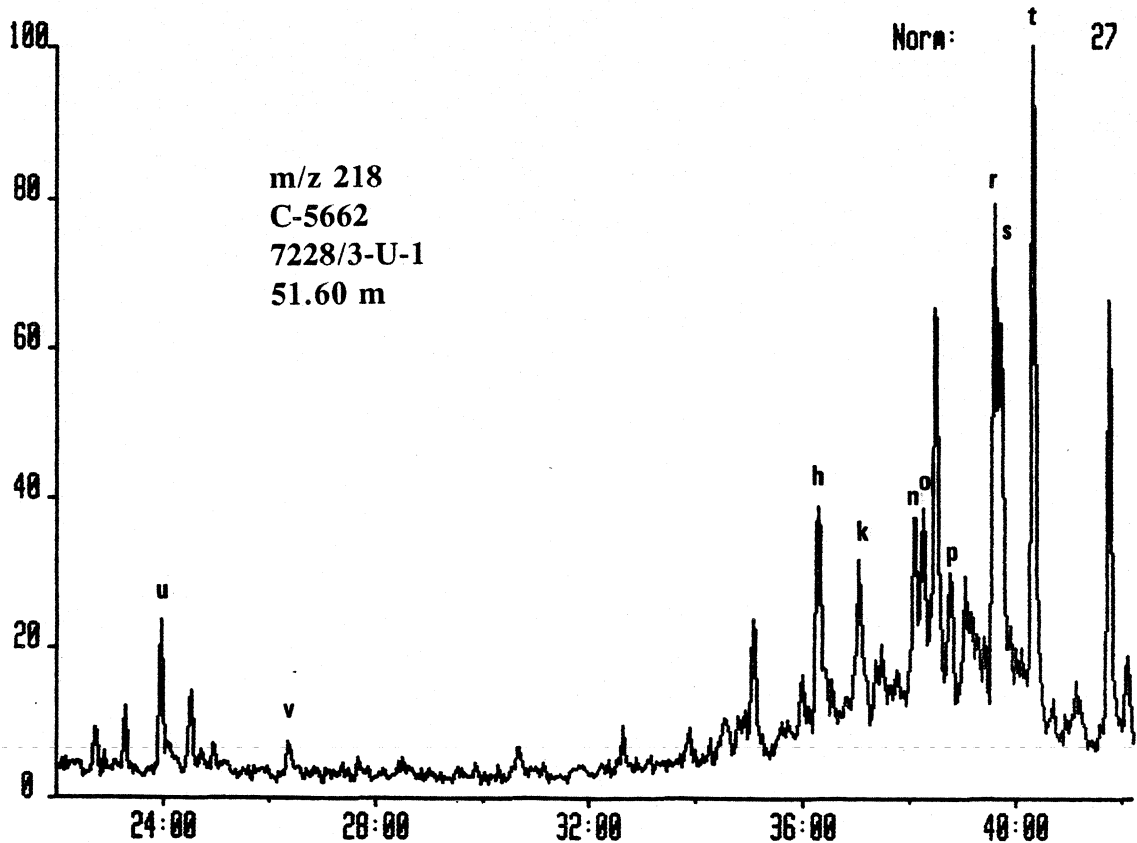
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Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



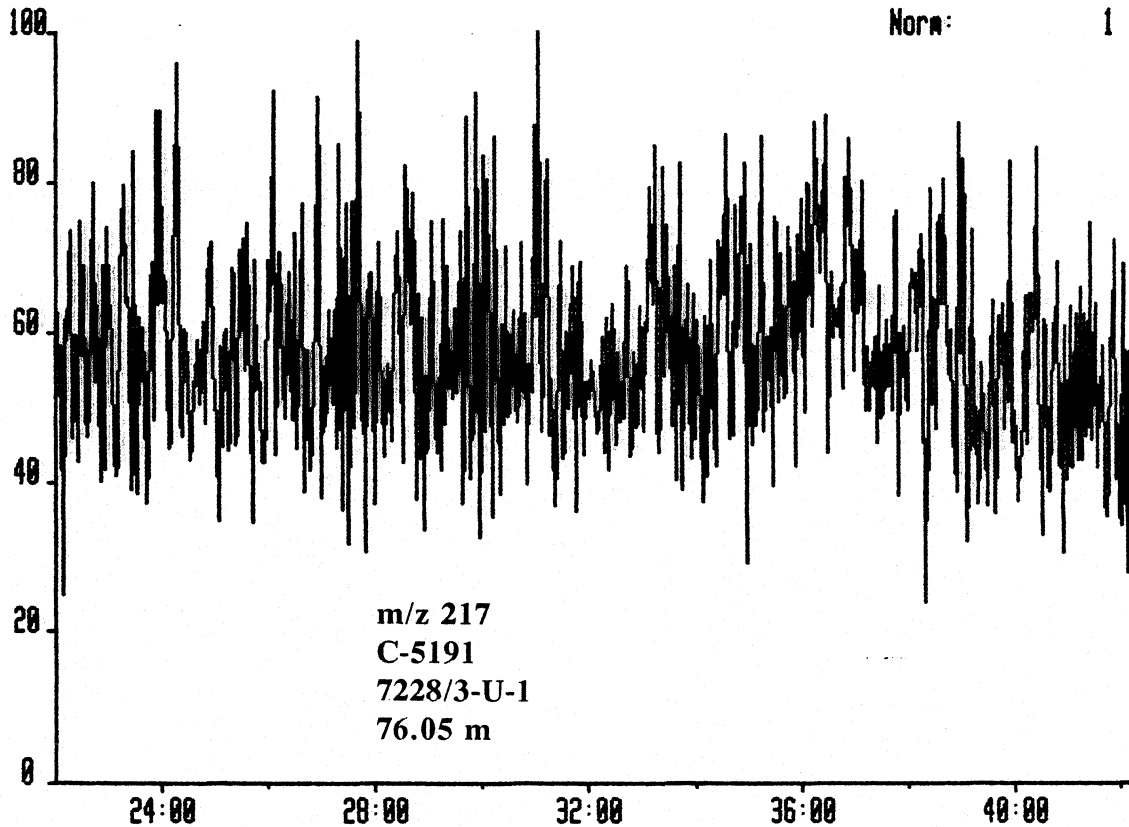
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Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT



C5191SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



C5191SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT

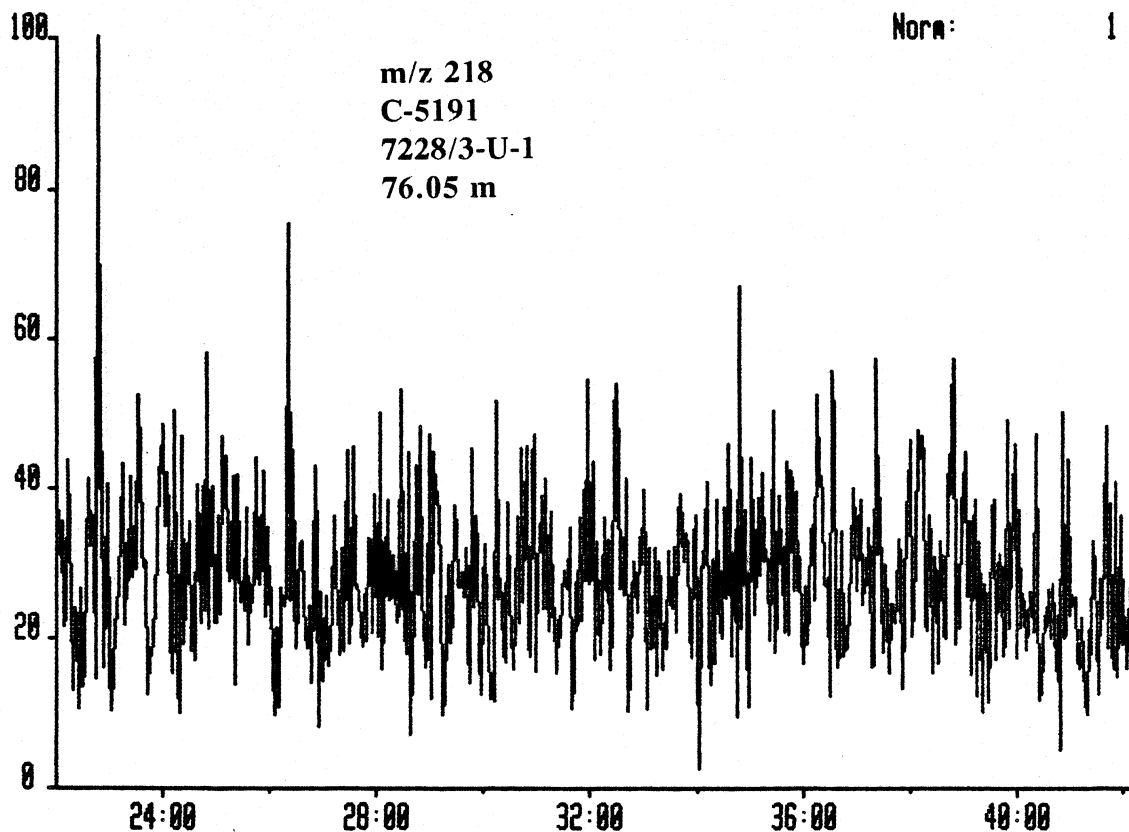


Figure A.II.1.6: VITRINITE REFLECTANCE HISTOGRAMS

Key: A = Grey-black-brown claystone.
 Upper case letters indicate values included in
 the main population. Lower case letters represent
 values in other populations.

 PP = Statistical data populations
 Y = Main population, not necessarily
 representative of sample maturity.
 N = Other populations.

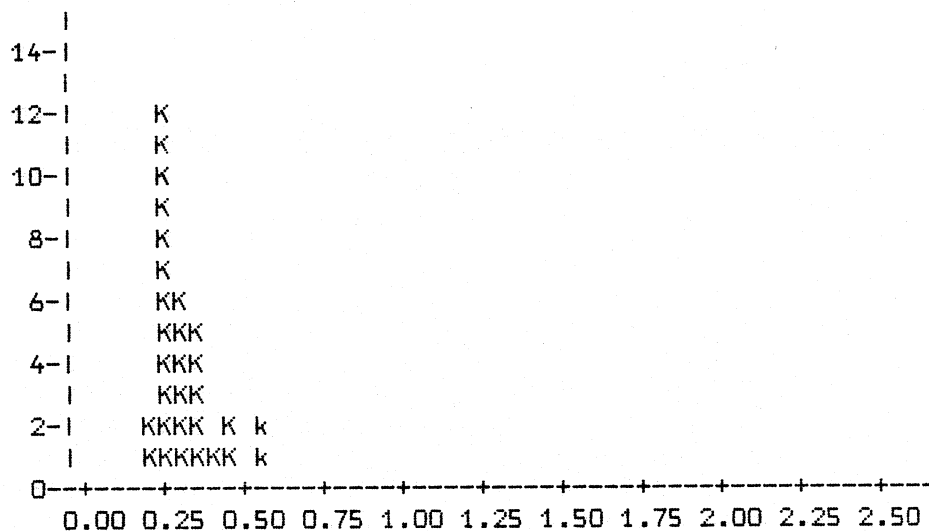
 LOW+ HIGH = Population limits.

 VAL. = Number of measurements in that
 population.

Lithology cross-reference table

A = Clst. gy
 B = Clst. dk gy
 C = Clst. gn
 D = Clst. bn
 E = Clst. rd
 F = Clst. calc.
 G = Clst. carb.
 H = Shale
 I = Sandstone
 J = Limestone
 K = Coal
 L = Lignite
 M = Carbargillite
 N = Siltstone
 O = Bit
 P = X

IKU# C-5662 51.6M 7228/3-U-1

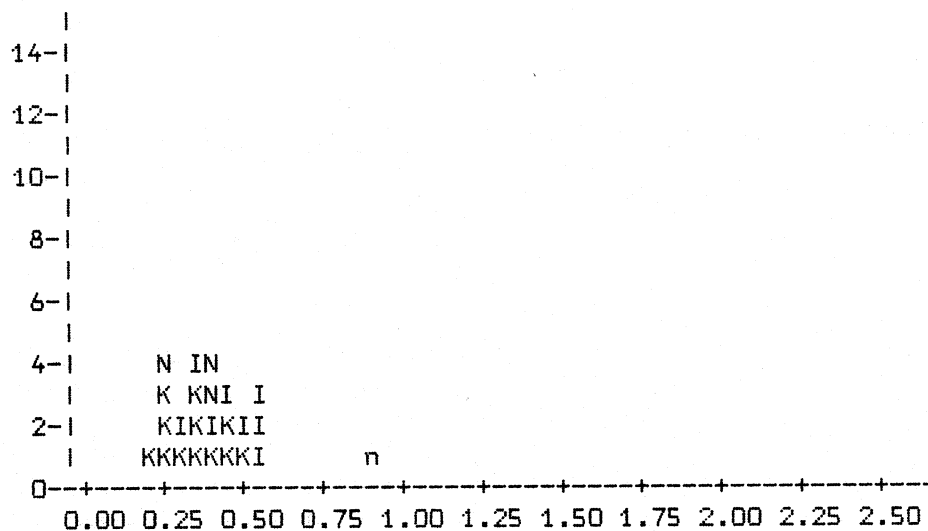


	PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.21	0.48	ALL	28	0.31	0.06	
N	0.56	0.58	ALL	2	0.56	0.01	
			OVERALL	30	0.33	0.09	

ORDERED VALUES FOLLOW:

0.21K	0.23K	0.25K	0.25K	0.26K	0.27K	0.27K	0.28K	0.28K	0.28K	0.28K
0.29K	0.29K	0.29K	0.30K	0.31K	0.32K	0.32K	0.33K	0.33K	0.35K	0.35K
0.36K	0.37K	0.39K	0.40K	0.47K	0.47K	0.56k	0.57k			

IKU# C-5674 74.8M 7228/3-U-1

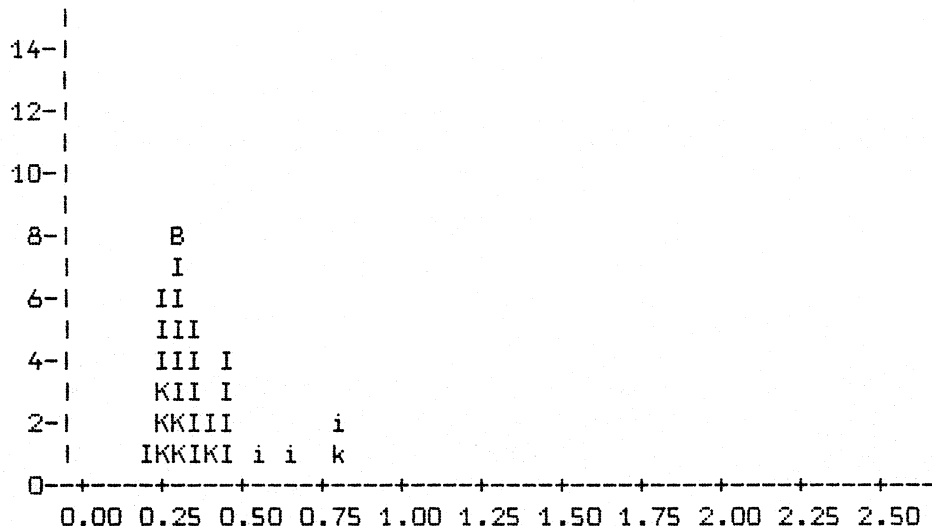


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.23	0.60	ALL	23	0.40	0.11
N	0.90	0.91	ALL	1	0.90	0.00
OVERALL				24	0.42	0.15

ORDERED VALUES FOLLOW:

0.23K	0.25K	0.25K	0.28N	0.29K	0.30K	0.31I	0.35K	0.36I	0.38K	0.39K
0.42K	0.43N	0.44N	0.44I	0.45I	0.47K	0.49K	0.51K	0.51I	0.57I	0.58I
0.59I	0.90n									

IKU# C-5194 82.3M 7228/3-U-1



PP LOW HIGH LIT #VAL MEAN STDV
 Y 0.24 0.50 ALL 26 0.35 0.08
 N 0.55 0.85 ALL 4 0.71 0.13
 OVERALL 30 0.39 0.15

ORDERED VALUES FOLLOW:

0.24I 0.25K 0.26I 0.26K 0.26K 0.27I 0.28I 0.31I 0.31I 0.32B 0.33I
 0.33I 0.33K 0.34I 0.34K 0.35I 0.35I 0.36I 0.36I 0.39I 0.43I 0.43K
 0.46I 0.47I 0.49I 0.49I 0.55i 0.65i 0.80k 0.84i

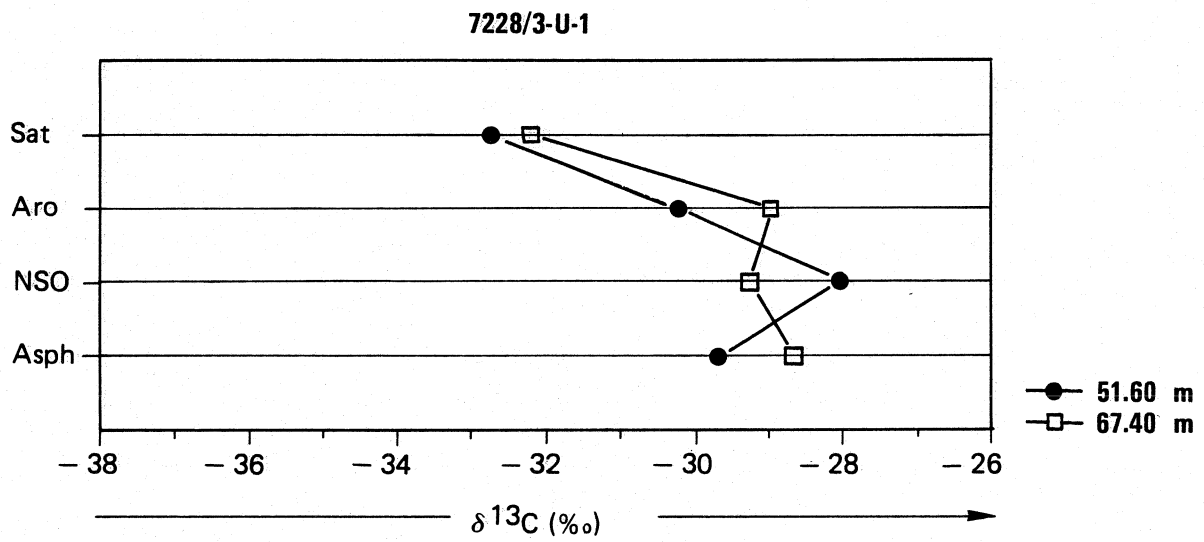


Figure A.II.1.7: $\delta^{13}\text{C}$ isotope profile for extract fractions.

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Core 7227/8-U-1:

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- Table A.II.2.1b: Concentration of C_1-C_5 + hydrocarbons in occluded gas.
- Table A.II.2.1c: Concentration of C_1-C_5 + hydrocarbons - summation.
- Table A.II.2.2: Total organic carbon and data from Rock-Eval pyrolysis.
- Table A.II.2.3: Data from pyrolysis-gas chromatograms.
- Table A.II.2.4: Vitrinite reflectance data.
- Table A.II.2.5: Weight of EOM and chromatographic fractions.
- Table A.II.2.6: Concentration of EOM and chromatographic fractions, related to rock weight.
- Table A.II.2.7: Concentration of EOM and chromatographic fractions, related to TOC weight.
- Table A.II.2.8: Composition of material extracted from the rock.
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- Table A.II.2.10: Molecular ratios from sterane and terpane mass chromatograms. Maturity and source characteristic ratios.
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- Figure A.II.2.2: Saturated hydrocarbon gas chromatograms.
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- Figure A.II.2.4: Mass chromatograms of m/z 191 (terpanes).
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- Figure A.II.2.6: Vitrinite reflectance histograms.
- Figure A.II.2.7: $\delta^{13}C$ isotope profile for extract fractions.

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Well ident.: 7227/8-U-1
DATE : 2 - 12 - 86.

Table A.II.2.1a:

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

[illegible]

Table A.II.2.1b:

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

I									SUM	SUM	WET-	i04	I
I	IKU	DEPTH	C1	C2	C3	i04	n04	C5+	C1-C4	C2-C4	NESS	-----	I
I	no.	m									(%)	nC4	I
I													I
I	C 5130	38.17	1624	121	73	24	18		1860	236	12.71	1.28	I
I	C 5131	40.71	319	24	29				372	53	14.37	*****	I
I	C 5132	43.44	600	35	34			25	669	69	10.30	*****	I
I	C 5133	47.81	519	44	63				626	107	17.05	*****	I
I	C 5134	50.66	725	54	68				847	122	14.38	*****	I
I	C 5135	53.40	965	73	79				1116	151	13.55	*****	I
I	C 5136	57.95	201	24	33		14		272	71	25.94	0.00	I

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Table A.II.2.1c:

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

I	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 ----- nC4	I
I	no.	m											I
I	C 5130	38.17	1677	121	73	24	18		1913	236	12.36	1.28	I
I	C 5131	40.71	369	24	29				423	53	12.66	*****	I
I	C 5132	43.44	600	35	34			25	669	69	10.30	*****	I
I	C 5133	47.81	519	44	63				626	107	17.05	*****	I
I	C 5134	50.66	725	54	68				847	122	14.38	*****	I
I	C 5135	53.40	965	73	79				1116	151	13.55	*****	I
I	C 5136	57.95	201	24	33		14		272	71	25.94	0.00	I

7227/8-U-1

DATA FROM ROCK EVAL PYROLYSIS

[illegible]

Table A.II.2.2 cont.

7227/8-U-1

DATA FROM ROCK EVAL PYROLYSIS

[illegible]

***** = not determinable

() = value questionable due to low TOC or S2

Table A.II.2.3: Data from pyrolysis-gas chromatograms.

Core 7227/8-U-1

Sample Nr.	Depth (m)	I I	TOC (%)	I I	C1 -	C2-C5 -	C6-C14 (a r e a %)	C15+ -	I I	(m+p)-xylene/ n-octene (pkht/pkht)
C-5217	33.97	I	1.91	I	9.04	15.35	43.12	31.73	I	1.59
C-5222	38.14	I	1.83	I	19.05	34.72	42.68	3.54	I	2.00
C-5223	38.55	I	2.24	I	8.35	9.99	50.14	31.44	I	3.38
C-5234	50.63	I	1.23	I	4.83	10.20	64.02	20.93	I	0.58

Table A.II.2.4:

 Well Identification: 7227/8-U-1
 Reference number: 21.3419.15
 (1/1)

VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
C 5222	----	38.1	0.28 (20) 0.51 (1)	G R	0.09 0.00	2-3,4-5
C 5231	----	46.7	0.34 (20) 0.75 (3) 1.27 (1)	G R R	0.05 0.16 0.00	3-4,5

 REL RAT (Reliability Rating): G = Good; F = Fair; P = Poor
 S = Stained; R = Reworked.

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 Well ident.: 7227/8-U-1
 DATE : 6 - 1 - 87.

Table A.II.2.5:

WEIGHT 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 5215	32.72	25.0	9.0	2.0	1.4	3.5	5.5	0.42
C 5217	33.97	9.8	20.6	0.4	1.9	2.3	18.3	0.97
C 5222	38.14	11.1	70.4	1.0	4.3	5.3	65.1	5.43
C 5223	38.55	15.2	53.8	1.1	5.0	6.1	47.7	2.78
C 5228	43.58	12.8	8.9	1.1	0.6	1.7	7.2	1.10

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Table A.II.2.6:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5215	32.72	:	360	82	58	139	221	I
I	C 5217	33.97	:	2108	37	197	233	1875	I
I	C 5222	38.14	:	6337	86	389	475	5861	I
I	C 5223	38.55	:	3537	71	331	402	3135	I
I	C 5228	43.58	:	696	84	47	131	565	I
I			:						I

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Table A.II.2.7:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5215	32.72	:	85.6	19.4	13.7	33.1	52.5	I
I			:						I
I	C 5217	33.97	:	217.4	3.8	20.3	24.1	193.3	I
I			:						I
I	C 5222	38.14	:	116.7	1.6	7.2	8.8	107.9	I
I			:						I
I	C 5223	38.55	:	127.2	2.6	11.9	14.5	112.8	I
I			:						I
I	C 5228	43.58	:	63.3	7.7	4.3	11.9	51.3	I
I			:						I

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DATE : 6 - 1 - 87.

Table A.II.2.8:

COMPOSITION OF MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH	Sat	Aro	HC	SAT	Non HC	HC
(m)		EOM	EOM	EOM	Aro	EOM	Non HC
		%	%	%	x 100	%	x 100
C 5215	32.72	22.7	16.0	38.7	141.7	61.3	63.0
C 5217	33.97	1.7	9.3	11.1	18.8	88.9	12.4
C 5222	38.14	1.4	6.1	7.5	22.2	92.5	8.1
C 5223	38.55	2.0	9.4	11.4	21.4	88.6	12.8
C 5228	43.58	12.1	6.7	18.9	180.0	81.1	23.3

Table A.II.2.9:

TABULATION OF DATA FROM THE GAS CHROMATOGRAMS

7227/8-U-1

I	DEPTH :	PRISTANE	PRISTANE	PHYTANE	A	n-C17			I
I	IKU No.	:	A =	B =				CPI	I
I	(m)	:	PHYTANE	n-C17	n-C18	B	n-C27		I
I		:							I
I		:							I
I	C 5215	32.72 :	1.3	2.0	1.0	1.9	0.7	1.2	I
I		:							I
I	C 5217	33.97 :	1.2	1.3	0.9	1.5	1.4	1.1	I
I		:							I
I	C 5222	38.14 :	1.4	2.2	1.4	1.6	0.8	1.2	I
I		:							I
I	C 5223	38.55 :	1.2	1.9	0.8	2.2	0.6	1.0	I
I		:							I
I	C 5228	43.58 :	1.7	1.0	0.6	1.8	2.0	1.0	I
I		:							I

Corrected replacement of

Table A.II.2.10: Molecular ratios from sterane and terpane mass chromatograms. Maturity and source characteristic ratios.

7227/8-U-1							
IKU-NR.	depth (m)	ab/(ab+ba)	%22S	%20S	%bb	Tm/Ts	C27 rearr. ster.
		hop.	ext. hop	ster.	ster.		
		1)	2)	3)	4)		
		----- maturity-dependent ----- ----- parameters -----					
C5222	38.14	0.86	56.56	13.92	61.46	18.52	25.00
C5228	43.58	0.77	42.99	--	--	8.98	--

- 1) $E / (E+F)$ in m/z 191
- 2) $100 * G / (G+H)$ in m/z 191
- 3) $100 * q / (q+t)$ in m/z 217
- 4) $100 * (r+s) / (q+r+s+t)$ in m/z 217
- 5) B / A in m/z 191
- 6) $100 * a / (a+j)$ in m/z 217

Table A.II.2.11:

a)

7227/8-U-1

Gas yields of the hydrocarbons C1-C7 of adsorbed gas of core samples (ug/kg rock)

IKU No.	Depth (m)	C1	C2	C3	iC4	nC4	2,2-DMC3	C5+
C5135	53.40	17.6	2.4	.	.	.	.	.

. = value missing, undefined, or below detection limit

b)

7227/8-U-1

Gas ratios (v/v) and isotope ratios of the hydrocarbons C1 to C7 of adsorbed gas of core samples.

IKU No.	Depth (m)	C1/ (C2+C3)	100*C1/ (C1+C2 +C3+iC4 +nC4)	100* (iC4/nC4)	d13C1 (0/00 PDB)	d13C2 (0/00 PDB)	dD C1 (0/00 SMOW)
C5135	53.40	13.88	88.00	.	-32.7	.	.

. = value missing, undefined, or below detection limit

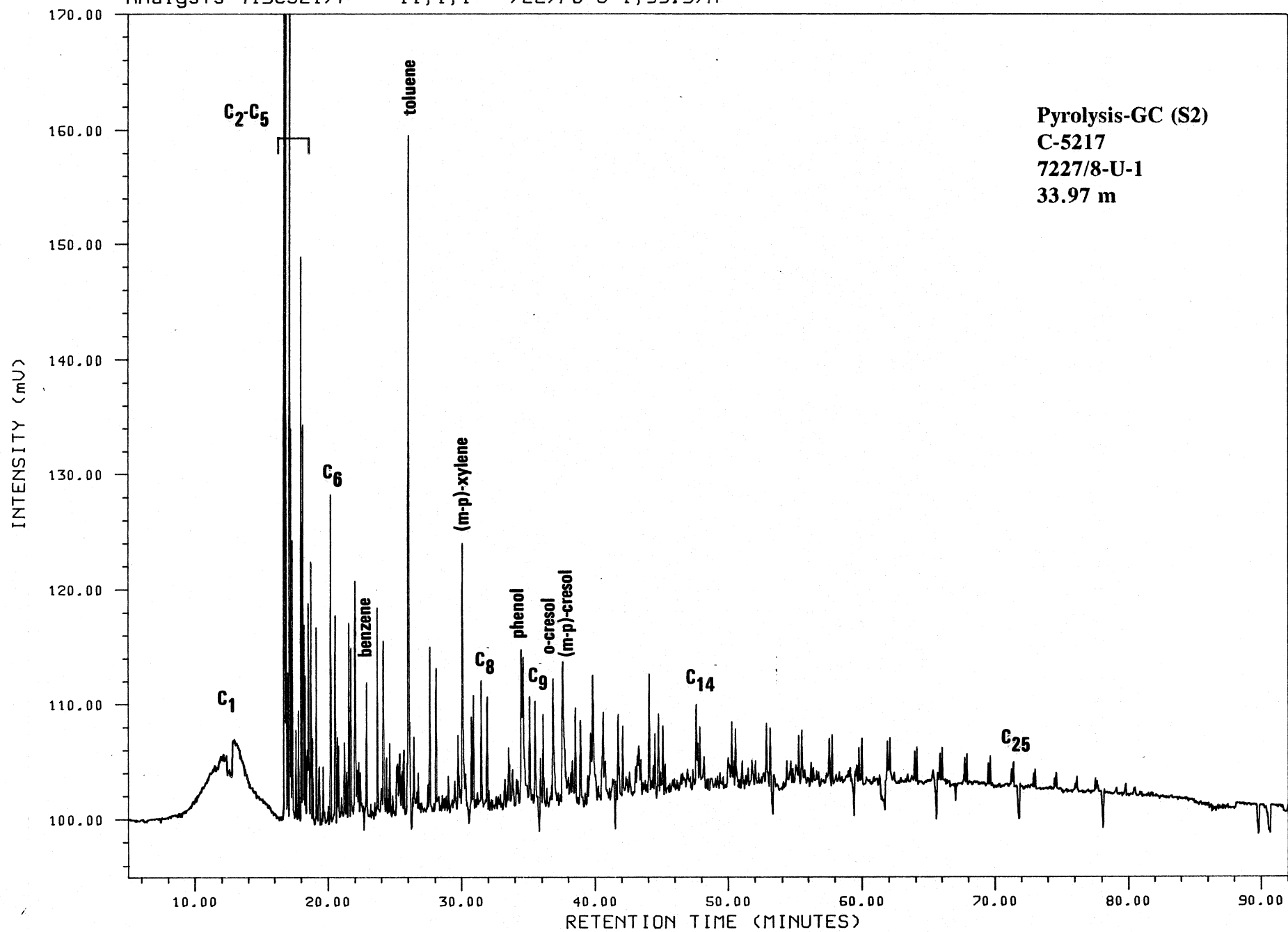
Table A.II.2.12: $\delta^{13}\text{C}$ isotope ratios for extract fractions.

7227/8-U-1

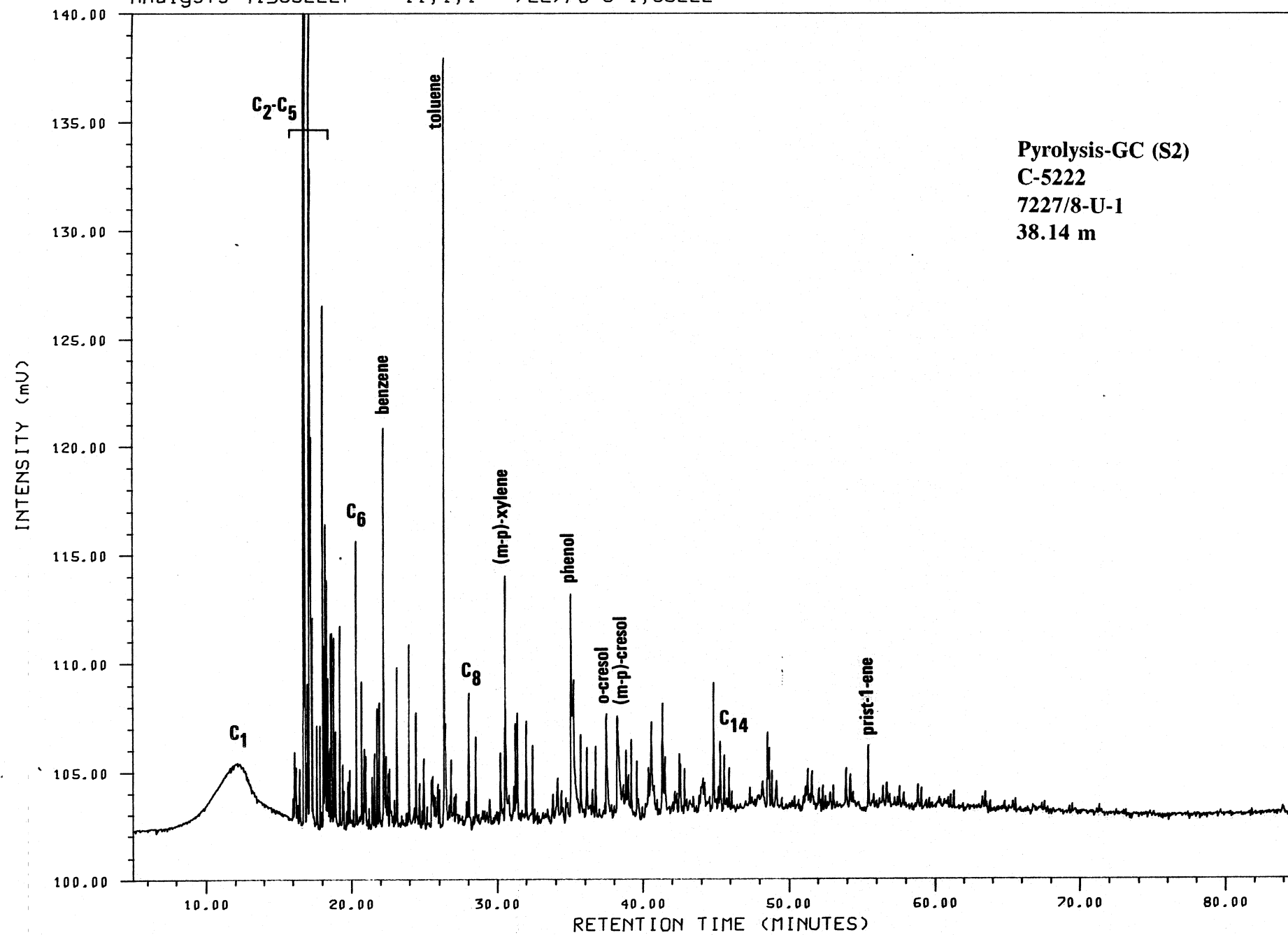
=====					
Sample	Depth (m)	delta 13 C			
		SAT	ARO	NSO	ASPH
=====					
C5222	38.14	-29.01	-26.57	---	-26.91
C5228	43.58	---	---	-27.66	---
=====					

Figure A.II.2.1: Pyrolysis-gas chromatograms (S2 peak).

