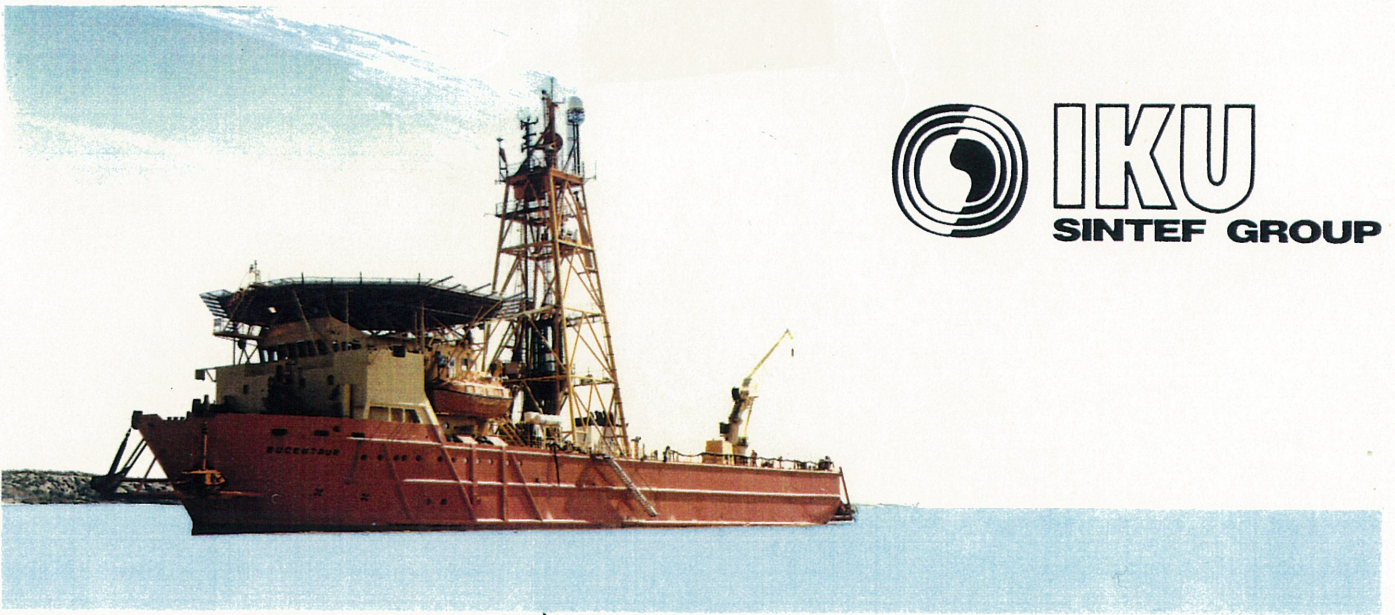
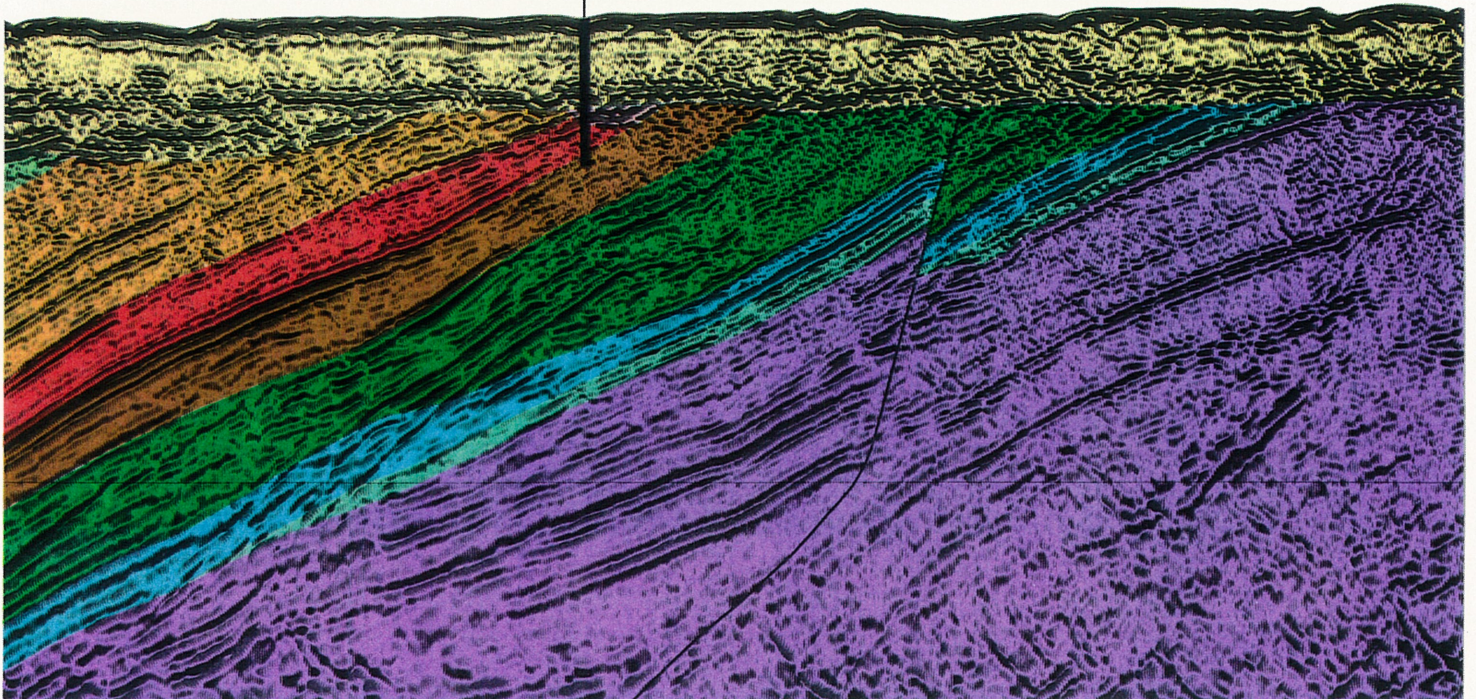




Shallow Drilling Bjørnøya West 1989

Appendix volume 3
Organic geochemistry data





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REPORT

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SHALLOW DRILLING BJØRNØYA WEST 1989

APPENDIX VOLUME 3: ORGANIC GEOCHEMICAL DATA

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SUMMARY:

This appendix volume contains:

- 1) Tables and figures of organic geochemical data obtained from samples of the shallow cores drilled by IKU in the Bjørnøya West area during 1989.

The data are organized core by core, each section having its own table of contents. The text describing and interpreting these data may be found under the relevant core chapter in the main body of the report.
- 2) Tables for the identification of steroid and triterpenoid hydrocarbon compounds in GC-MS mass fragmentograms.
- 3) A description of the experimental methods used to obtain the organic geochemical data and an outline of the criteria used in their interpretation.

KEY WORDS:	
Shallow drilling	Organic Geochemistry
Barents Sea	Source potential
Bjørnøya West	Maturation

PREFACE

This appendix volume contains:

- 1) Tables and figures containing the organic geochemical data obtained from the shallow core samples taken by IKU in the Bjørnøya West area during August 1989 (Chapter I).

The data are grouped by core, each core's data having its own table of contents. The text concerned with the interpretation of these data are located within the relevant core chapter in the main body of the report.

- 2) Tables showing the identification of steroid and triterpenoid hydrocarbon compounds present in GC-MS mass fragmentograms obtained from the samples (Chapter II).
- 3) A description of the experimental methods used to obtain the organic geochemical data and an outline of the criteria used in their interpretation (Chapter III).

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CONTENTS

Page

I. LABORATORY RESULTS

I.1	Core 7317/10-U-01.....	4
I.2	Core 7316/06-U-02.....	42
I.3	Core 7316/06-U-01.....	85
I.4	Core 7316/03-U-01.....	90

II.	PEAK IDENTIFICATIONS FOR M/Z 191, 217 AND 218 GC/MS MASS CHROMATOGRAMS.....	138
-----	--	-----

III.	ANALYTICAL METHODS AND INTERPRETATION LEVELS.....	141
------	---	-----

1 **I. LABORATORY RESULTS**
 I.1 Core 7317/10-U-01

2 **I.1 Core 7316/06-U-02**

3 **I.2 Core 7316/06-U-01**

4 **I.3 Core 7316/03-U-01**

5 **II PEAK IDENTIFICATIONS FOR**
 m/z 191, 217 and 218

 GC-MS
 MASS FRAGMENTOGRAMS

6 **III. EXPERIMENTAL METHODS**
 AND INTERPRETATION
 LEVELS

APPENDIX I.1

Core 7317/10-U-01

TABLES:

Table A.I.1.1a: Concentration of C ₁ -C ₅ + hydrocarbons in headspace gas.....	5
Table A.I.1.1b: Concentration of C ₁ -C ₅ + hydrocarbons in occluded gas.....	5
Table A.I.1.1c: Concentration of C ₁ -C ₅ + hydrocarbons - summation.....	5
Table A.I.1.2: Stable carbon isotope data for adsorbed gas fractions.....	6
Table A.I.1.3: Total organic carbon content and data from Rock-Eval pyrolysis.....	7
Table A.I.1.4: Data from pyrolysis-gas chromatograms (prog. S ₂).....	8
Table A.I.1.5: Vitrinite reflectance data.....	9
Table A.I.1.6: Visual kerogen analysis.....	10
Table A.I.1.7a: Weight of EOM, asphaltenes and chromatographic fractions.....	13
Table A.I.1.7b: Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	13
Table A.I.1.7c: Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	13
Table A.I.1.7d: Composition of EOM and chromatographic fractions.....	14
Table A.I.1.8: Ratios derived from gas chromatograms of saturated hydrocarbons.....	15
Table A.I.1.9: Molecular ratios from sterane and terpane mass chromatograms.....	16

FIGURES:

Figure A.I.1.1a: $\delta^{13}\text{C}$ composition of methane related to gas composition.....	17
Figure A.I.1.1b: $\delta^{13}\text{C}$ composition of adsorbed methane.....	18
Figure A.I.1.2: Pyrolysis-gas chromatograms (S ₂ peak): whole-rock samples...	19
Figure A.I.1.3: Gas chromatograms of saturated and aromatic hydrocarbons.....	25
Figure A.I.1.4: Pyrolysis-gas chromatograms (S ₂ peak): asphaltene fraction..	31
Figure A.I.1.5: Mass fragmentograms of m/z 191, 205 (terpanes) and m/z 217, 218 (steranes).....	34
Figure A.I.1.6: Vitrinite reflectance histograms.....	37