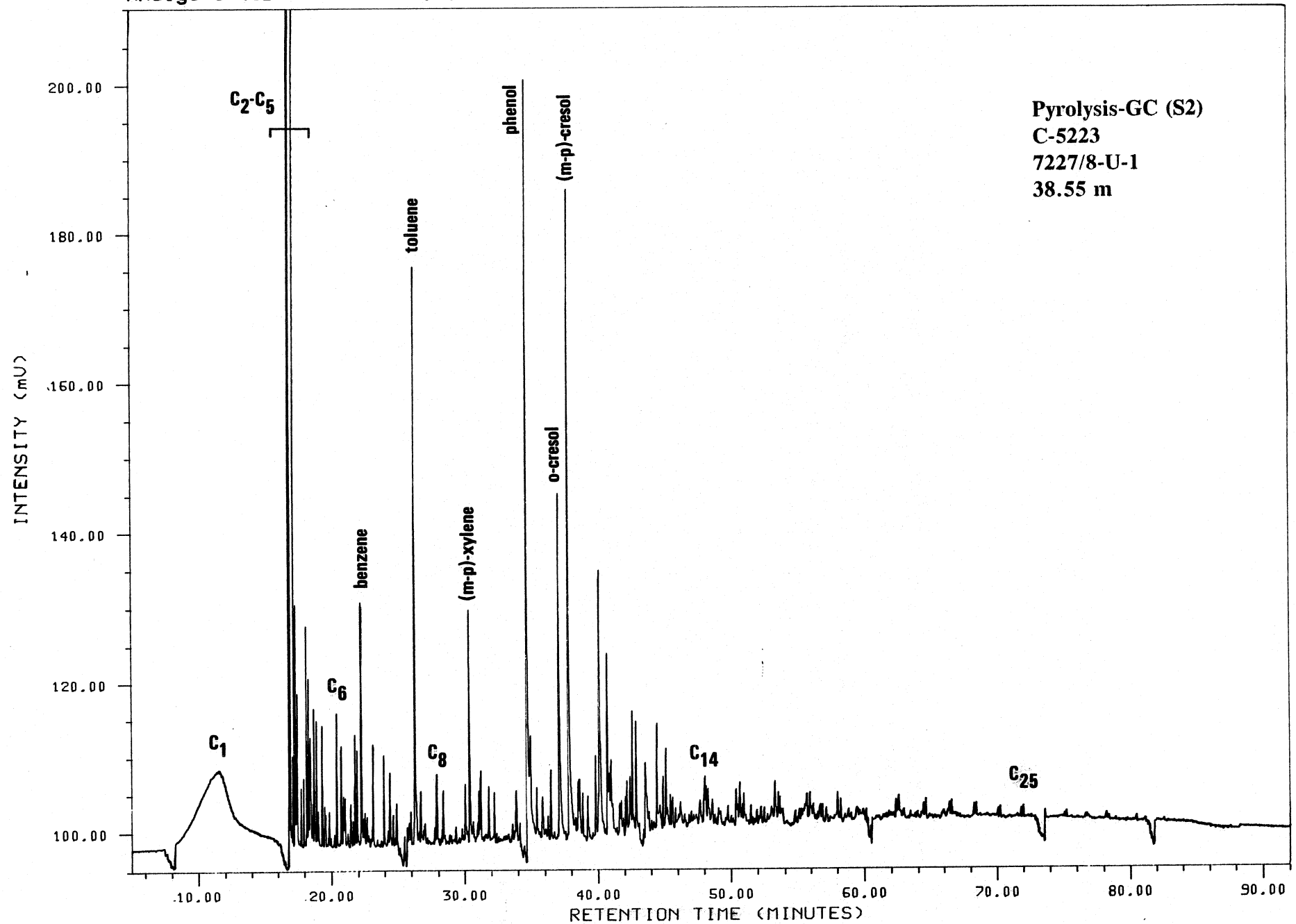
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Analysis 419C5222P 11,1,1 7227/8-U-1,C5222



Analysis 419C5223P 11,1,1 7227/8-U-1,38.55M



Analysis 419C5234P 11,1,1 7227/8-U-1,50.63M

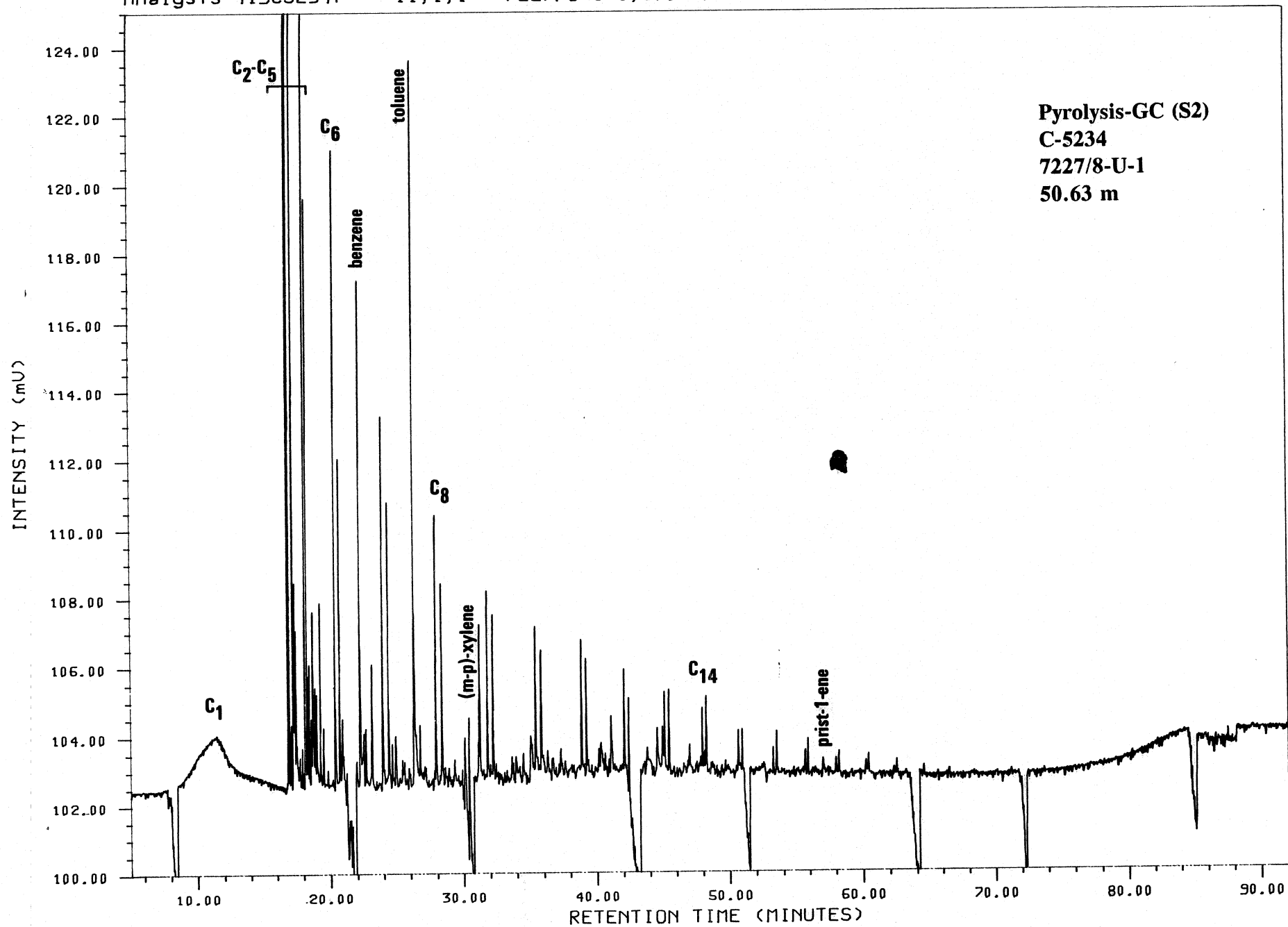


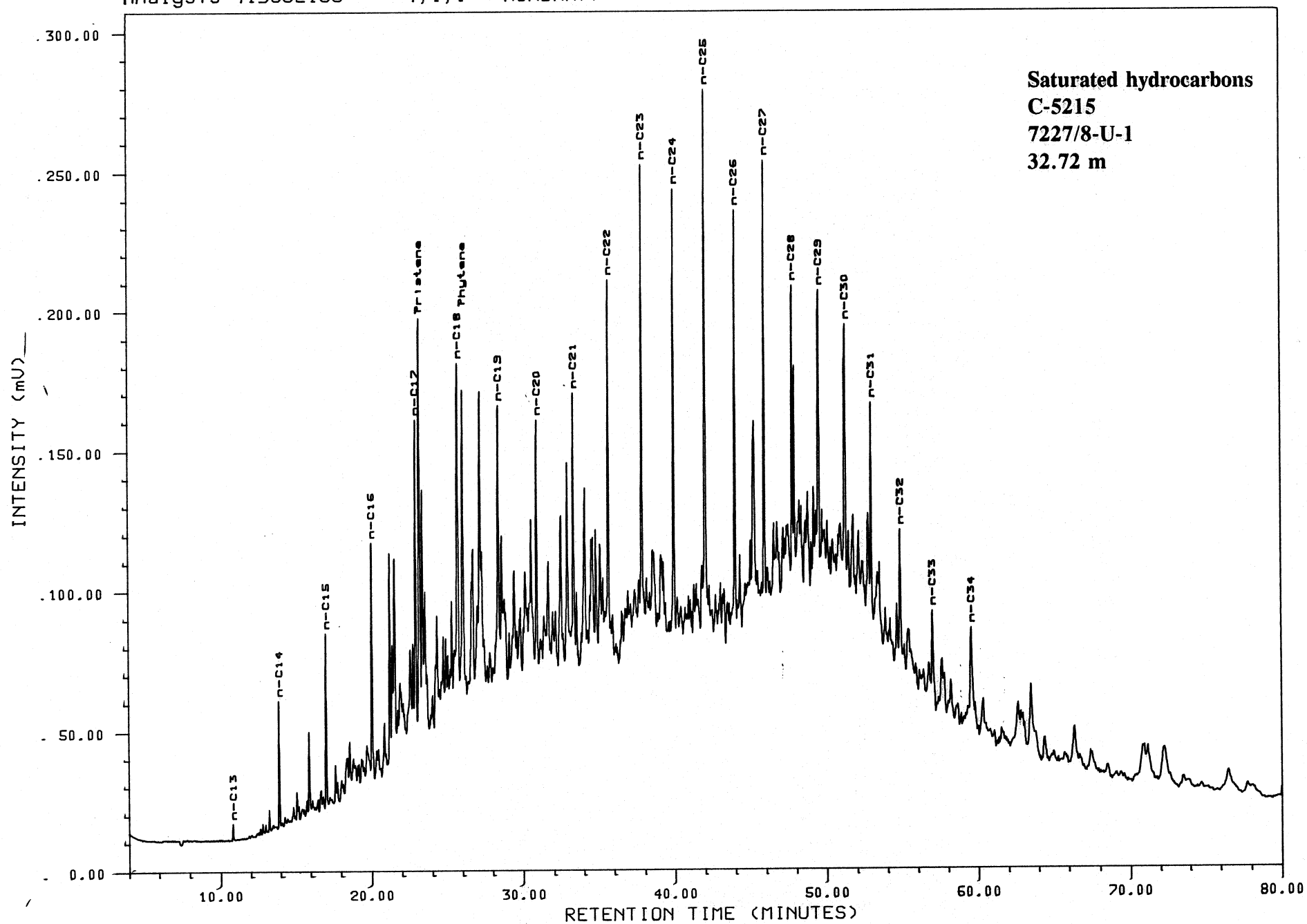
Figure A.II.2.2: Saturated hydrocarbon gas chromatograms.

n-C ₁₅ etc.	- n-alkanes
Pr	- pristane
Ph	- phytane
*	- other acyclic isoprenoids

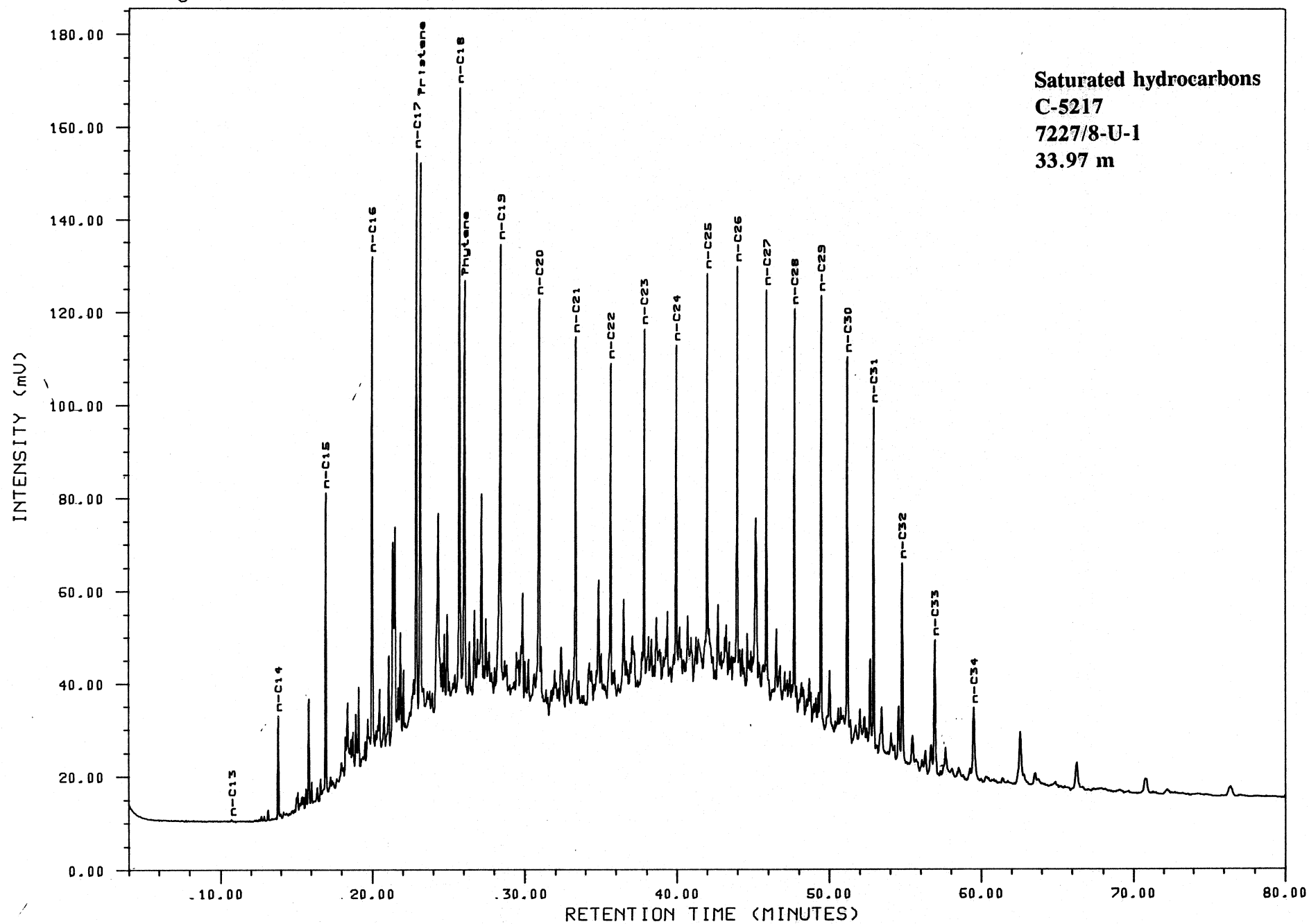
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4,1,1

NORDKAPP



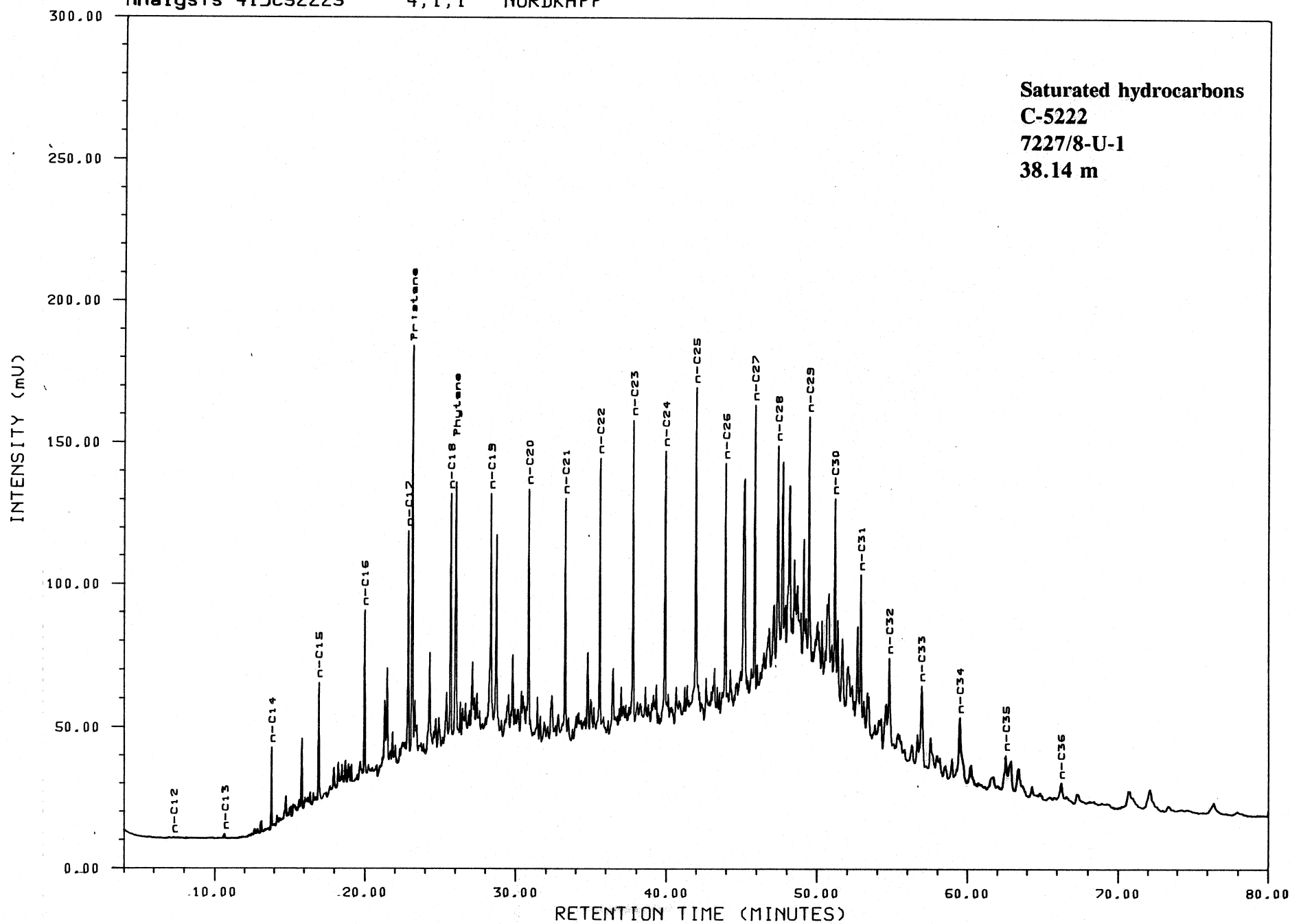
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Analysis 419C5222S

4,1,1

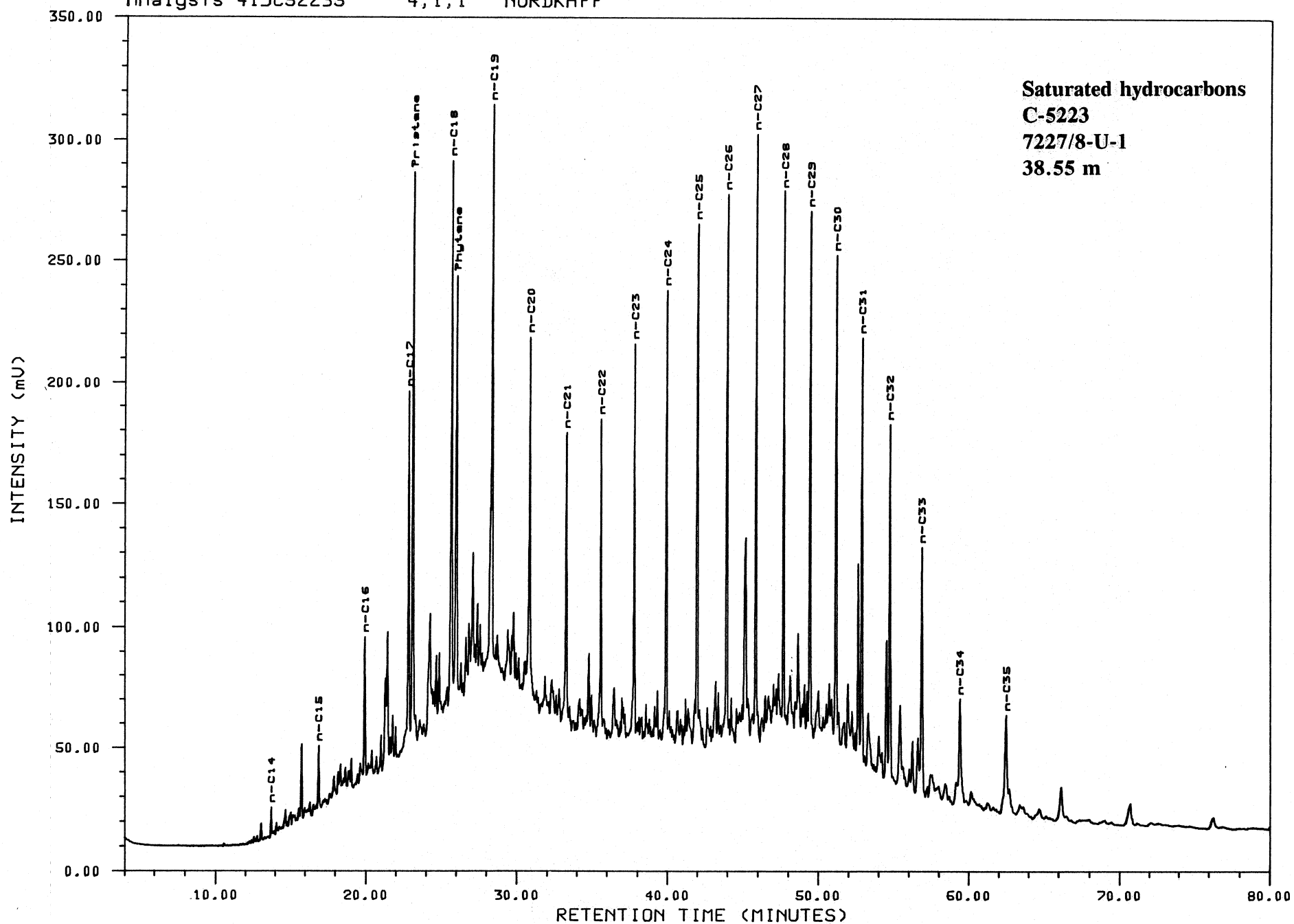
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Analysis 419C5223S

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NORDKAPP



Analysis 419C5228S

4,1,1

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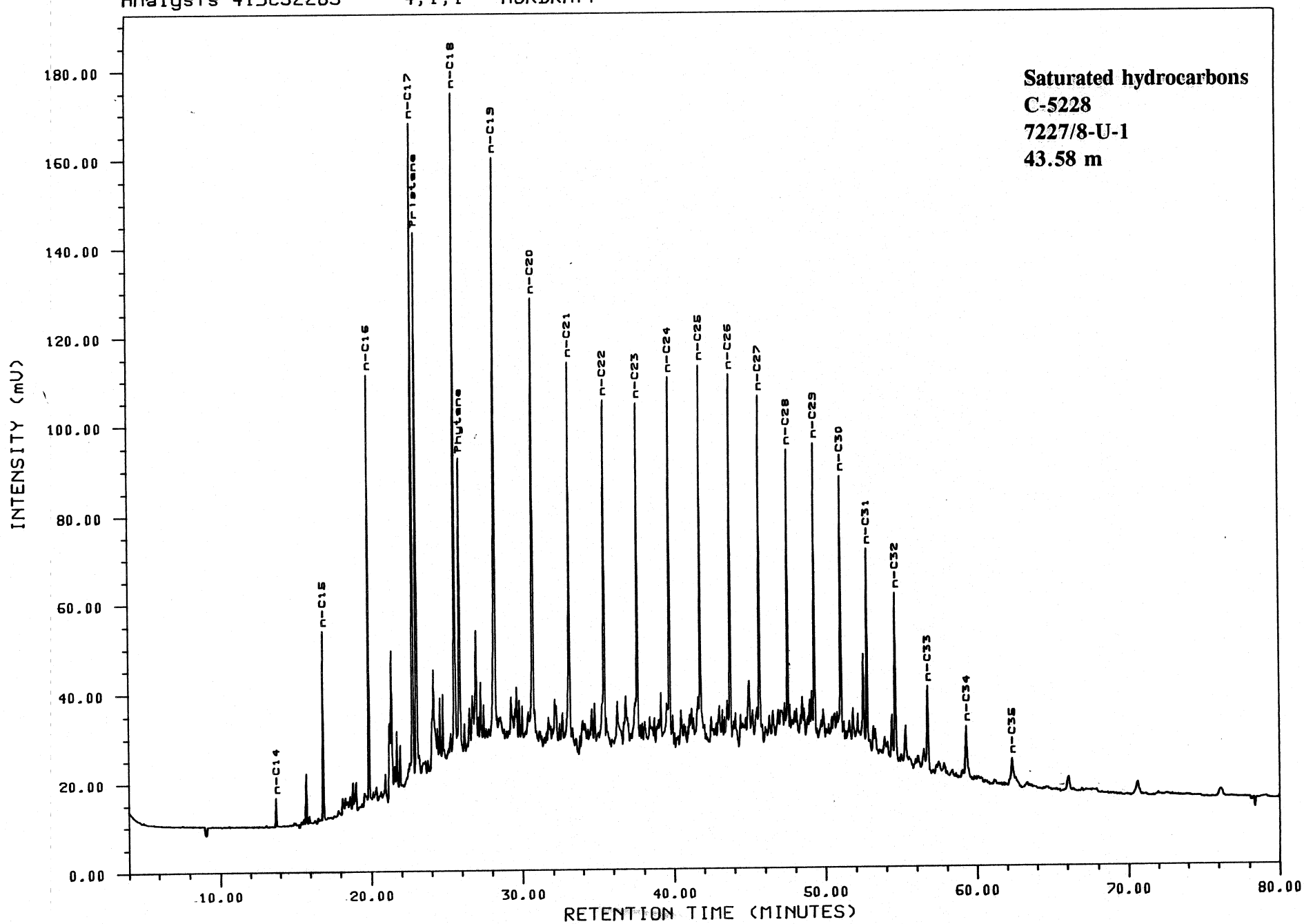


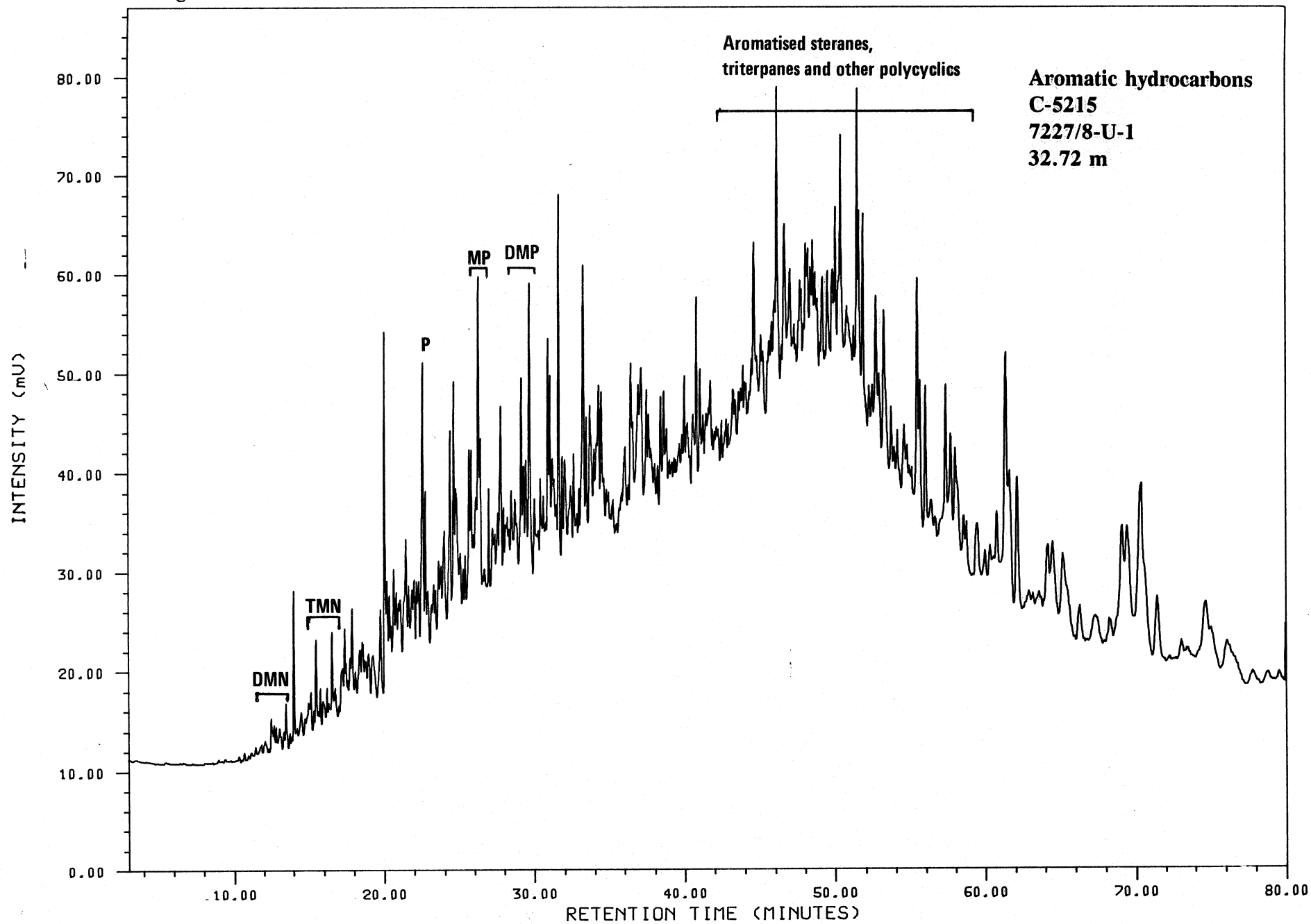
Figure A.II.2.3: Aromatic hydrocarbon gas chromatograms.

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

Analysis 419C5215A

2,1,1

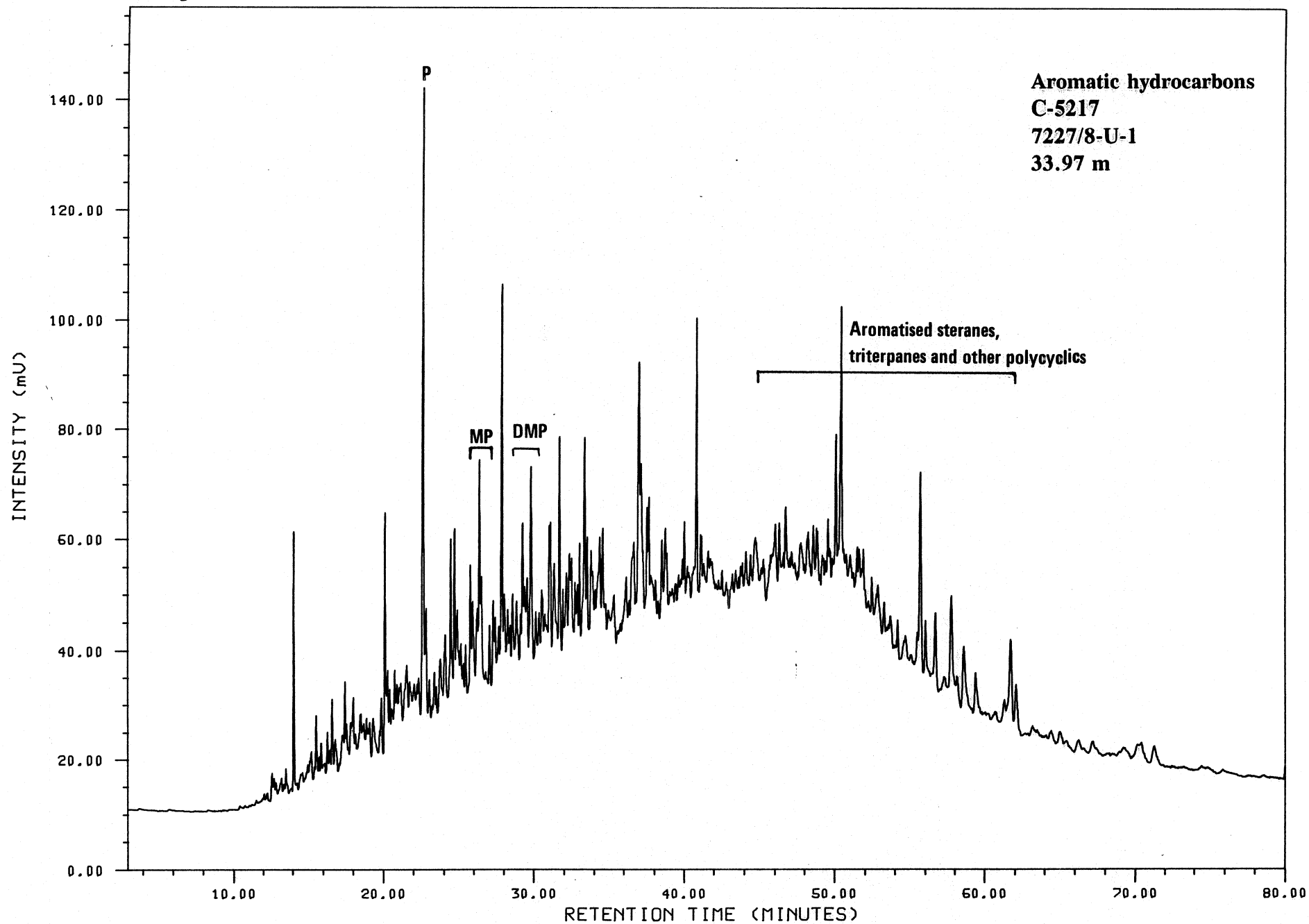
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Analysis 419C5217A

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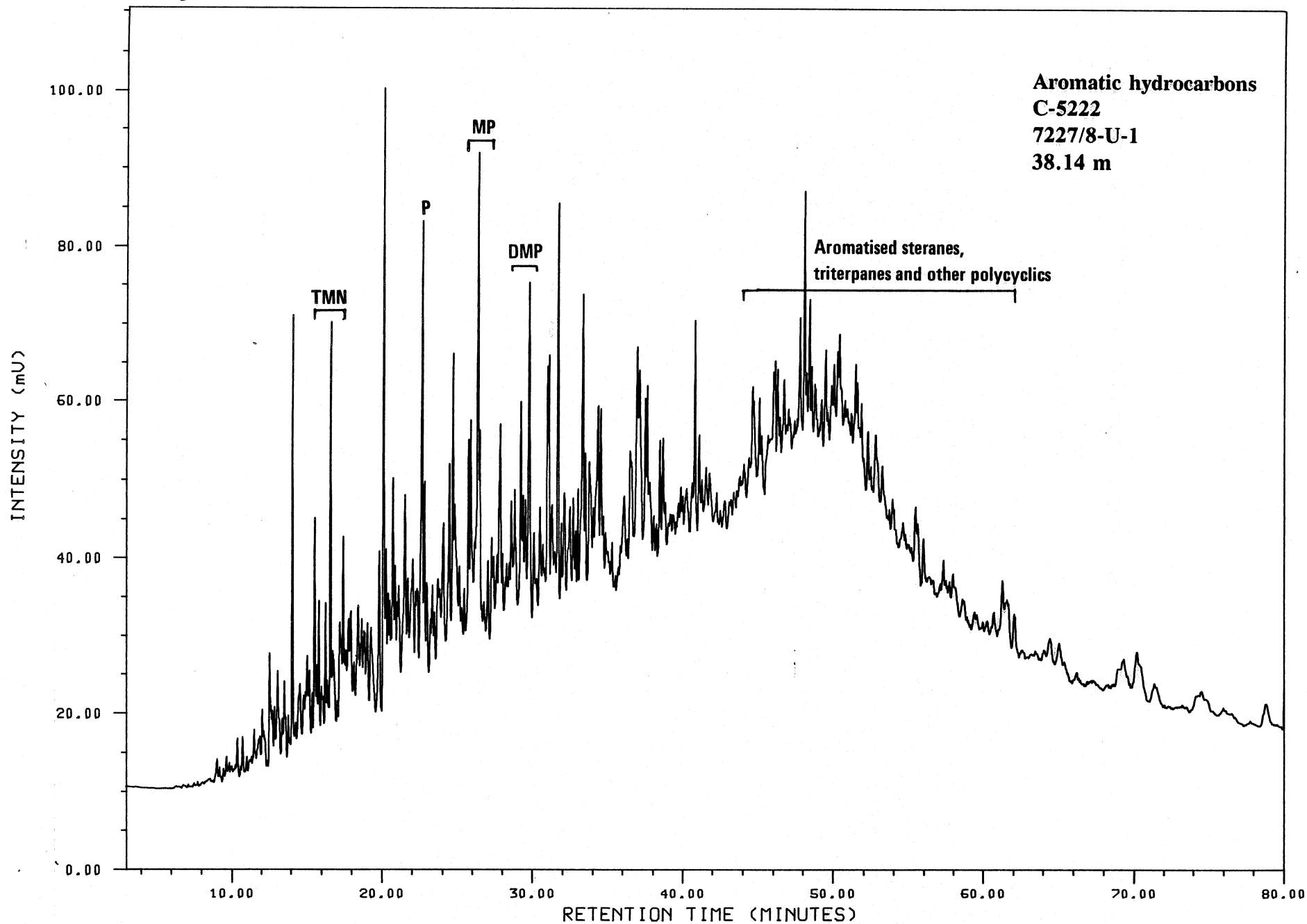
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Analysis 419C5222A

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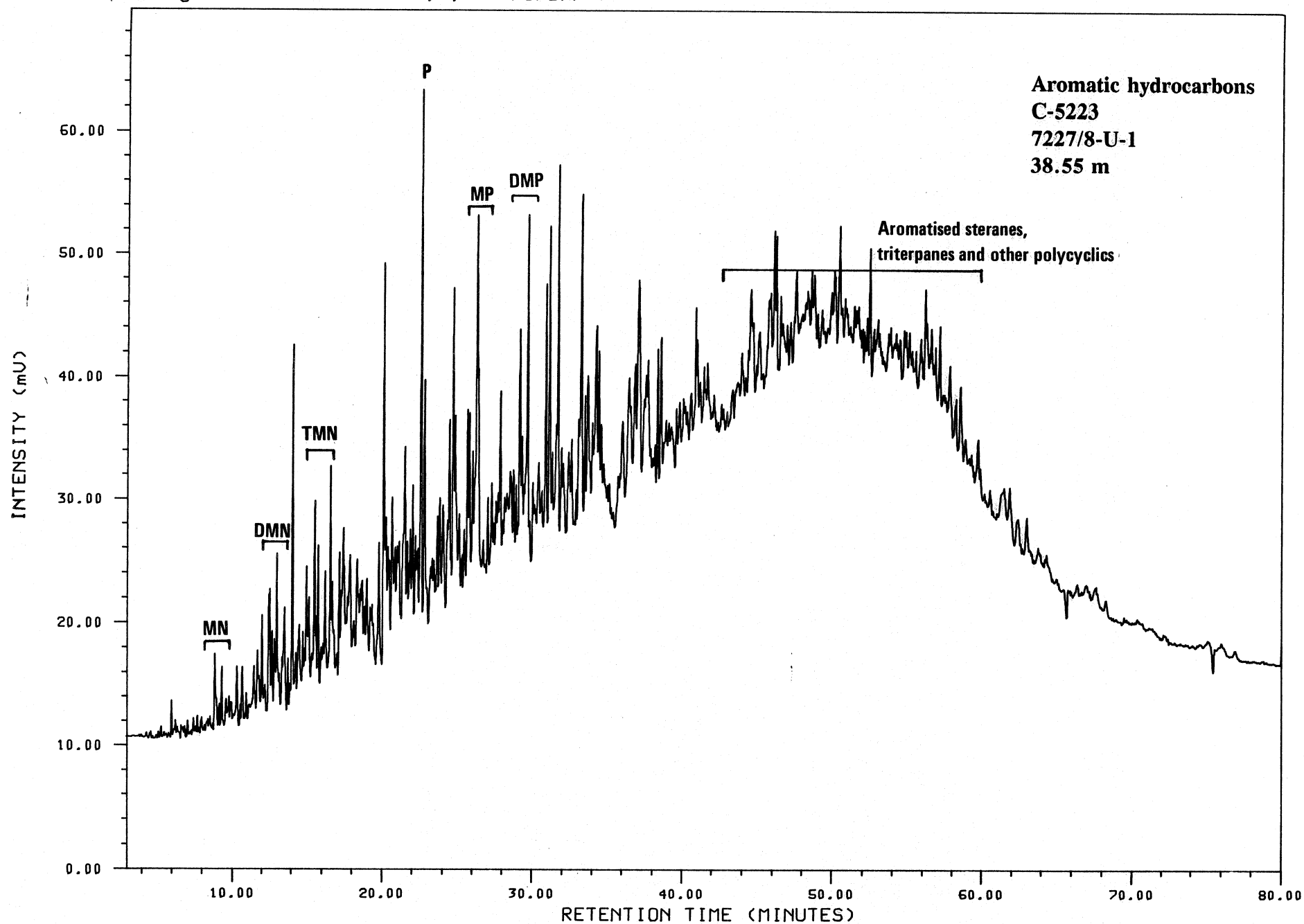
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Analysis 419C5223A

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Analysis 419C5228A

2,1,1

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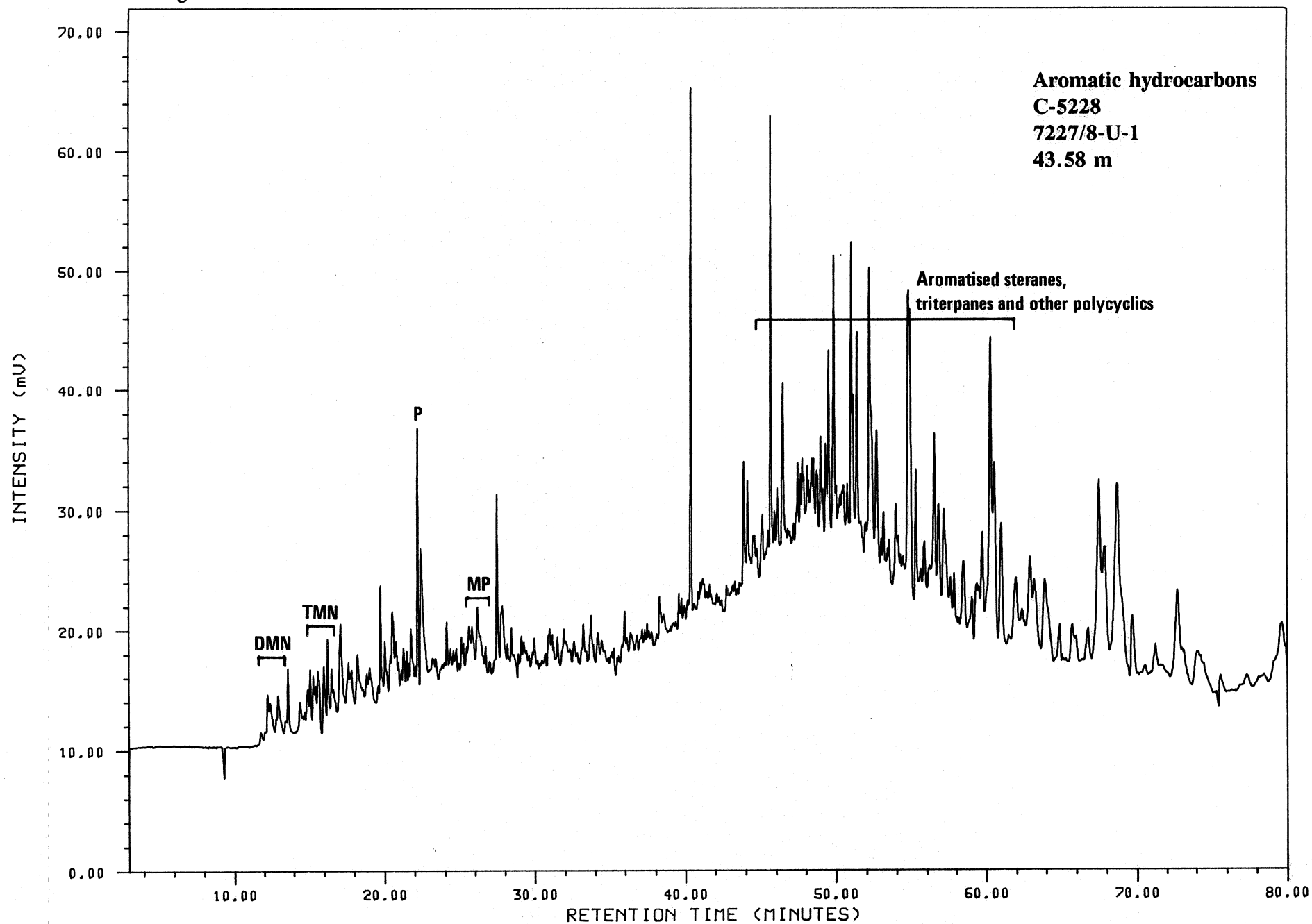
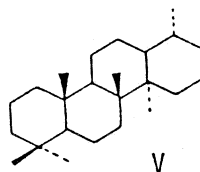
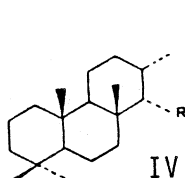
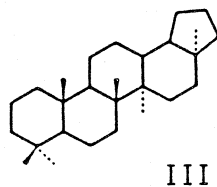
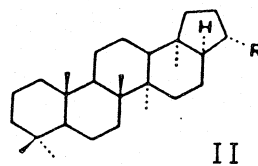
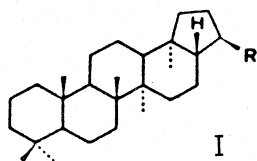


Figure A.II.2.4:

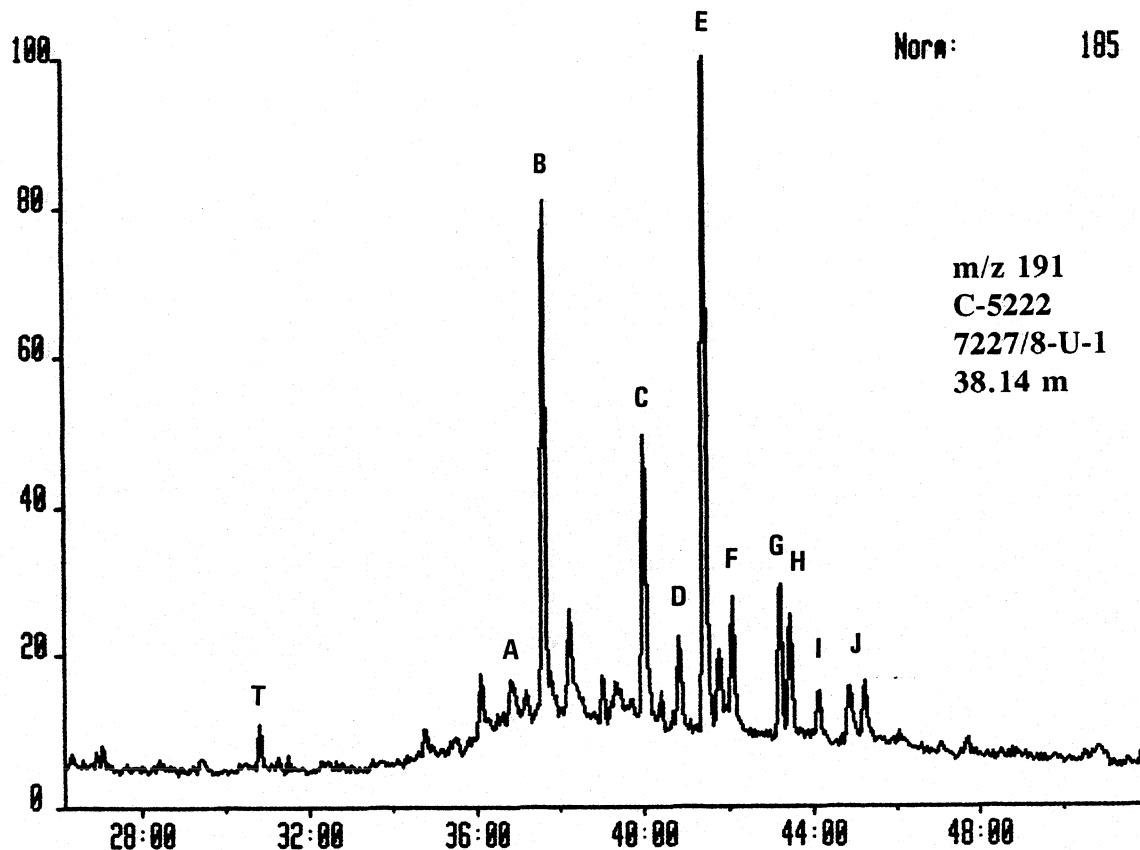
Mass chromatograms of terpanes (m/z 191) for expelled pyrolysates.