Project no.: 21346500
Location : 7317/10-U-01
Date : 89.09.21

Table A.I.1.1: TABLE OF GAS RESULTS

a: Headspace gas (µl gas per kg rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8415	149.40	98619	0	0	0	0	0	98619	0	0.0	-1.00
E8430	160.45	93487	0	0	0	0	0	93487	0	0.0	-1.00
E8441	169.50	64359	0	0	0	0	0	64359	0	0.0	-1.00
E8453	177.60	64080	0	0	0	0	0	64080	0	0.0	-1.00
E8466	187.66	63161	0	0	0	0	0	63161	0	0.0	-1.00
E8481	199.04	18099	0	0	0	0	0	18099	0	0.0	-1.00
E8499	206.36	109487	0	0	0	0	0	109487	0	0.0	-1.00
E8513	214.30	104641	0	0	0	0	0	104641	0	0.0	-1.00

b: Occluded gas (µl gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8415	149.40	6820	14	0	0	0	0	6834	14	0.2	-1.00
E8430	160.45	4341	13	0	0	0	0	4354	13	0.3	-1.00
E8441	169.50	5319	15	0	0	0	0	5334	15	0.2	-1.00
E8453	177.60	5612	50	18	6	20	332	5706	94	1.6	0.30
E8466	187.66	10700	18	10	24	36	498	10788	88	0.8	0.67
E8481	199.04	6324	16	18	50	77	667	6485	161	2.4	0.65
E8499	206.36	5491	19	11	30	49	612	5600	109	1.9	0.61
E8513	214.30	6933	14	10	29	48	644	7034	101	1.4	0.60

c: Summation of Headspace and Occluded gas
(µl gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8415	149.40	105439	14	0	0	0	0	105453	14	0.0	-1.00
E8430	160.45	97828	13	0	0	0	0	97841	13	0.0	-1.00
E8441	169.50	69678	15	0	0	0	0	69693	15	0.0	-1.00
E8453	177.60	69692	50	18	6	20	332	69786	94	0.1	0.30
E8466	187.66	73861	18	10	24	36	498	73949	88	0.1	0.67
E8481	199.04	24423	16	18	50	77	667	24584	161	0.7	0.65
E8499	206.36	114978	19	11	30	49	612	115087	109	0.1	0.61
E8513	214.30	111574	14	10	29	48	644	111675	101	0.1	0.60

Legend

-1 - No data available.

Table A.I.1.2: STABLE CARBON ISOTOPE DATA FOR ADSORBED GAS FRACTIONS

CORE 7317/10-U-01

IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	$\delta^{13}\text{C}_1$ (‰) _{PDB}	$\delta^{13}\text{C}_2$ (‰) _{PDB}	$\delta^{13}\text{C}_1$ (‰) _{PDB}
E-8415	149.40	Core	Shale	-44.1	-28.4	na
E-8466	187.66	Core	Siltstone	-39.1	-23.8	-162

Legend:

na: Data not available for this fraction

Project no.: 21346500
Location : 7317/10-U-01
Date : 89.12.19

Table A.I.1.3: DATA FROM ROCK EVAL PYROLYSIS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	S1 (mg/g rock)	S2	TOC (%)	HYDRO. INDEX (mg/g TOC)	PETR. POTEN. S1+S2	PROD. INDEX S1 ----- S1+S2	Tmax (°C)
E8406		143.55	CORE	0.01	0.35	0.96	36	0.36	0.03	428
E8410		145.55	CORE			1.09				
E8413		147.55	CORE	0.04	0.37	0.96	39	0.41	0.10	429
E8415		149.40	CORE			1.08				
E8417		151.18	CORE	0.03	0.33	1.04	32	0.36	0.08	422
E8418		153.60	CORE			0.81				
E8422		155.08	CORE	0.01	0.31	0.91	34	0.32	0.03	426
E8425		157.08	CORE			1.07				
E8428		159.15	CORE	0.01	0.45	1.01	45	0.46	0.02	430
E8430		160.45	CORE			1.04				
E8432		163.40	CORE	0.02	0.24	0.67	36	0.26	0.08	429
E8434		164.90	CORE			1.05				
E8437		166.75	CORE	0.03	0.51	1.17	44	0.54	0.06	427
E8440		168.97	CORE			0.76				
E8441		169.50	CORE			1.09				
E8444		171.15	CORE	0.01	0.29	0.82	35	0.30	0.03	433
E8446		172.39	CORE			0.96				
E8448		174.51	CORE	0.07	0.34	0.95	36	0.41	0.17	425
E8453		177.60	CORE			1.02				
E8454		179.36	CORE	0.03	0.46	1.16	40	0.49	0.06	424
E8456		181.46	CORE			1.05				
E8461		184.13	CORE	0.02	0.35	0.90	39	0.37	0.05	429
E8464		185.96	CORE			0.91				
E8466		187.66	CORE	0.03	0.61	1.24	49	0.64	0.05	433
E8467		190.01	CORE			1.03				
E8473		192.98	CORE	0.03	0.51	1.11	46	0.54	0.06	433
E8476		196.52	CORE	0.05	0.52	1.10	47	0.57	0.09	431
E8479		198.23	CORE			1.33				
E8481		199.04	CORE	0.02	0.50	1.11	45	0.52	0.04	430
E8484		201.87	CORE	0.05	0.43	1.01	43	0.48	0.10	428
E8488		203.86	CORE			1.07				
E8497		205.34	CORE	0.08	0.38	0.94	40	0.46	0.17	434
E8499		206.36	CORE			0.91				
E8503		208.08	CORE	0.00	0.38	1.03	37	0.38	0.00	431
E8506		210.14	CORE			1.03				
E8511		212.85	CORE	0.01	0.27	0.88	31	0.28	0.04	428
E8513		214.30	CORE	0.02	0.41	0.92	45	0.43	0.05	433
E8514		215.80	CORE	0.02	0.41	1.01	41	0.43	0.05	429
E8516		217.25	CORE			0.88				
E8517		218.25	CORE	0.01	0.43	0.94	46	0.44	0.02	432
E8520		220.02	CORE			0.94				
E8519		221.57	CORE	0.05	0.61	1.25	49	0.66	0.08	435
E8521		222.35	CORE			1.18				
E8522		224.50	CORE	0.03	0.54	1.11	49	0.57	0.05	434

Table A.I.1.4: DATA FROM PYROLYSIS-GAS CHROMATOGRAMS (PROG. S₂)

CORE 7317/10-U-01							
IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	C ₁	C ₂ -C ₅	C ₆ -C ₁₅	C ₁₅ +
(percent of peak area)							
<u>Whole rock</u>							
E-8413	147.53	Core	Claystone	25.3	23.0	51.7	0.0
E-8437	166.75	Core	Siltstone	20.5	38.4	40.6	0.5
E-8466	187.66	Core	Siltstone	22.2	22.7	53.3	1.9
E-8503	208.08	Core	Siltst/Sandst	25.6	25.2	49.0	0.2
E-8522	224.50	Core	Siltstone	15.3	48.4	35.2	1.1
<u>Asphaltenes</u>							
E-8453	177.60	Core	Siltstone	14.4	15.6	46.6	23.5
E-8499	206.36	Core	Siltstone	11.0	19.3	33.5	34.5

Core number: 7317/10-U-01
Reference number: 21.3465.23
(1/1)

Table A.I.1.5: VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE** REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
E-8410	-----	145.55	0.40 (21)	G	0.04	3-4
E-8428	-----	159.15	0.39 (20)	G	0.04	3-4
E-8446	-----	172.39	0.38 (22)	G	0.06	3-4
E-8454	-----	179.36	0.38 (13)	F	0.06	3-4
E-8464	-----	185.96	0.41 (11)	F	0.06	3-4
E-8484	-----	201.87	0.38 (13)	F	0.05	3-4
E-8514	-----	215.80	0.43 (3)	P	0.06	3-4
E-8521	-----	222.35	0.42 (14)	F	0.06	3-4

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

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.1.6
WELL NO.: 7317/10-U-1

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8413	147.55	Am: 5% Lm: 5-10% W: 85-90% C:	F-M-L	Fair	<2.0	Organic residue dominated by (reworked) dark brown woody and black angular coaly fragments.
E-8585	148.14	Am: 10-15% Lm: 20% W: 65-70% C:	F-M-L	Fair	2.0 - 2.5	Organic residue dominated by dark brown to black woody/coaly angular fragments. Evidence of reworked Mid-Cretaceous material.
E-8436	166.28	Am: 10% Lm: 20-25% W: 65-70% C:	F-M-L	Fair	2.0 - 2.5	Comparable to sample E-8585.
E-8437	166.75	Am: 15-20% Lm: 5-10% W: 70-75% C:	F-M-L	Fair-Good	<2.0	Organic residue dominated by woody and coaly phytoclasts.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.1.6 (ctd.)
WELL NO.: 7317/10-U-1

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8586	185.06	Am: <5% Lm: <5% W: 5% C: >90%	F-M-L	Fair-Poor	?2.0 - 2.5	Organic residue completely dominated by black angular coaly fragments. Evidence of reworked Mid-Cretaceous material.
E-8466	187.66	Am: 10-15% Lm: 30-35% W: 50-55% C:	F-M-L	Fair-Good	<2.0	Comparable to samples E-8360 and E-8379.
E-8589	206.90	Am: 10-15% Lm: 10-15% W: 70-80% C:	F-M-L	Poor-Fair	2.0 - 2.5	Comparable to samples E-8585 and E-8436, but with a slightly increased fraction of woody/coaly fragments.
E-8503	208.08	Am: 5-10% Lm: 20-25% W: 65-70% C:	F-M-L	Fair-Good	<2.0	Organic residue dominated by (recycled) woody and coaly phytoclasts.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.1.6 (ctd.)
WELL NO.: 7317/10-U-1

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8522	224.50	Am: 10% Lm: 20-25% W: 65-70% C:	F-M-L	Fair	2.0 - 2.5	Comparable to samples E-8585 and E-8436.

ABBREVIATIONS:

Am = Amorphous
 Al = Algae
 W = Woody material
 C = Coaly fragments
 Lm = Liptinitic material
 + = Present in traces

F = Fine
 M = Medium
 L = Large

* New TAI (1-10 scale; see experimental).