A	T_s , 18 α (H)-trisorneohopane	$C_{27}H_{46}$	(III)
B	T_m , 17 α (H)-trisnorhopane	$C_{27}H_{46}$	(I, R=H)
C	17 α (H)-norhopane	$C_{29}H_{50}$	(I, R= C_2H_5)
D	17 β (H)-normoretane	$C_{29}H_{50}$	(II, R= C_2H_5)
E	17 α (H)-hopane	$C_{30}H_{52}$	(I, R= C_3H_7)
F	17 β (H)-moretane	$C_{30}H_{52}$	(II, R= C_3H_7)
G	17 α (H)-homohopane (22S)	$C_{31}H_{54}$	(I, R= C_4H_9)
H	17 α (H)-homohopane (22R)	$C_{31}H_{54}$	(I, R= C_4H_9)
	+ unknown triterpane (gammacerane?)		
I	17 β (H)-homomoretane	$C_{31}H_{54}$	(II, R= C_4H_9)
J	17 α (H)-bishomohopane (22S,22R)	$C_{32}H_{56}$	(I, R= C_5H_{11})
K	17 α (H)-trishomohopane (22S,22R)	$C_{33}H_{58}$	(I, R= C_6H_{13})
L	17 α (H)-tetrakishomohopane (22S,22R)	$C_{34}H_{60}$	(I, R= C_7H_{15})
M	17 α (H)-pentakishomohopane (22S,22R)	$C_{35}H_{62}$	(I, R= C_8H_{17})
Z	bisnorhopane	$C_{28}H_{48}$	
X	unknown triterpane	$C_{30}H_{52}$	
P	tricyclic terpene	$C_{23}H_{42}$	(IV, R= C_4H_9)
Q	tricyclic terpene	$C_{24}H_{44}$	(IV, R= C_5H_{11})
R	tricyclic terpene (17R,17S)	$C_{25}H_{46}$	(IV, R= C_6H_{13})
S	tetracyclic terpene	$C_{24}H_{42}$	(V)
T	tricyclic terpene (17R,17S)	$C_{26}H_{48}$	(IV, R= C_7H_{15})



C522SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:TRIT



C5228SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:TRIT

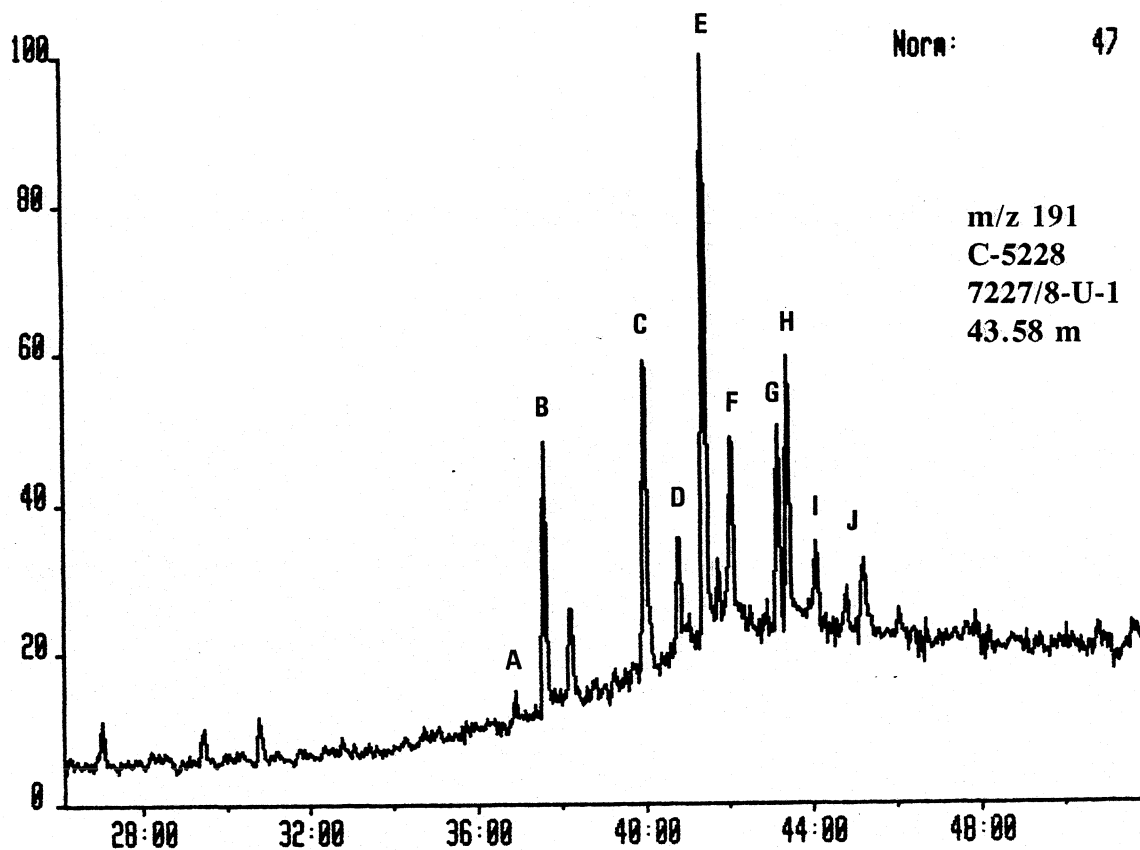
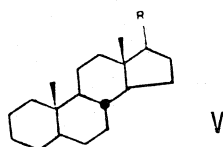
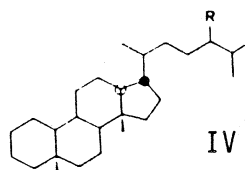
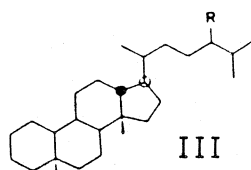
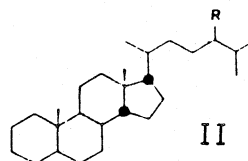
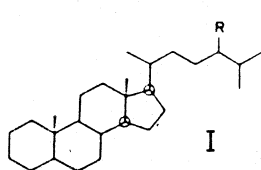


Figure A.II.2.5:

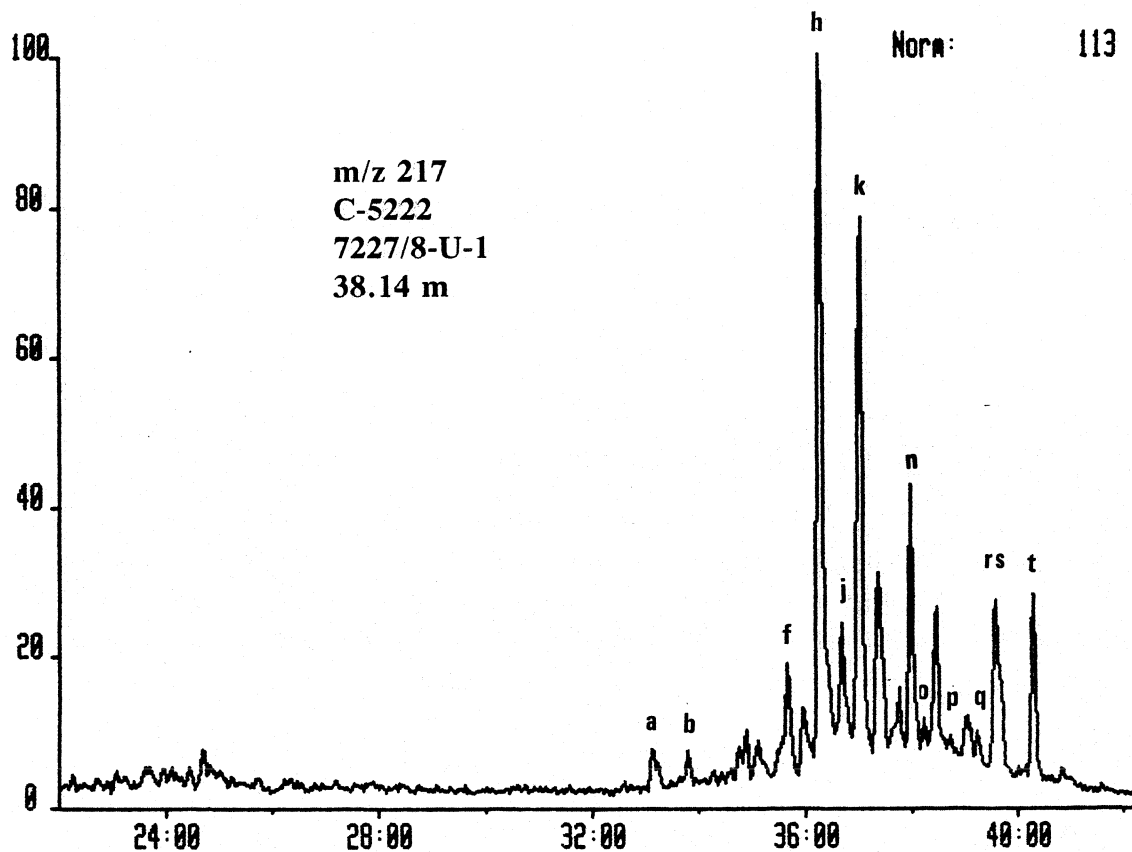
Mass chromatograms of steranes (m/z 217 and 218)
for expelled pyrolysates.

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 α (H),17 α (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)



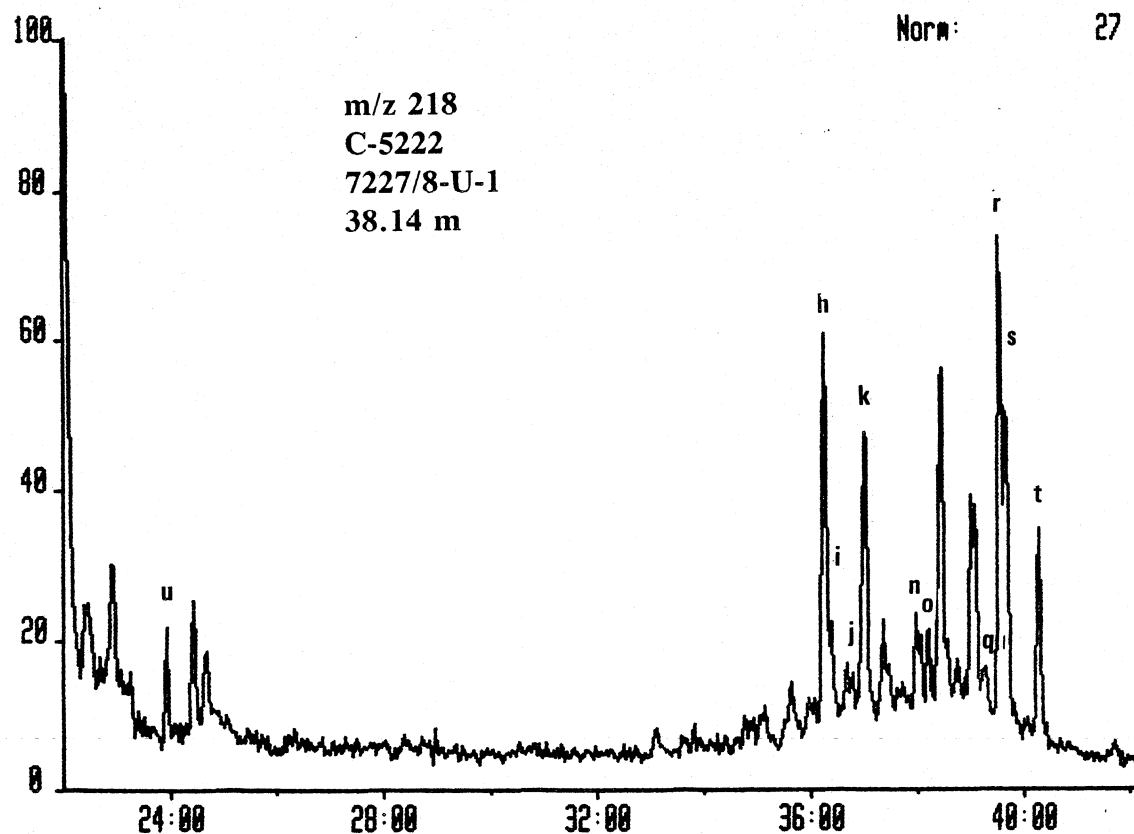
C5222SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



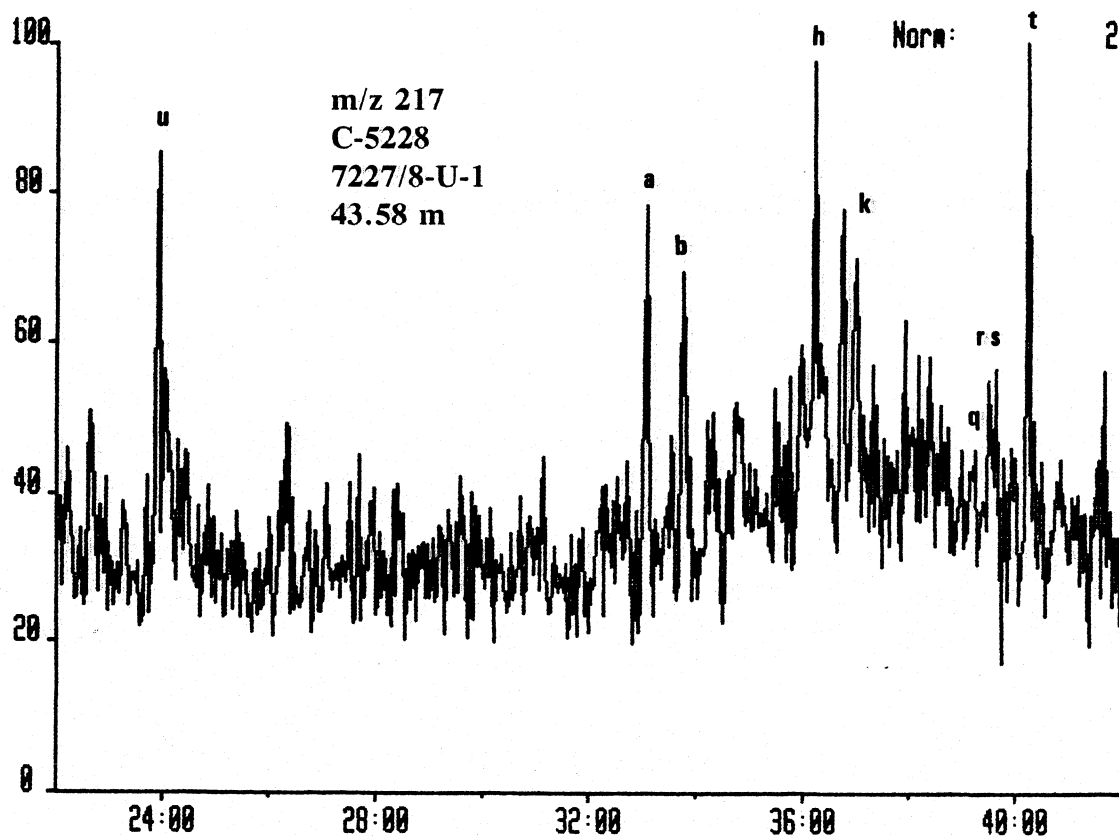
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Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT



C5220SAT 14-JAN-07 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



C5220SAT 14-JAN-07 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT

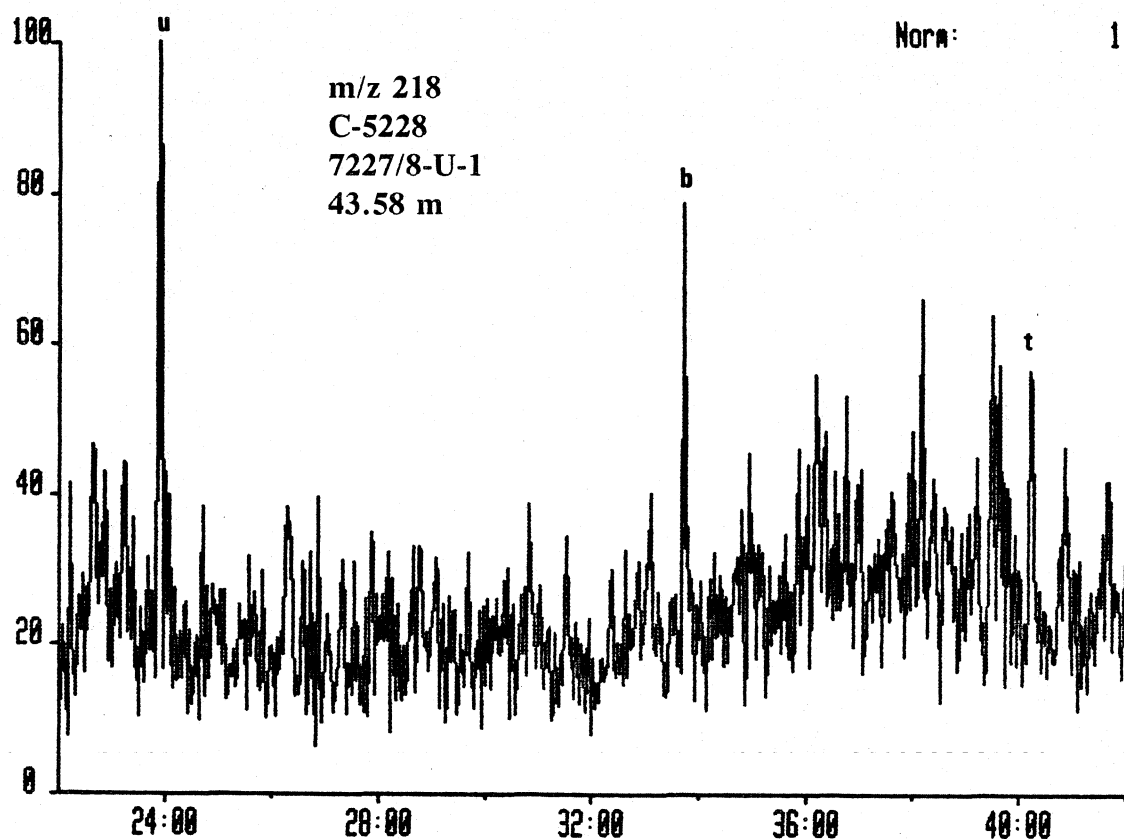


Figure A.II.2.6: VITRINITE REFLECTANCE HISTOGRAMS

Key: A = Grey-black-brown claystone.

Upper case letters indicate values included in the main population. Lower case letters represent values in other populations.

PP = Statistical data populations

Y = Main population, not necessarily representative of sample maturity.

N = Other populations.

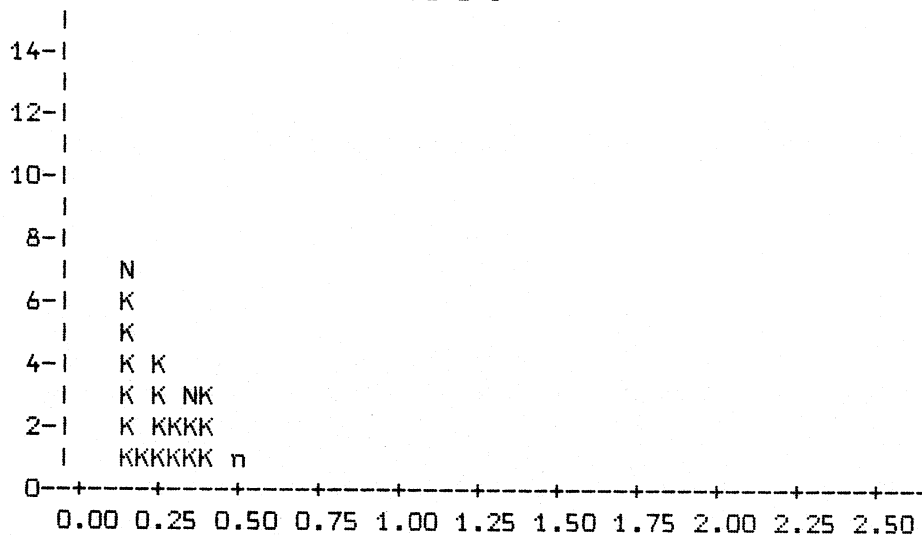
LOW+ HIGH = Population limits.

VAL. = Number of measurements in that population.

Lithology cross-reference table

A = Clst. gy
B = Clst. dk gy
C = Clst. gn
D = Clst. bn
E = Clst. rd
F = Clst. calc.
G = Clst. carb.
H = Shale
I = Sandstone
J = Limestone
K = Coal
L = Lignite
M = Carbargillite
N = Siltstone
O = Bit
P = X

IKU# C-5222 38.1M 7227/8-U-1

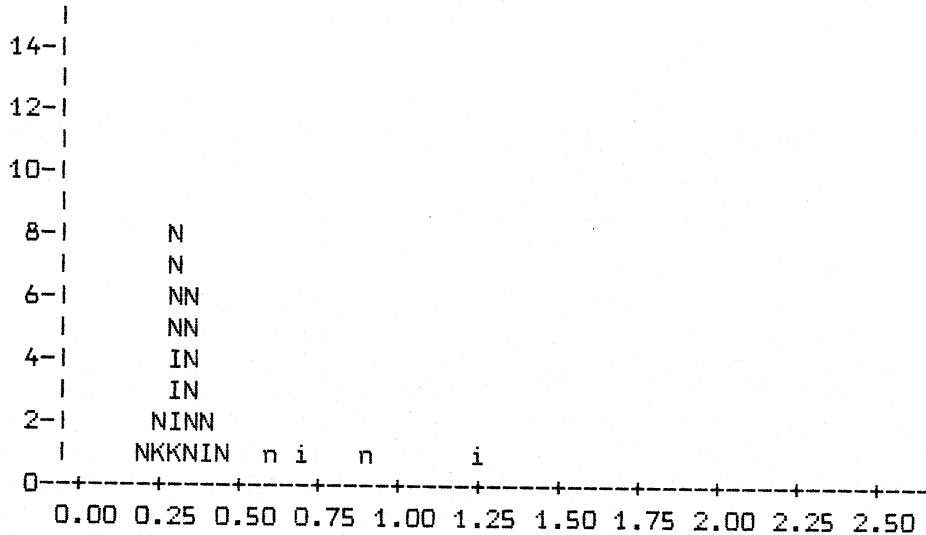


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.15	0.44	ALL	20	0.28	0.09
N	0.51	0.52	ALL	1	0.51	0.00
OVERALL				21	0.29	0.10

ORDERED VALUES FOLLOW:

0.15K	0.17K	0.17K	0.18K	0.19N	0.19K	0.19K	0.24K	0.25K	0.25K	0.29K
0.29K	0.30K	0.31K	0.35N	0.36K	0.36K	0.41K	0.42K	0.43K	0.51n	

IKU# C-5231 46.7M 7227/8-U-1



PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.24	0.47	ALL	20	0.34	0.05
N	0.60	0.93	ALL	3	0.75	0.16
N	1.27	1.28	ALL	1	1.27	0.00
OVERALL				24	0.43	0.23

ORDERED VALUES FOLLOW:

0.24N 0.26N 0.28K 0.30I 0.30N 0.31N 0.33N 0.34K 0.34I 0.34I 0.34N
 0.35N 0.35N 0.36N 0.37N 0.38N 0.39N 0.40I 0.43N 0.46N 0.60n 0.72i
 0.92n 1.27i

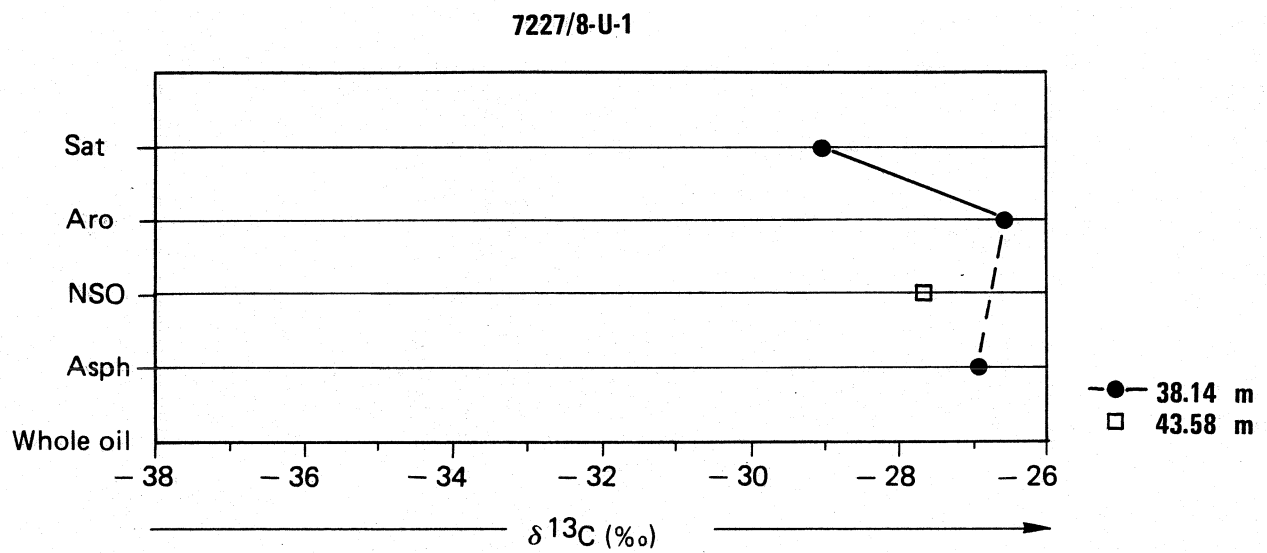


Figure A.II.2.7: $\delta^{13}\text{C}$ isotope profile for extract fractions.

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Core 7227/8-U-3:

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Figure A.II.2.7:	$\delta^{13}C$ isotope profile for extract fractions.

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DATE : 2 - 12 - 86.

Table A.II.3.1a:

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

[illegible]

Project no.: 21.3419.15
Well ident.: 7227/8-U-3
DATE : 2 - 12 - 86.

Table A.II.3.1b:

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

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	
	no.	m							C1-C4	C2-C4	NESS	-----	
											(%)	nC4	
I	C 5019	32.03	925	361	28			65	1314	389	29.63	*****	
I	C 5020	33.21	1260	433	50	99	36	245	1877	617	32.89	2.80	
I	C 5021	38.38	16576	7484	9935	1790	1509	1625	37295	20718	55.55	1.19	
I	C 5022	39.28	1667	2302	6693	1939	203	1201	12804	11137	86.98	9.55	
I	C 5023	44.31	5928	4131	3556	2995	168	1729	16779	10851	64.67	17.83	
I	C 5024	47.13	7723	1371	2290	1148	533	988	13065	5343	40.89	2.15	
I	C 5025	49.67	562	175	657	1534	216	1810	3144	2582	82.11	7.11	
I	C 5026	52.94	6394	173	25	34	16	556	6641	247	3.72	2.12	

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Table A.II.3.1c:

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
	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM	SUM	WET-	iC4	
	no.	m							C1-C4	C2-C4	NESS	-----	
											(%)	nC4	
I	C 5019	32.03	1497	405	28			1452	1931	433	22.45	*****	
I	C 5020	33.21	2364	517	50	99	36	245	3066	702	22.89	2.80	
I	C 5021	38.38	71467	10966	12058	2311	1906	2490	98707	27241	27.60	1.21	
I	C 5022	39.28	136265	12341	16389	5002	542	2353	170539	34274	20.10	9.23	
I	C 5023	44.31	147821	9008	5010	4387	168	1729	166394	18573	11.16	26.12	
I	C 5024	47.13	60650	3088	3596	1797	533	988	69664	9014	12.94	3.37	
I	C 5025	49.67	29120	525	657	1534	216	1810	32052	2931	9.15	7.11	
I	C 5026	52.94	26493	173	25	34	16	556	26740	247	0.92	2.12	

Table A.II.3.2:

7227/8-U-3

DATA FROM ROCK EVAL PYROLYSIS

I			:					HYDR. OXYGEN	PETROLEUM	PROD.	TEMP.	I	
I	IKU	DEPTH	:	S1	S2	S3	TOC	INDEX	INDEX	POTENTIAL	INDEX	MAX	I
I	No.		:								S1		I
I			:								-----		I
I		m	:	(mg/g ROCK)	(%)		(mg/g TOC)		S1+S2		S1+S2	(C)	I
I	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	=====	I
I			:										I
I	C 5095	31.60	:	2.00	37.06	0.64	12.18	304	5	39.06	0.05	419	I
I			:										I
I	C 5019	32.03	:	2.08	36.36	0.33	10.19	357	3	38.44	0.05	407	I
I			:										I
I	C 5096	32.83	:	0.49	12.49	0.66	4.72	265	14	12.98	0.04	412	I
I			:										I
I	C 5020	33.21	:	1.64	36.75	0.49	8.75	420	6	38.39	0.04	409	I
I			:										I
I	C 5097	33.75	:	1.85	35.45	0.94	11.81	300	8	37.30	0.05	412	I
I			:										I
I	C 5098	34.70	:	0.95	21.70	0.61	7.50	289	8	22.65	0.04	418	I
I			:										I
I	C 5099	35.75	:	1.91	35.00	1.05	11.31	309	9	36.91	0.05	411	I
I			:										I
I	C 5100	36.35	:	0.85	18.54	1.27	7.05	263	18	19.39	0.04	422	I
I			:										I
I	C 5101	37.65	:	1.13	24.74	0.55	8.02	308	7	25.87	0.04	410	I
I			:										I
I	C 5021	38.38	:	1.75	36.15	0.58	10.27	352	6	37.90	0.05	406	I
I			:										I
I	C 5102	38.80	:	1.27	28.02	0.62	8.42	333	7	29.29	0.04	411	I
I			:										I
I	C 5022	39.28	:	4.03	56.62	0.65	13.22	428	5	60.65	0.07	401	I
I			:										I
I	C 5103	39.70	:	2.89	52.27	1.17	14.16	369	8	55.16	0.05	400	I
I			:										I
I	C 5104	40.80	:	3.63	57.50	0.80	17.44	330	5	61.13	0.06	412	I
I			:										I
I	C 5105	41.75	:	1.58	38.40	1.29	9.52	403	14	39.98	0.04	413	I
I			:										I
I	C 5106	42.70	:	1.06	29.45	0.85	7.93	371	11	30.51	0.03	414	I
I			:										I
I	C 5107	43.77	:	3.69	49.50	1.25	16.15	307	8	53.19	0.07	413	I
I			:										I
I	C 5023	44.31	:	3.31	56.32	0.59	13.68	412	4	59.63	0.06	404	I
I			:										I
I	C 5108	44.88	:	3.18	64.16	1.45	14.55	441	10	67.34	0.05	410	I
I			:										I
I	C 5109	45.78	:	2.06	43.10	1.07	11.46	376	9	45.16	0.05	403	I
I			:										I
I	C 5110	46.78	:	3.10	62.99	1.30	14.89	423	9	66.09	0.05	409	I
I			:										I
I	C 5024	47.13	:	3.43	58.34	0.75	16.11	362	5	61.77	0.06	403	I
I			:										I
I	C 5111	47.85	:	1.14	72.99	1.51	15.23	479	10	74.13	0.02	412	I
I			:										I

Table A.II.3.2 cont.

7227/B-U-3

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. OXYGEN INDEX	PETROLEUM INDEX	PROD. INDEX	TEMP. MAX	
	No.								POTENTIAL	S1	(C)	
		m	(mg/g ROCK)	(%)	(mg/g TOC)	S1+S2	S1+S2					
I	C 5112	48.80	5.43	85.74	1.81	19.22	446	9	91.17	0.06	408	
I	C 5025	49.67	0.66	22.81	0.75	5.41	422	14	23.47	0.03	420	
I	C 5113	49.90	0.27	9.30	0.73	4.53	205	16	9.57	0.03	425	
I	C 5114	50.90	0.50	13.49	0.71	5.85	231	12	13.99	0.04	421	
I	C 5115	51.86	0.28	4.12	0.54	3.65	113	15	4.40	0.06	430	
I	C 5116	52.92	0.76	27.60	1.38	7.90	349	17	28.36	0.03	419	
I	C 5026	52.94	0.85	31.14	0.65	8.50	366	8	31.99	0.03	420	

Table A.II.3.3: Data from pyrolysis-gas chromatograms.

Core 7227/8-U-3

Sample Nr.	Depth (m)	I I I	TOC (%)	I I I	C1 - -	C2-C5 (a r e a %)	C6-C14	C15+ - -	I I I	(m+p)-xylene/ n-octene (pkht/pkht)
C-5096	32.83	I	4.72	I	6.73	13.81	47.20	28.65	I	1.07
C-5020	33.21	I	8.75	I	6.75	12.84	54.62	23.78	I	1.35
C-5800	40.80	I	15.07	I	7.98	16.55	49.47	25.04	I	1.36
C-5111	47.85	I	15.23	I	10.37	29.66	49.13	10.84	I	0.99
C-5115	51.86	I	3.65	I	11.60	24.21	57.17	7.02	I	1.18

Table A.II.3.4:

 Well Identification: 7227/8-U-3
 Reference number: 21.3419.15
 (1/1)

VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
C 5800	----	40.8	0.29 (30)	G	0.06	1-3
C 5800 HY-PY	----	40.8	1.23 (30)	F	0.16	---
C 5111	----	47.8	0.27 (24)	G	0.06	1-2
C 5115	----	51.9	0.30 (11) 0.56 (4)	G R	0.05 0.09	1-2,6-7
C 5801 HY-PY	----	51.9	1.22 (4) 0.87 (1) 1.66 (10)	P BP R	0.04 0.00 0.15	---

 REL RAT (Reliability Rating): G = Good; F = Fair; P = Poor
 S = Stained; R = Reworked;
 BP = Bad Particle.

Project no.: 21.3419.15
Well ident.: 7227/8-U-3
DATE : 6 - 1 - 87.

Table A.II.3.5:

WEIGHT 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 5096	32.83	8.5	55.2	0.7	4.8	5.5	49.7	6.77
C 5102	38.80	29.3	178.2	3.5	36.6	40.1	138.1	8.81
C 5104	40.80	13.7	247.0	4.3	29.6	33.9	213.1	15.25
C 5107	43.77	15.9	335.8	7.5	59.8	67.3	268.5	18.64
C 5109	45.78	25.3	243.4	4.7	40.7	45.4	198.0	11.49
C 5111	47.85	13.8	234.3	6.0	39.8	45.8	188.5	15.86
C 5115	51.86	16.6	42.4	1.1	5.4	6.5	35.9	4.62

Project no.: 21.3419.15
 Well ident.: 7227/8-U-3
 DATE : 6 - 1 - 87.

Table A.II.3.6:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	:	EOM	Sat.	Aro.	HC	Non HC	I
I		(m)	:						I
I			:						I
I	C 5096	32.83	:	6464	84	562	646	5817	I
I	C 5102	38.80	:	6084	120	1250	1370	4714	I
I	C 5104	40.80	:	18082	318	2165	2484	15598	I
I	C 5107	43.77	:	21133	472	3760	4232	16901	I
I	C 5109	45.78	:	9628	185	1609	1794	7834	I
I	C 5111	47.85	:	17040	436	2895	3331	13709	I
I	C 5115	51.86	:	2554	65	325	390	2164	I
I			:						I

Project no.: 21.3419.15
 Well ident.: 7227/8-U-3
 DATE : 6 - 1 - 87.

Table A.II.3.7:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
C 5096	32.83	95.5	1.2	8.3	9.5	85.9
C 5102	38.80	69.1	1.4	14.2	15.5	53.5
C 5104	40.80	118.6	2.1	14.2	16.3	102.3
C 5107	43.77	113.4	2.5	20.2	22.7	90.7
C 5109	45.78	83.8	1.6	14.0	15.6	68.2
C 5111	47.85	107.4	2.8	18.3	21.0	86.4
C 5115	51.86	55.3	1.4	7.0	8.4	46.8

Project no.: 21.3419.15
 Well ident.: 7227/8-U-3
 DATE : 6 - 1 - 87.

Table A.II.3.8:

COMPOSITION OF MATERIAL EXTRACTED FROM THE ROCK

I	I	I	I	I	I	I	I	I	I	I
I	IKU-No	DEPTH	:	Sat	Aro	HC	SAT	Non HC	HC	I
I			:	---	---	---	---	---	---	I
I		(m)	:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I			:	%	%	%	x 100	%	x 100	I
I			:							I
I	C 5096	32.83	:	1.3	8.7	10.0	15.0	90.0	11.1	I
I	C 5102	38.80	:	2.0	20.5	22.5	9.6	77.5	29.1	I
I	C 5104	40.80	:	1.8	12.0	13.7	14.7	86.3	15.9	I
I	C 5107	43.77	:	2.2	17.8	20.0	12.6	80.0	25.0	I
I	C 5109	45.78	:	1.9	16.7	18.6	11.5	81.4	22.9	I
I	C 5111	47.85	:	2.6	17.0	19.5	15.1	80.5	24.3	I
I	C 5115	51.86	:	2.5	12.7	15.3	20.0	84.7	18.0	I
I			:							I

Table A.II.3.9:

TABULATION OF DATA FROM THE GAS CHROMATOGRAMS

7227/8-U-3

I	DEPTH	:	PRISTANE	PRISTANE	PHYTANE	A	n-C17		I
I	IKU No.	:	-----	A = -----	B = -----	-----	-----	CPI	I
I	(m)	:	PHYTANE	n-C17	n-C18	B	n-C27		I
I		:							I
I	C 5096	32.83	1.5	3.6	2.6	1.4	0.9	1.6	I
I		:							I
I	C 5102	38.80	1.5	3.8	3.2	1.2	0.6	1.6	I
I		:							I
I	C 5104	40.80	1.3	5.1	4.0	1.3	1.4	1.7	I
I		:							I
I	C 5107	43.77	1.3	3.8	4.0	1.0	1.6	1.7	I
I		:							I
I	C 5109	45.78	2.0	4.8	2.9	1.7	2.2	1.3	I
I		:							I
I	C 5111	47.85	1.2	4.9	5.1	0.9	2.4	1.2	I
I		:							I
I	C 5115	51.86	3.5	3.8	1.3	2.9	1.1	1.6	I
I		:							I

Corrected replacement of

Table A.II.3.10: Molecular ratios from sterane and terpane mass chromatograms. Maturity and source characteristic ratios.

7227/8-U-3							
IKU-NR.	depth (m)	ab/(ab+ba)	%22S	%20S	%bb	Tm/Ts	C27 rearr.
		hop.	ext. hop	ster.	ster.		ster.
		1)	2)	3)	4)	5)	6)
		----- maturity-dependent -----				maturity- and	
		----- parameters -----				source-dependent	
C5096	32.83	0.79	56.68	15.63	39.83	48.62	78.65
C5104	40.80	0.79	57.32	23.08	59.38	92.45	85.71
C5109	45.78	0.80	58.13	10.05	36.81	85.93	66.77
C5111	47.85	0.83	53.48	7.55	34.57	133.00	61.16
C5115	51.86	0.73	44.57	5.00	40.64	120.60	52.81

- 1) $E / (E+F)$ in m/z 191
- 2) $100 * G / (G+H)$ in m/z 191
- 3) $100 * q / (q+t)$ in m/z 217
- 4) $100 * (r+s) / (q+r+s+t)$ in m/z 217
- 5) B / A in m/z 191
- 6) $100 * a / (a+j)$ in m/z 217

Table A.II.3.11:

a)

7227/8-U-3

Gas yields of the hydrocarbons C1-C7 of adsorbed gas of core samples (ug/kg rock)

IKU No.	Depth (m)	C1	C2	C3	iC4	nC4	2,2-DMC3	C5+
C5019	32.03	245.0	194.7	113.3	40.0	28.2	101.7	290.0
C5021	38.38	649.0	3021.8	11856.7	4673.0	5032.7	5.0	6557.6
C5023	44.31	143.9	421.2	3179.6	8361.7	603.9	5084.7	.
C5024	47.13	243.8	61.6	929.5	2856.4	1457.6	3.2	3776.1
C5026	52.94	256.0	105.8	39.4	194.5	93.0	1886.9	7935.8

. = value missing, undefined, or below detection limit

b)

7227/8-U-3

Gas ratios (v/v) and isotope ratios of the hydrocarbons C1 to C7 of adsorbed gas of core samples.