Project no.: 21346500
Location : 7317/10-U-01
Date : 89.11.21

Table A.I.1.7a: WEIGHT OF CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ROCK EXTR. (g)	EOM (mg)	ASPH (mg)	SAT HC (mg)	ARO HC (mg)	POLAR COMP. (mg)	HC (mg)	NONHC (mg)	TOC (%)
E8413		147.55	CORE	55.7	5.5	5.5	0.2	1.1	1.3	1.3	4.2	0.96
E8453		177.60	CORE	25.0	8.9	5.3	0.7	0.5	3.3	1.2	7.7	1.02
E8481		199.04	CORE	22.8	9.3	3.6	0.4	1.0	2.7	1.4	7.9	1.11
E8499		206.36	CORE	29.4	11.6	8.2	0.7	1.3	2.2	2.0	9.6	0.91
E8513		214.30	CORE	17.6	5.9	3.0	0.5	0.7	1.6	1.2	4.7	0.92

Legend:

- * - Not all the available EOM was used for MPLC.
- ? - MPLC results assumed more EOM than originally extracted.
- 1- No data available.

Table A.I.1.7b: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8413		147.55	CORE	99	99	4	19	24	23	76
E8453		177.60	CORE	357	212	29	19	130	48	309
E8481		199.04	CORE	408	158	16	42	116	58	350
E8499		206.36	CORE	395	279	25	45	74	70	325
E8513		214.30	CORE	335	171	27	41	89	68	267

Legend:

- 1- No data available.

Project no.: 21346500
Location : 7317/10-U-01
Date : 89.11.21

Table A.I.1.7c: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8413		147.55	CORE	10.3	10.3	0.5	2.0	2.5	2.5	7.8
E8453		177.60	CORE	35.0	20.8	2.8	1.9	12.8	4.7	30.3
E8481		199.04	CORE	36.7	14.2	1.4	3.8	10.5	5.2	31.5
E8499		206.36	CORE	43.4	30.7	2.7	5.0	8.1	7.7	35.7
E8513		214.30	CORE	36.5	18.5	3.0	4.5	9.7	7.5	29.0

Legend:

-1- No data available.

Table A.I.1.7d: COMPOSITION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ASPH ----- EOM (%)	SAT ----- EOM (%)	ARO ----- EOM (%)	HC ----- EOM (%)	POLAR ----- EOM (%)	SAT ----- ARO x 100	HC ----- NONHC x 100
E8413		147.55	CORE	100.0	4.4	19.7	24.1	24.1	22.2	31.7
E8453		177.60	CORE	59.6	8.1	5.4	13.5	36.5	150.0	15.6
E8481		199.04	CORE	38.7	3.9	10.4	14.3	28.5	37.5	16.6
E8499		206.36	CORE	70.7	6.2	11.4	17.6	18.7	54.5	21.4
E8513		214.30	CORE	50.8	8.2	12.2	20.4	26.5	66.7	25.6

Legend:

-1- No data available.

Project no.: 21346500
Location : 7317/10-U-01
Date : 89.12.19

Table A.I.1.8: RATIOS DERIVED FROM GAS CHROMATOGRAMS OF SATURATED HYDROCARBONS

IKUNO FRAC NAME	DEPTH	Pri	Pri	Phy	A	n-C17	n-C31	CPI 1	CPI 2
		--- Phy	A=--- n-C17	B=--- n-C18	---	---	---		
E8413	147.55	2.2	1.1	0.5	2.4	0.6	1.1	1.8	1.8
E8453	177.60	1.4	2.0	1.1	1.8	0.3	1.2	2.3	2.2
E8481	199.04	1.4	2.2	1.1	2.0	0.3	1.5	2.2	2.4
E8499	206.36	1.7	1.5	0.6	2.3	0.5	0.9	2.0	1.9
E8513	214.30	1.1	2.1	0.9	2.3	0.3	1.1	2.2	2.3

-1 = No data available

Legend:

$$\text{CPI 1} = \frac{1}{2} \cdot \left(\frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{24}+C_{26}+C_{28}+C_{30}} + \frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{26}+C_{28}+C_{30}+C_{32}} \right)$$

$$\text{CPI 2} = \frac{2 \cdot C_{27}}{C_{26}+C_{28}}$$

Ratios involving pristane and phytane are calculated from peak areas.
All other ratios are calculated from peak heights.

Table A.I.1.9:

*Molecular ratios from sterane and terpane mass chromatograms.
Core 7317/10-U-01.*

Code	Depth (m)	$\alpha\beta/\alpha\beta+\beta\alpha$ ¹⁾	%22S ²⁾	% $\beta\beta$ ³⁾	%20S ⁴⁾	30:1/30:0 ⁵⁾	a/a+j ⁶⁾
E-8453	177.60	0.69	14.9	40.6	7.1	-	0.28
E-8499	206.36	0.69	16.2	31.2	6.4	0.35	0.33

- 1) E/(E+F) in m/z 191 (note coelution with peak 10).
- 2) Average % distribution between first and second eluting isomers of extended hopanes (G/G+H in m/z 191).
- 3) $100 * 2(r+s)/(q+t+2(r+s))$ in m/z 217.
- 4) $100 * q/(q+t)$ in m/z 217.
- 5) 9/E in m/z 191.
- 6) Relative abundance of diasteranes in m/z 217.

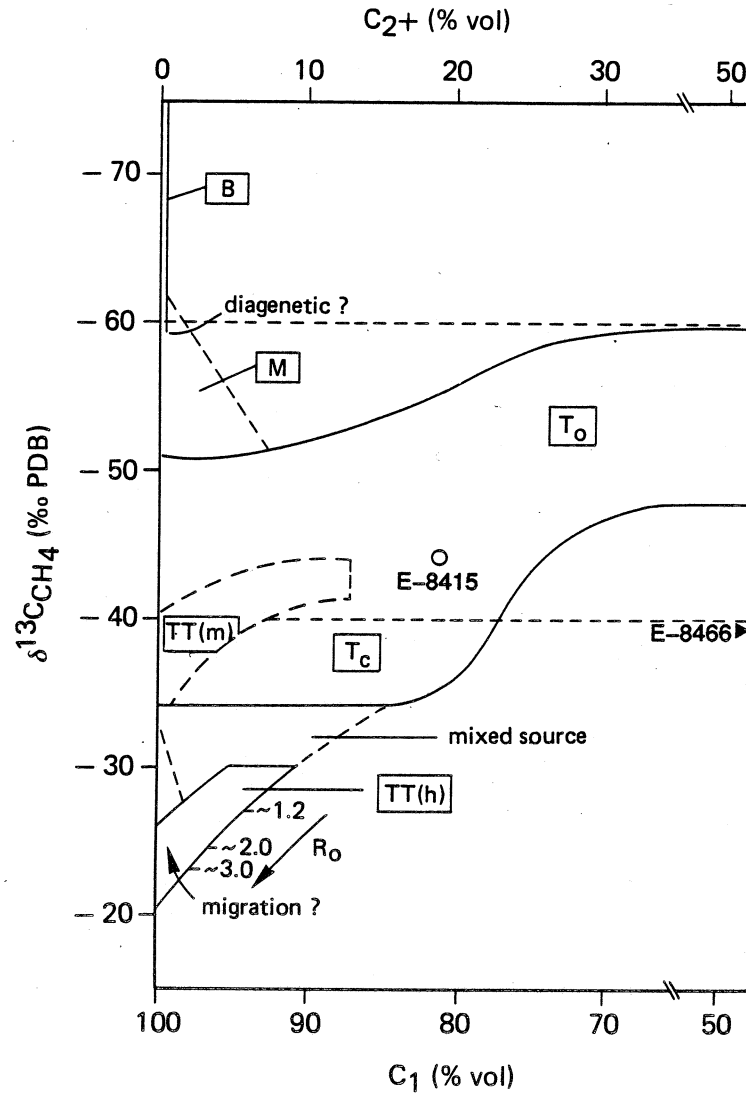


Figure A.I.1.1a

$\delta^{13}\text{C}$ isotopic composition of adsorbed methane in relation to gas composition for selected samples from core 7317/10-U-01 (after Schoell 1983).

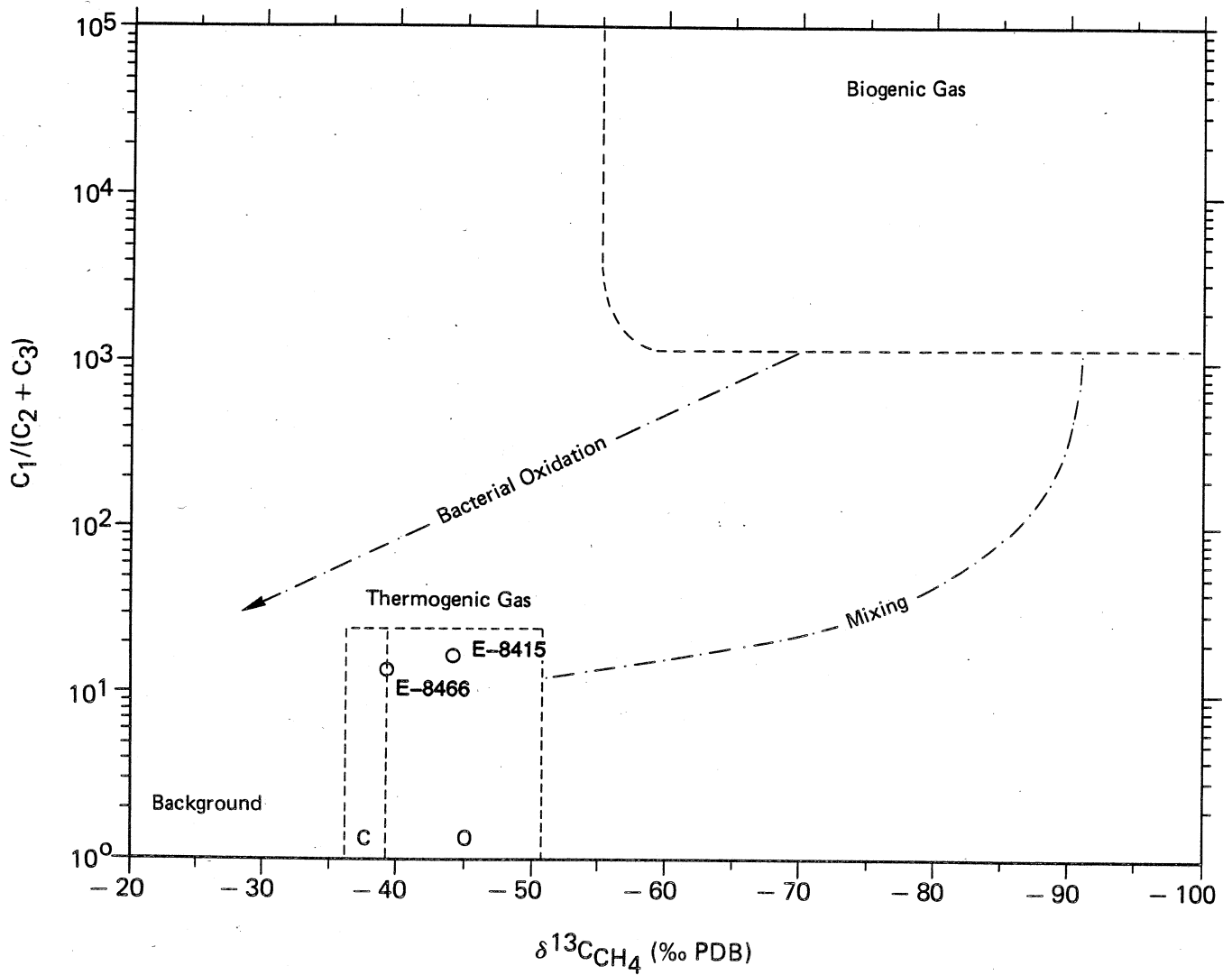
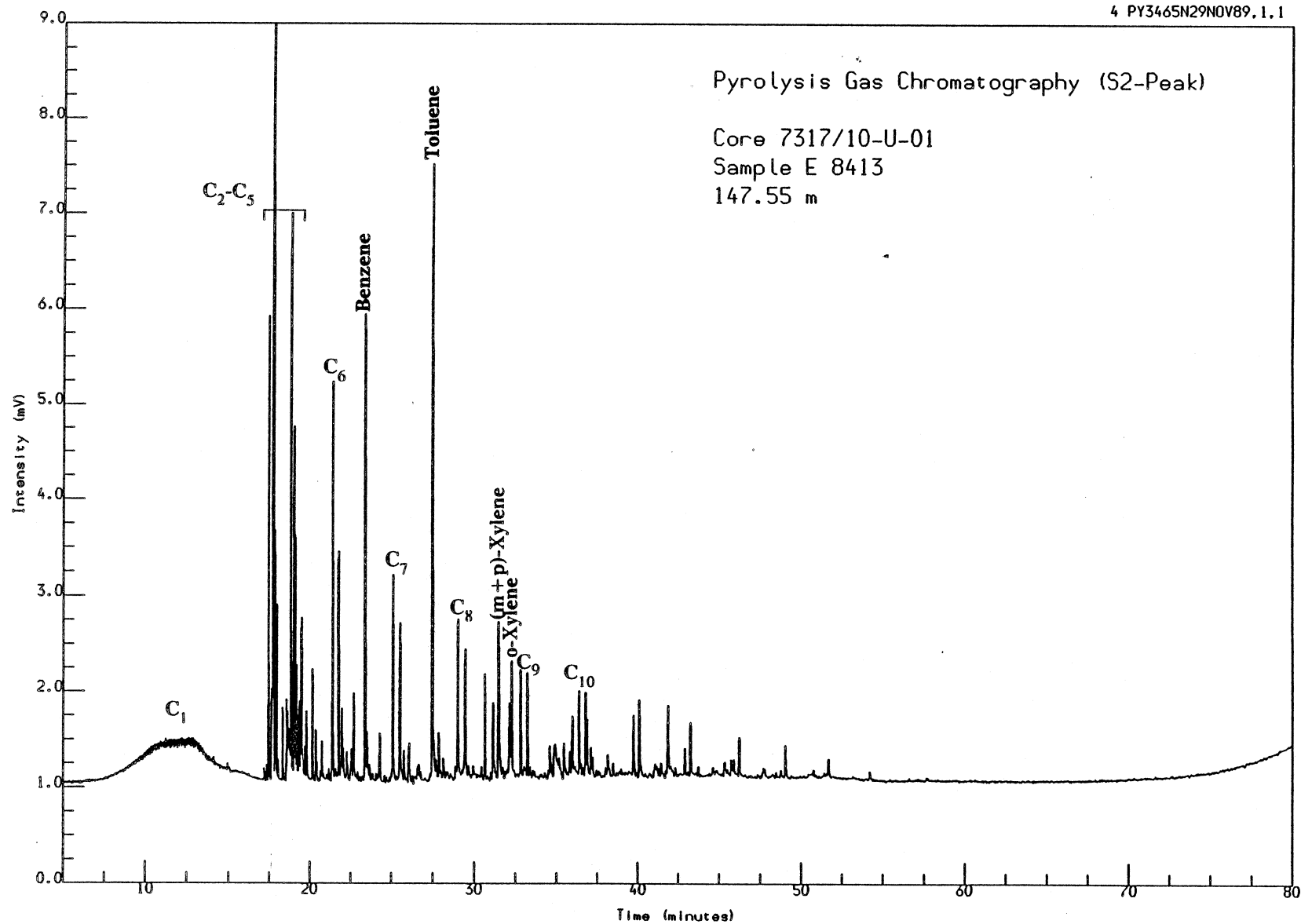