IKU No.	Depth (m)	C1/ (C2+C3)	100*C1/ (C1+C2 +C3+iC4 +nC4)	100* (iC4/nC4)	d13C1 (0/00 PDB)	d13C2 (0/00 PDB)	dD C1 (0/00 SMOW)
C5019	32.03	1.71	60.12	133.88	-39.4	-23.4	.
C5021	38.38	.11	7.06	87.64	-45.6	-29.5	.
C5023	44.31	.11	3.66	1306.83	-33.5	.	.
C5024	47.13	.67	13.57	184.96	-40.4	-31.1	.
C5026	52.94	3.65	63.19	197.39	-35.3	.	-116.1

. = value missing, undefined, or below detection limit

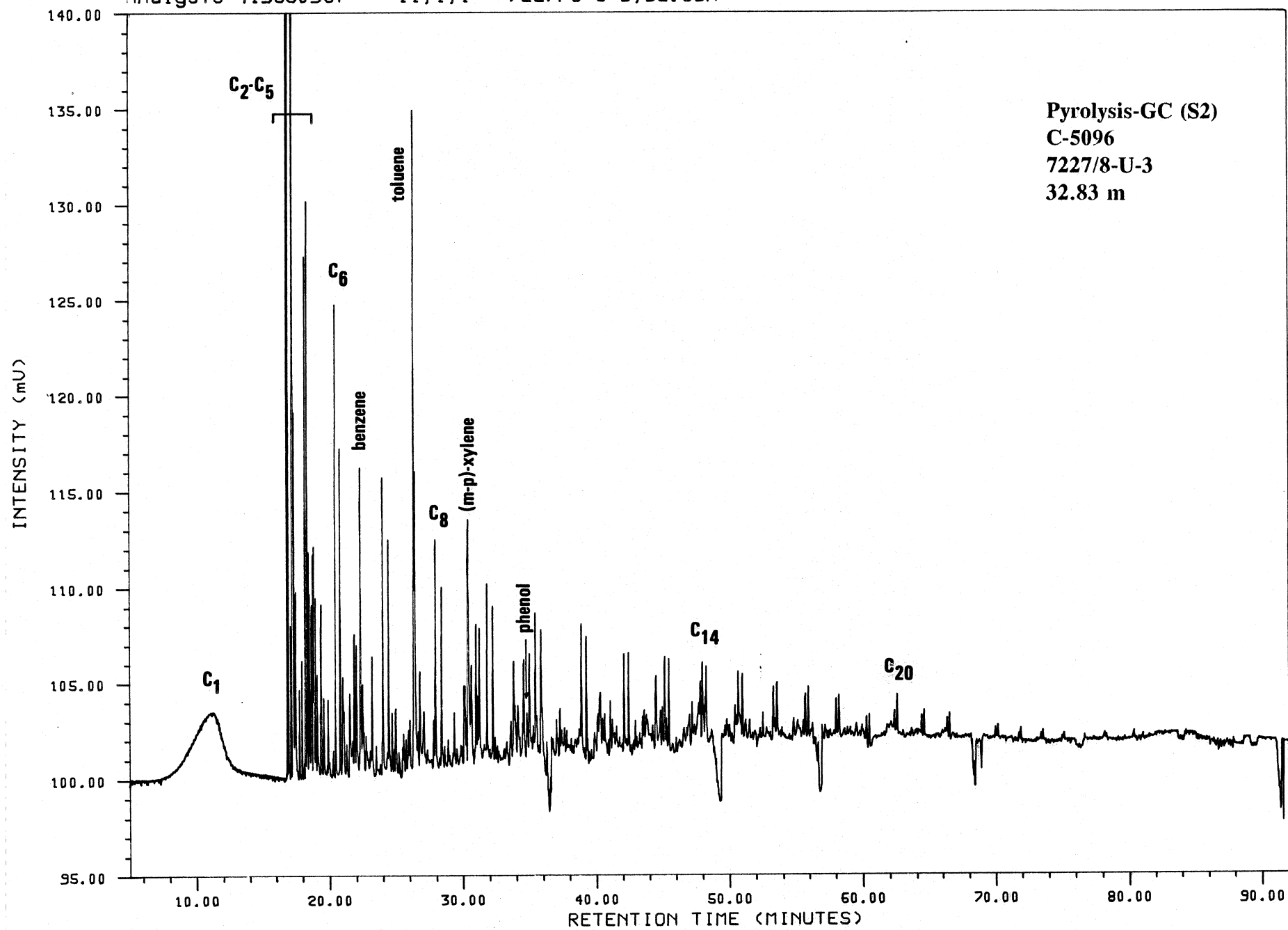
Table A.II.3.12: $\delta^{13}\text{C}$ isotope ratios for extract fractions.

7227/8-U-3

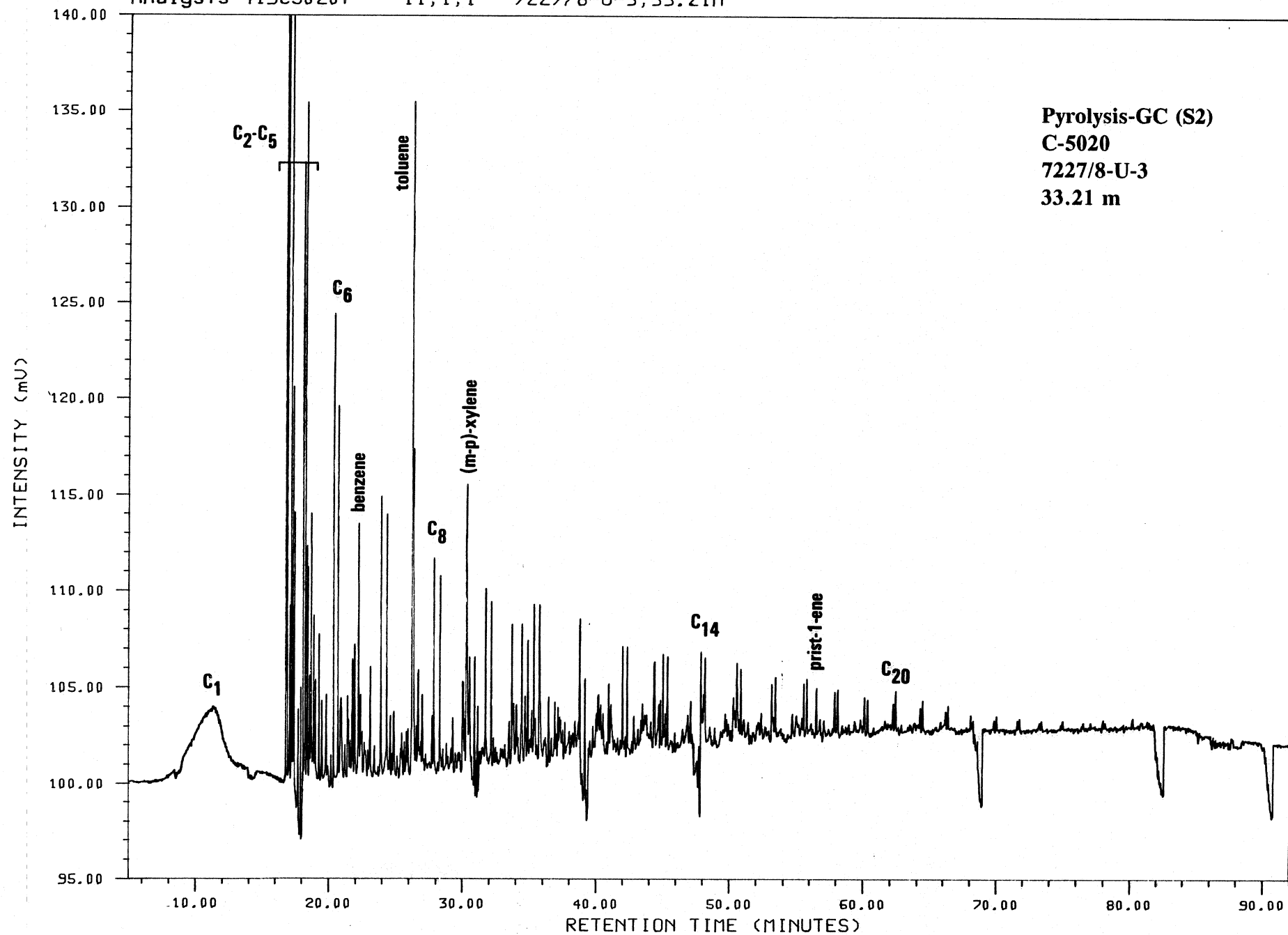
=====					
Sample	Depth (m)	----- delta 13 C -----			
		SAT	ARO	NSO	ASPH
=====					
C5096	32.83	-28.67	-28.66	-28.70	-28.44
C5102	38.80	-28.95	-28.61	-28.45	-28.27
C5104	40.80	-29.71	-29.31	-28.73	-28.26
C5111	47.85	-29.12	-28.32	-28.31	-28.20
C5115	51.86	-31.02	-27.08	-27.73	-27.81
=====					

Figure A.II.3.1: Pyrolysis-gas chromatograms (S2 peak).

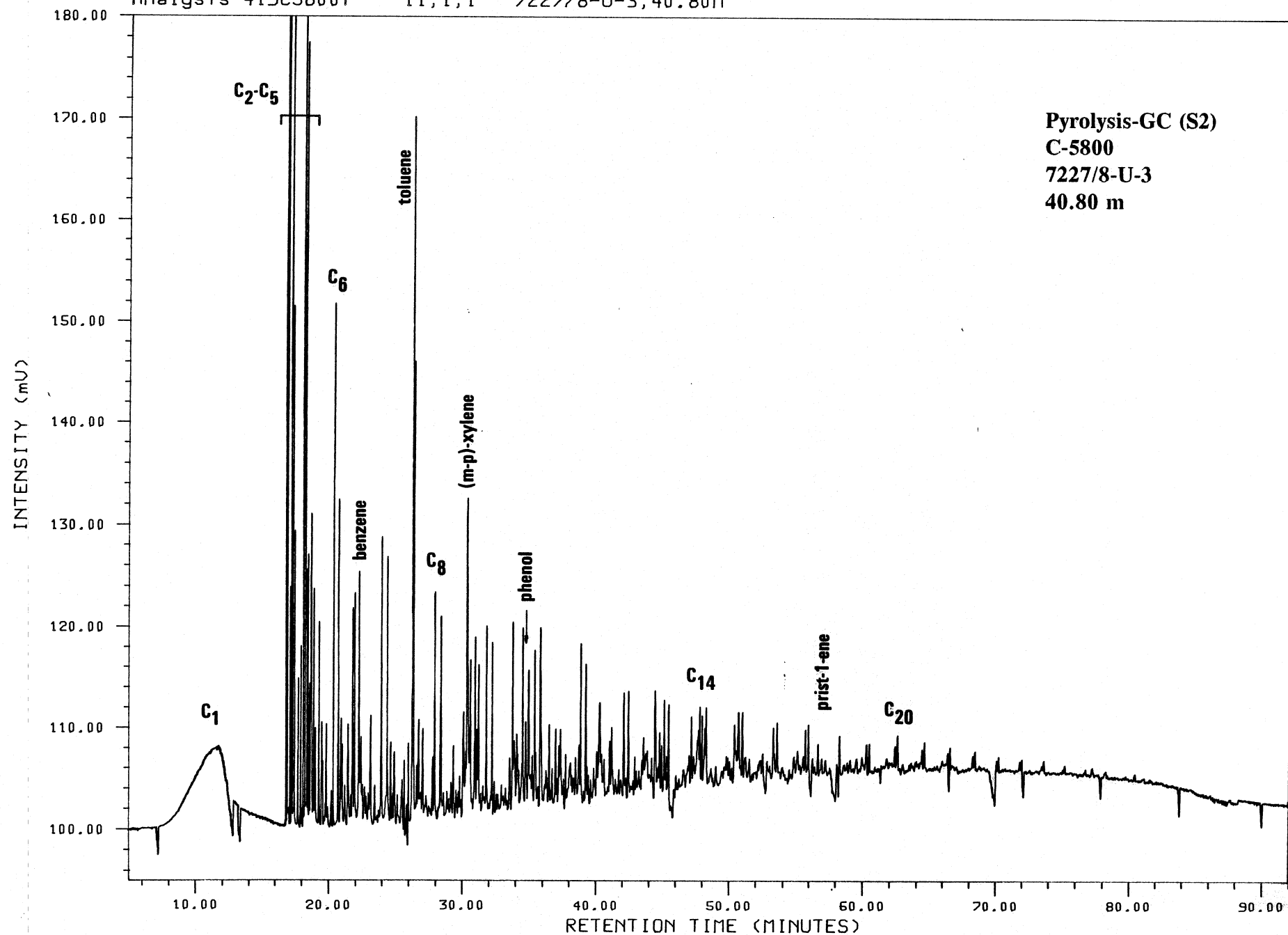
analysis 419C5096P 11,1,1 7227/8-U-3,32.83M



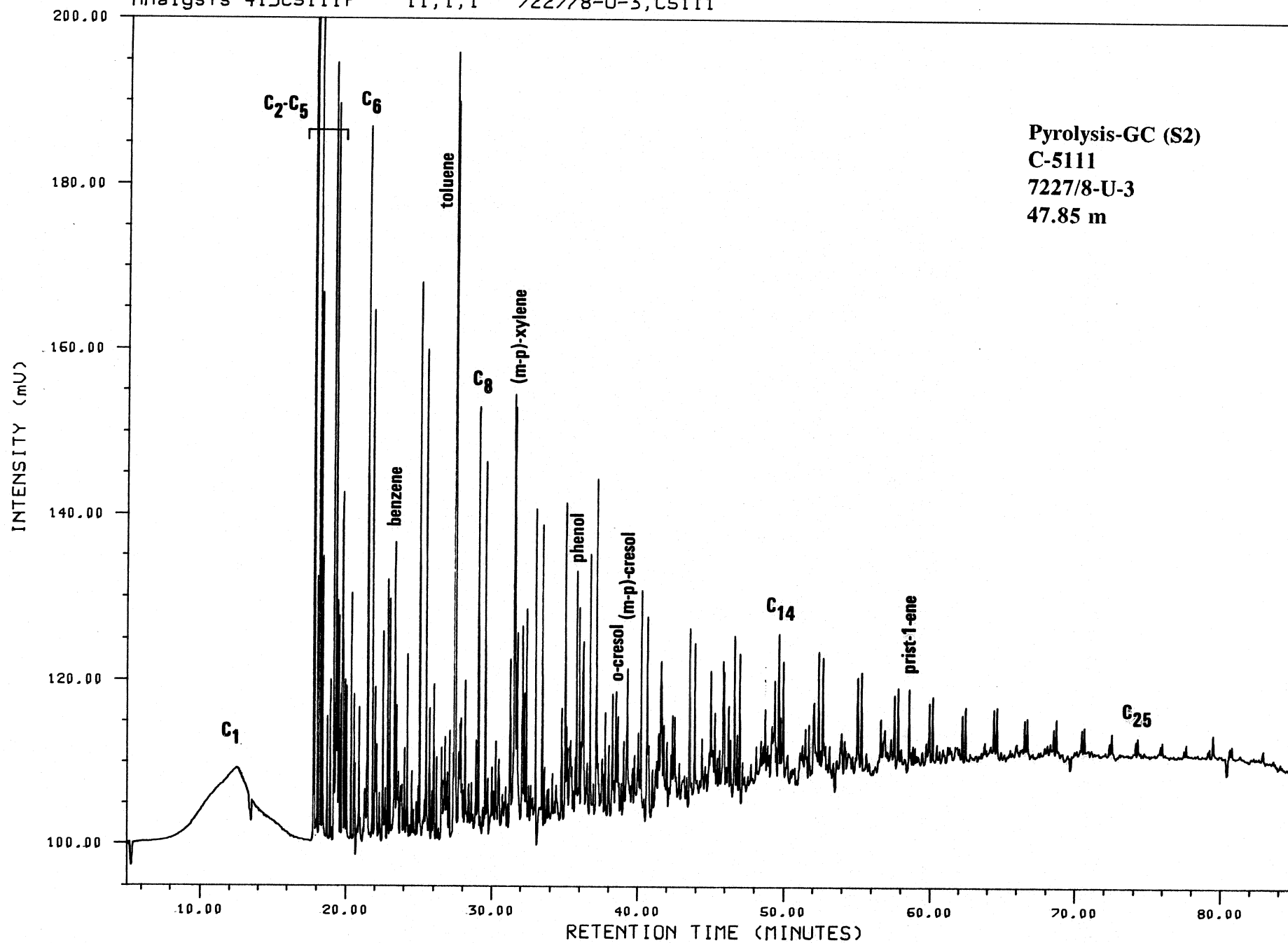
Analysis 419C5020P 11,1,1 7227/8-U-3,33.21M



Analysis 419C5800P 11,1,1 7227/8-U-3,40.80M



Analysis 419C5111P 11,1,1 7227/8-U-3,C5111



Analysis 419C5115P 11,1,1 7227/8-U-3,C5115

Pyrolysis-GC (S2)
C-5115
7227/8-U-3
51.86 m

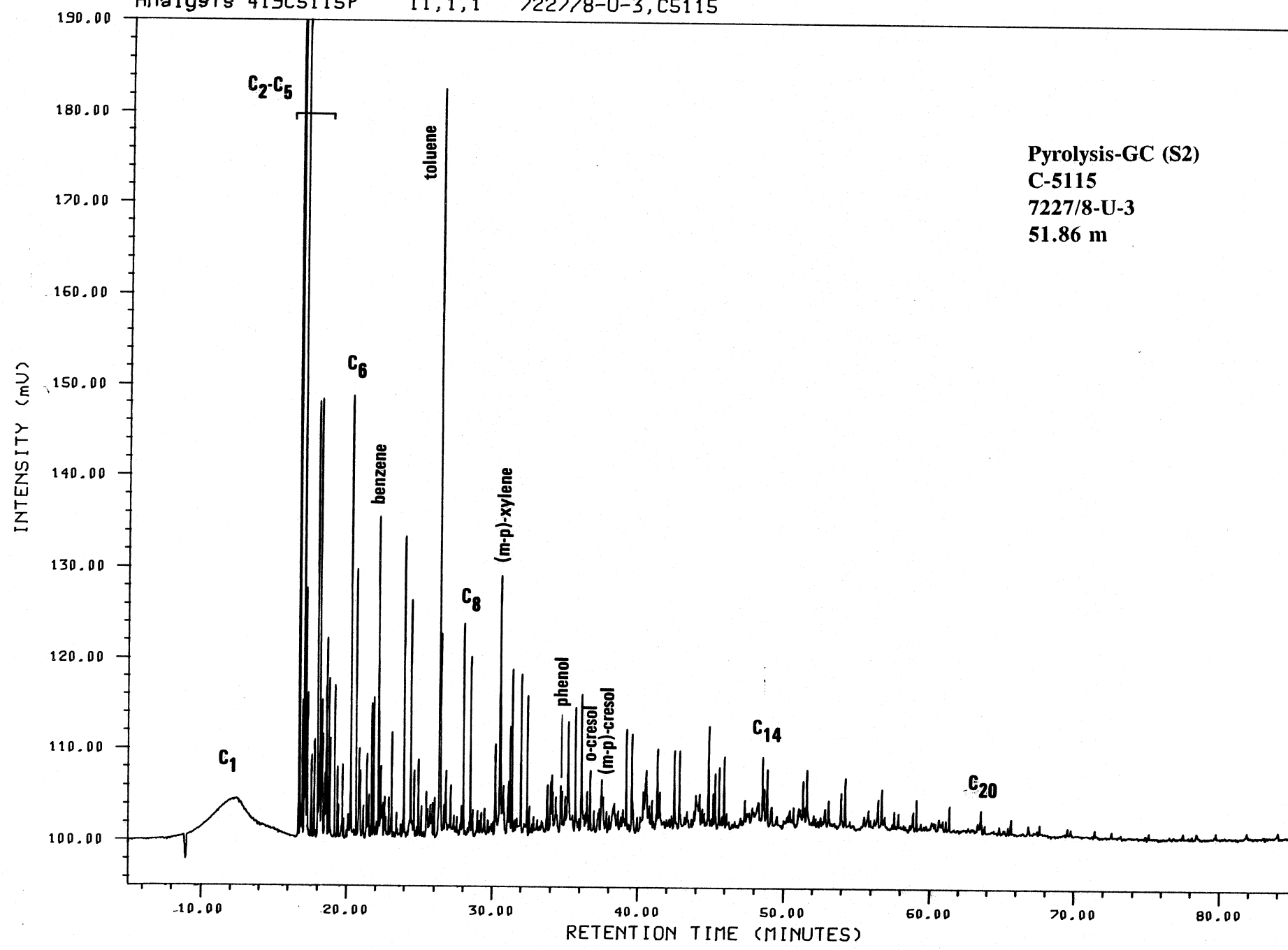
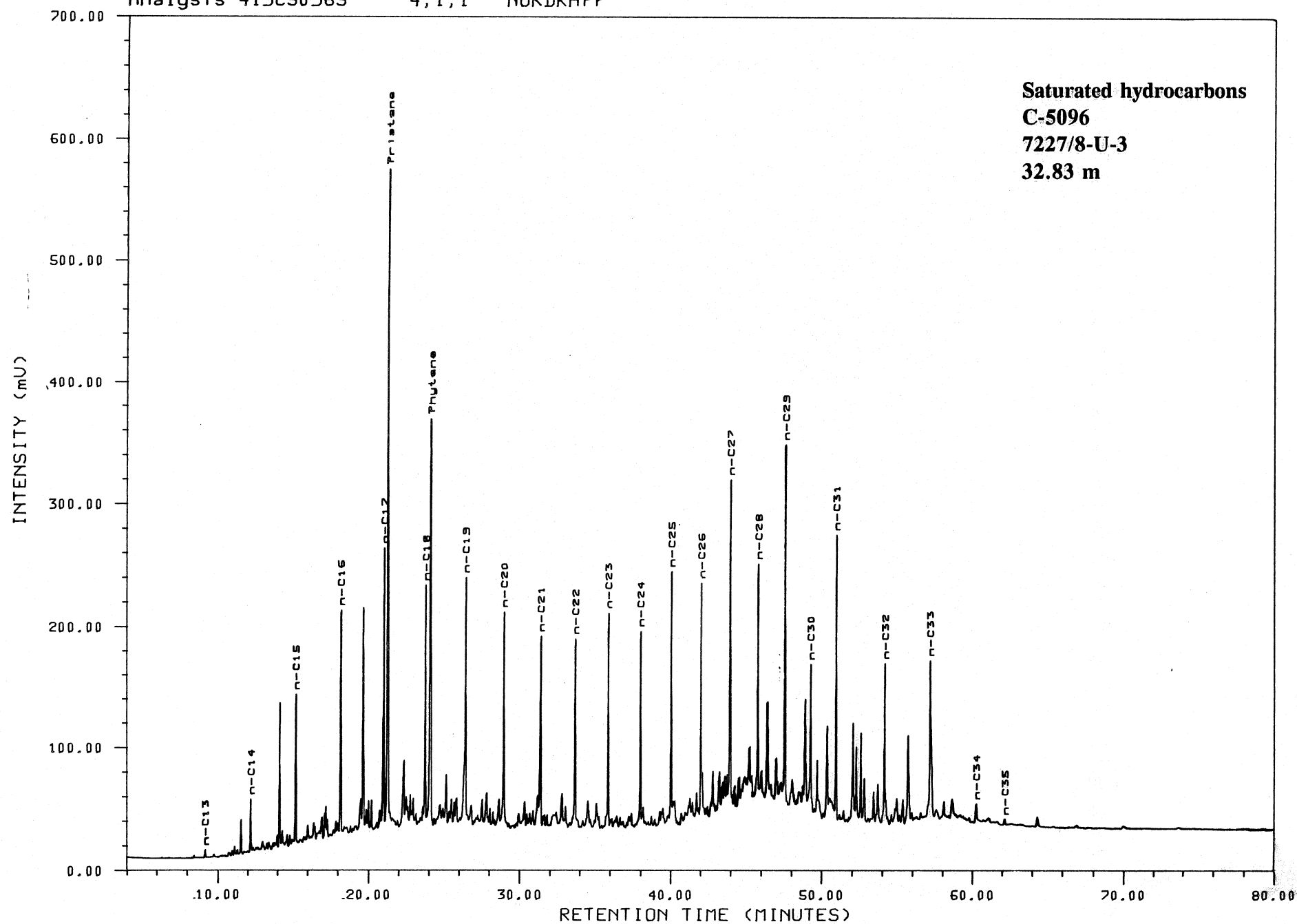


Figure A.II.3.2: Saturated hydrocarbon gas chromatograms.

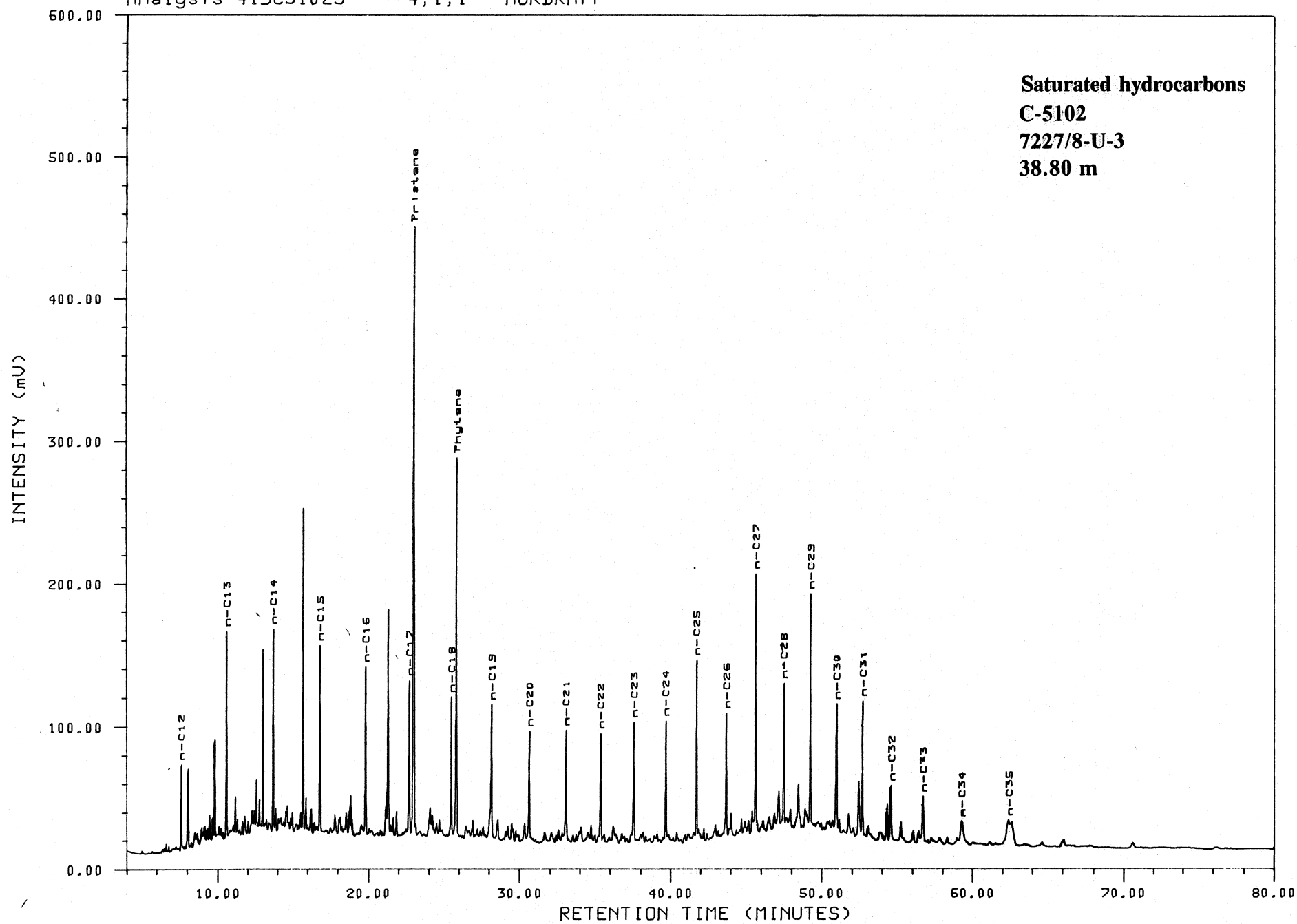
n-C ₁₅ etc.	- n-alkanes
Pr	- pristane
Ph	- phytane
*	- other acyclic isoprenoids

Analysis 419C5096S

4,1,1 NORDKAPP



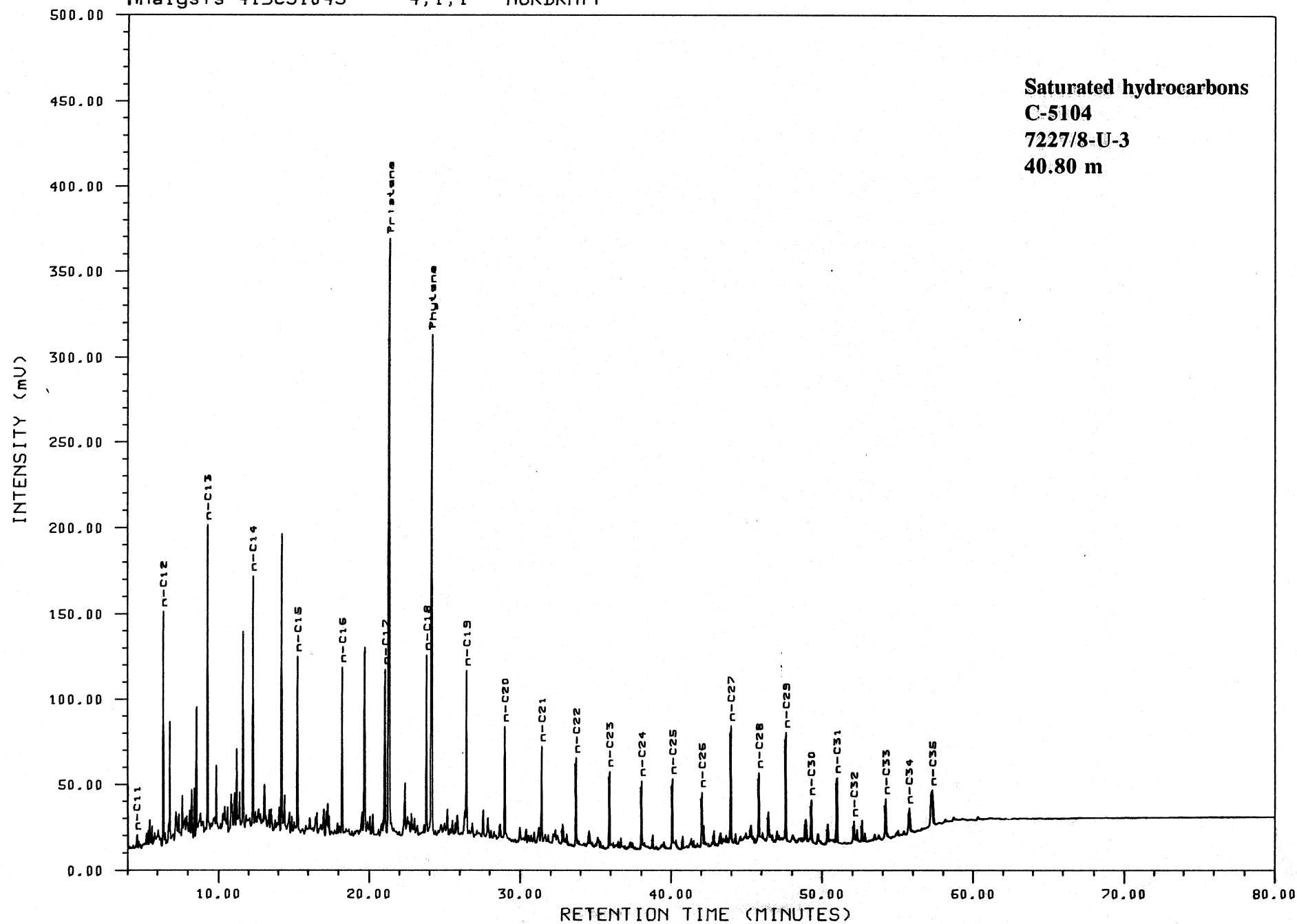
Analysis 419C5102S 4,1,1 NORDKAPP



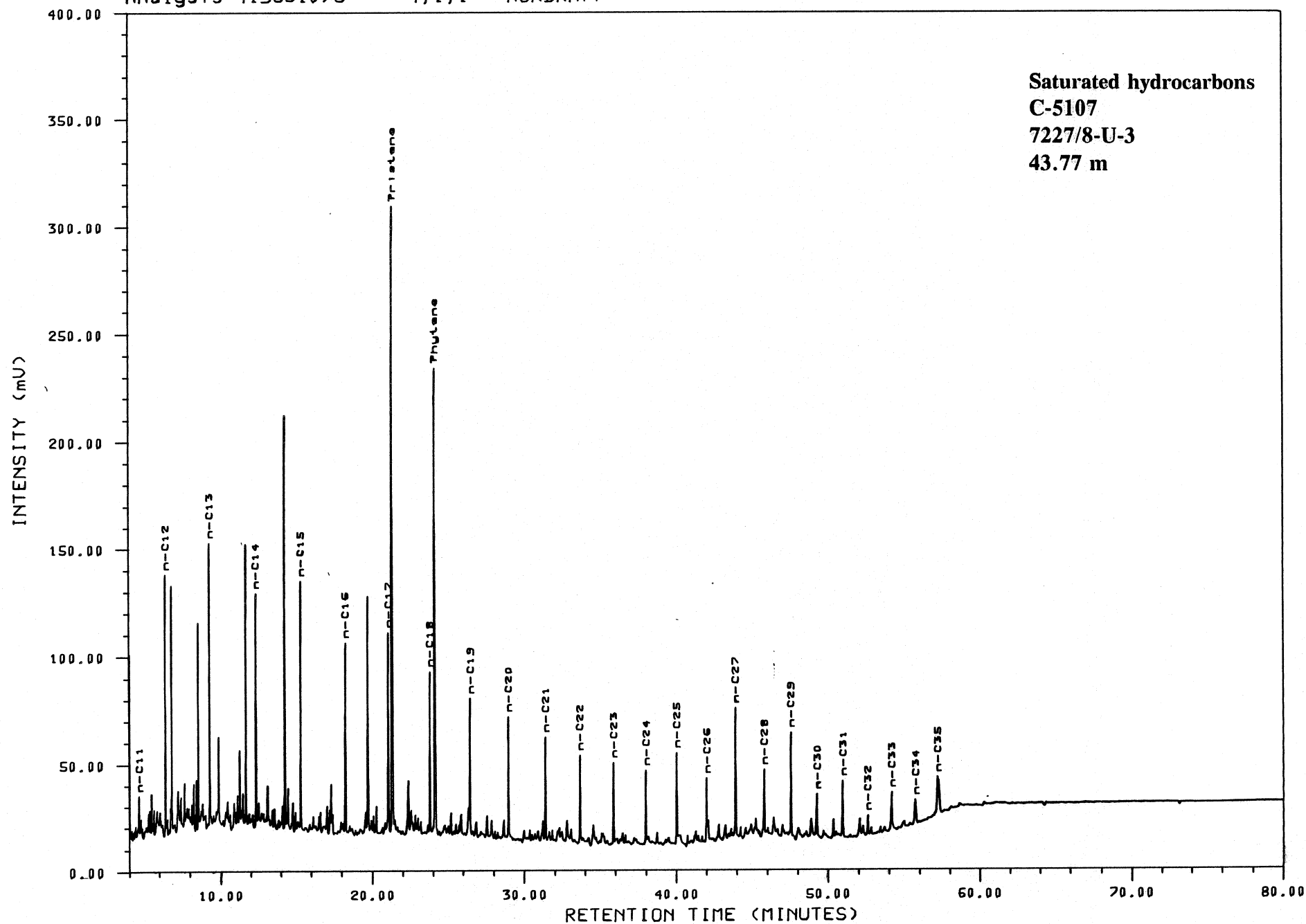
Analysis 419C5104S

4,1,1

NORDKAPP

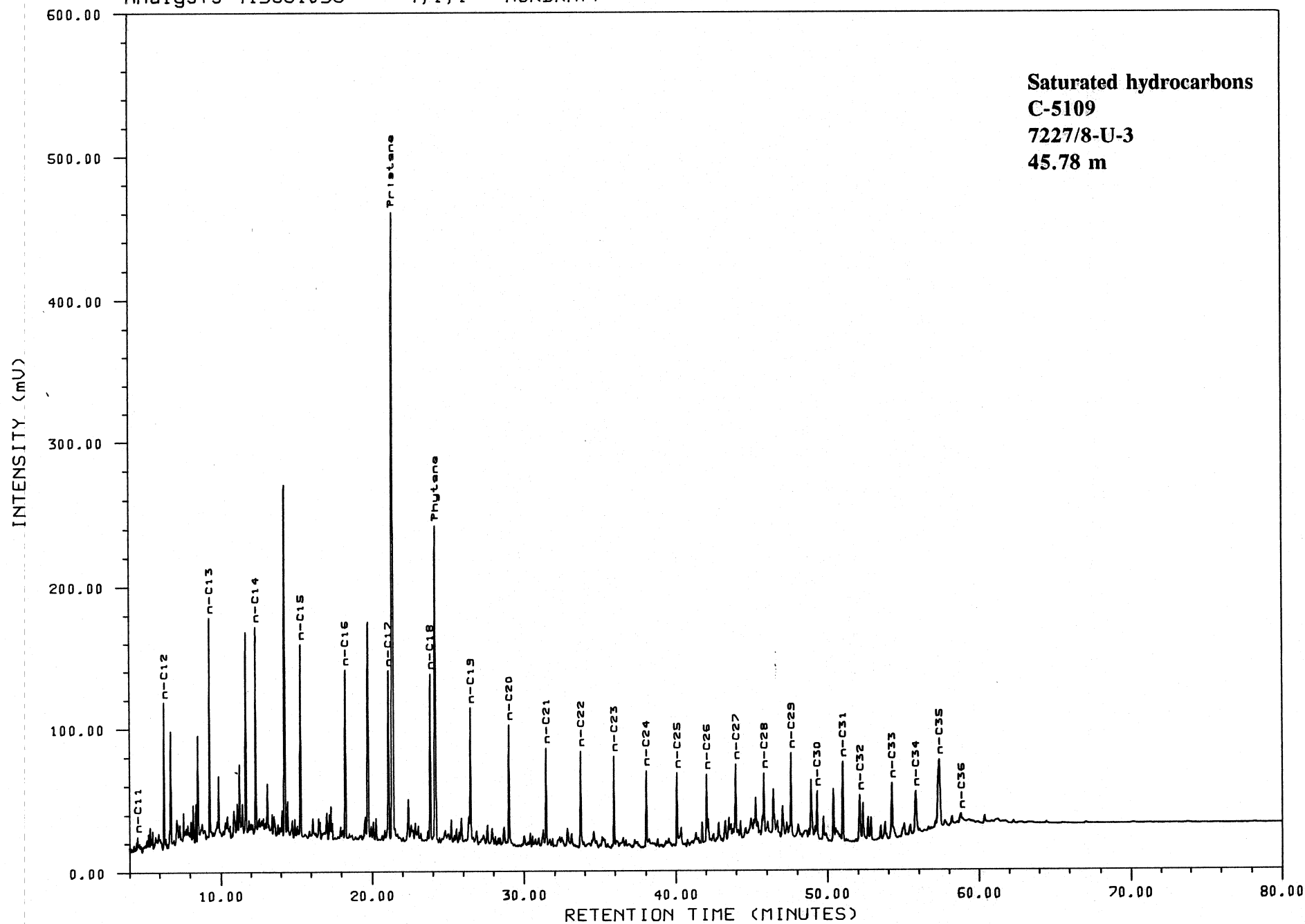


Analysis 419C5107S 4,1,1 NORDKAPP



Analysis 419C5109S

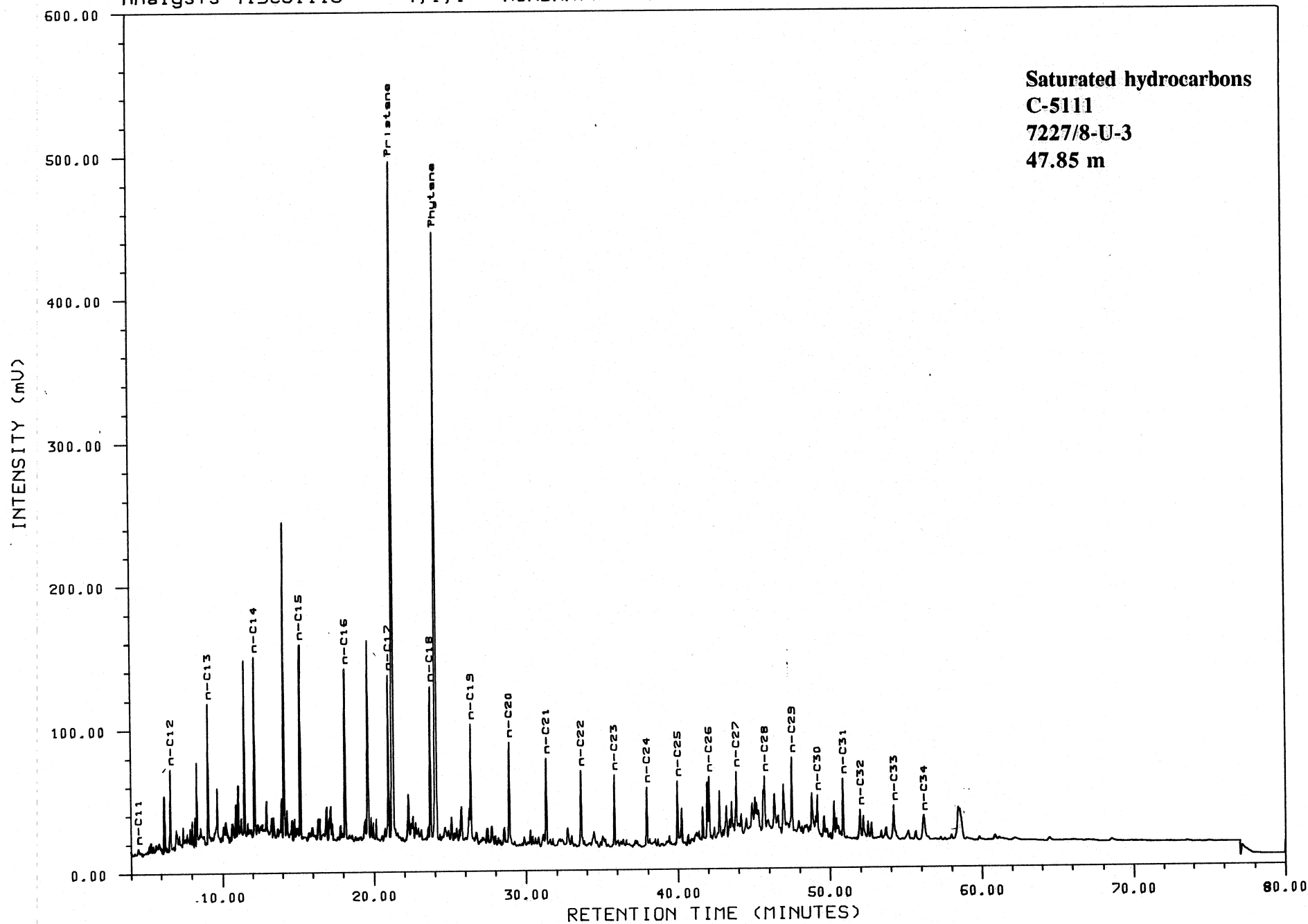
4,1,1 NORDKAPP



Analysis 419C5111S

4,1,1

NORDKAPP



Analysis 419C5115S

4,1,1 NORDKAPP

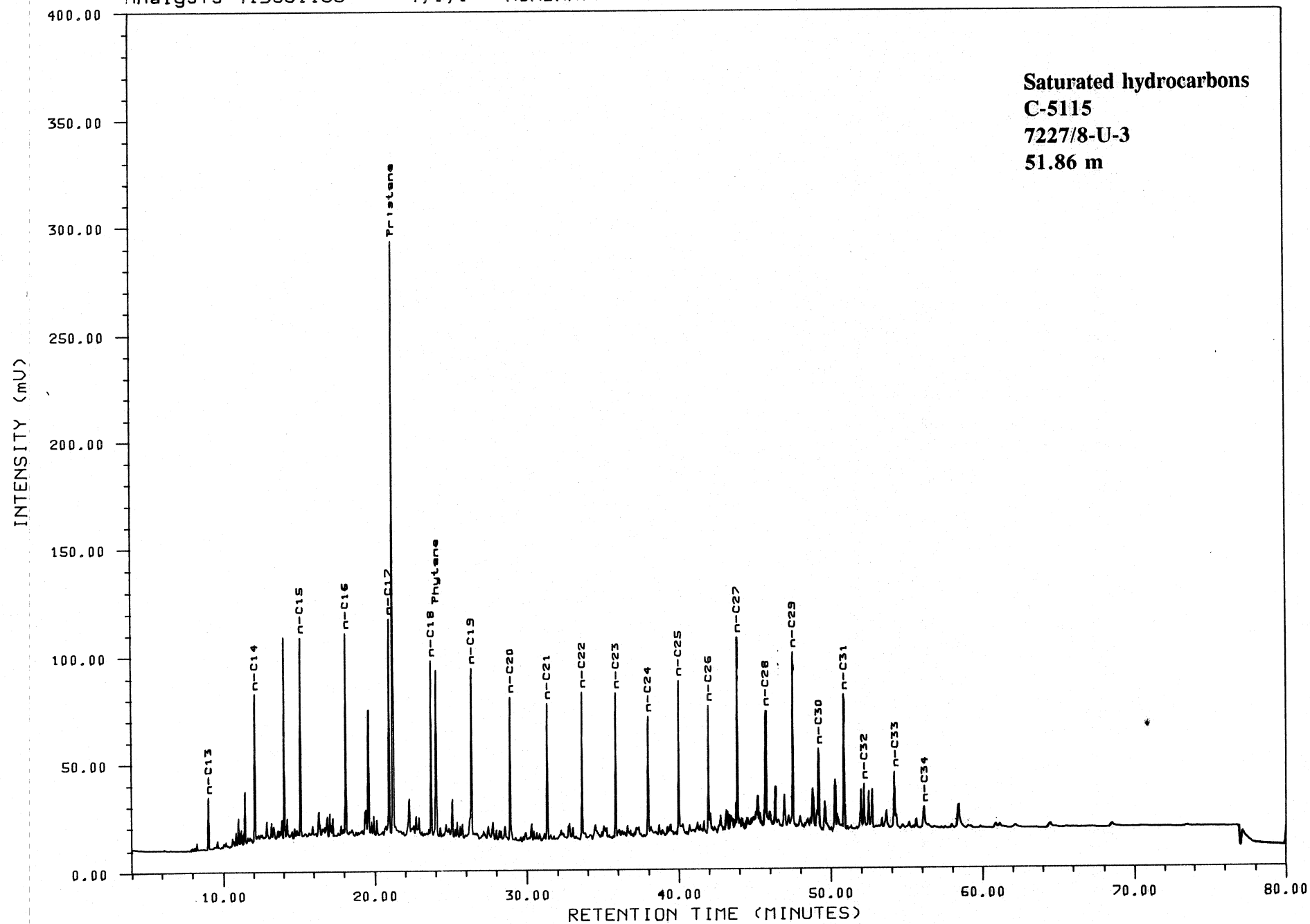


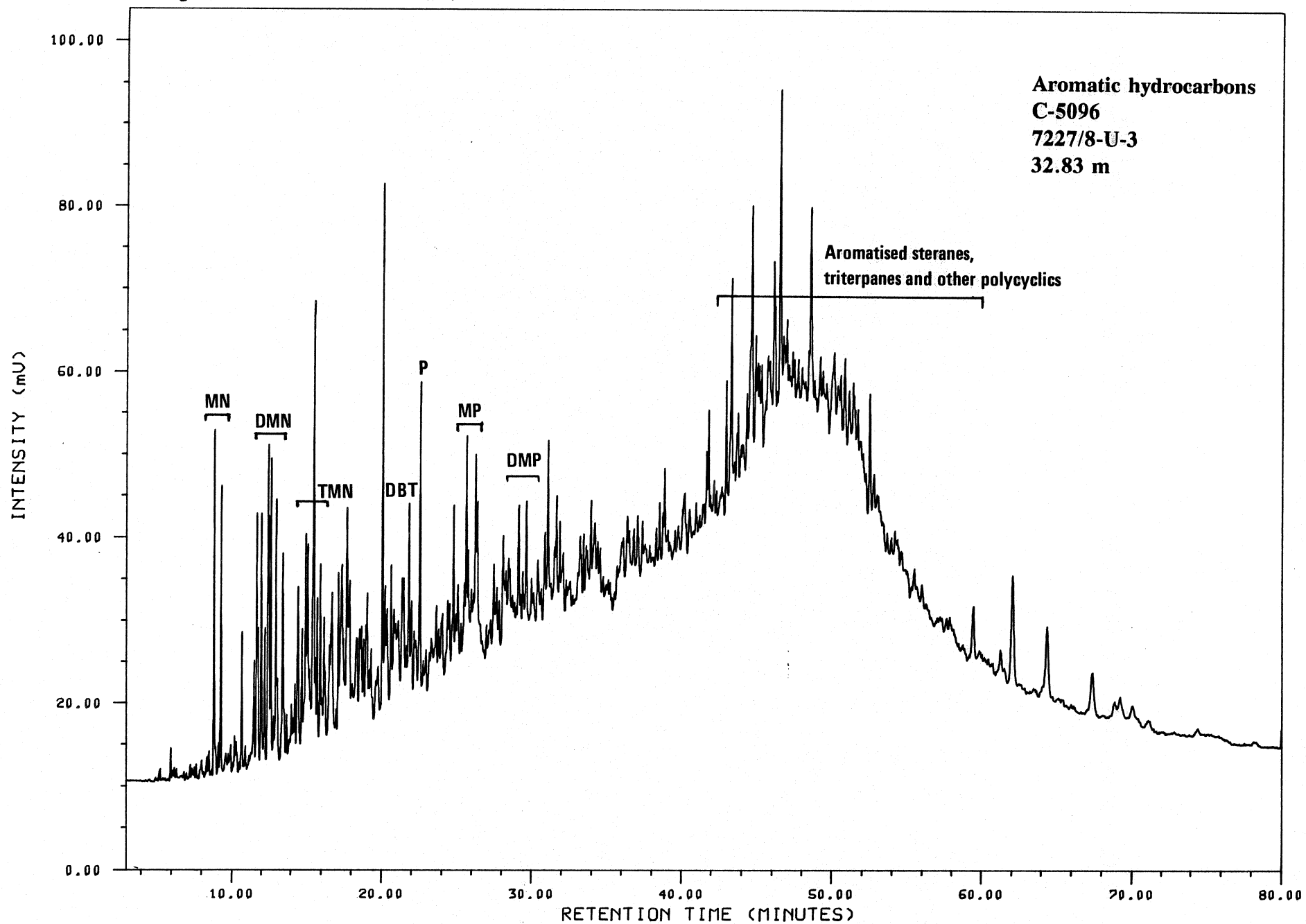
Figure A.II.3.3: Aromatic hydrocarbon gas chromatograms.

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

Analysis 419C5096A

2,1,1

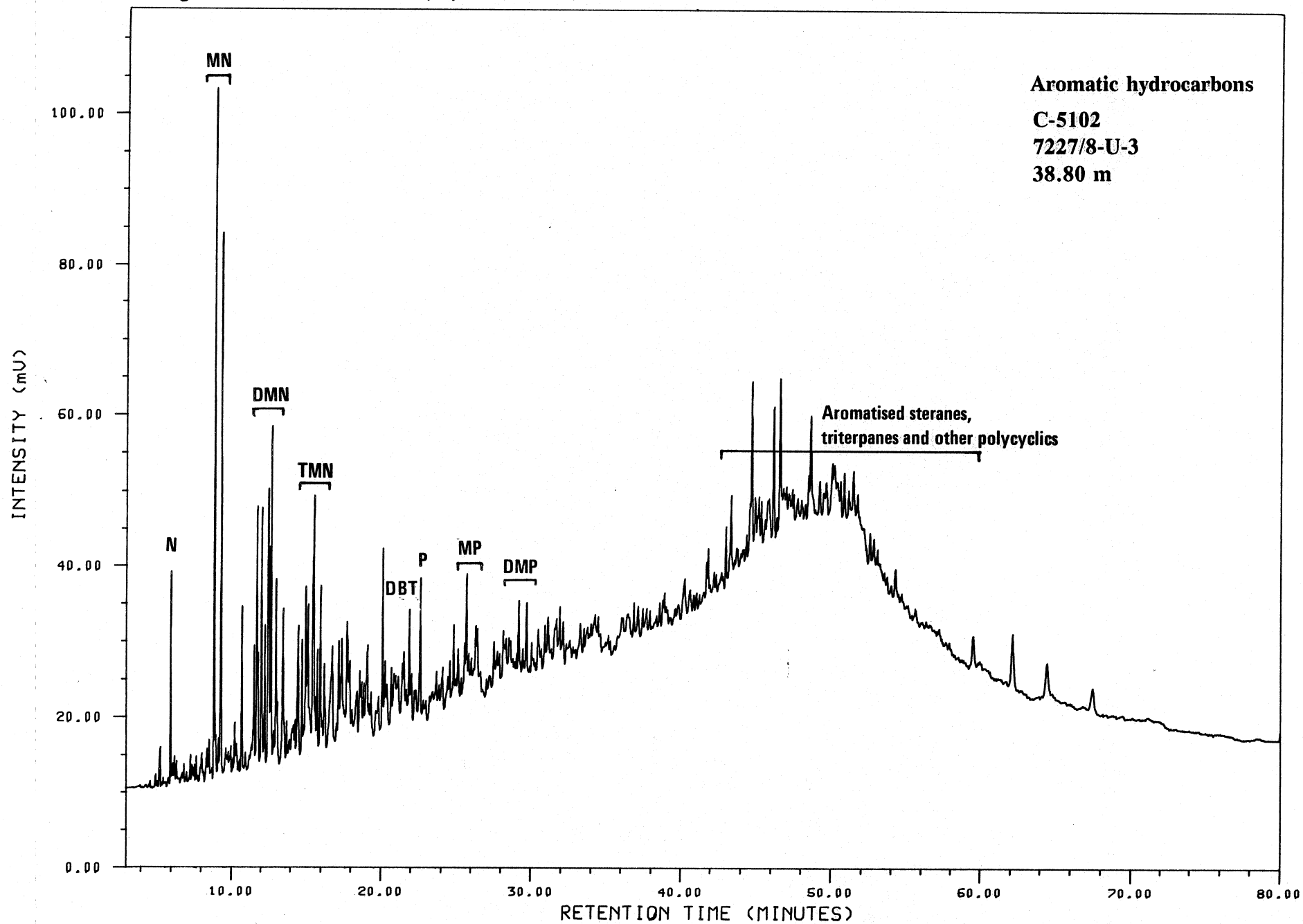
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Analysis 419C5102A

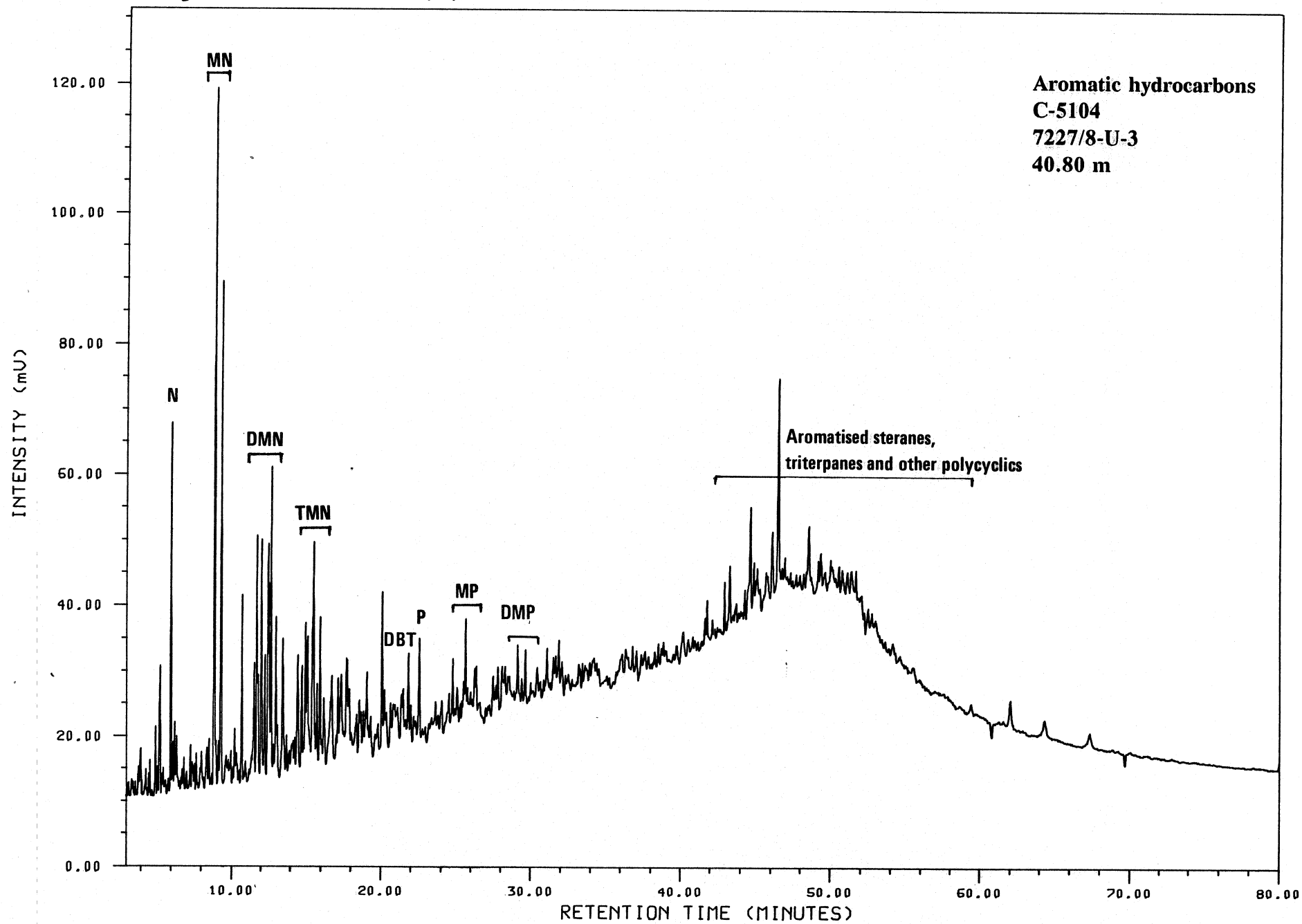
2,1,1

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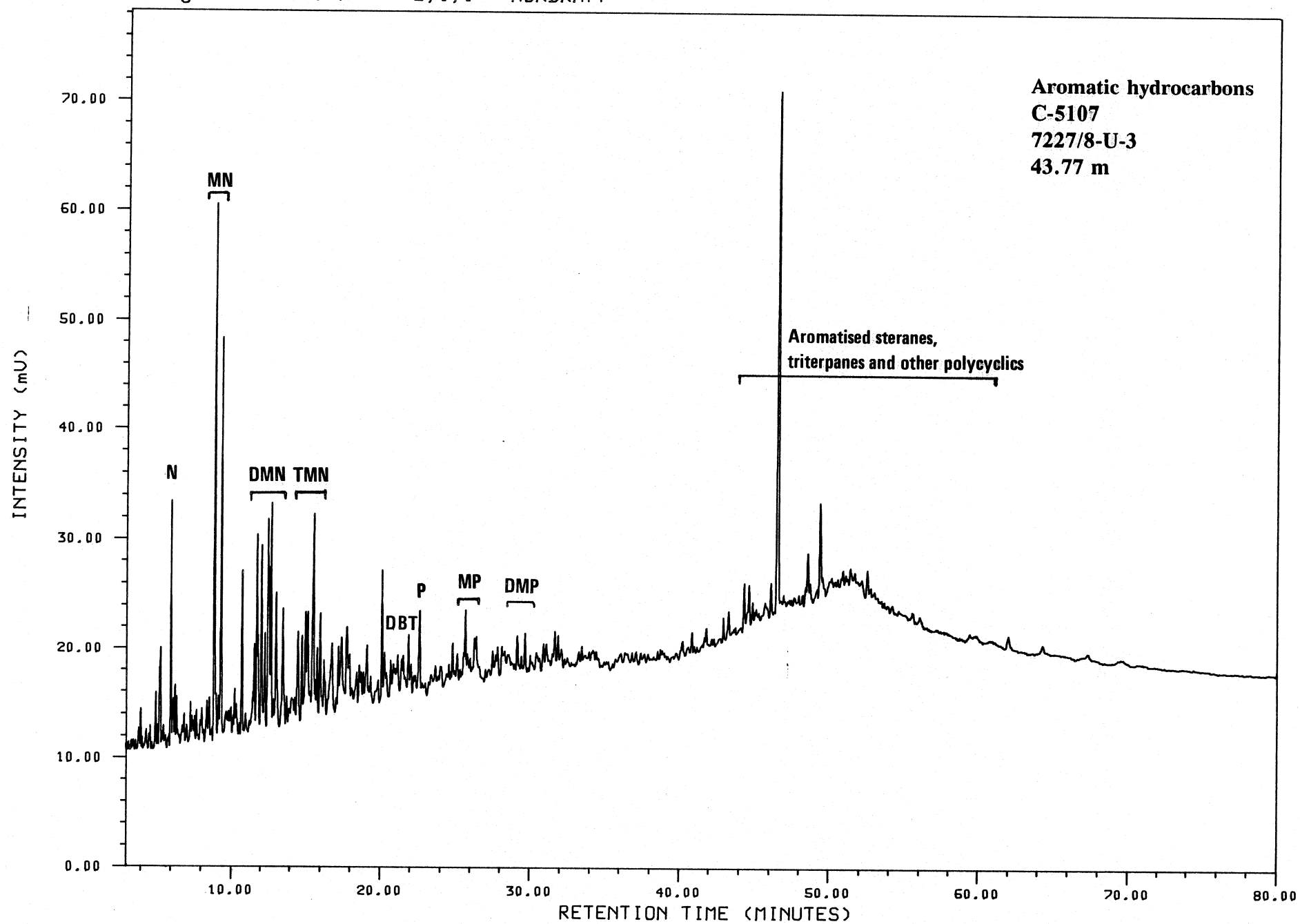
Analysis 419C5104A

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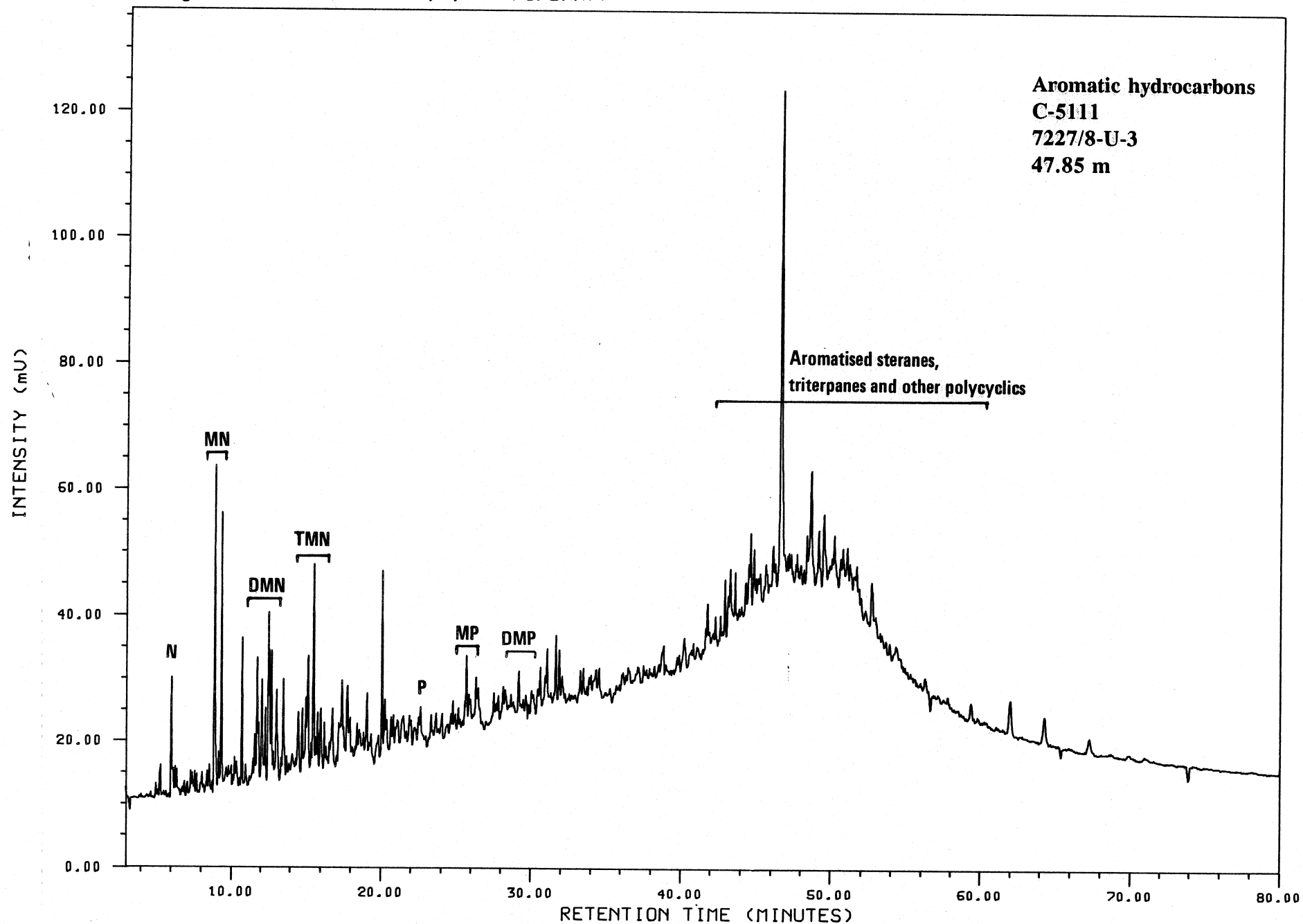


Analysis 419C5107A

2,1,1 NORDKAPP



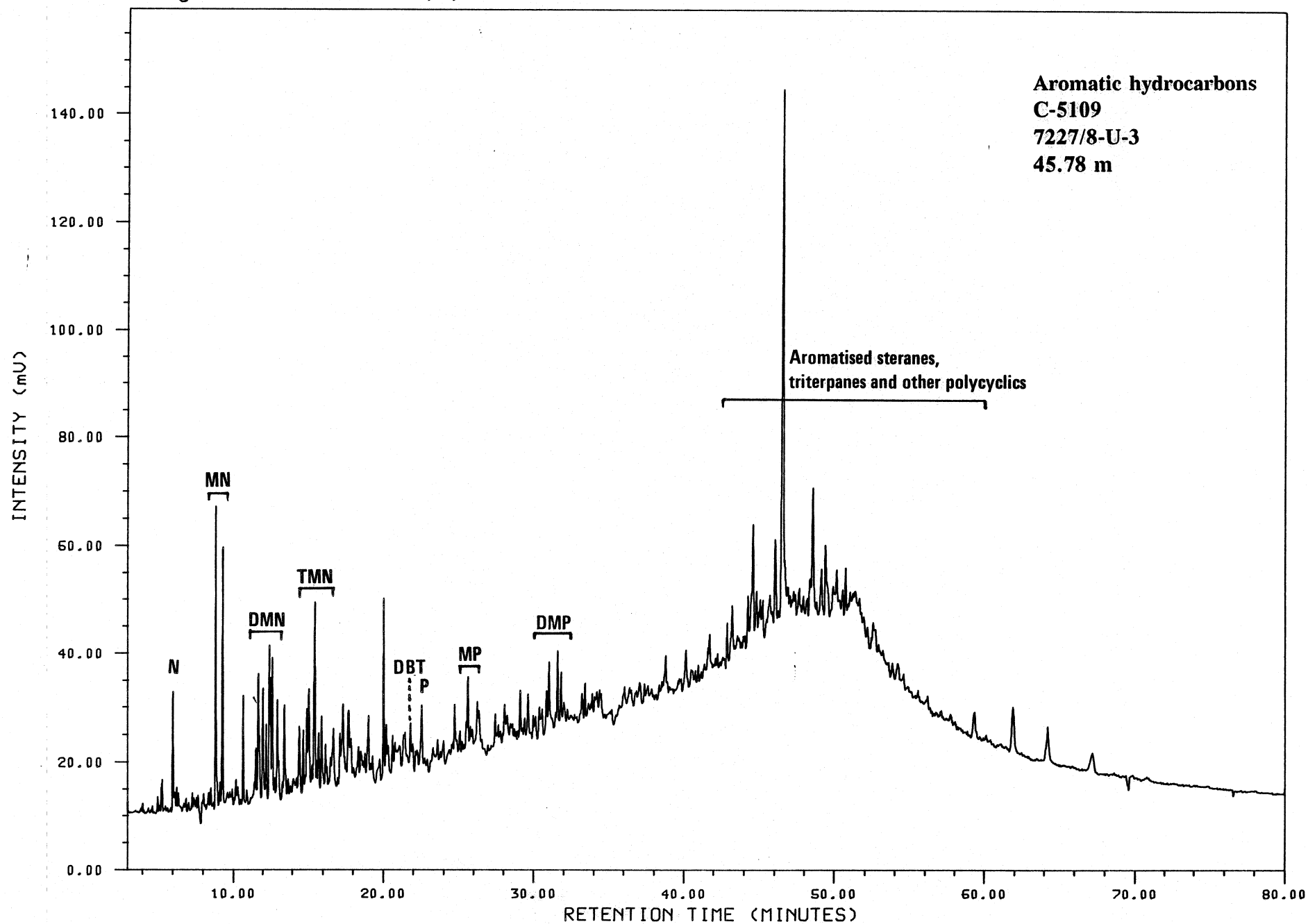
Analysis 419C5111A 2,1,1 NORDKAPP



Analysis 419C5109A

2,1,1

NORDKAPP



Analysis 419C5115A

2,1,1

NORDKAPP

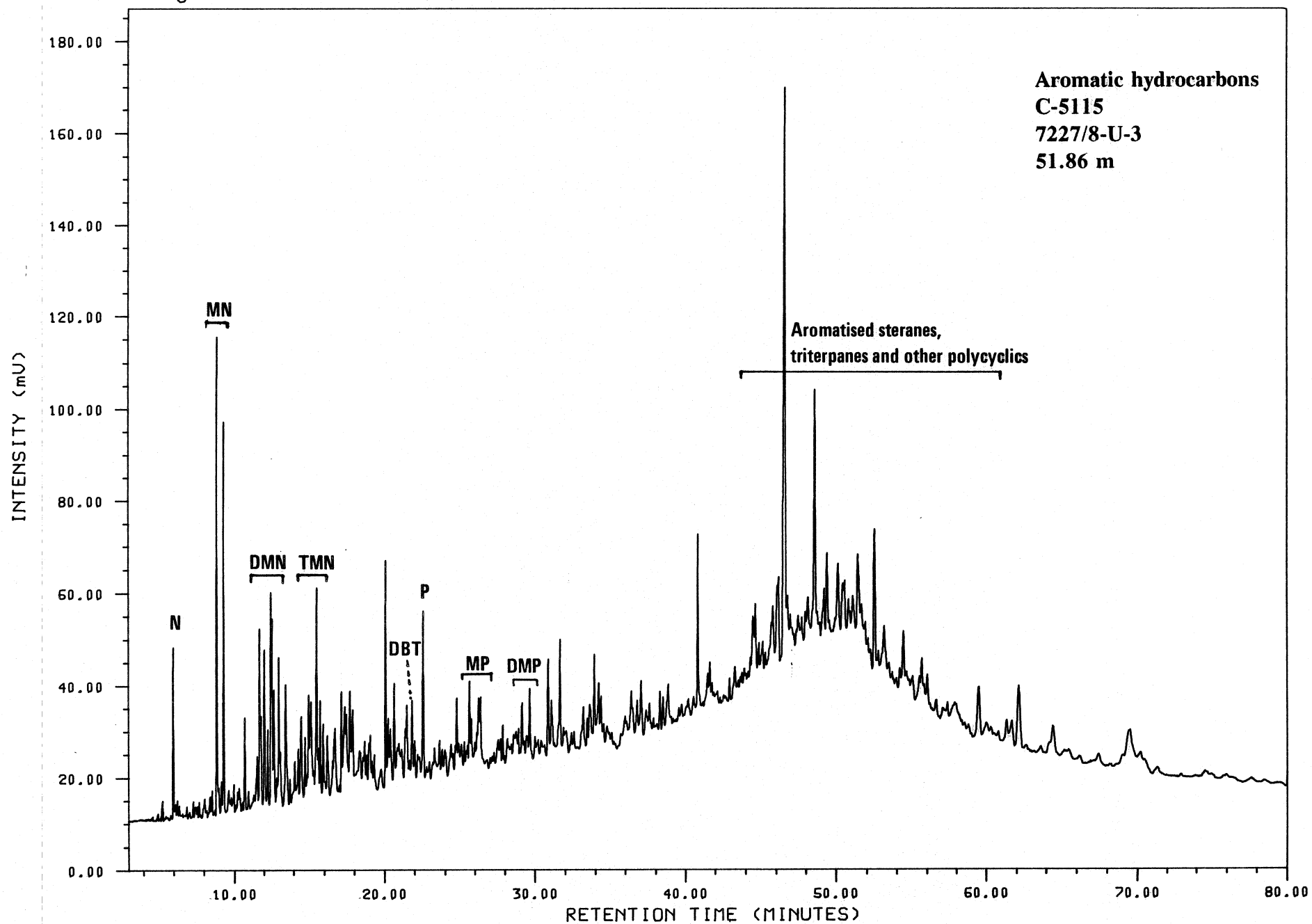
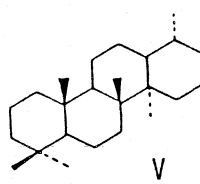
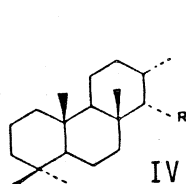
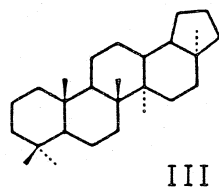
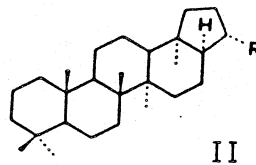
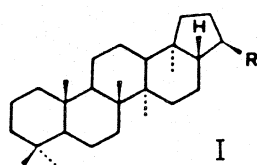


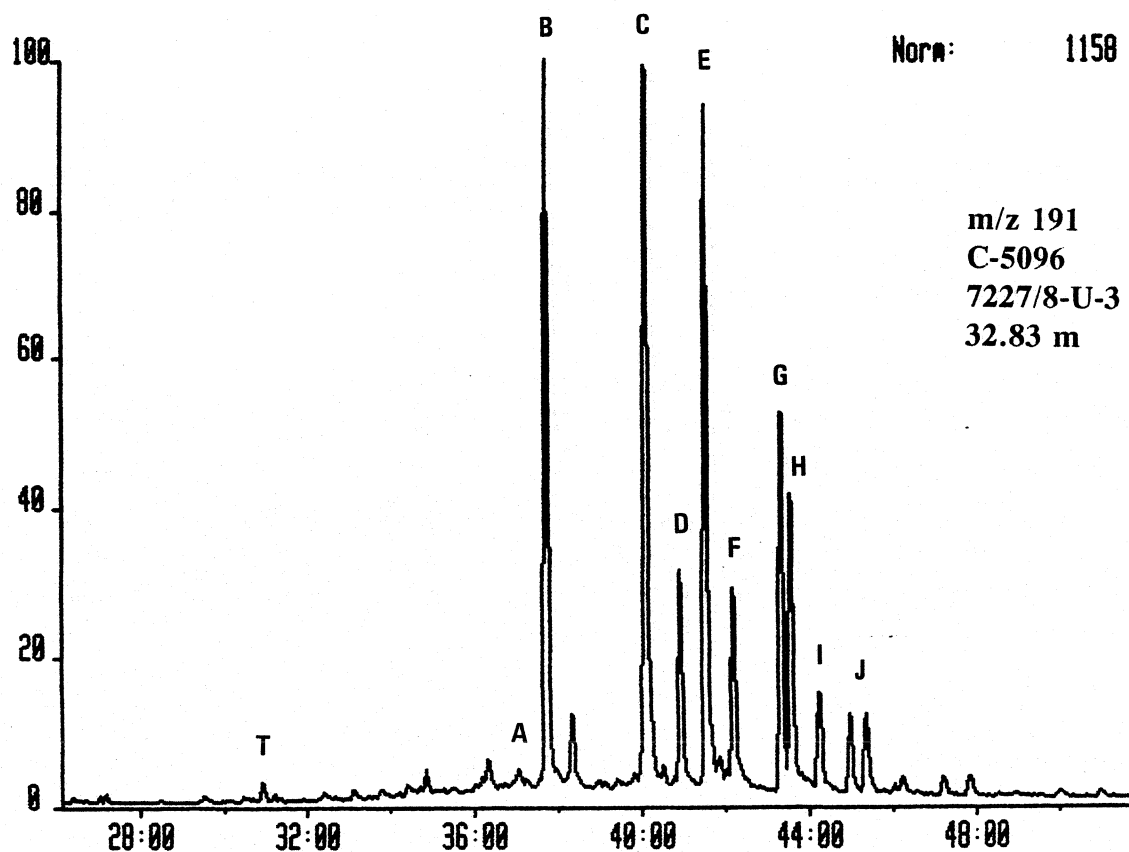
Figure A.II.3.4:
Mass chromatograms of terpanes (m/z 191)

A	T _S , 18α(H)-trisorneohopane	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)