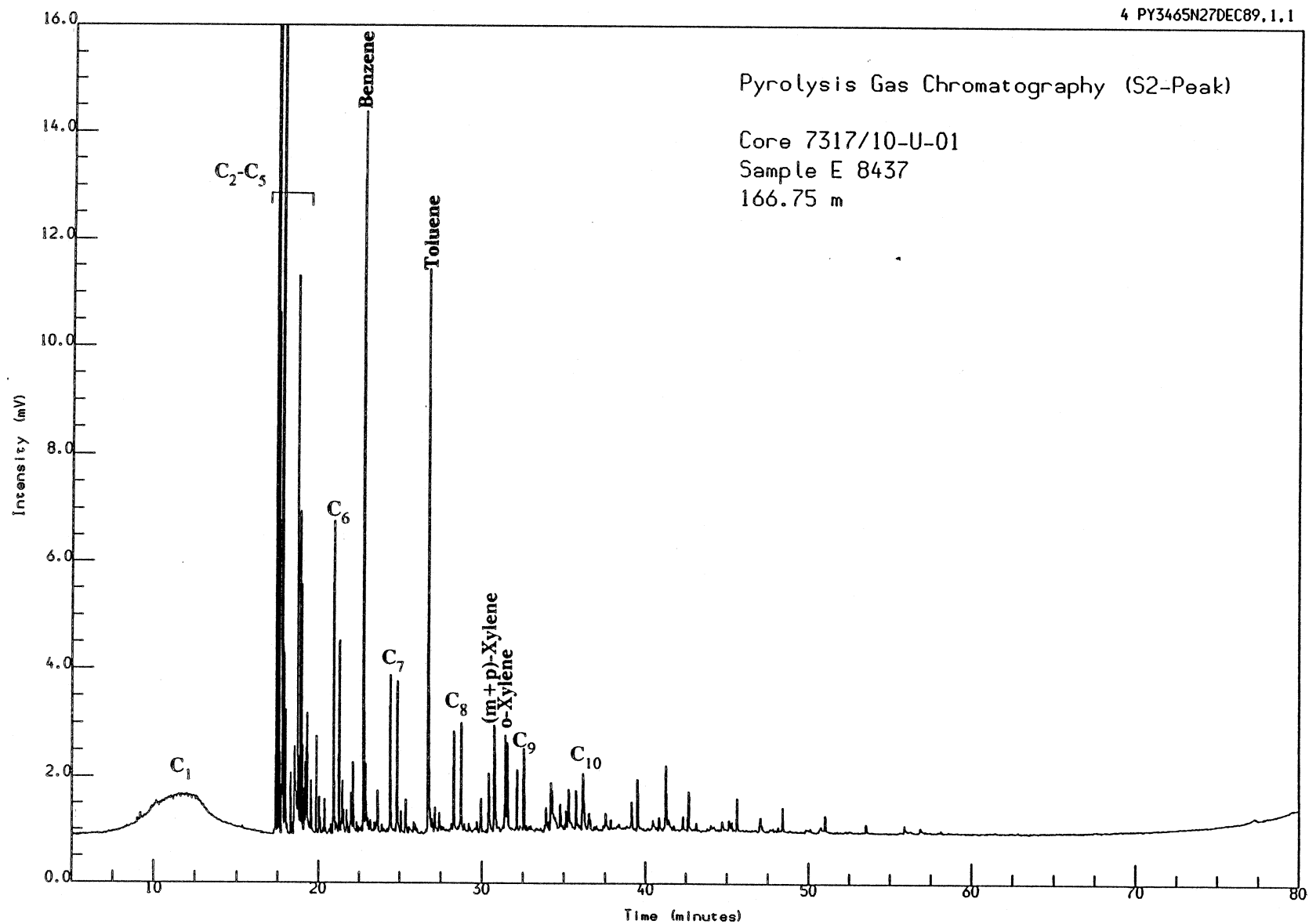
Figure A.1.1.1b

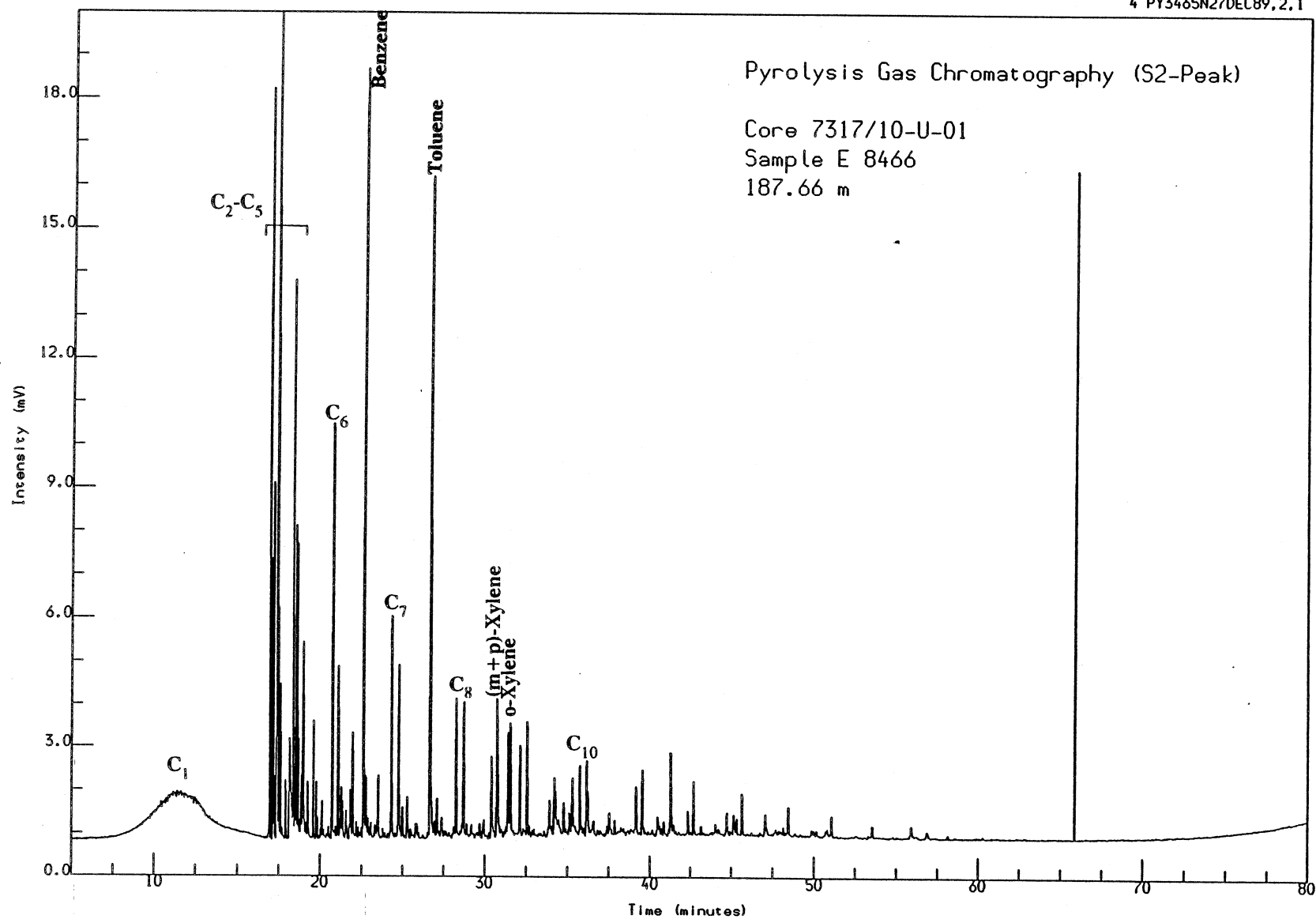
$\delta^{13}C$ isotopic composition of adsorbed methane for selected samples from core 7317/10-U-01 (after Schoell 1983).

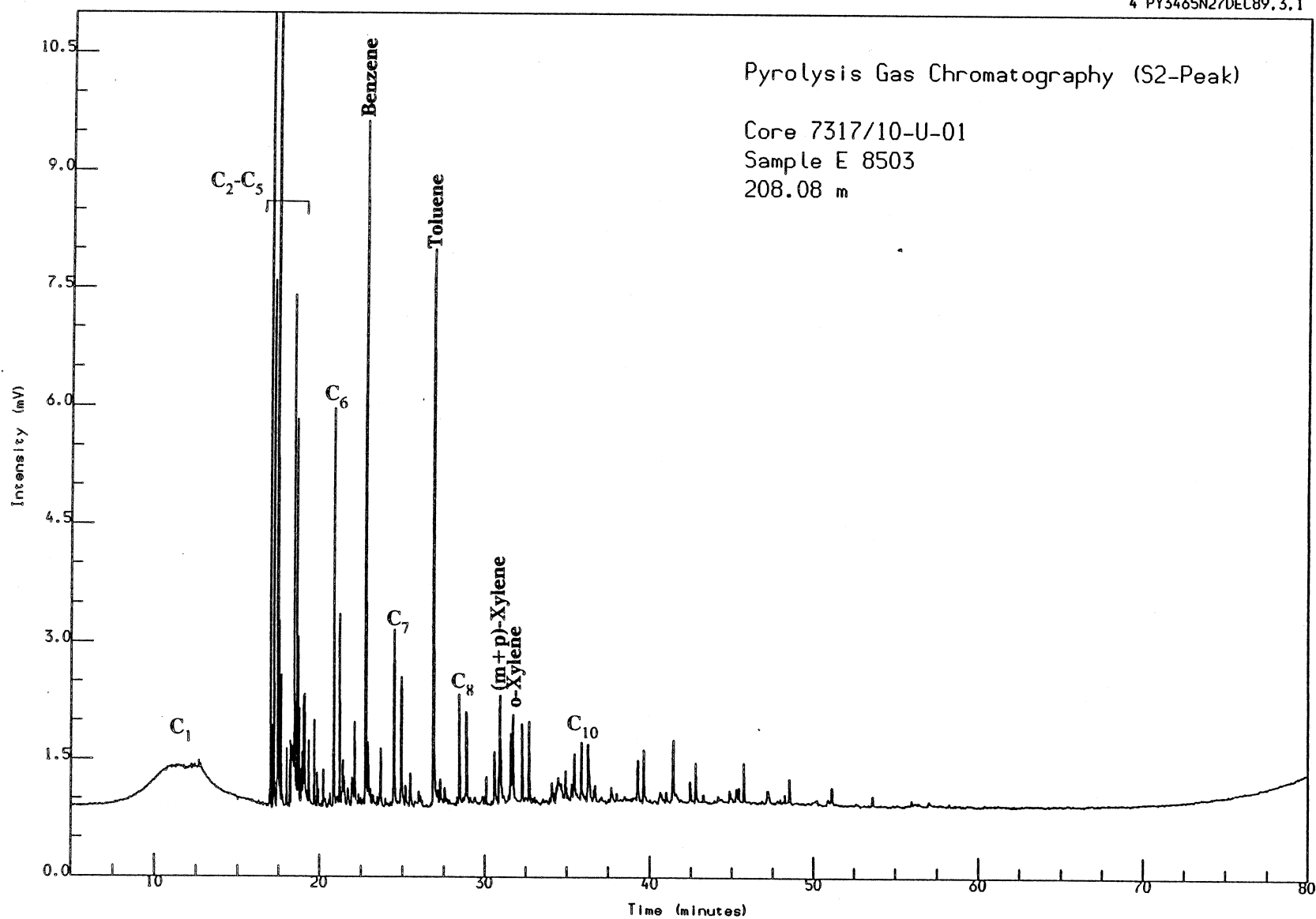
Figure A.I.1.2:

Pyrolysis-gas chromatograms (S_2 peak):
Whole-rock samples









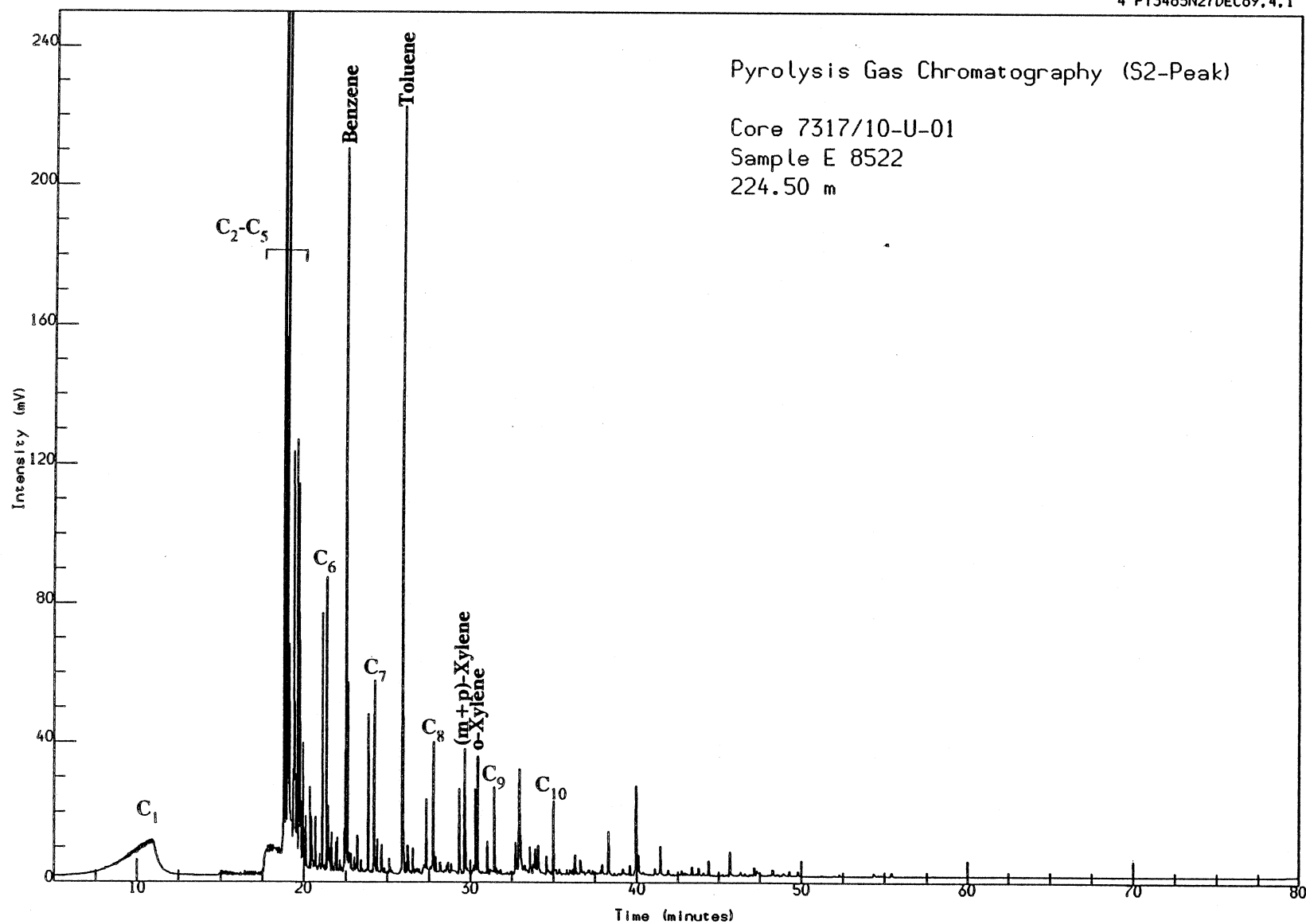


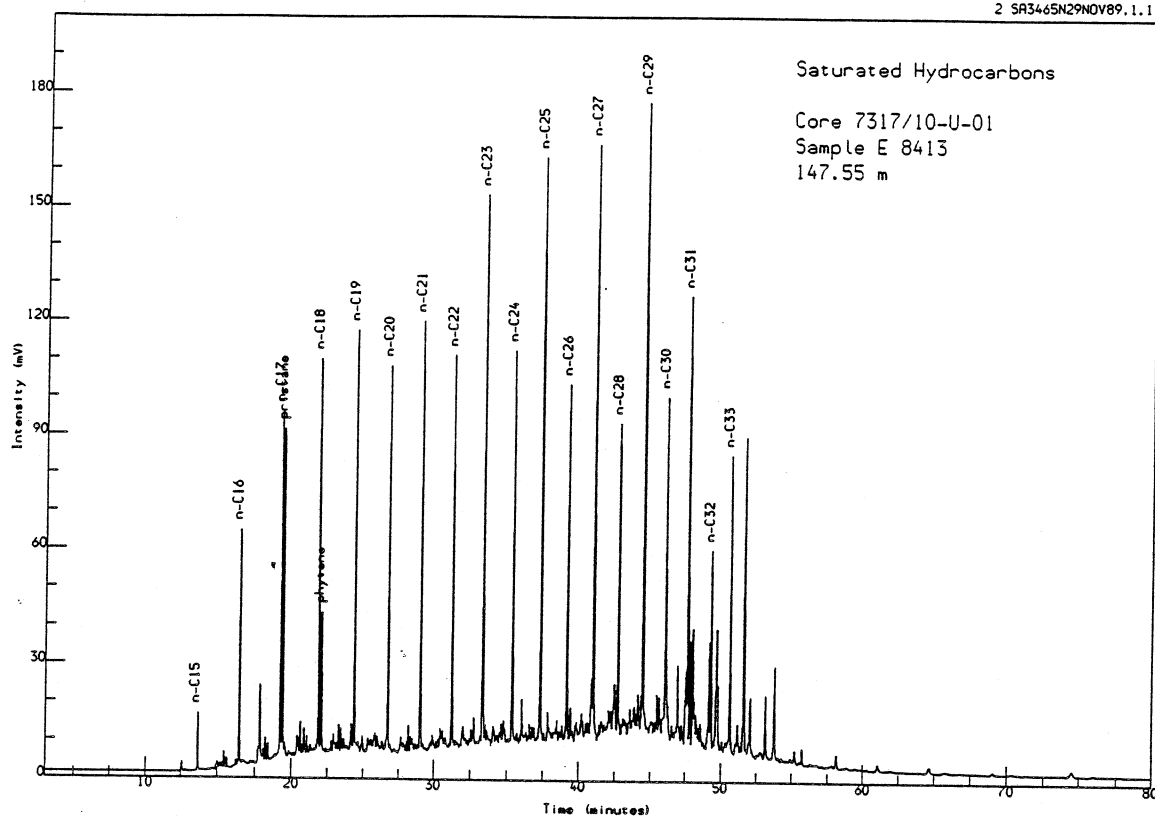
Figure A.I.1.3:

Gas chromatograms of saturated and aromatic hydrocarbons

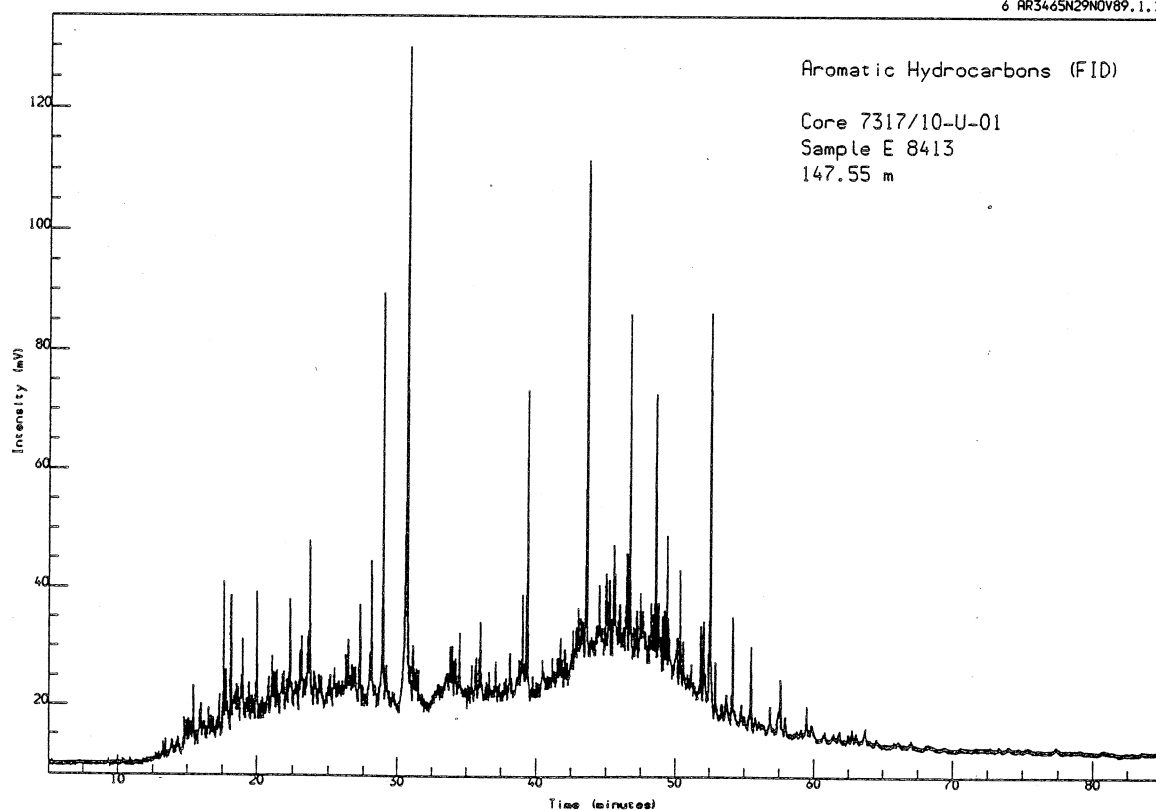
nC₁₅, etc. - n-alkanes

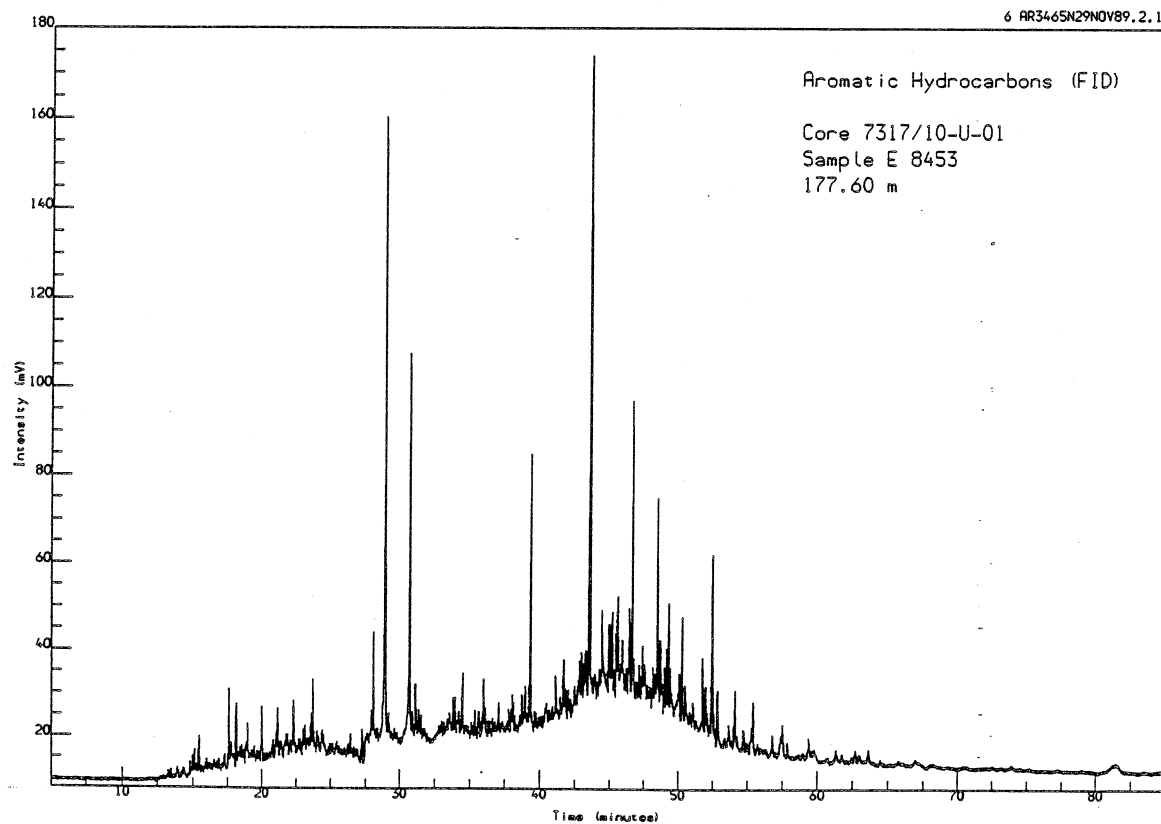
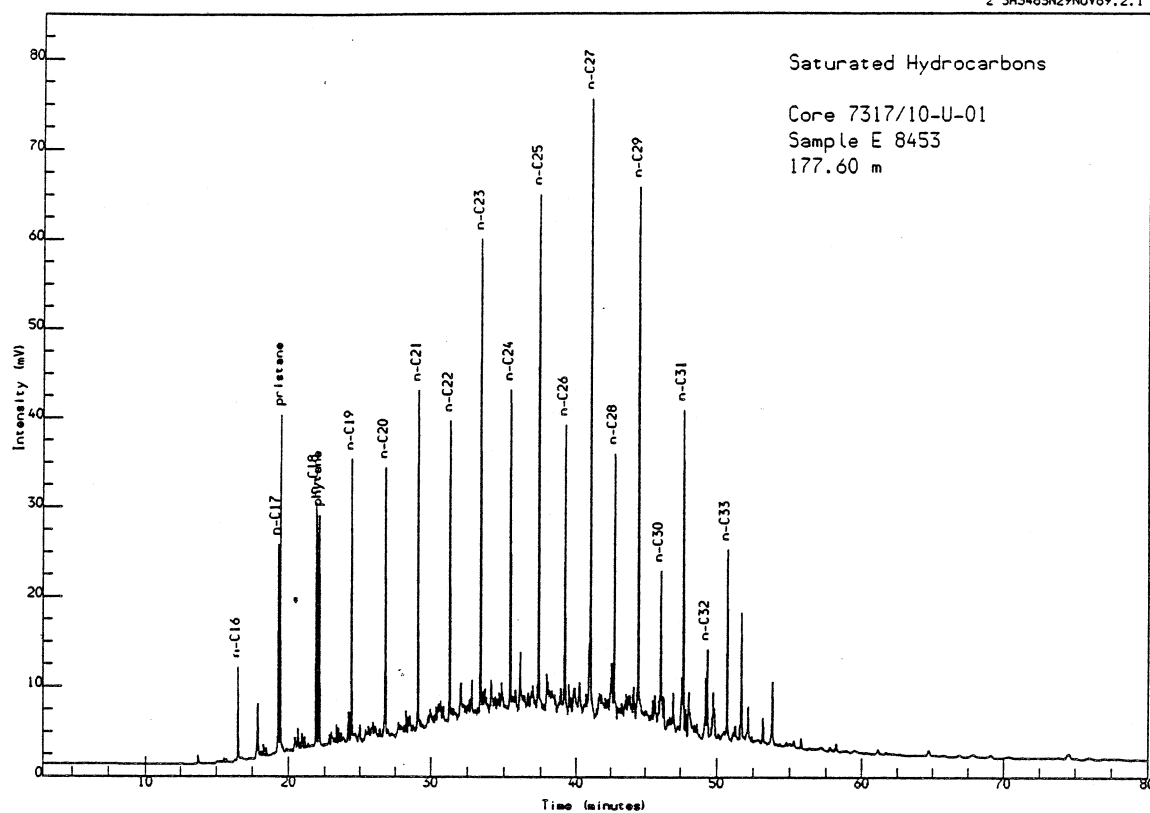
N	- Naphthalene
MN	- Methylnaphthalenes
DMN	- Dimethylnaphthalenes
TMN	- Trimethylnaphthalenes
P	- Phenanthrene
MP	- Methylphenanthrenes
DMP	- Dimethylphenanthrenes