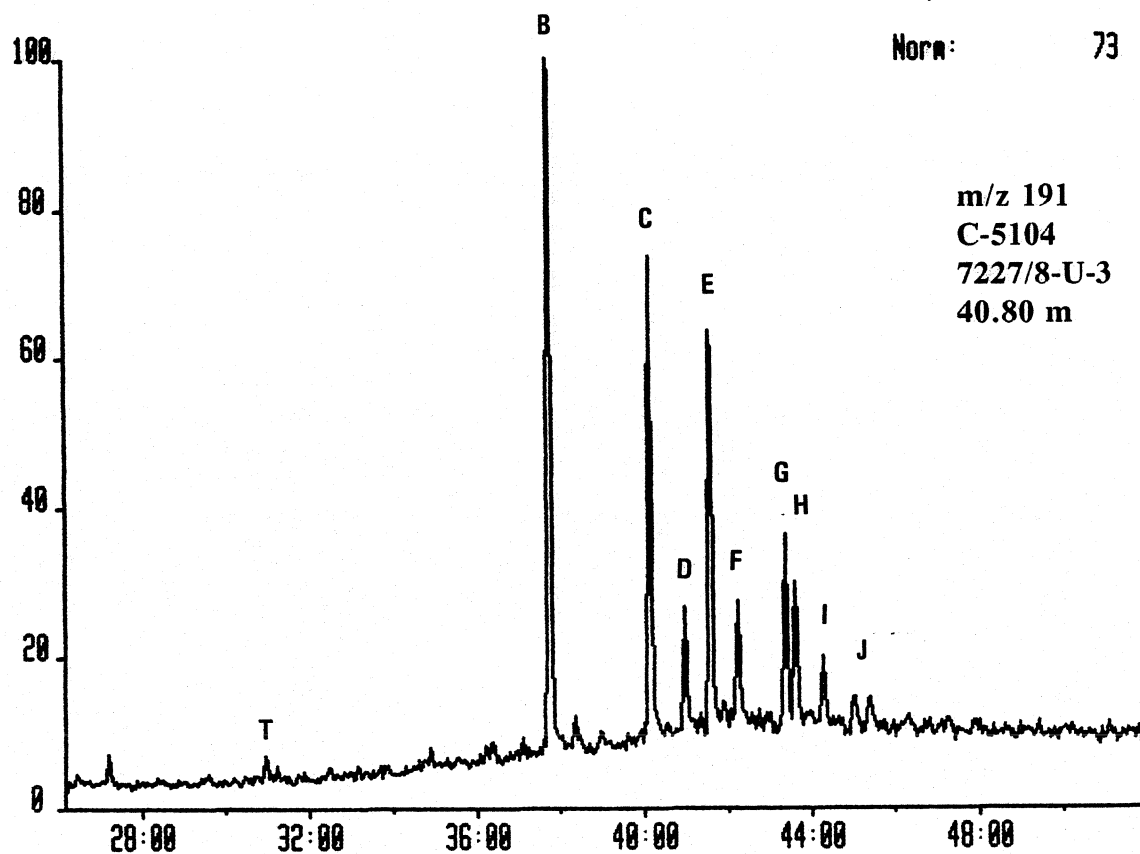
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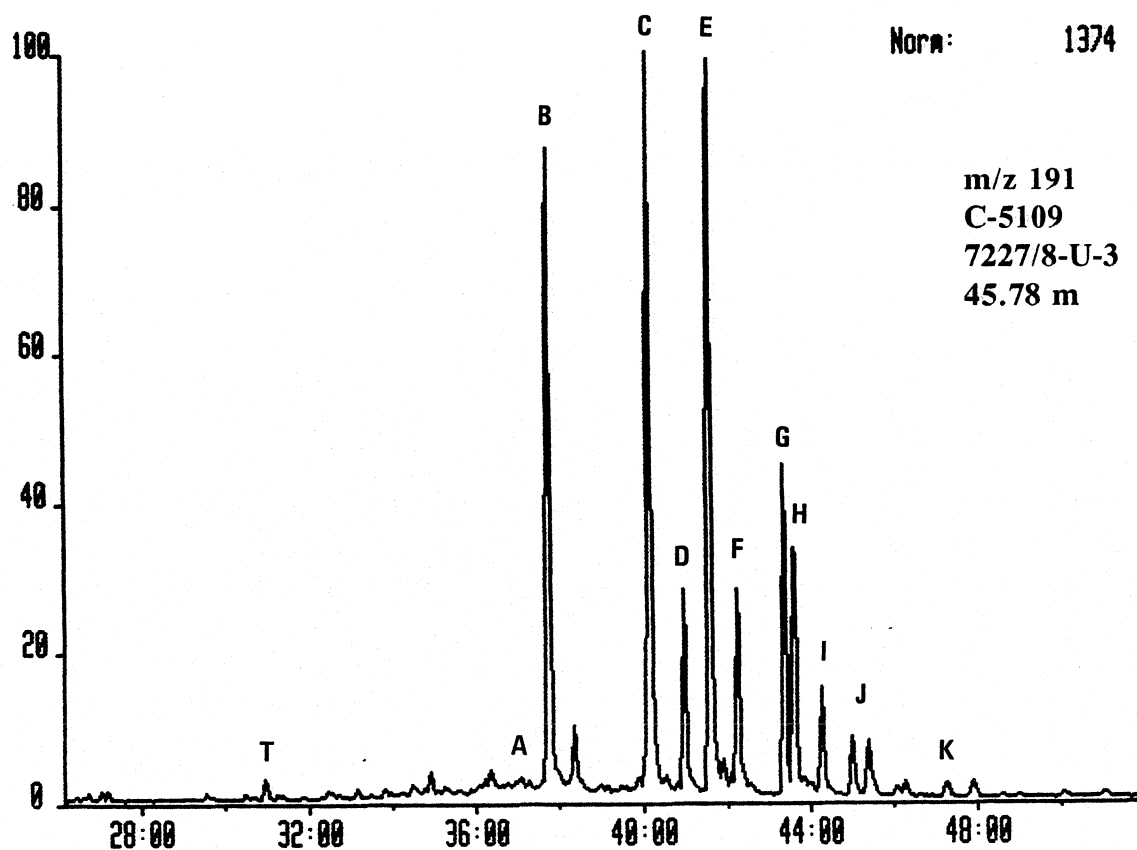
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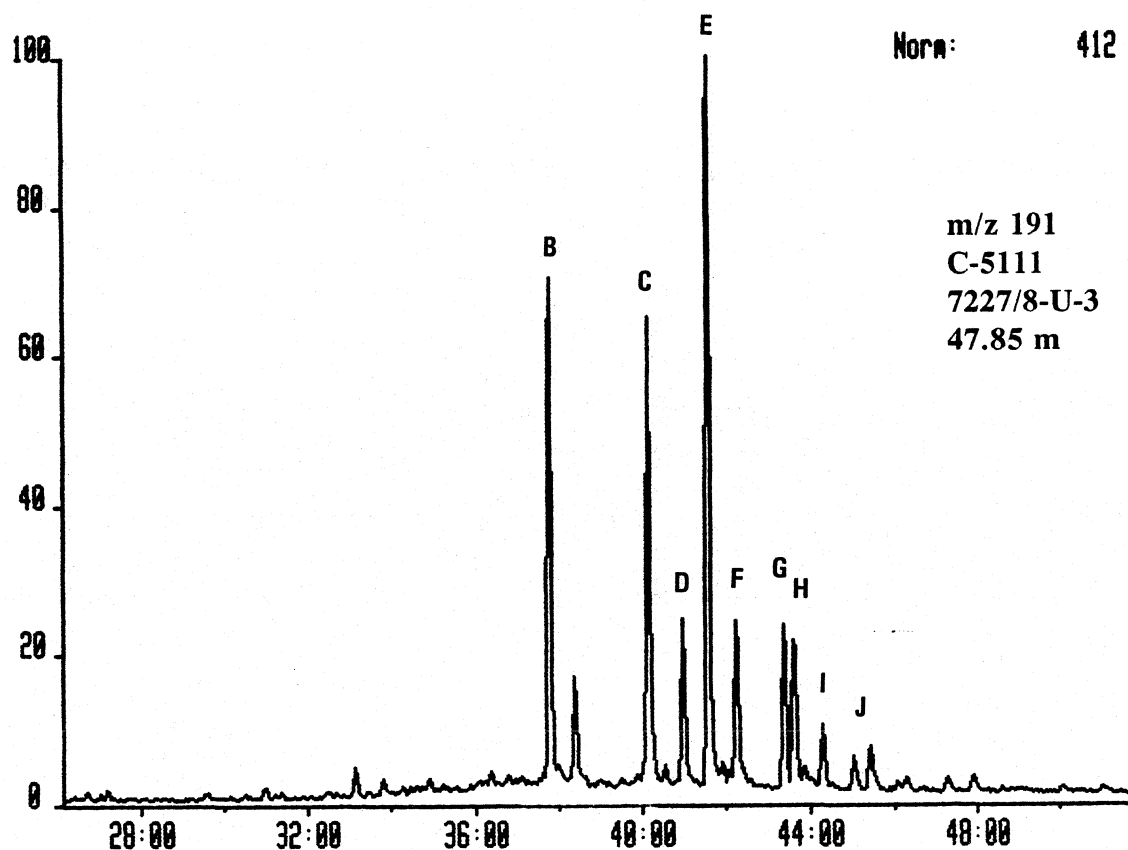
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Sample 1 Injection 1 Group 1 Mass 191.1000
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C5115SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
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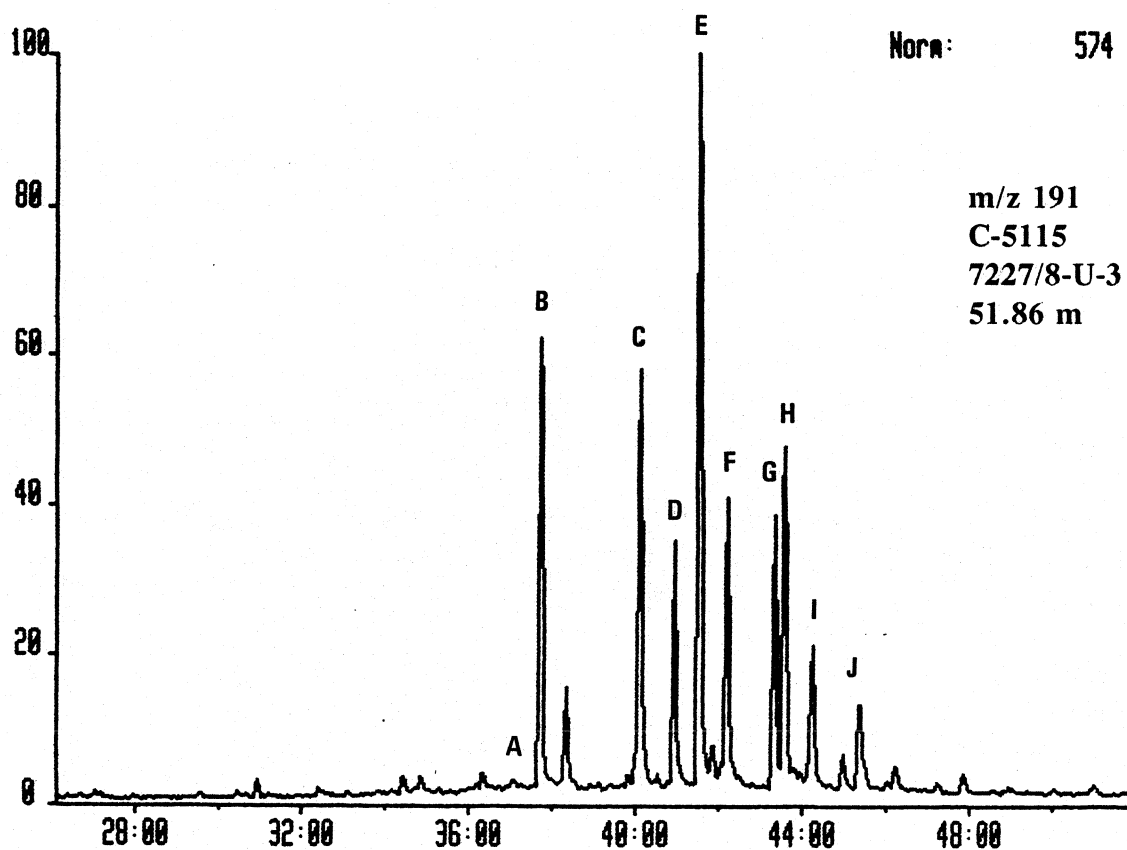
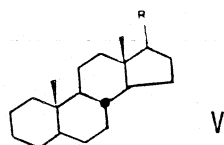
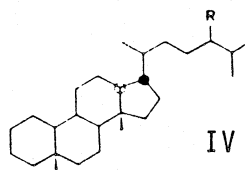
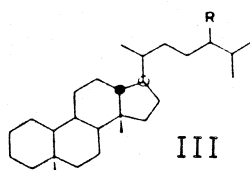
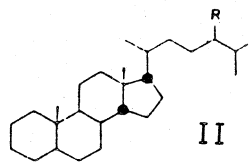
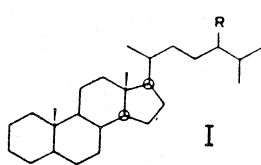


Figure A.II.3.5:

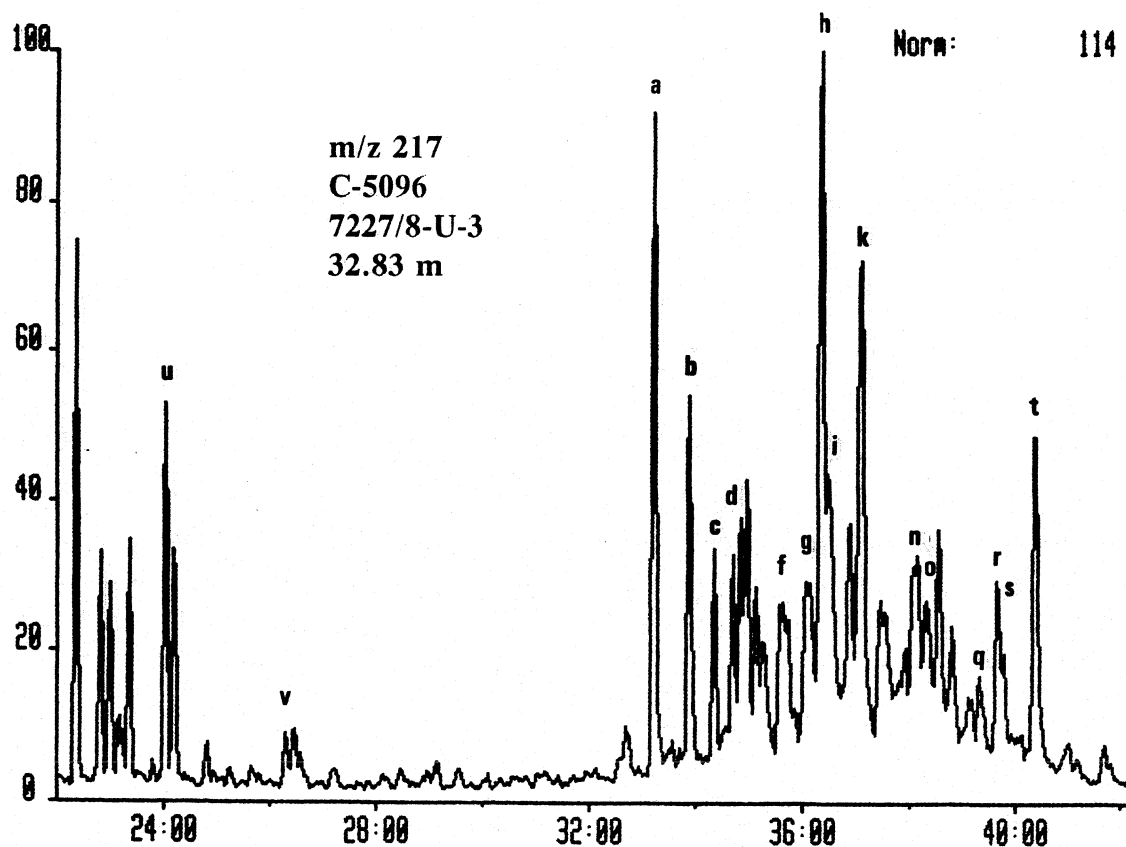
Mass chromatograms of steranes (m/z 217 and 218)

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 α (H),17 α (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)



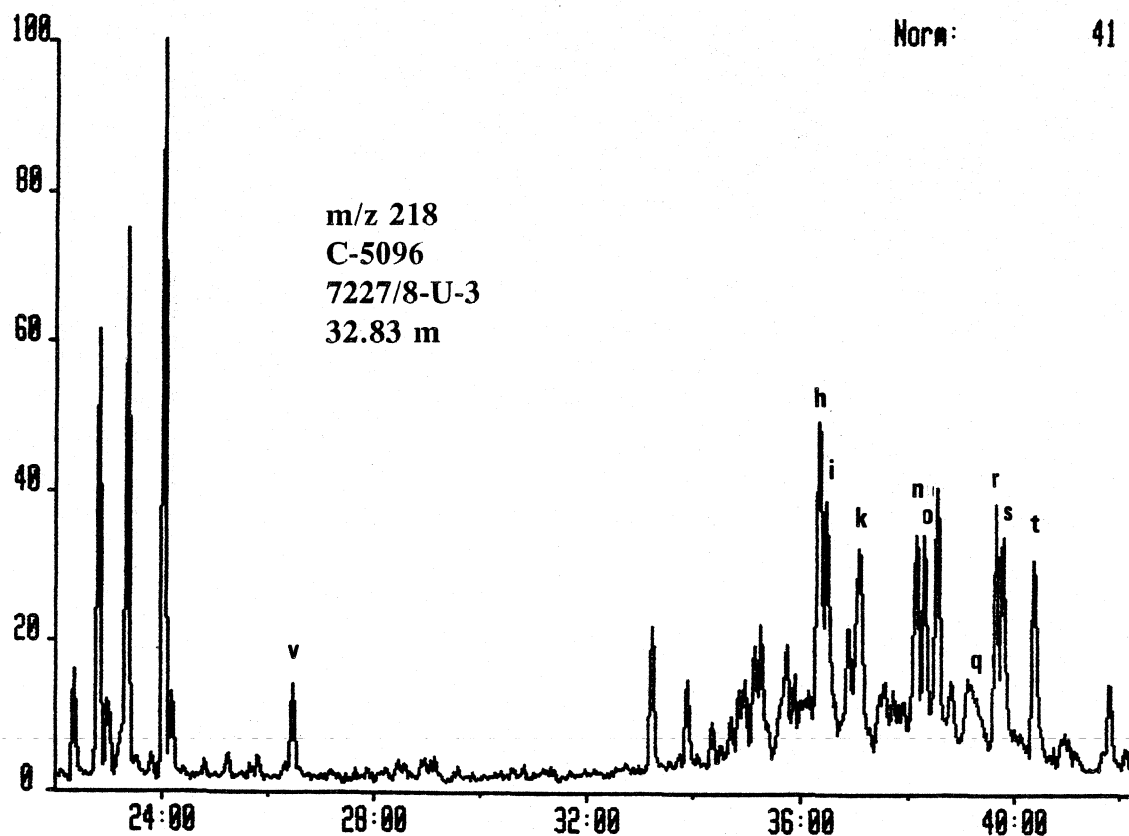
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Text:

System:TRIT



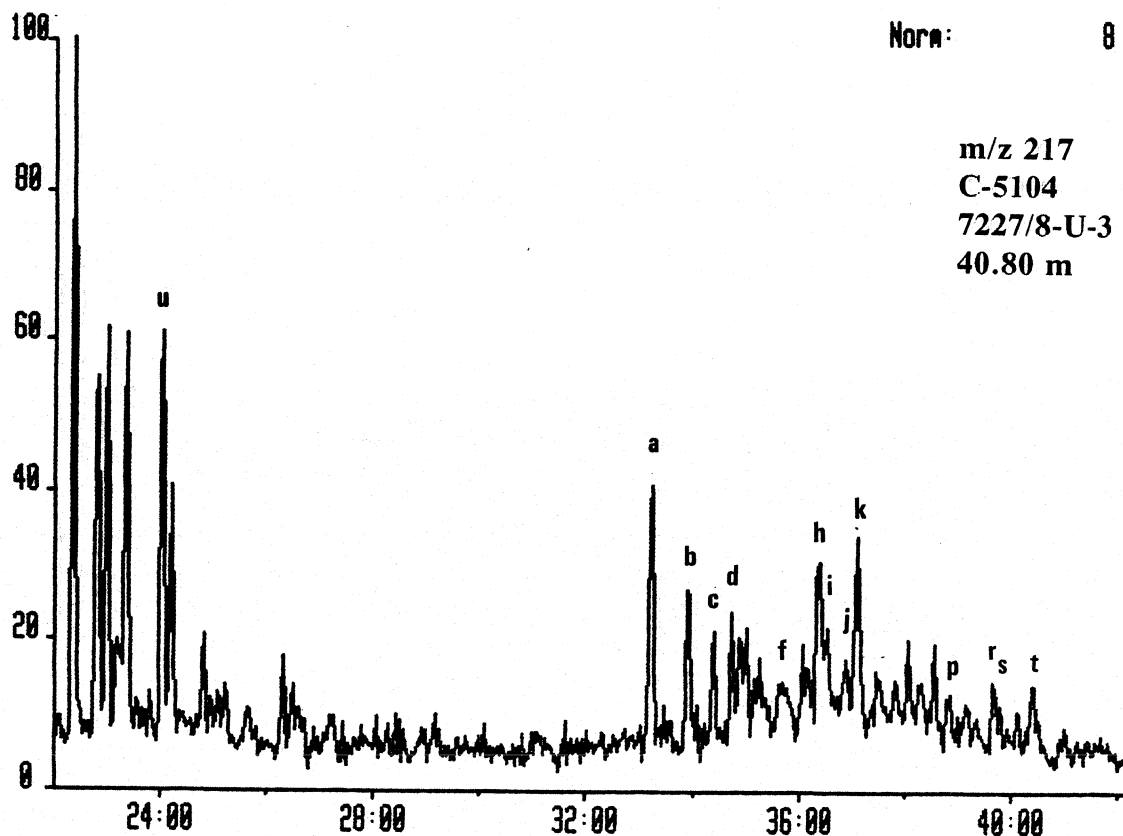
C5096SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT



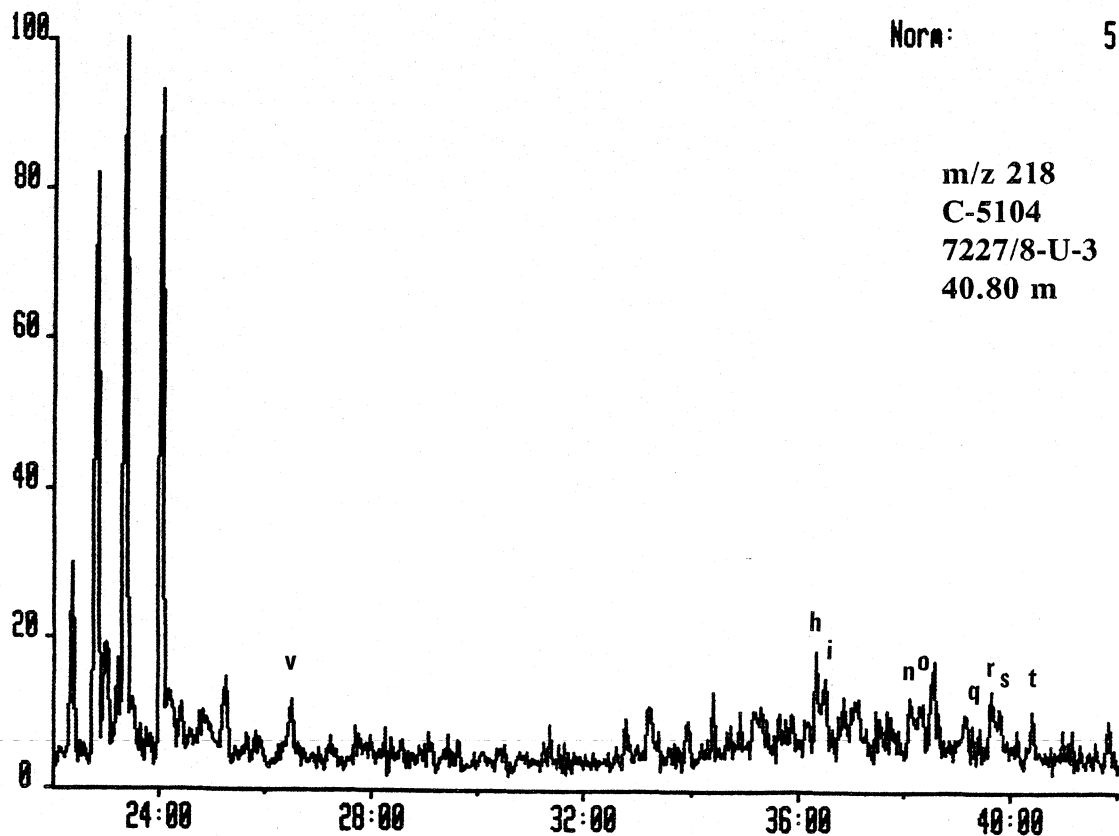
C5104SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

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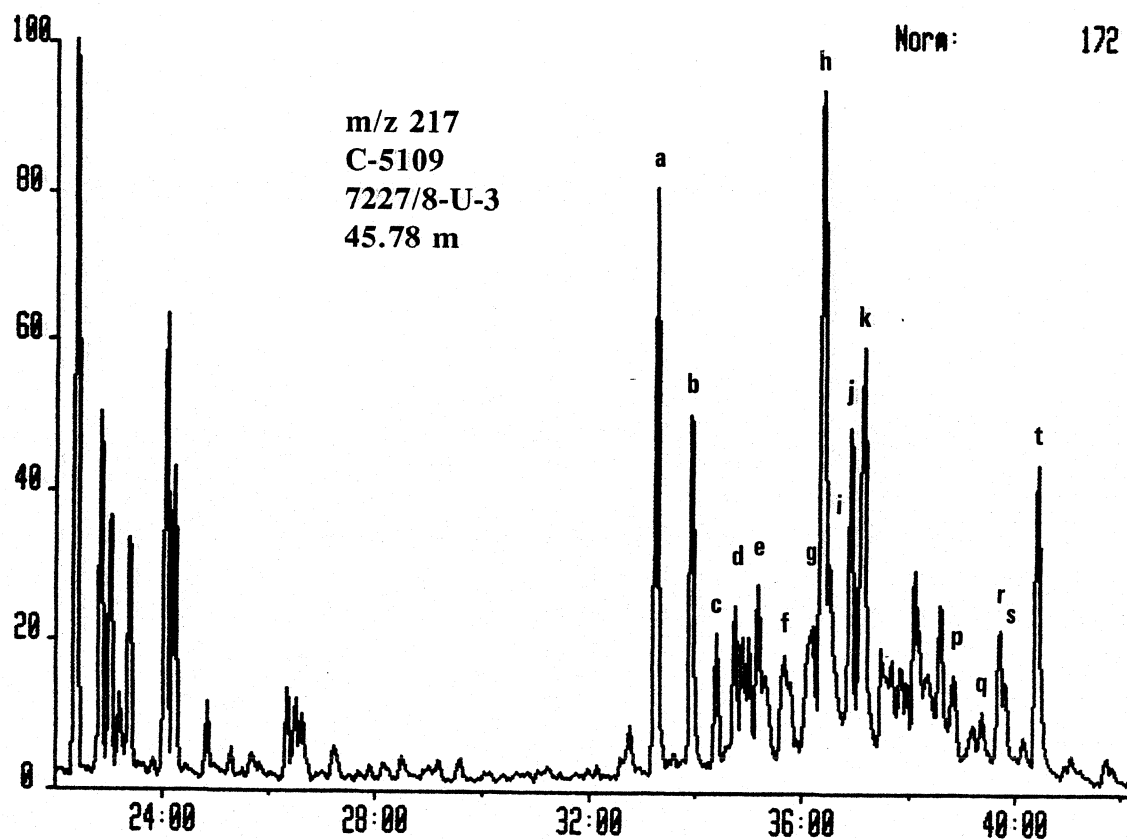
C5104SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
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Text:

System:TRIT



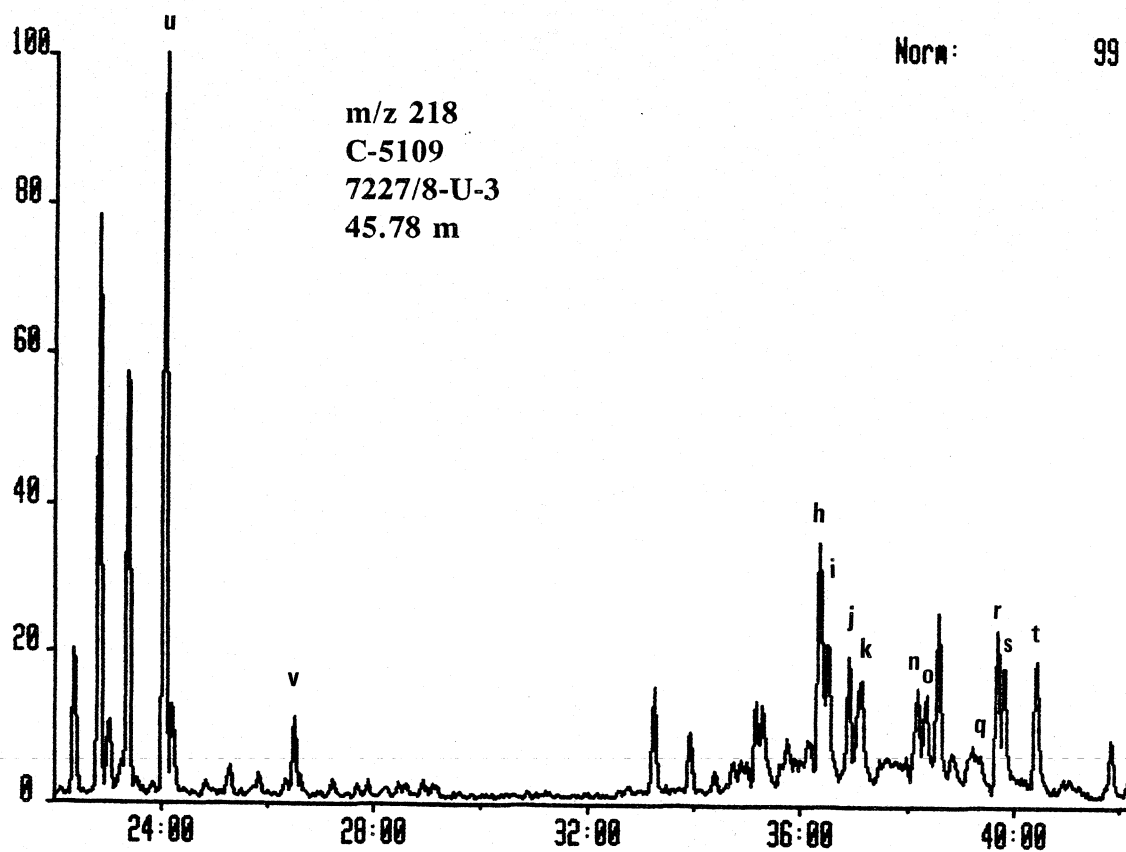
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Text:

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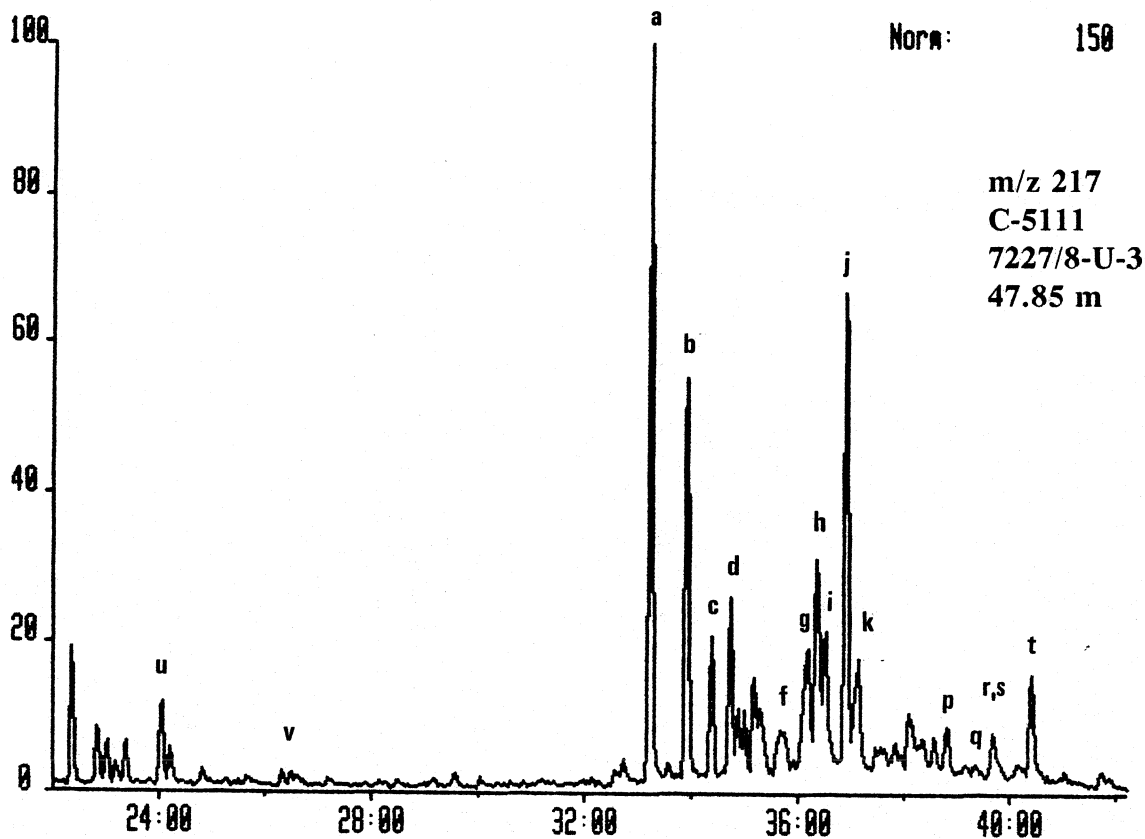
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Text:

System:TRIT



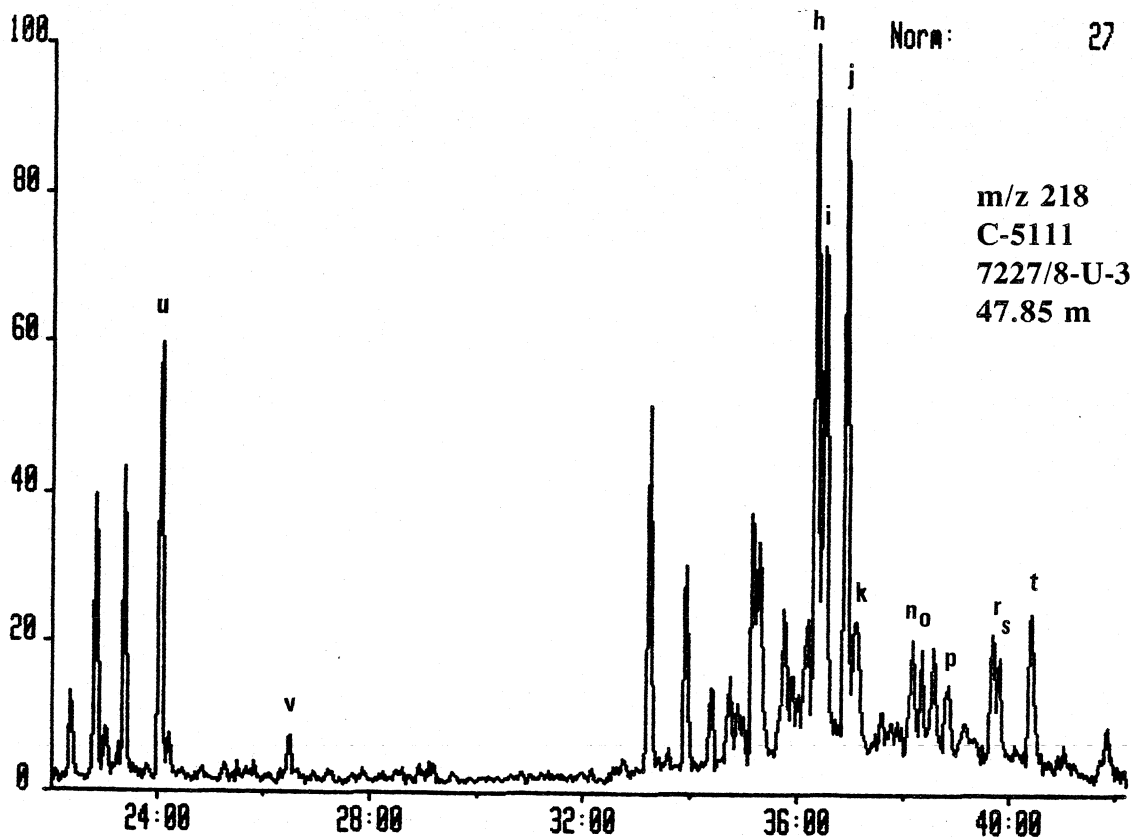
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Text:

System:TRIT



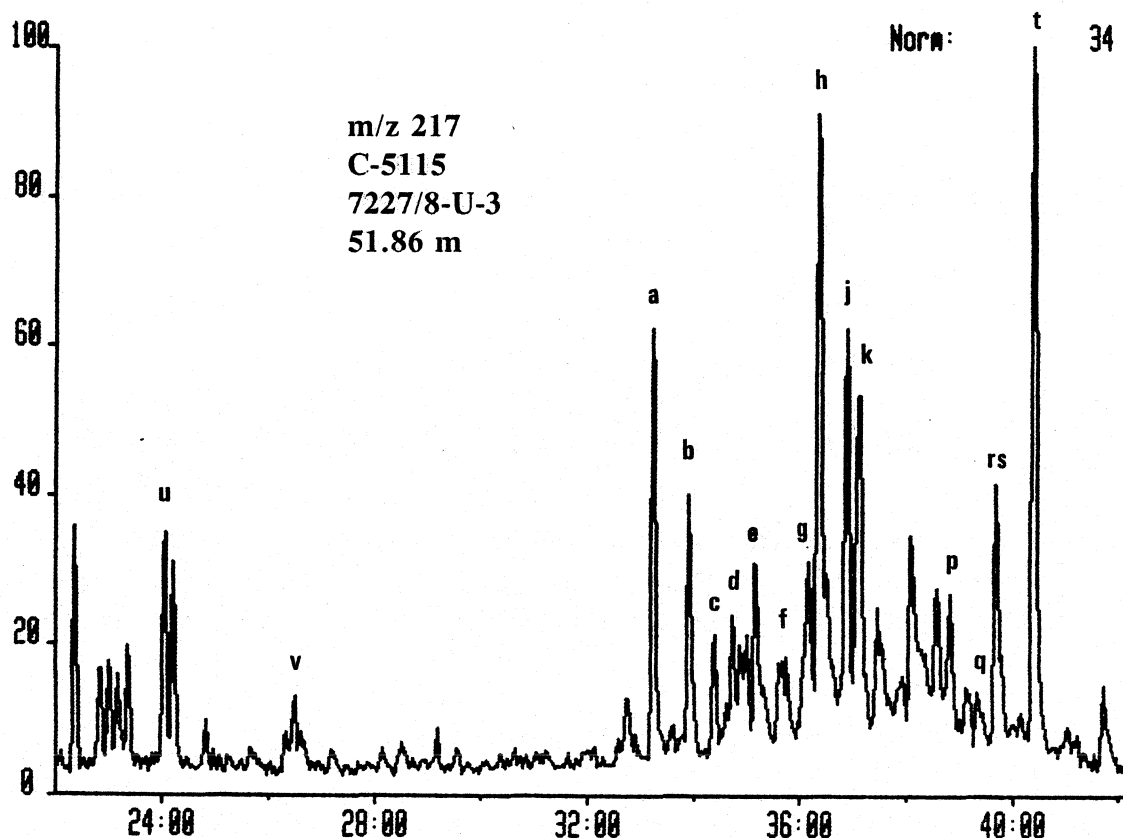
C5111SAT 8-JAN-86 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT



C5115SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



C5115SAT 7-JAN-86 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT

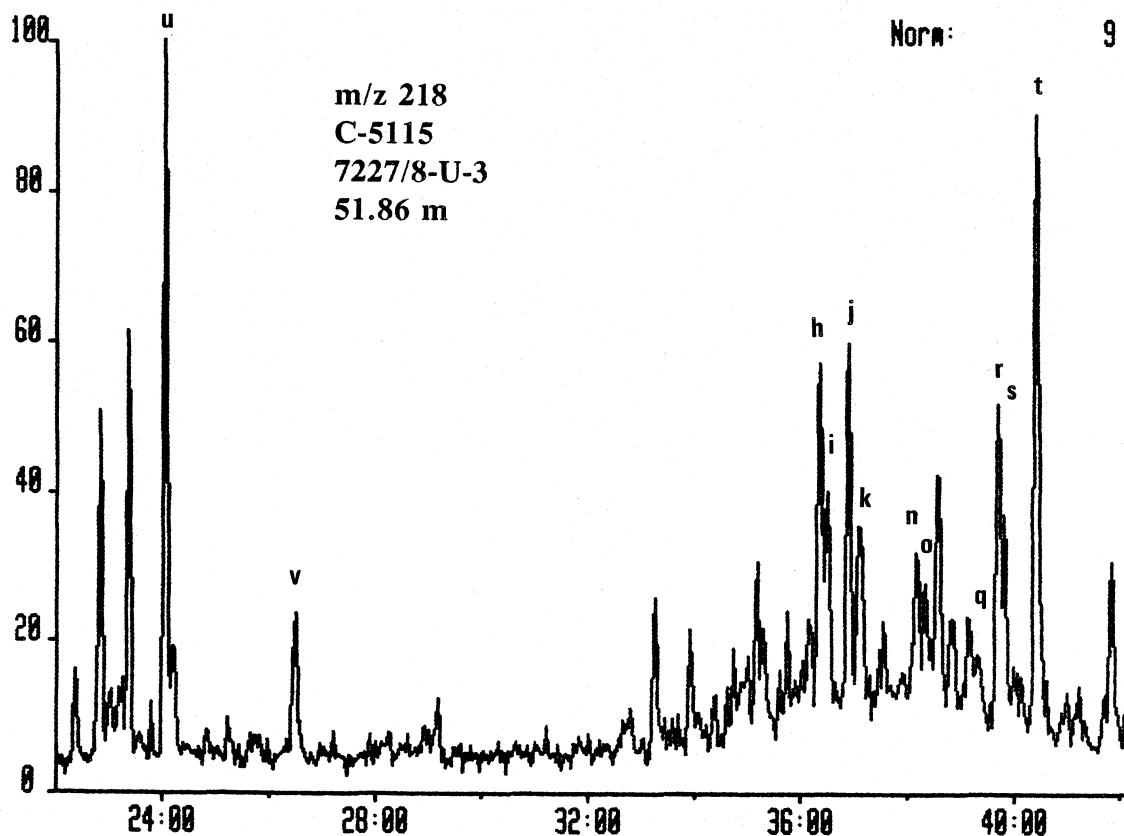


Figure A.II.3.6: VITRINITE REFLECTANCE HISTOGRAMS

Key: A = Grey-black-brown claystone.

 Upper case letters indicate values included in
 the main population. Lower case letters represent
 values in other populations.

 PP = Statistical data populations

 Y = Main population, not necessarily
 representative of sample maturity.

 N = Other populations.

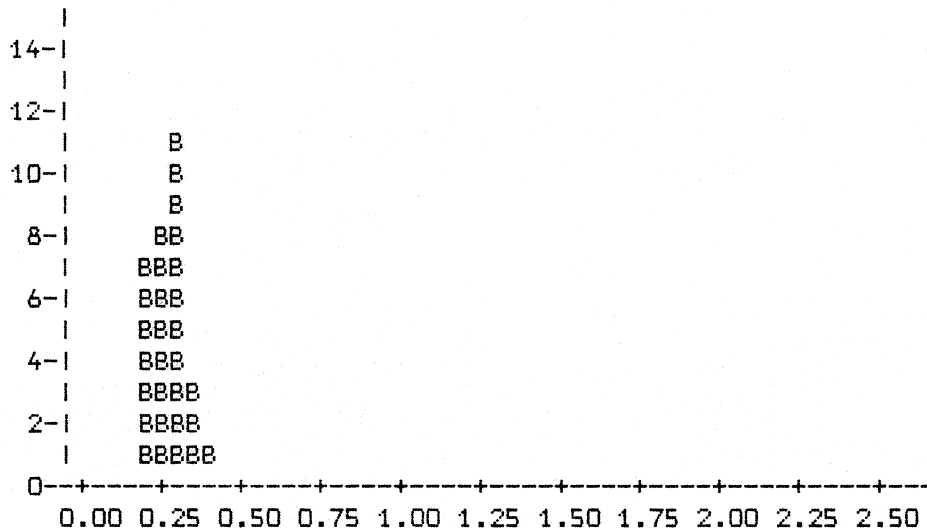
 LOW+ HIGH = Population limits.

 VAL. = Number of measurements in that
 population.

Lithology cross-reference table

A = Clst. gy
B = Clst. dk gy
C = Clst. gn
D = Clst. bn
E = Clst. rd
F = Clst. calc.
G = Clst. carb.
H = Shale
I = Sandstone
J = Limestone
K = Coal
L = Lignite
M = Carbargillite
N = Siltstone
O = Bit
P = X

IKU# C-5800 40.8M 7227/8-U-3



PP LOW HIGH LIT #VAL MEAN STDV
 Y 0.20 0.45 ALL 30 0.29 0.06
 OVERALL 30 0.29 0.06

ORDERED VALUES FOLLOW:

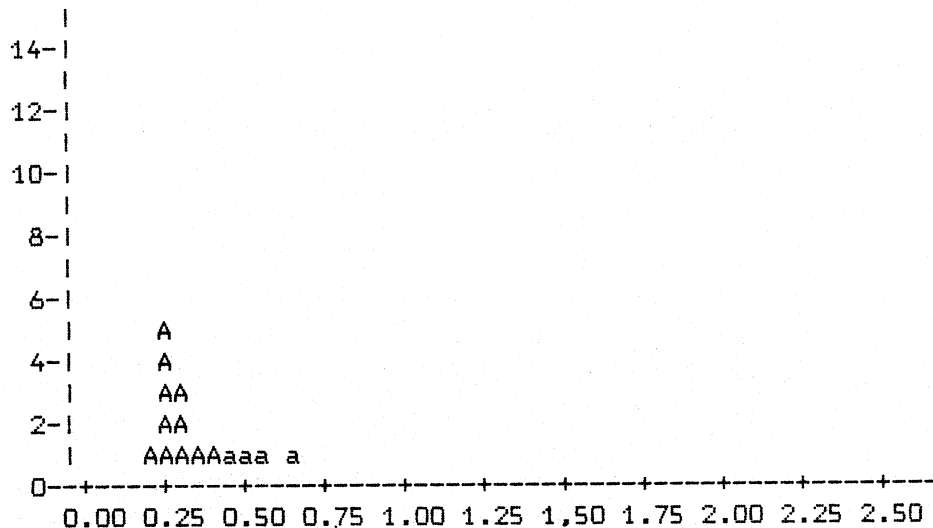
0.20B 0.21B 0.21B 0.21B 0.22B 0.22B 0.23B 0.25B 0.25B 0.25B 0.26B
 0.26B 0.26B 0.28B 0.29B 0.30B 0.30B 0.30B 0.30B 0.31B 0.32B 0.33B
 0.34B 0.34B 0.34B 0.34B 0.35B 0.36B 0.39B 0.44B

14-		
12-		
10-		
		D
8-		D
		D
6-		DD
		DDD
4-		DDD
		DDD
2-		DDDD
		DDDDDD

```
PP LOW HIGH LIT #VAL MEAN STDV
Y 0.19 0.41 ALL 24 0.27 0.06
OVERALL 24 0.27 0.06
```

0.190 0.210 0.210 0.210 0.220 0.230 0.230 0.230 0.240 0.240 0.250
0.250 0.260 0.260 0.280 0.290 0.300 0.300 0.330 0.340 0.340 0.370
0.390 0.400

IKU# C-5115 51.9M 7227/8-U-3



PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.21	0.41	ALL	11	0.30	0.05
N	0.47	0.69	ALL	4	0.56	0.09
OVERALL				15	0.37	0.13

ORDERED VALUES FOLLOW:

0.21A	0.26A	0.27A	0.28A	0.29A	0.29A	0.33A	0.33A	0.33A	0.35A	0.40A
0.47a	0.54a	0.57a	0.68a							

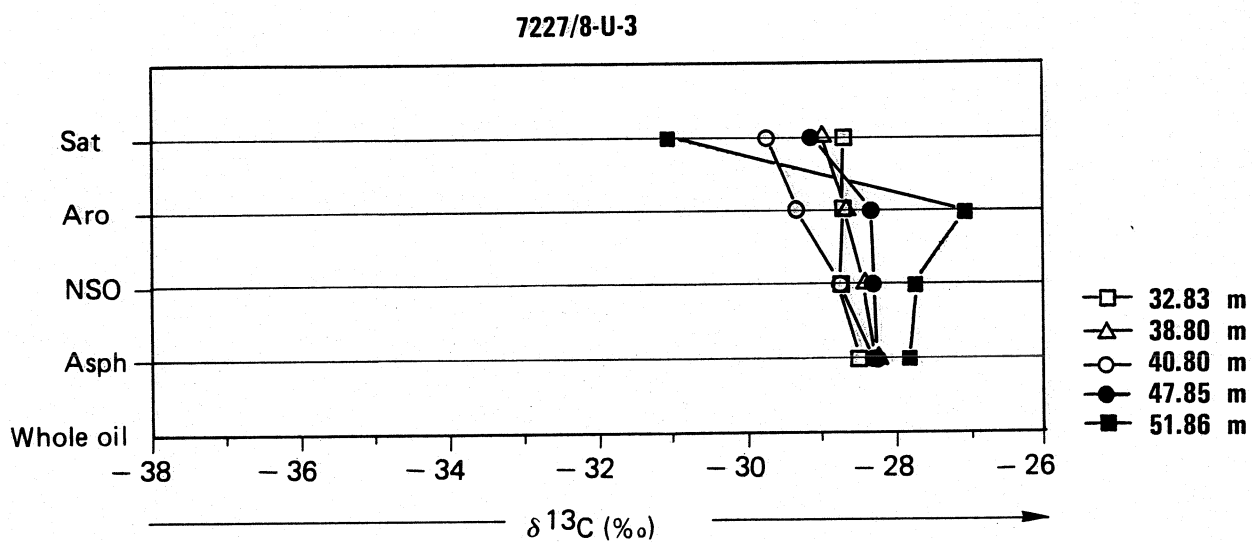


Figure A.II.3.7: δ¹³C isotope profile for extract fractions.

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Core 7227/8-U-2:

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Table A.II.4.3: Data from pyrolysis-gas chromatograms.
Table A.II.4.4: Vitrinite reflectance data.
Table A.II.4.5: Weight of EOM and chromatographic fractions.
Table A.II.4.6: Concentration of EOM and chromatographic fractions, related to rock weight.
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 DATE : 2 - 12 - 86.

Table A.II.4.1:

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

I	IKU	DEPTH	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 ----- nC4	I
I	no.	m											I
I	C 5137	39.48	372	52	69				493	120	24.45	*****	I
I	C 5138	42.33	285	39	50				374	89	23.82	*****	I
I	C 5139	43.76	269	36	44		24		373	104	27.85	0.00	I
I	C 5140	47.29	238	30	33			89	300	63	20.93	*****	I

Table A.II.4.2:

7227/8-U-2

DATA FROM ROCK EVAL PYROLYSIS

I		:					HYDR.	OXYGEN	PETROLEUM	PROD.	TEMP.	I		
I	IKU	DEPTH	:	S1	S2	S3	TOC	INDEX	INDEX	POTENTIAL	INDEX	MAX	I	
I	No.	:	:								S1		I	
I		:	:								-----		I	
I		m/ft	:	(	mg/g ROCK	)	(%)	(	mg/g TOC	)	S1+S2	S1+S2	(C)	I
I			:										I	
I	C 5198	32.60	:	0.03	0.36	1.44	0.83	43	173	0.39	0.08	422	I	
I			:										I	
I	C 5199	33.50	:	0.02	0.25	0.93	0.62	40	150	0.27	0.07	429	I	
I			:										I	
I	C 5200	34.43	:	0.03	0.16	0.09	0.73	22	12	0.19	0.16	(401)	I	
I			:										I	
I	C 5201	35.80	:	0.01	0.29	0.19	0.50	58	38	0.30	0.03	446	I	
I			:										I	
I	C 5202	36.67	:	0.02	0.27	0.14	0.79	34	18	0.29	0.07	(455)	I	
I			:										I	
I	C 5203	37.85	:	0.01	0.10	0.41	0.49	20	84	0.11	0.09	(453)	I	
I			:										I	
I	C 5204	38.90	:	0.02	0.23	0.17	0.88	26	19	0.25	0.08	416	I	
I			:										I	
I	C 5205	39.80	:	0.02	0.23	0.28	0.97	24	29	0.25	0.08	434	I	
I			:										I	
I	C 5206	41.24	:	0.03	0.18	0.19	0.68	26	28	0.21	0.14	448	I	
I			:										I	
I	C 5207	42.70	:	0.02	0.16	0.13	0.73	22	18	0.18	0.11	425	I	
I			:										I	
I	C 5208	43.60	:	0.01	0.13	0.23	0.54	24	43	0.14	0.07	(472)	I	
I			:										I	
I	C 5209	44.50	:	0.03	0.23	0.35	0.84	27	42	0.26	0.12	438	I	
I			:										I	
I	C 5210	45.54	:	0.01	0.21	0.47	0.67	31	70	0.22	0.05	428	I	
I			:										I	
I	C 5211	46.70	:	0.00	0.03	0.67	0.18	17	(372)	0.03	0.00	443	I	
I			:										I	
I	C 5212	47.31	:	0.01	0.23	0.18	0.57	40	32	0.24	0.04	(530)	I	
I			:										I	

Table A.II.4.3: Data from pyrolysis-gas chromatograms.

Core 7227/8-U-2

Sample Nr.	Depth (m)	I I	TOC (%)	I I	C1 -	C2-C5 (a r e a %)	C6-C14 -	C15+ -	I I	(m+p)-xylene/ n-octene (pkht/pkht)
C-5201	35.80	I	0.50	I	- no reliable data obtained					I --
C-5205	39.80	I	0.97	I					I	0.58
C-5209	44.50	I	0.84	I	23.14	57.89	18.98	0.00	I	1.00

Table A.II.4.4:

Well Identification: 7227/8-U-2
Reference number: 21.3419.15
(1/1)

VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
C 5204	----	38.9	0.91 (3)	R	0.11	3?
C 5205	----	39.8	0.64 (5)	R	0.10	5-6?
C 5209	----	44.5	0.28 (5)	P	0.09	2-3,6
			0.77 (2)	R	0.00	
			1.19 (1)	R	0.00	

REL RAT (Reliability Rating): G = Good; F = Fair; P = Poor
S = Stained; R = Reworked.

Project no.: 21.3419.15
Well ident.: 7227/8-U-2
DATE : 6 - 1 - 87.

Table A.II.4.5:

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)	
		Extr. (g)							
C 5200	34.43	22.3	7.5	0.7	1.4	2.2	5.3	0.95	
C 5205	39.80	25.4	1.3	0.7	1.2	1.9	***	0.94	
C 5206	41.24	62.1	5.1	0.4	1.1	1.4	3.7	0.74	
C 5209	44.50	23.4	8.8	0.8	1.8	2.6	6.2	0.84	

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 DATE : 6 - 1 - 87.

Table A.II.4.6:

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKU-No	DEPTH (m)	:	EOM	Sat.	Aro.	HC	Non HC
C 5200	34.43	:	337	32	65	97	240
C 5205	39.80	:	51	28	47	76	***
C 5206	41.24	:	82	6	17	23	59
C 5209	44.50	:	376	36	77	113	263

Table A.II.4.7:

(mg/g TOC)

I	I	I	I	I	I	I	I
	IKU-No	DEPTH	EOM	Sat.	Arg.	HC	Non HC
		(m)					
I							
I	C 5200	34.43	35.4	3.4	6.8	10.2	25.2
I							
I	C 5205	39.80	5.4	3.0	5.0	8.0	****
I							
I	C 5206	41.24	11.1	0.8	2.3	3.1	8.0
I							
I	C 5209	44.50	44.8	4.3	9.2	13.4	31.4
I							

Project no.: 21.3419.15
 Well ident.: 7227/8-U-2
 DATE : 6 - 1 - 87.

Table A.II.4.8:

COMPOSITION OF MATERIAL EXTRACTED FROM THE ROCK

I			:	Sat	Aro	HC	SAT	Non HC	HC	I
I	IKU-No	DEPTH	:	---	---	---	---	---	---	I
I			:	EOM	EOM	EOM	Aro	EOM	Non HC	I
I		(m)	:	%	%	%	x 100	%	x 100	I
I			:							I
I	C 5200	34.43	:	9.6	19.2	28.8	50.0	71.2	40.4	I
I			:							I
I	C 5205	39.80	:	***	****	****	60.0	****	****	I
I			:							I
I	C 5206	41.24	:	7.1	21.2	28.2	33.3	71.8	39.3	I
I			:							I
I	C 5209	44.50	:	9.5	20.5	30.0	46.7	70.0	42.9	I
I			:							I

Table A.II.4.9:

TABULATION OF DATA FROM THE GAS CHROMATOGRAMS

7227/8-U-2

I	DEPTH	:	PRISTANE	PRISTANE	PHYTANE	A	n-C17		I
I	IKU No.	:	-----	A = -----	B = -----	-----	-----	CPI	I
I	(m)	:	PHYTANE	n-C17	n-C18	B	n-C27		I
I		:							I
I	C 5200	34.43	1.1	1.1	0.7	1.6	1.7	1.3	I
I		:							I
I	C 5205	39.80	1.1	0.9	0.8	1.1	1.5	1.2	I
I		:							I
I	C 5206	41.24	0.7	0.6	0.6	1.1	1.4	1.1	I
I		:							I
I	C 5209	44.50	0.9	0.9	0.7	1.2	1.9	1.1	I
I		:							I

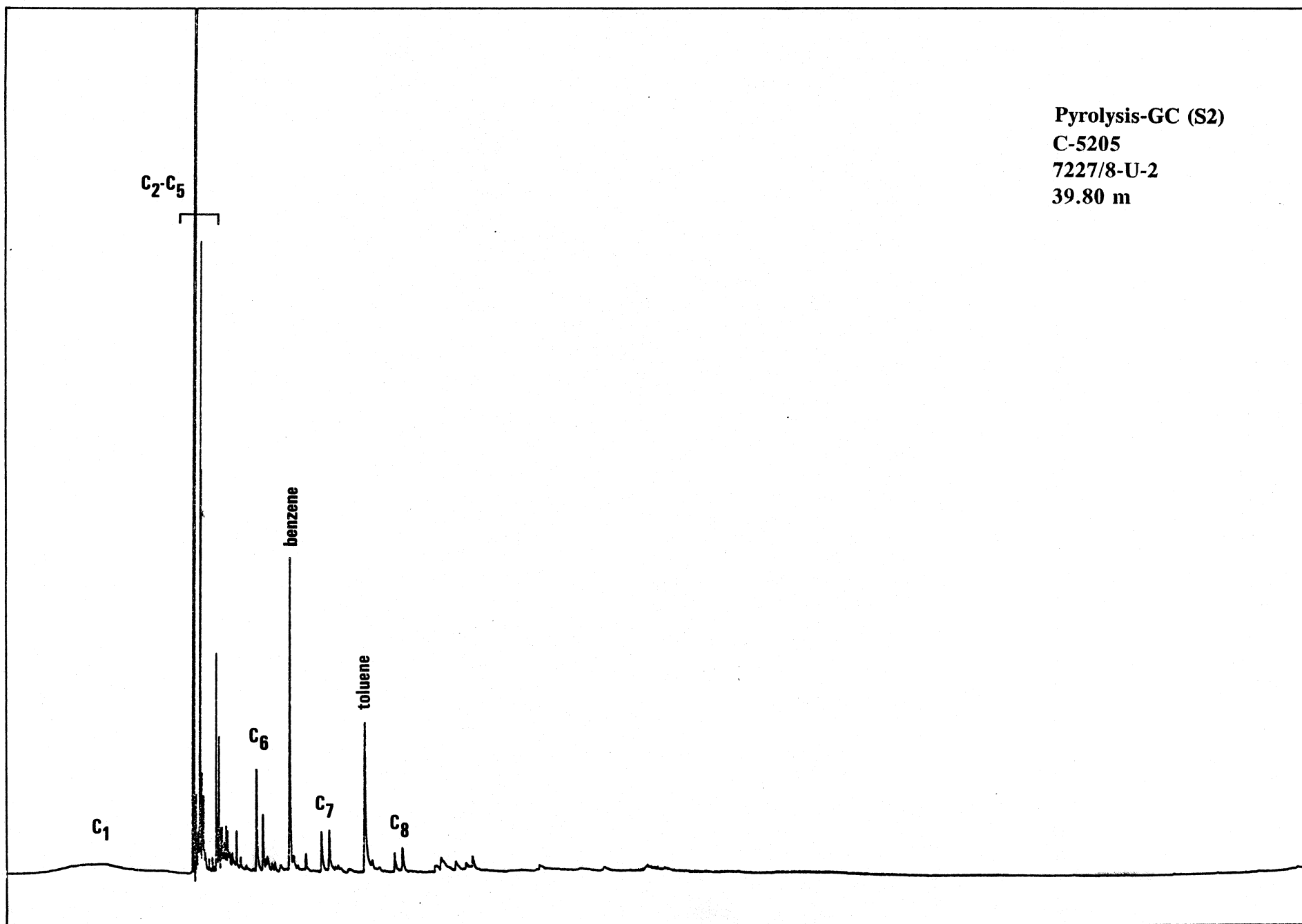
Figure A.II.4.1: Pyrolysis-gas chromatograms (S2 peak).

Pyrolysis-GC (S2)
C-5201
7227/8-U-2
35.80 m

C₂-C₅

benzene

Pyrolysis-GC (S2)
C-5205
7227/8-U-2
39.80 m



analysis 419C5209P 11,1,1 7227/8-U-2,C5209

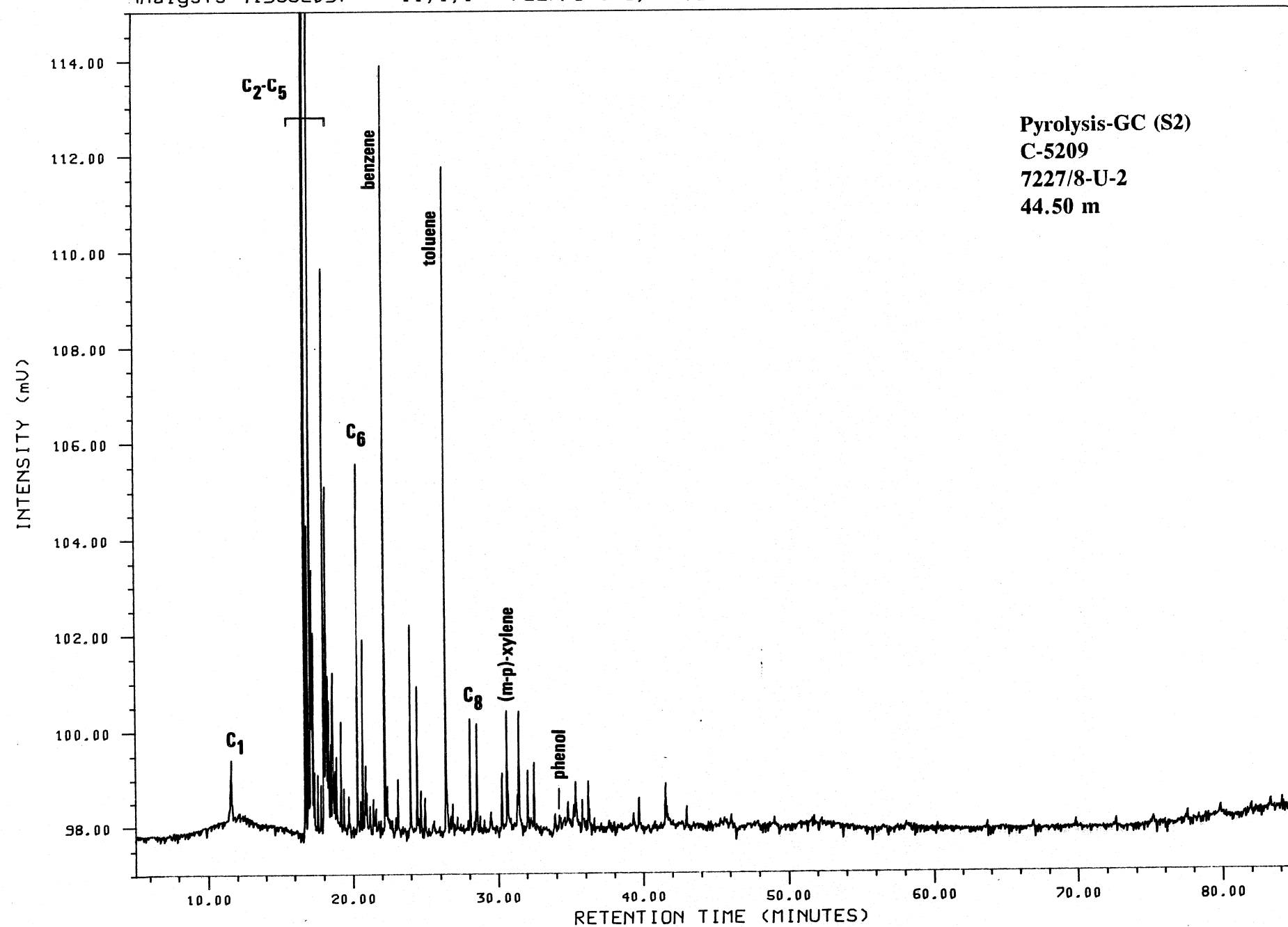
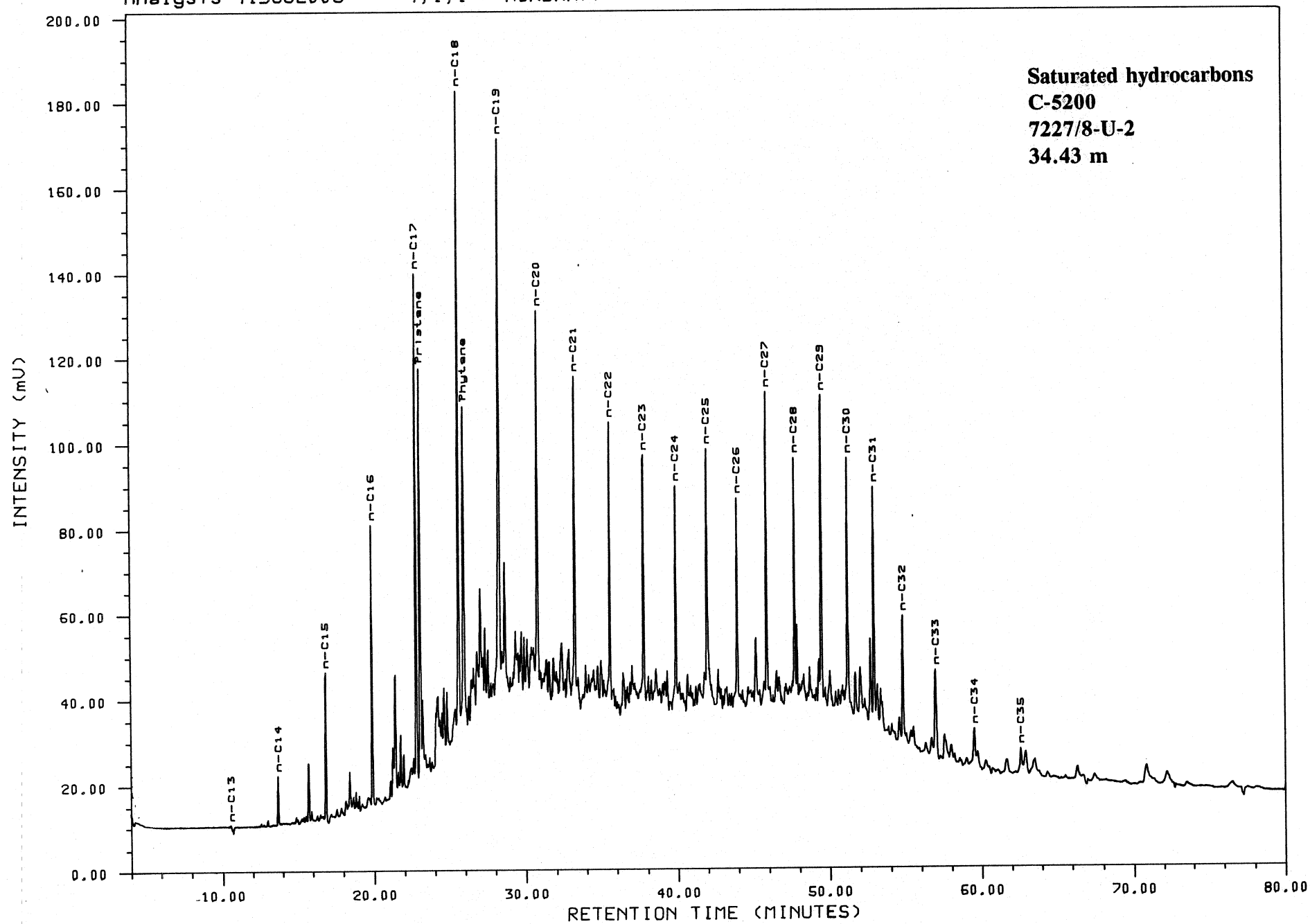


Figure A.II.4.2: Saturated hydrocarbon gas chromatograms.

n-C ₁₅ etc.	- n-alkanes
Pr	- pristane
Ph	- phytane
*	- other acyclic isoprenoids

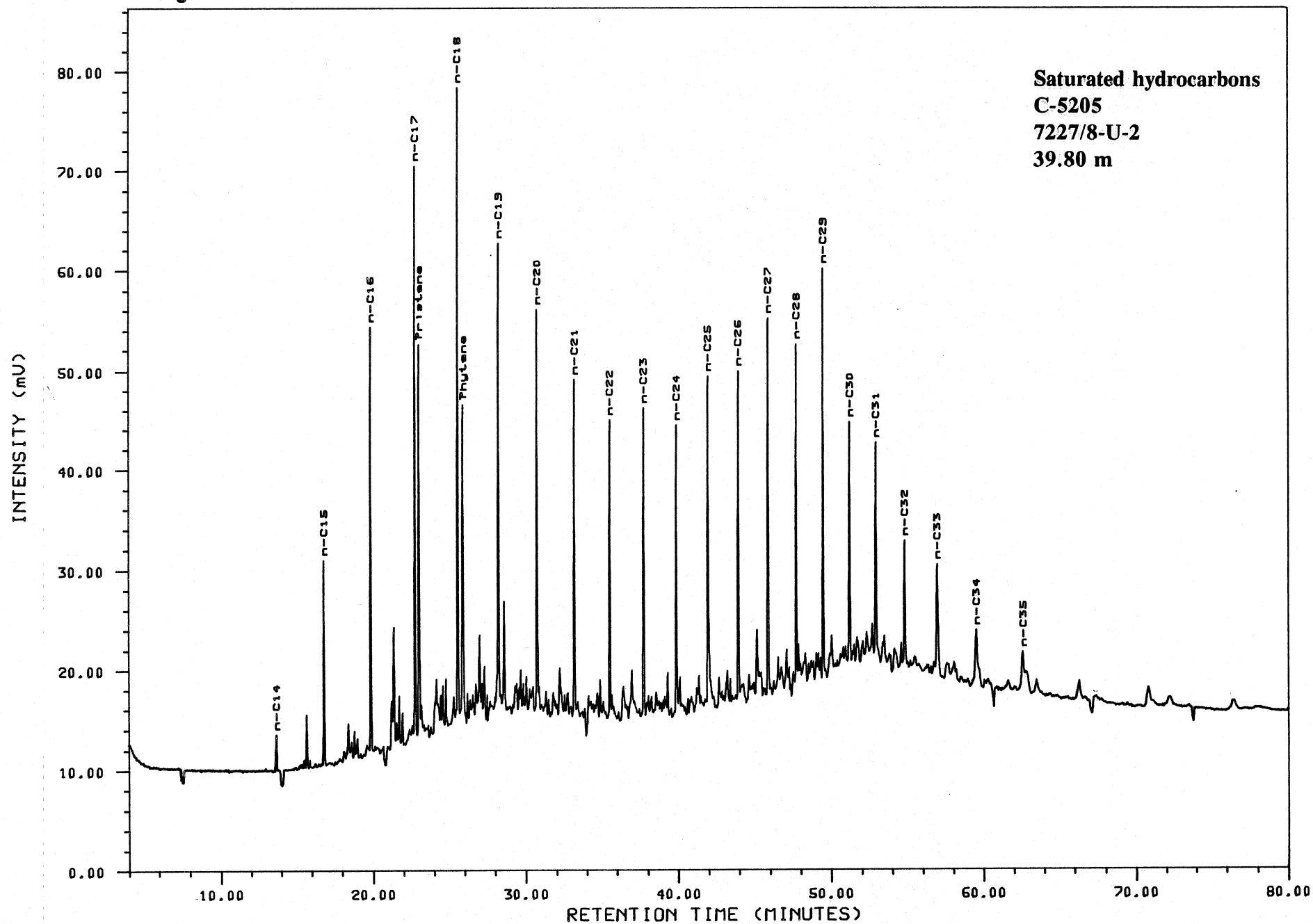
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Analysis 419C5205S

4,1,1

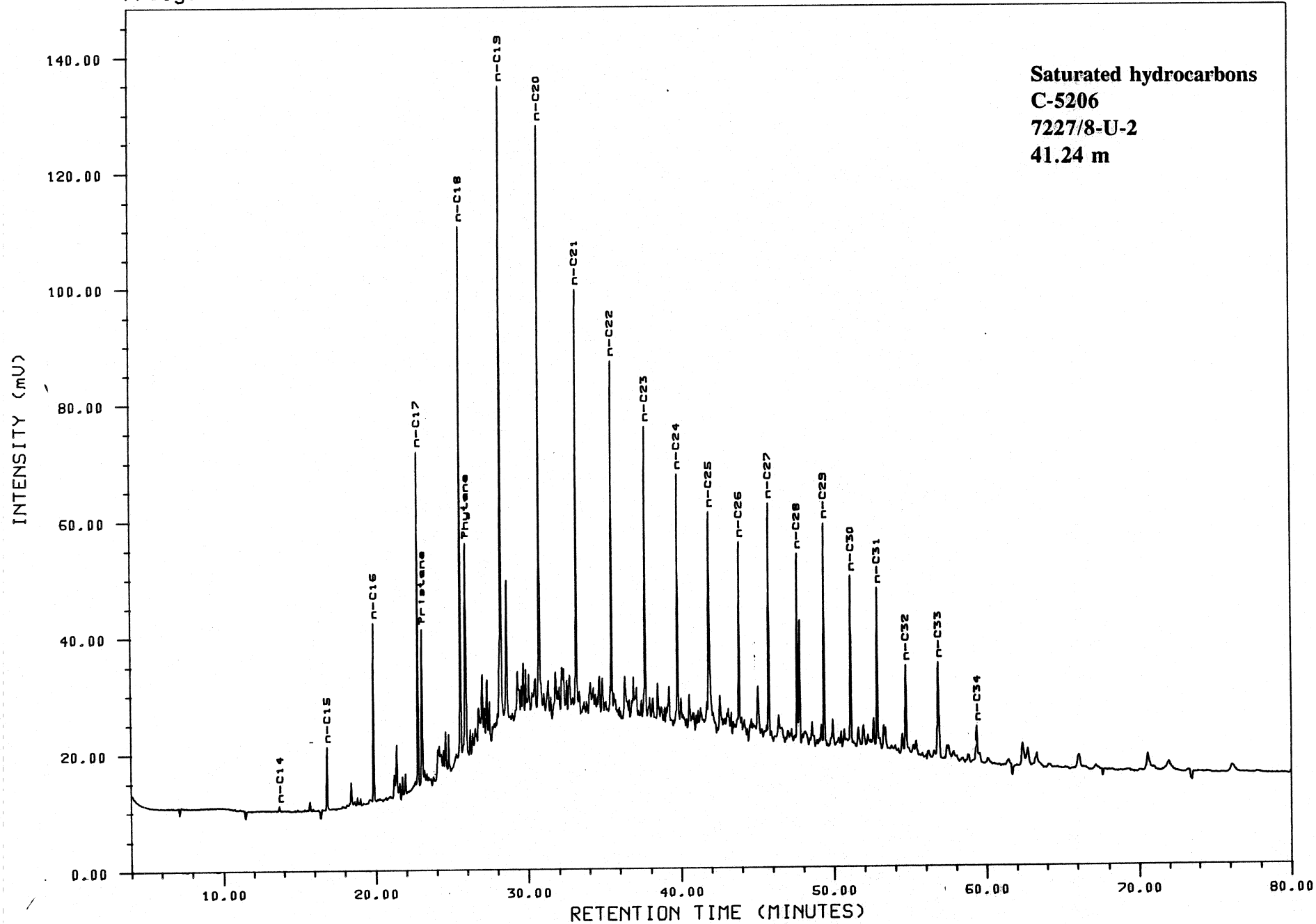
NORDKAPP



Analysis 419C5206S

4,1,1 NORDKAPP

Saturated hydrocarbons
C-5206
7227/8-U-2
41.24 m



Analysis 419C5209S

4,1,1

NORDKAPP

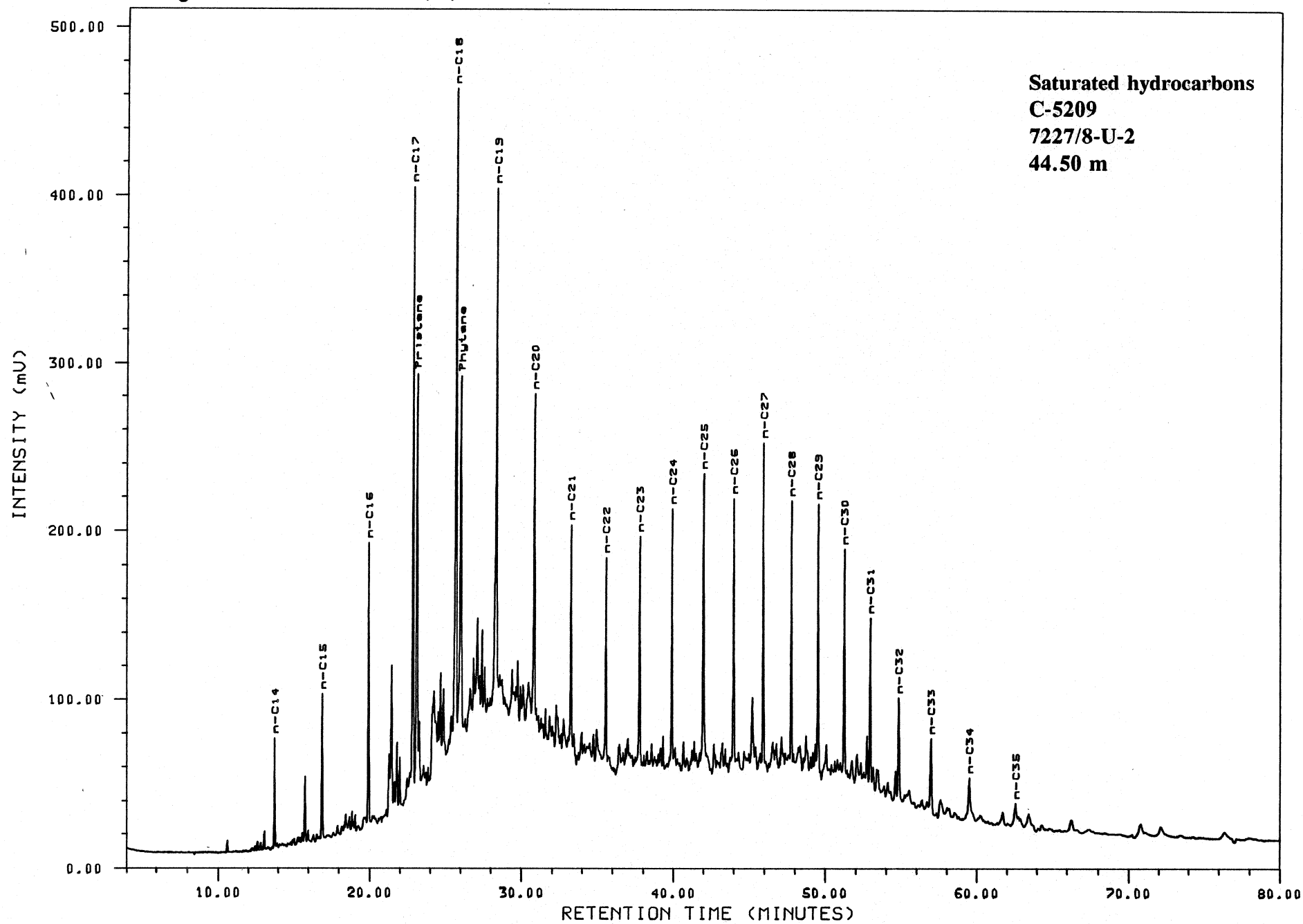
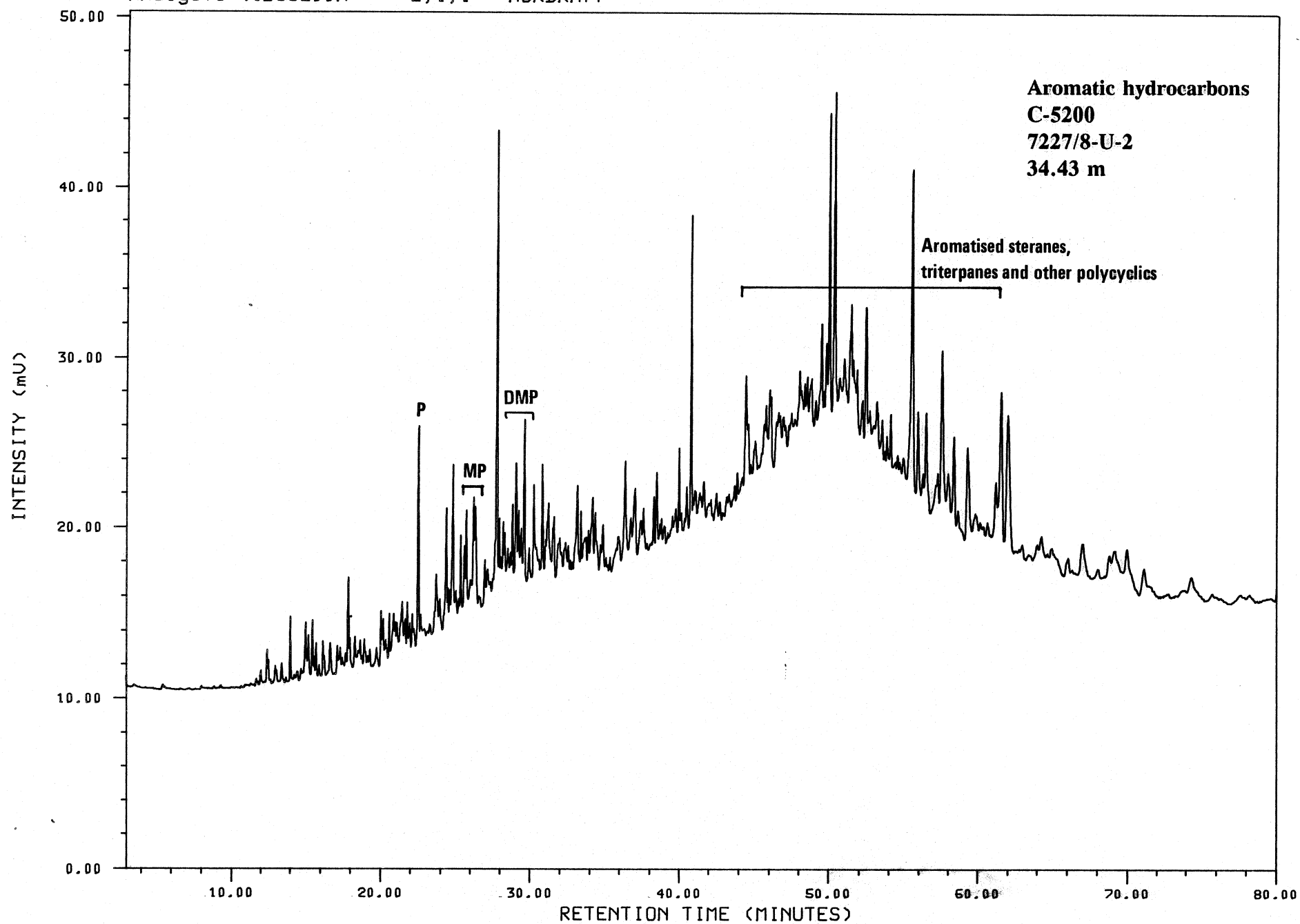


Figure A.II.4.3: Aromatic hydrocarbon gas chromatograms.