2 SA3465N29NOV89.1.1

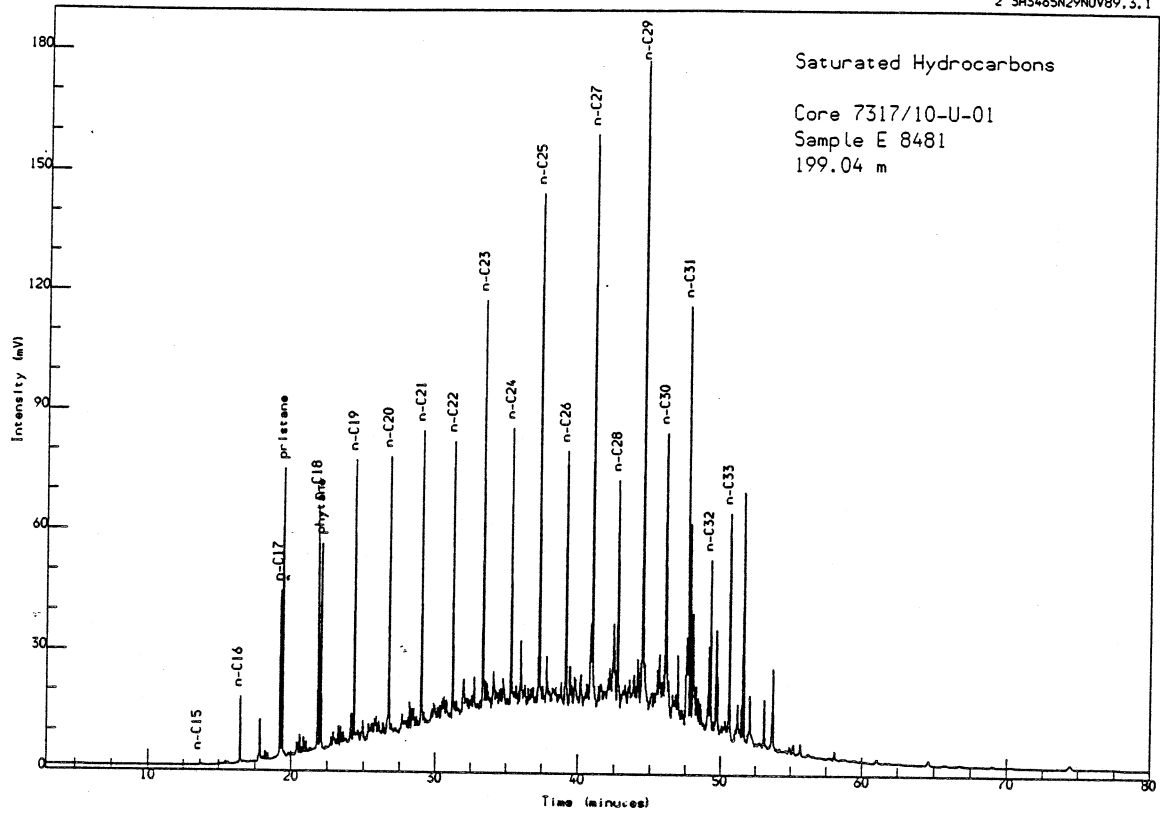


6 AR3465N29NOV89.1.1

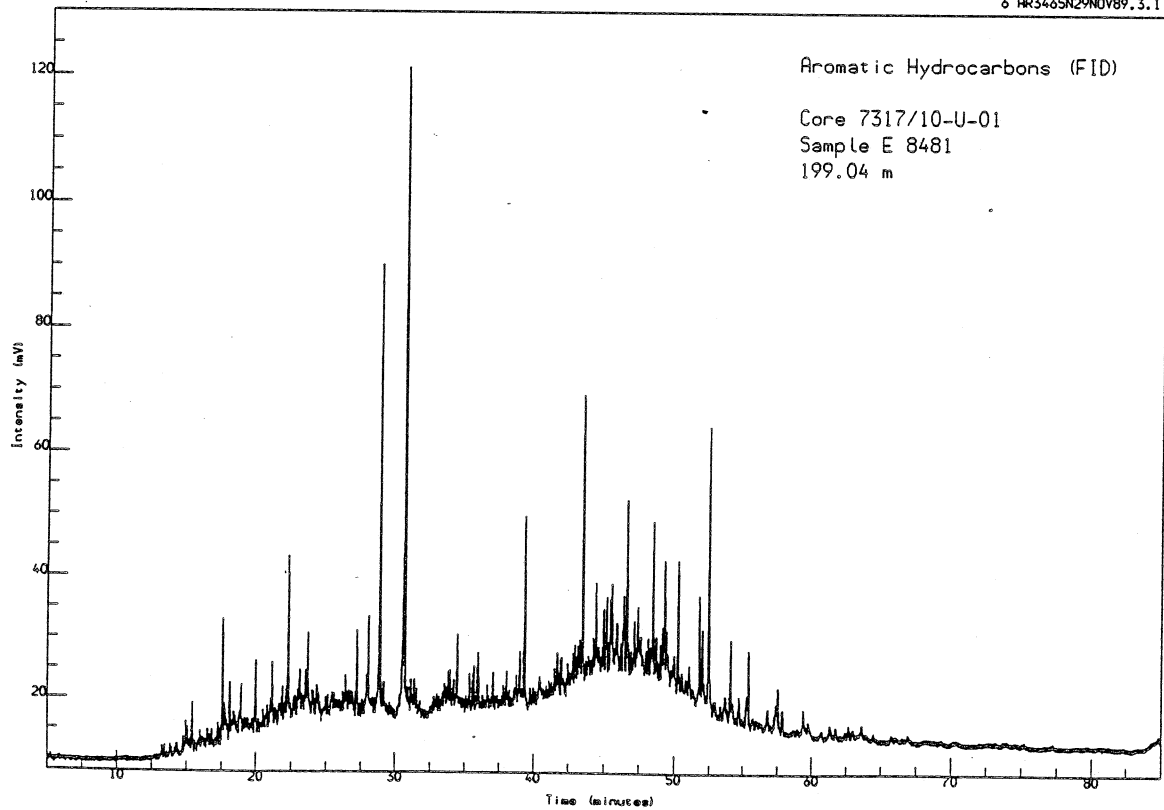




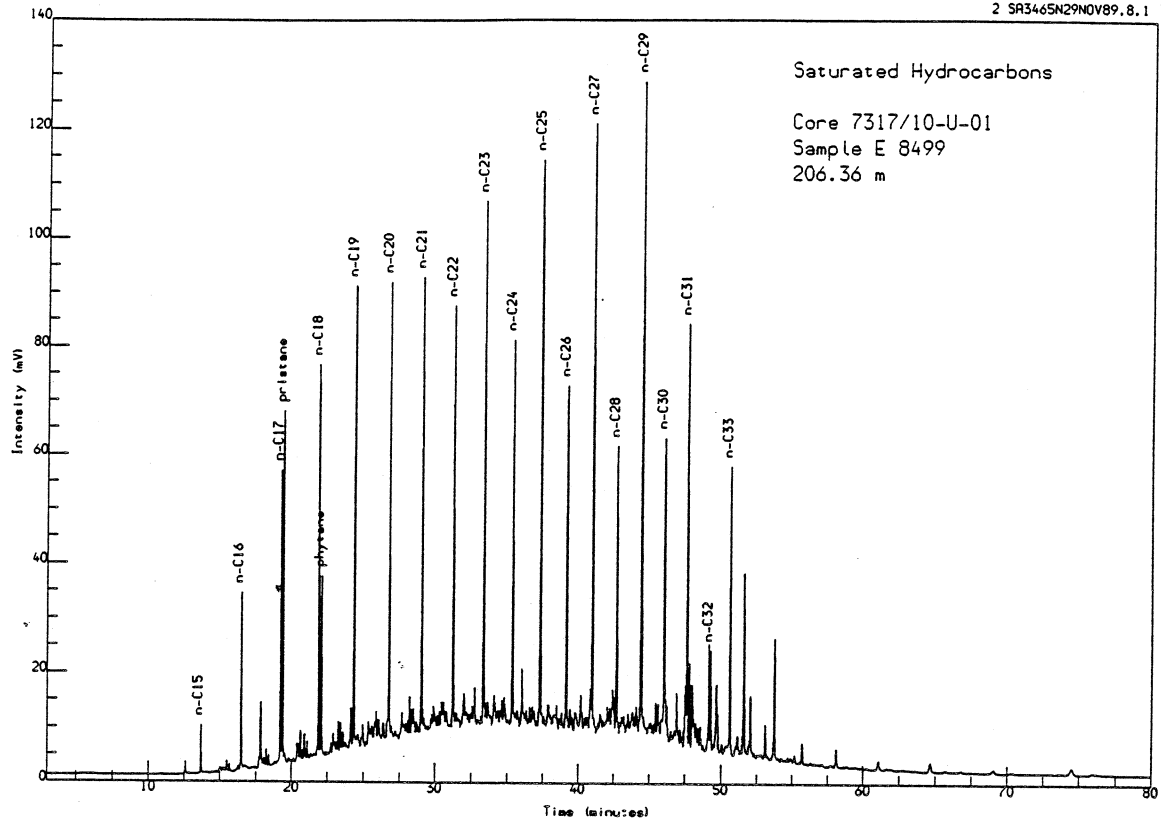
2 SR3465N29NOV89.3.1