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

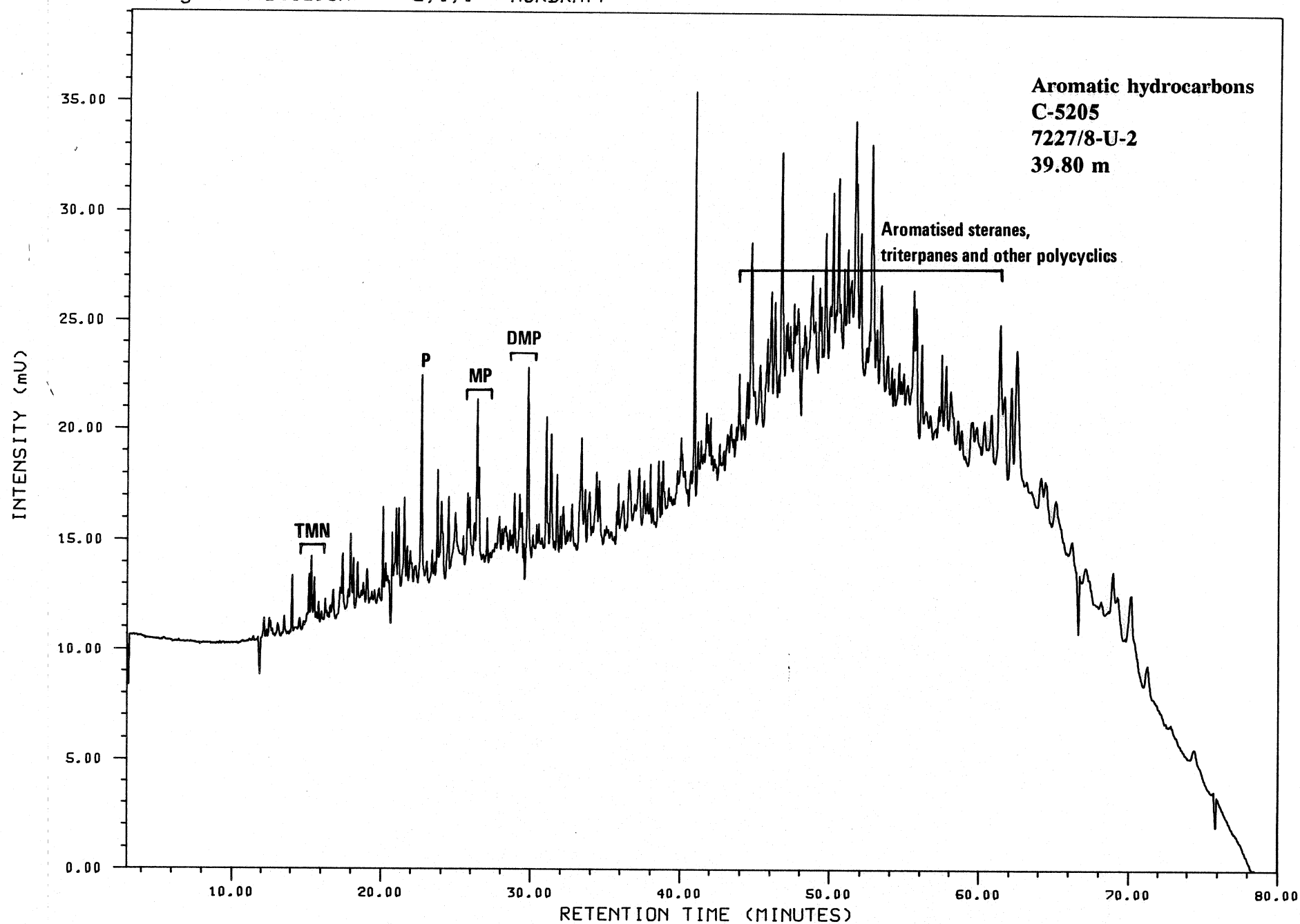
Analysis 419C5200A 2,1,1 NORDKAPP



Analysis 419C5205A

2,1,1

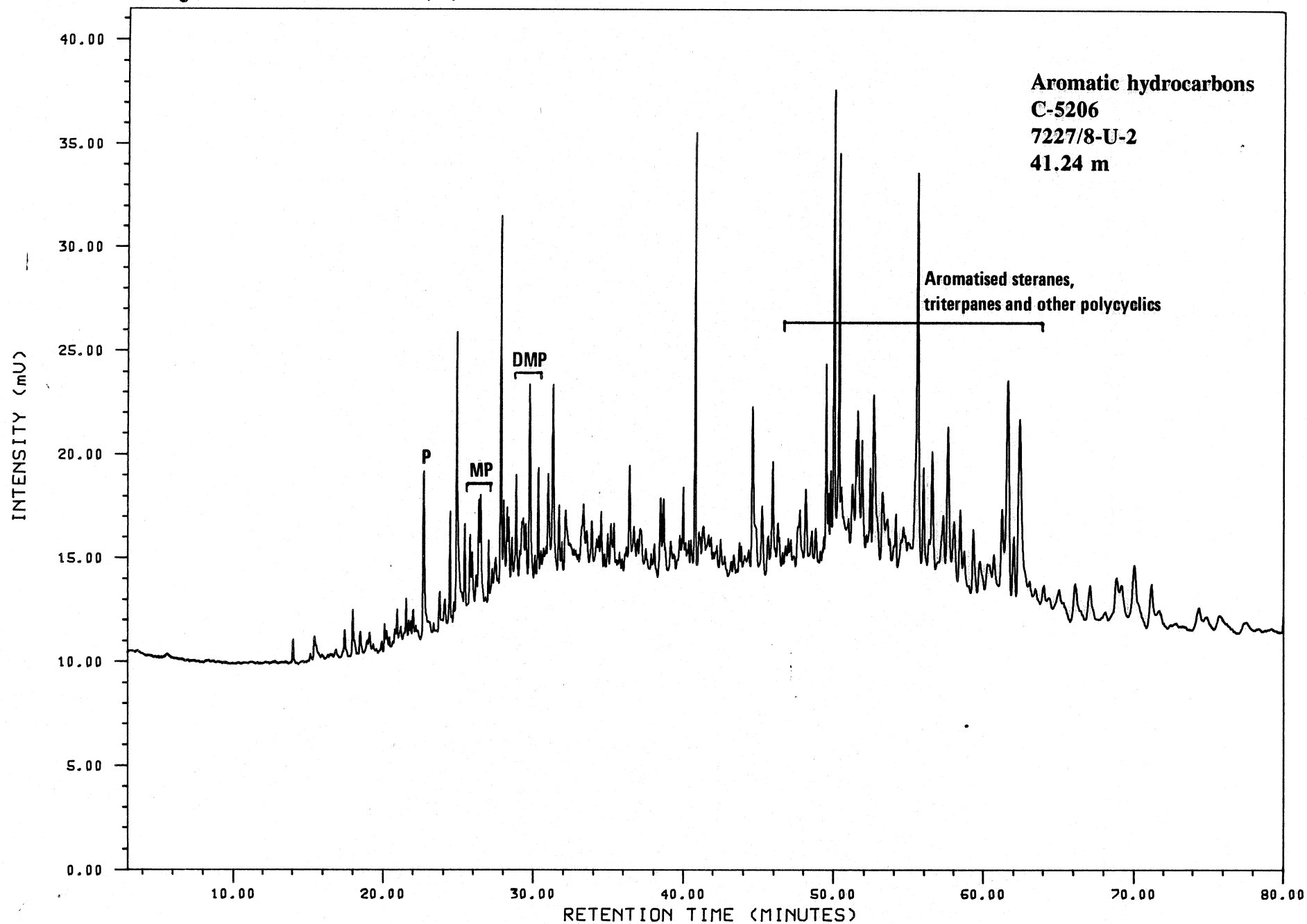
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Analysis 419C5206A

2,1,1

NORDKAPP



Analysis 419C5209A 2,1,1 NORDKAPP

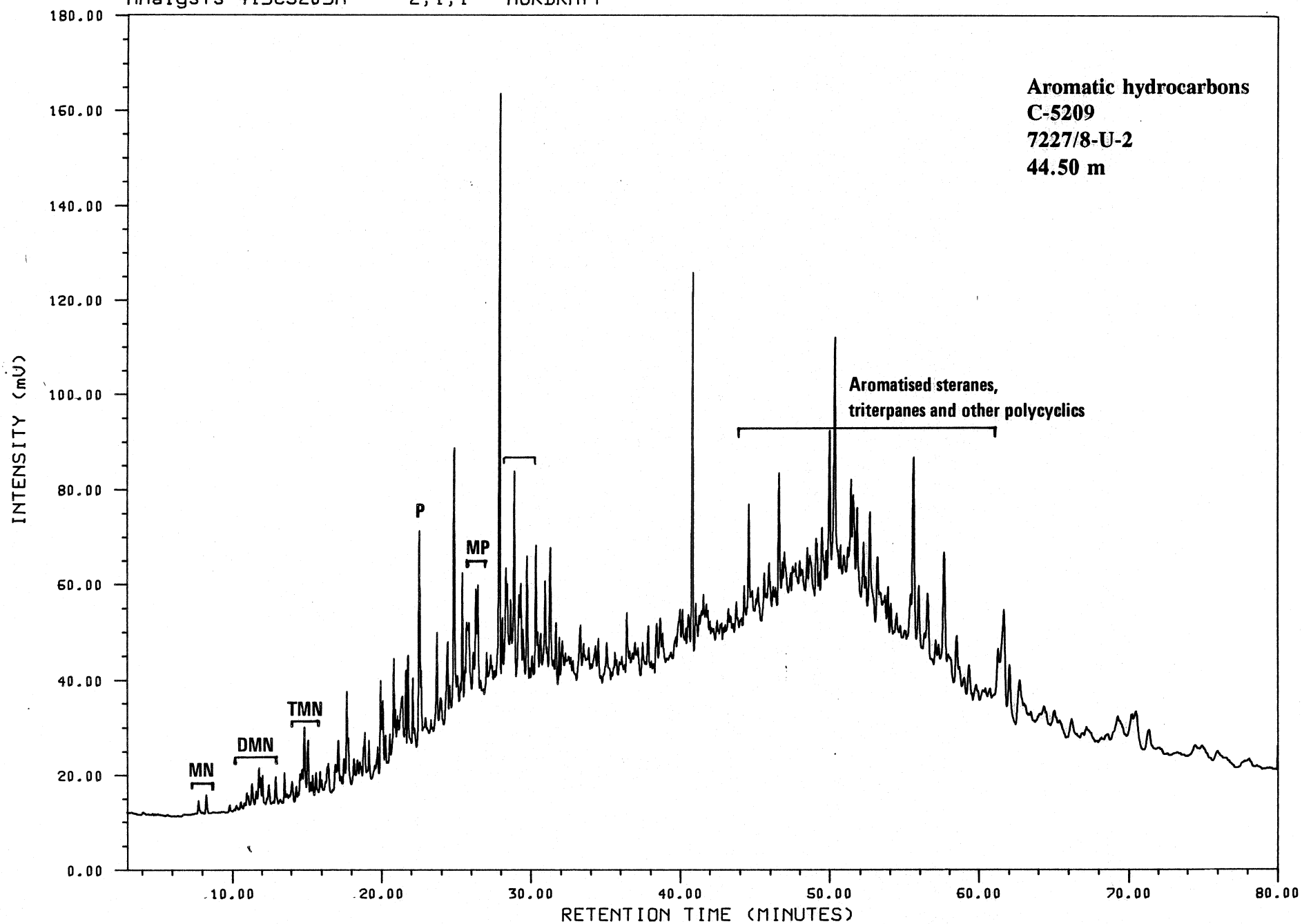
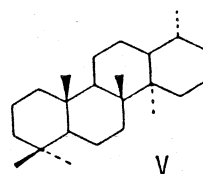
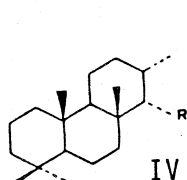
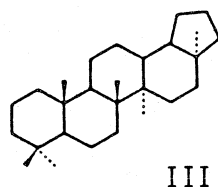
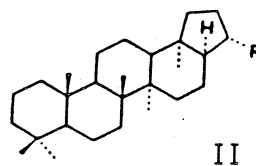
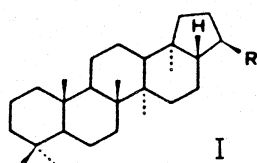


Figure A.II.4.4:

Mass chromatogram. of 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)



C5206SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 191.1000
Text:

System:TRIT

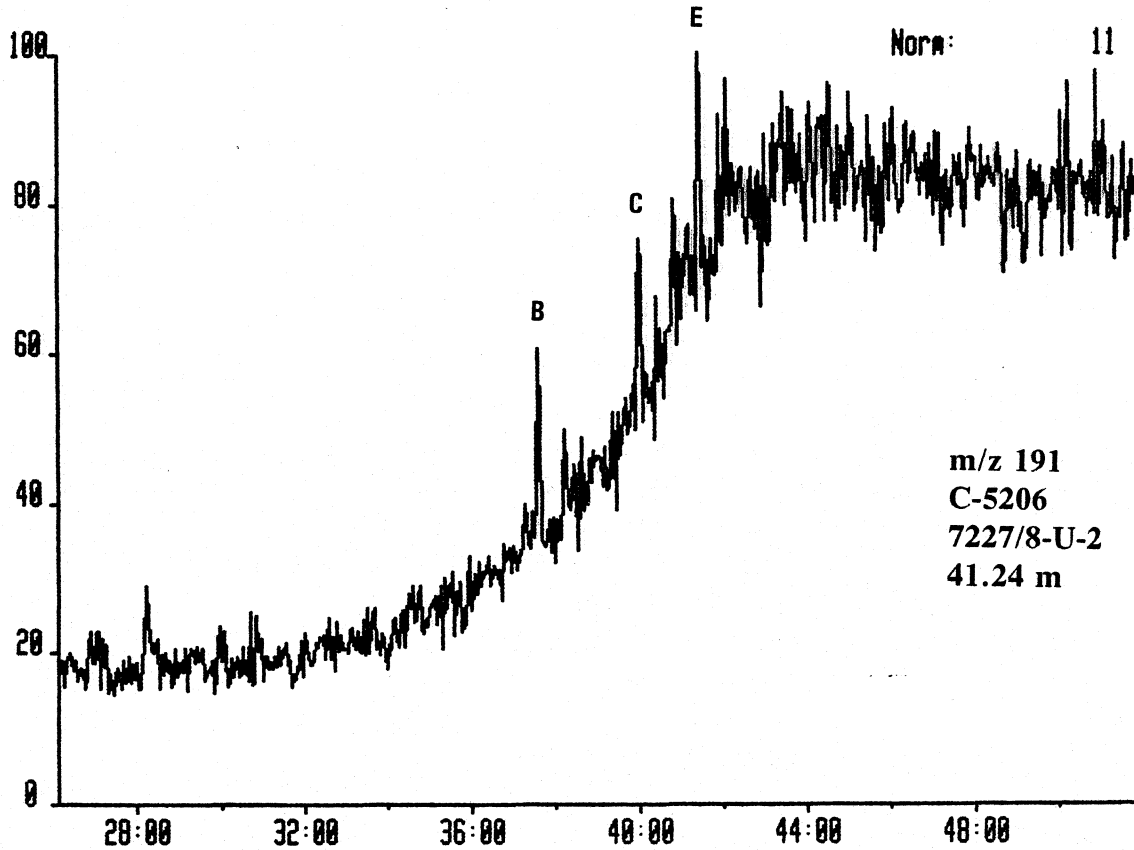
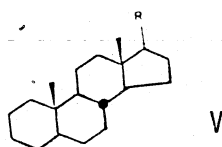
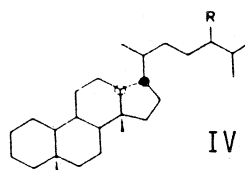
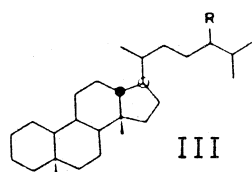
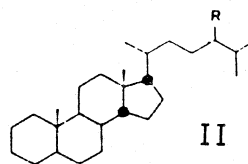
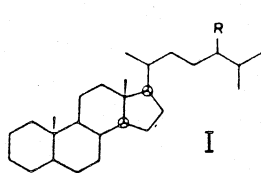


Figure A.II.4.5:

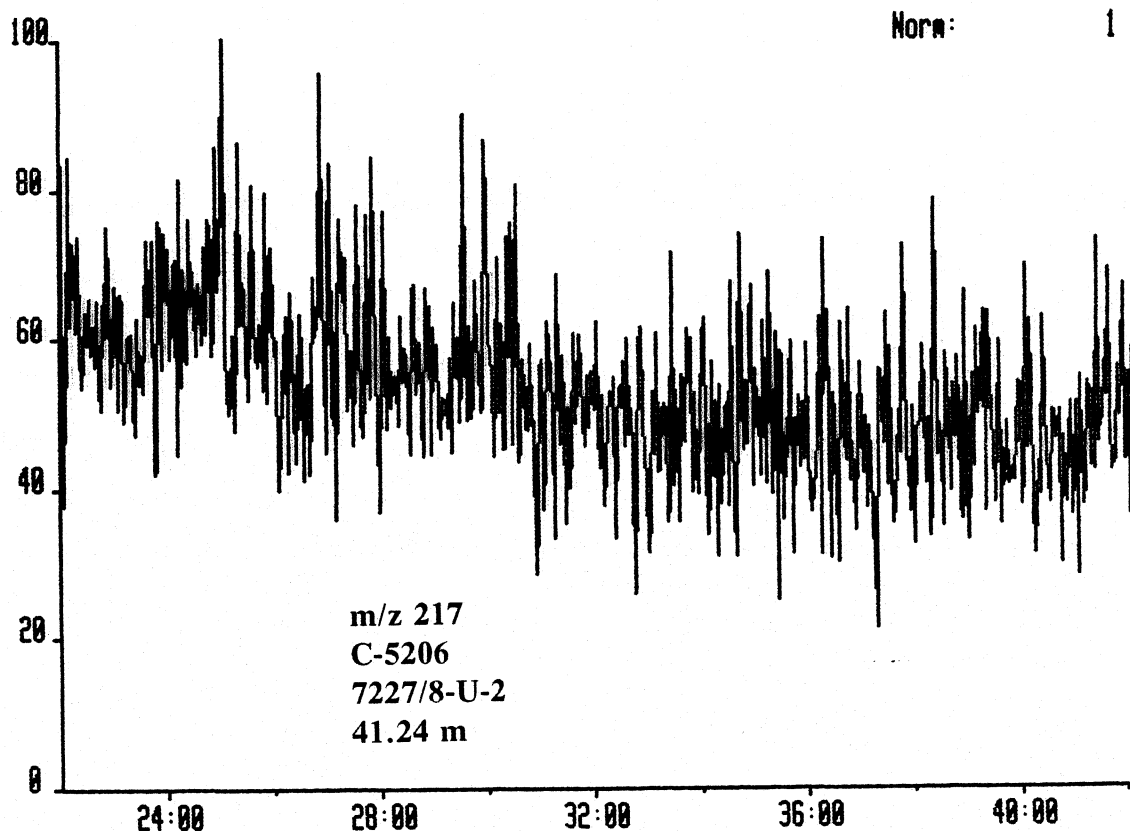
Mass chromatograms of steranes (m/z 217 and 218)

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 α (H),17 α (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)



C5206SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 217.1000
Text:

System:TRIT



C5206SAT 14-JAN-87 Sir:Voltage 7070H Acnt:IKU
Sample 1 Injection 1 Group 1 Mass 218.1000
Text:

System:TRIT

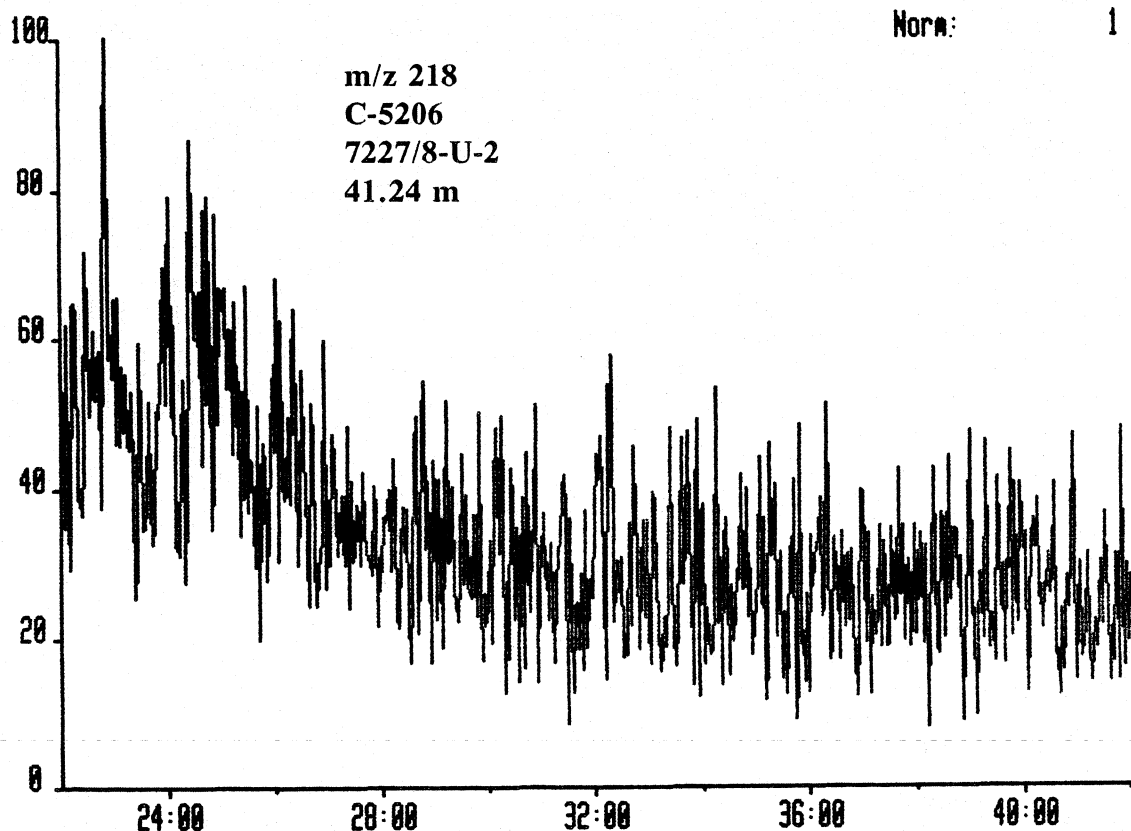


Figure A.II.4.6: VITRINITE REFLECTANCE HISTOGRAMS

Key: A = Grey-black-brown claystone.
 Upper case letters indicate values included in
 the main population. Lower case letters represent
 values in other populations.

 PP = Statistical data populations
 Y = Main population, not necessarily
 representative of sample maturity.
 N = Other populations.

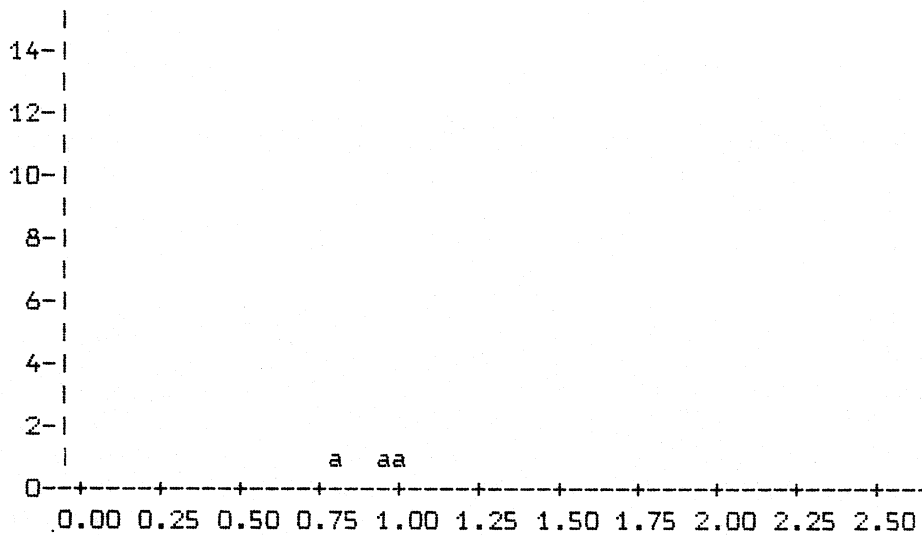
 LOW+ HIGH = Population limits.

 VAL. = Number of measurements in that
 population.

Lithology cross-reference table

A = Clst. gy
 B = Clst. dk gy
 C = Clst. gn
 D = Clst. bn
 E = Clst. rd
 F = Clst. calc.
 G = Clst. carb.
 H = Shale
 I = Sandstone
 J = Limestone
 K = Coal
 L = Lignite
 M = Carbargillite
 N = Siltstone
 O = Bit
 P = X

IKU# C-5204 38.9M 7227/8-U-2

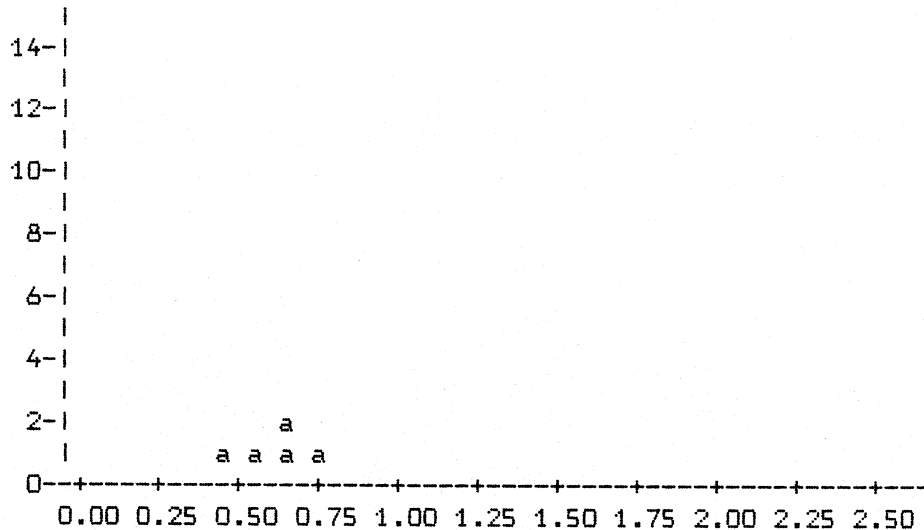


PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
N	0.83	1.01	ALL	2	0.91	0.11
	OVERALL			3	0.94	0.10

ORDERED VALUES FOLLOW:

0.83a 0.98a 1.01a

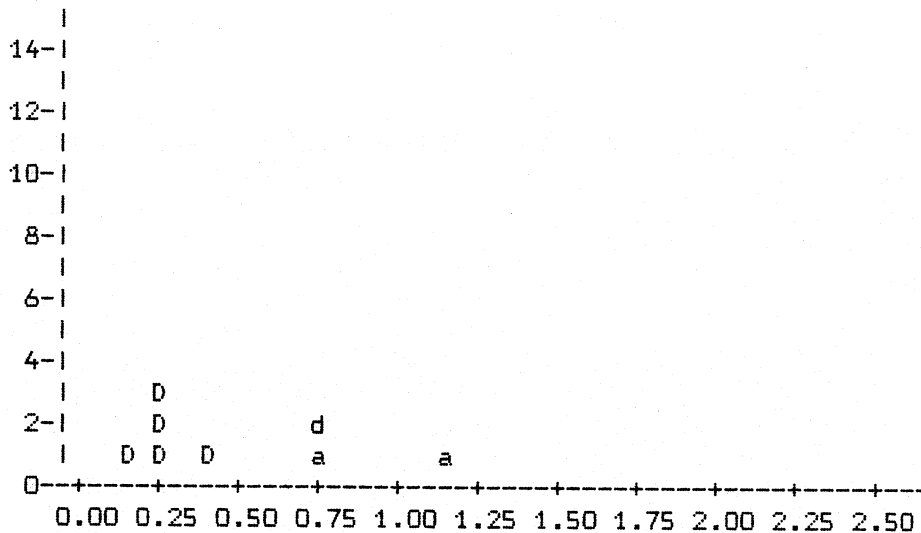
IKU# C-5205 39.8M 7227/8-U-2


 PP LOW HIGH LIT #VAL MEAN STDV
 OVERALL 5 0.64 0.10

ORDERED VALUES FOLLOW:

0.49a 0.59a 0.67a 0.69a 0.75a

IKU# C-5209 44.5M 7227/8-U-2



PP	LOW	HIGH	LIT	#VAL	MEAN	STDV
Y	0.17	0.44	ALL	5	0.28	0.09
N	0.77	0.78	ALL	2	0.77	0.00
N	1.19	1.20	ALL	1	1.19	0.00
OVERALL				8	0.52	0.36

ORDERED VALUES FOLLOW:

0.17D 0.25D 0.27D 0.27D 0.43D 0.77a 0.77d 1.19a

A.III ANALYTICAL METHODS

Gas analyses

Pyrolysis gas (full analysis of hydrocarbons and inert gases):

Pyrolysis gas samples were analysed on an HP 5880 gas chromatograph equipped with a capillary column and an FID for hydrocarbon analysis and two packed columns and a TCD for analysis of the inert gases (N_2 , O_2 , CO_2):

- 50 m x 0.2 mm i.d. fused silica column, coated with 0.5 μ m OV-101.
- 3 ft steel column packed with molecular sieve 13x, 80/100 mesh.
- 6 ft steel column packed with Porapack T x 4 ft steel column packed with Porapack Q, 80/100 mesh.

Temperature program: 30°C (12 min.) - 8°C/min. - 150°C (5 min.).

A standard gas sample containing methane, ethane, propane, n-butane, n-pentane and n-hexane was used for quantification.

Headspace gas:

A septum was attached to the can and a sample of the headspace gas was taken for analysis of C_1 , C_2 , C_3 , i- C_4 , n- C_4 and C_{5+} hydrocarbons.

This analysis was performed on Carlo Erba Fractovap 2150 and 2350 gas chromatographs equipped with 2 m x 1/8" stainless steel columns filled with Porapack Q on Chromosorb using nitrogen as carrier gas. An oven temperature of 150°C was used. After elution of n-butane, the column was back-flushed and C_{5+} compounds were recorded as one peak. A standard gas sample containing methane, ethane, propane, n-butane, n-pentane and n-hexane (100 ppm each) was used for quantification.

The can was then opened and headspace volume, water volume, and sample weight were measured. The canned samples were washed with warm water (30-40°C) on 4.0, 2.0 and 0.125 mm sieves to remove drilling mud and were then dried at 35°C.

Occluded gas:

Prior to drying, an aliquot of the 1-4 mm fraction of each sample was crushed in water for 10 minutes using a gas-tight ball mill. The evolved gas was analysed as described for headspace gas.

Analysis of adsorbed gas and $\delta^{13}\text{C}$ isotope analysis of adsorbed methane (GCA):

These analyses were performed by Geochemische Analysen, Manfred Schmitt, Lehrte, F.R.G.

The sediment samples were kept at -80°C before preparation. After thawing the samples were washed to remove interstitial gas and sieved to obtain the $<63\ \mu\text{m}$ fraction. 200-300 g of the centrifuged $<63\ \mu\text{m}$ fraction and 100 ml degassed water were placed in an evacuated glass flask. Phosphoric acid (50 ml, 85 %vol) was slowly added (20 min.). The carbon dioxide evolved from carbonated was trapped in potassium hydroxide solution.

After no more carbon dioxide did evolve, the sample was heated up to the boiling point for 5 minutes. Then the complete apparatus was filled with degassed water in order to press the gaseous hydrocarbons into a container from which it could be transferred into the gas chromatograph.

Separation of the adsorbed gas was performed using microprocessor-controlled chromatographs PACKARD 430 and 438, each of them equipped with double columns and two flame ionisation detectors and thermal conductivity detectors. A specially treated adsorbent was used as column filling. Ultrapure helium was used as carrier gas. Inlet, separation, and oxidation of the gas were controlled by an automated valve switching system.

Gas samples from the degassing process were expanded into the evacuated inlet system. The methane and carrier gas leaving the thermal conductivity detector was led through an oxidation furnace. The oxidation products carbon dioxide and water were trapped in a stainless steel loop cooled with liquid nitrogen, while the helium could leave the trap. Carbon dioxide was separated from water by recrystallisation in a high vacuum system attached to the trap, and sealed in a 6 mm glass tube.

The $^{13}\text{C}/^{12}\text{C}$ - isotope ratio was measured with a high precision mass spectrometer Finnigan MAT 251.

Precision of the preparation lines and the mass spectrometer was daily controlled by measurements of standard substances and by double analyses.

The isotope ratios are given as delta-values (del):

$$\text{del (\%)} = ((R \text{ sample} - R \text{ stand.}) / (R \text{ stand.})) * 1000$$

$^{13}\text{C}/^{12}\text{C}$ - isotope ratios are calculated versus PDB.

Total Organic Carbon

Bulk samples were crushed in a mortar. Aliquots of the samples were then weighed into Leco crucibles, treated three times with hot 10% HCl to remove carbonate, and washed 4 times with distilled water to remove any traces of HCl. The crucibles were then placed on a hot plate (60°C) and dried for 24 hours. The total organic carbon (TOC) content of the dried samples was determined using a Leco CS244 carbon analyser.

The instrument was calibrated using a Triassic shale (4.96% TOC) as a standard. Calibration and blank runs were carried out every 15th measurement.

Rock-Eval pyrolysis

Powdered sample (100 mg shale, 5-10 mg coal) was weighed into a platinum crucible (the base and cover of which are made of sintered steel), and analysed on a Rock-Eval II pyrolyser (Girdel/IFP) under standard conditions (Carrier gas: Helium; Flow Rate: 100 ml/min.; Temp.Program: 300°C (3 min.) - 25°C/min. - 550°C).

Extractable Organic Matter

Powdered rock was extracted by Soxhlet technique with boiling dichloromethane (DCM) containing 7% methanol (v/v) as solvent in a Soxhlet apparatus for 18 hours.

DCM of organic geochemical grade was used and blank analyses indicated that the occurrence of contaminating hydrocarbons was negligible. Activated copper filings were used to remove any free sulphur from the samples.

After extraction, the solvent was evaporated off using a Büchi Rotavapor and the amount of extractable organic matter (EOM) was determined.

Medium-pressure liquid chromatography (MPLC)

The EOM/oil ($>210^{\circ}\text{C}$) sample was diluted in DCM (1:3 mg/ μl) and the asphaltenes were precipitated using excess n-pentane (40:1 pentane:(DCM+EOM)). The asphaltene fraction was weighed after drying at 50°C for 12 hours.

The remaining maltenes were separated into saturated, aromatic and non-hydrocarbon fractions using an MPLC system with n-hexane as eluant (Radke et al., 1980). The various fractions were concentrated using a Büchi Rotavapor, transferred to glass vials and the remaining solvent removed.

Vitrinite reflectance

Vitrinite reflectance measurements were carried out on whole-rock samples using the following method. The rock samples were broken up, if necessary, and mounted in a fast-setting, synthetic resin. Temperatures in excess of about 50°C were avoided as these can result in alteration of the organic material. Once the resin was set, the samples were ground on coarse silicon carbide paper in order to expose an area of sample for polishing. The samples were then ground on 600 and 280 grade silicon carbide paper to remove any coarse scratches. Where clastic sediments were involved, grinding and polishing was carried out using propan-2-ol to avoid swelling of any clay minerals in the sample. If coals were to be measured, water was used. The samples were then polished on Selvyt cloth using 5/20, 3/50 and gamma grade alumina powder. Following polishing, the surface of the samples was carefully cleaned to remove any traces of the polishing powders.

Reflectance measurements were carried out using a Leitz M.P.V. microscope and photomultiplier combination. The measurements were made under oil immersion, using an oil with a refractive index of 1.518, at a wavelength of 546 nm. The surface of the sample was examined for suitable particles of vitrinite and reflectance measurements were taken on these.

The reflectance of the vitrinite particle was determined relative to an optical glass standard with a known reflectance of a similar order to that of the sample. If possible, a minimum of twenty reflectance measurements were made on each rock sample. Coals and carbonaceous claystones generally provide the most reliable data, while sandstones and carbonates generally provide the least reliable data.

UV-fluorescence of liptinite

The samples were also examined in ultra-violet light in order to determine the composition and colour of the fluorescent material present in the sample. The colour of certain liptinite macerals in ultra-violet light can be related to the thermal maturity of the sample. A scale comparing vitrinite reflectance measurements and spore fluorescence to thermal maturity is shown below.

VITRINITE REFLECTANCE (% Ro)	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. (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: The relationship between liptinite fluorescence colour, vitrinite reflectance and carbon content may vary with depositional environment and catagenic history. The above is only a guide.

Gas chromatographic analysis

The whole oil sample from hydrous pyrolysis was analysed using an HP 5730A gas chromatograph fitted with a 15 m DB-5 fused silica

column. 0.02 μ l of sample solution was injected in split mode (split ratio = 1:10). Hydrogen was used as a carrier gas with a flow rate of 2.5 ml/min, and the temperature programme used was -50°C (2 min) - 4°C/min - 280°C.

The C₂-C₈ hydrocarbon compounds were investigated by hydrogen stripping on a Carlo Erba Fractovap gas chromatograph fitted with a 60 m x 0.32 mm (i.d.) fused silica column coated with DB-1, 1.0 μ m. The temperature programme used was 50°C (2 min) - 4°C/min - 210°C. An internal standard was used for quantification.

The saturated hydrocarbon fractions were diluted with n-hexane and analysed on a Carlo Erba Fractovap gas chromatograph equipped with a 15 m DB-1 fused silica column. Hydrogen is used as carrier gas with a flow rate of about 1.5 ml/min. Injections were performed in split mode (split ratio 1:10). The temperature programme used was 80°C (2 min) - 4°C/min - 280°C.

The total aromatic fractions were diluted with n-hexane and analysed on an HP 5710A gas chromatograph, fitted with a DB-5 fused silica column (15 x 0.25 mm i.d.), using a hydrogen carrier gas with a flow rate of 2.5 ml/min. The injection split ratio was 1:10.

The temperature programme used was 80°C (2 min.) - 4°C/min - 280°C.

Gas chromatography - mass spectrometry (GC-MS)

GC-MS analysis 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 0.3 mm i.d.). Helium (1.5 ml/min) was used as carrier gas and the injections were performed in split mode (1.5 μ l, split ratio 1:15).

The GC oven was programmed from 120°C (2 min.) to 280°C at 4°C/min. for analysis of the saturated hydrocarbons, and from 70°C/min. to 280°C at 4°C/min. for analysis of the aromatic hydrocarbons.

The saturated hydrocarbons were analysed in multiple ion mode (MID) at a scan cycle time of approximately 2 secs. Full data collection was applied for the aromatic hydrocarbons at a scan time of 1 sec./decade. The mass spectrometers operated at 70eV electron energy with an ion

source temperature of 200°C. Data acquisition was performed using VG data systems.

Peaks were identified by comparison with elution patterns in certain mass chromatograms. Peak ratios were calculated from peak heights in the appropriate mass chromatograms.

$\delta^{13}\text{C}$ isotope analysis of EOM fractions

The $\delta^{13}\text{C}$ (and $\delta^2\text{H}$) isotope analyses were performed by Geochemische Analysen, Manfred Schmitt (GCA) in Lehrte, F.R.G.

The samples were filled in a glass capillary and transferred into a combustion system filled with copper dioxide, heated to 900°C. A stream of ultrapure helium and oxygen flushed the reaction products through silver wool (450°C) to remove traces of halogens and sulphur.

H_2O and CO_2 were trapped in separate cooltraps. After removal of the carrier gas by high vacuum, CO_2 and H_2O were sealed off separately in 6 mm glass tubes. H_2O was reduced to H_2 by zinc at 460°C.

The $^{13}\text{C}/^{12}\text{C}$ - isotope ratio (and D/H- isotope ratio) was measured with a high precision mass spectrometer Finnigan MAT 251.

Precision of the preparation lines and the mass spectrometer was daily controlled by measurements of standard substances and by double analyses.

The isotope ratios are given as delta-values (del):

$$\text{del} (\%) = ((R \text{ sample} - R \text{ stand.}) / (R \text{ stand.})) * 1000$$

$^{13}\text{C}/^{12}\text{C}$ - isotope ratios are calculated versus PDB.

D/H-isotope ratios are calculated versus SMOW.

The CV value is calculated after SOFER (1984) to differentiate between marine and terrestrial-sourced oils:

$$\text{CV} = (-2.53 * \text{del}^{13}\text{C}_{\text{sat}}) + (2.22 * \text{del}^{13}\text{C}_{\text{aro}}) - 11.65.$$

Hydrous pyrolysis

The samples were pyrolysed at 340°C for 72 hrs. covered by water. This was done in stainless steel (SS-316) containers equipped with a valve by covering the sample with water of a volume not less (in ml) than the sample weight in grams and between 22 and 40% of the container volume. This will guarantee that the sediment samples remain covered with liquid water also at the pyrolysis temperature. Void volume air was replaced by helium by repeated evacuation (4x) and filling with helium. When heating was discontinued the container was aircooled to room temperature and the gas produced was quantitatively collected and analysed. The container was opened and a sample of any hydrous pyrolysis oil floating on top of the water was collected and analysed, remaining expelled pyrolysate on the surfaces of water container walls and sediment was washed out with hexane/pentane/DCM (1:1:1).

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APPENDIX

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

Geochemical fossil/biological marker compounds are characteristic of the type of organic matter present at the time the sediments were deposited. The biological isomers of these compounds are converted to the geochemical isomers with increasing maturity until a stable mixture of the isomers is attained. Migration and weathering processes also alter the distribution of biomarker compounds in a sample.

Hopanes, moretanes and tricyclic terpanes are the most common compounds in the m/z 191 mass chromatograms of most extracts and oils. Of the hopanes, the C_{27} and C_{29} - C_{35} homologs are ubiquitous, while 28,30-bisnorhopane is believed to be typical of certain types of source rocks. This is also thought to be true for a component, probably gammacerane, which sometimes coelutes with the 22S isomer of the C_{31} 17 α (H)-hopanes. The relative distribution of the C_{27} trisnorhopanes is thought to be both source- and maturity-dependant.

In the m/z 217 and 218 sterane mass chromatograms, the molecular weight distribution of the C_{27} - C_{30} regular steranes is thought to be representative of the original organic matter input. The C_{29} steranes are generally indicative of input from higher land plants, but, more recently, similar compounds have been reported from marine micro-organisms. Moldowan (1984) has also recently published data on C_{30} steranes that are thought to be characteristic of input from marine organisms. This is one of the few marine markers reported, and previously the indication of marine origin for mature geolipids was assessed on the basis of absence of nonmarine marker compounds.

The biological hopane isomers, the 17 β (H),21 β (H)-hopanes, undergo structural changes during maturation. These isomerisation reactions are believed to proceed through the 17 β (H),21 α (H)-hopane structure (moretanes) to the stable 17 α (H),21 β α (H)-hopane structure. With thermal maturity, 17 α (H)-hopanes account for 90-100% of the hopanes present. 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 compared to the biologically preferred R configu-

rations with increased maturity. The ratio of the 22S:22R isomers stabilises at about 60:40 at thermal maturity. The Tm/Ts C₂₇ hopane ratio (Seifert et al, 1978) also varies with thermal maturity such that, with increasing maturity, 17 α (H)-trishnorhopane (Tm) is reduced in intensity relative to the more stable 18 α (H)-trishnorhopane (Ts), causing the Tm/Ts ratio to decrease. However, this ratio is also thought to be source-dependent, and this should be allowed for when using the ratio as a maturation indicator. The tricyclic terpanes vary in abundance with maturity (Schou et al., 1984a), as does 28,30-bishnorhopane (Cornford et al., 1983; Schou et al., 1984b).

Two sterane isomerisation reactions are commonly used for maturity determination based on data from the m/z 217 mass chromatogram. The biologically preferred 14 α (H),17 α (H) regular sterane isomers are gradually replaced by the more thermally stable 14 β (H),17 β (H)-sterane isomers. At thermal maturity, $\beta\beta$ isomers may account for 75-85% of the $\alpha\alpha/\beta\beta$ mixture. Mackenzie et al (1980) have observed a change from a dominance of the biological sterane epimer in recent sediments to the more stable S-configuration at C₂₀, such that this configuration accounts for 50% of the epimers at thermal maturity. The abundance of rearranged steranes relative to regular steranes has also been reported to increase with thermal 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 triaromatic analogs. This process is measured by the abundance of triaromatic compounds relative to mono-aromatic compounds (% tri/tri+mono) from the m/z 231 and 253 mass chromatograms, respectively. Cracking processes also take place during early diagenesis, and may be used for maturity determination together with the %tri/tri+mono ratio (Mackenzie et al., 1980; 1981; 1982).

The effect of migration and weathering on the distribution of biological markers is less well understood than maturity-induced changes. Migration may be observed to cause an increase in the relative amounts of rearranged and 14 β (H),17 β (H) regular steranes (Seifert and Moldowan, 1978). Severe biological alteration leads to the formation of desmethyl-hopanes (Seifert and Moldowan, 1979).

APPENDIX: REFERENCES - GC-MS

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Appendix:
Organic Geochemical Data