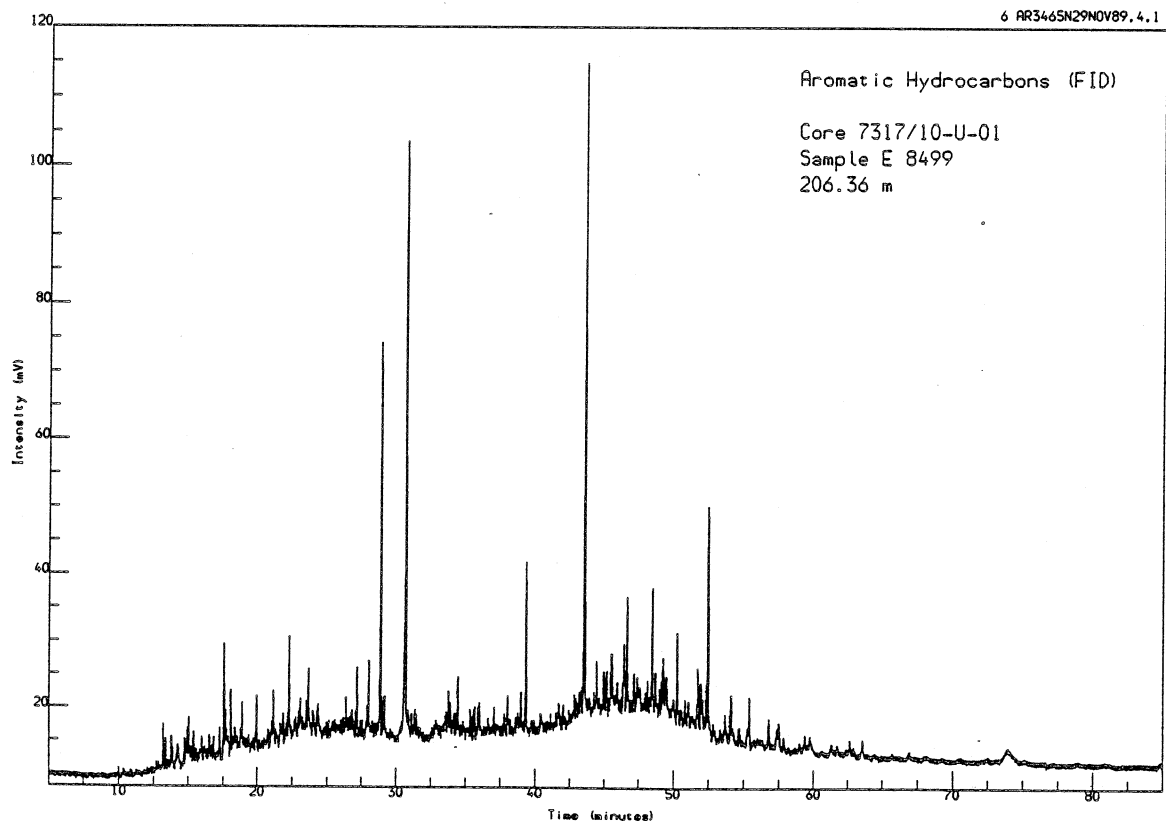
6 AR3465N29NOV89.3.1



2 SR3465N29NOV89.8.1



6 AR3465N29NOV89.4.1



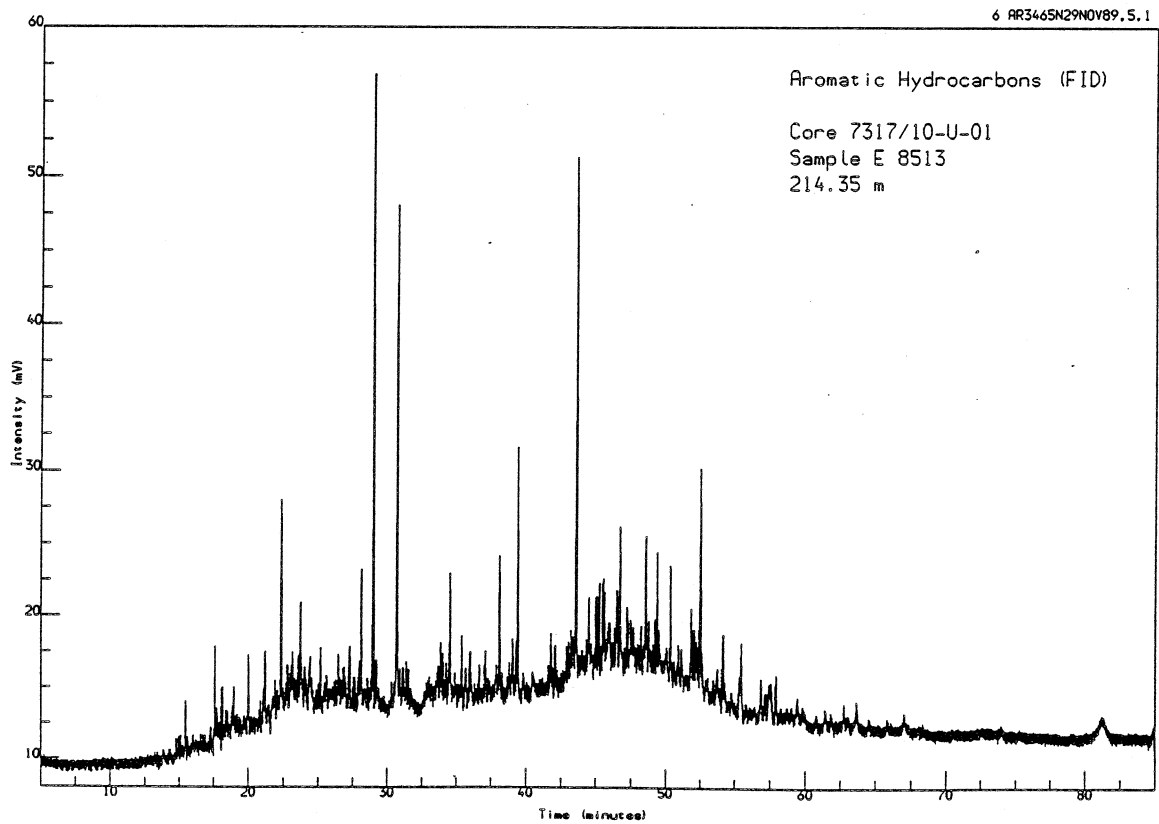
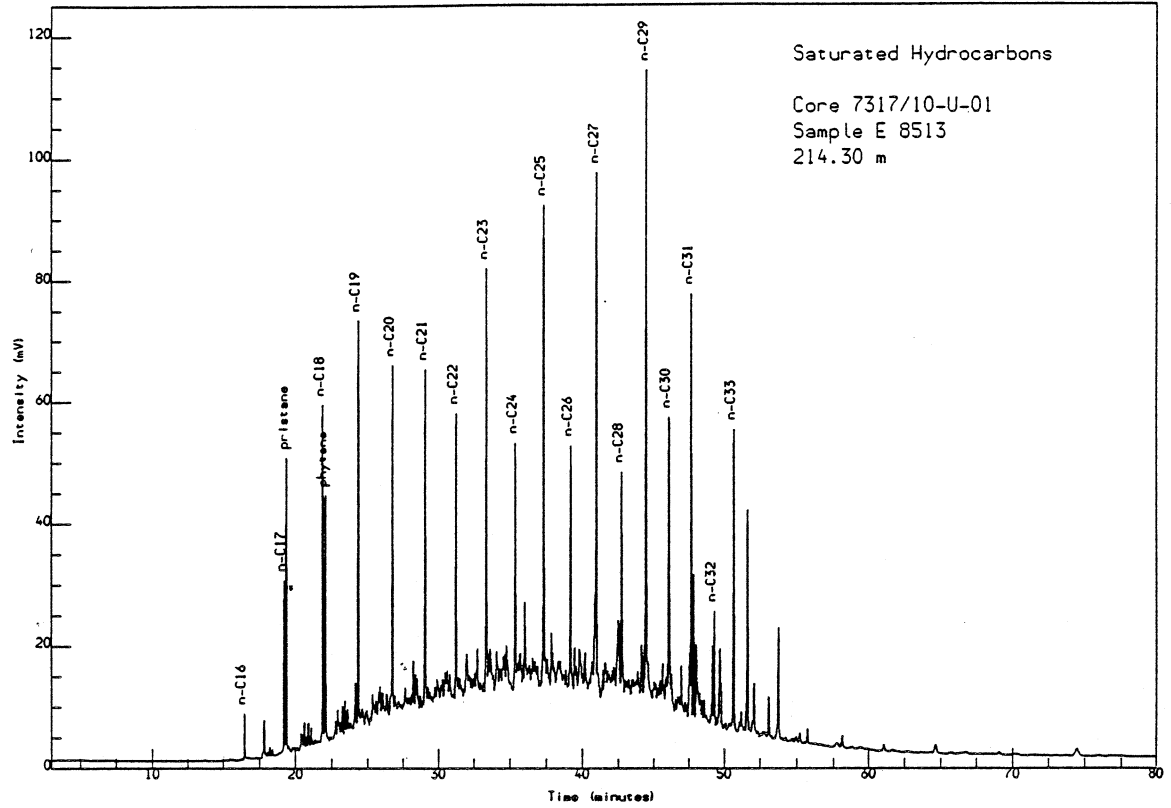
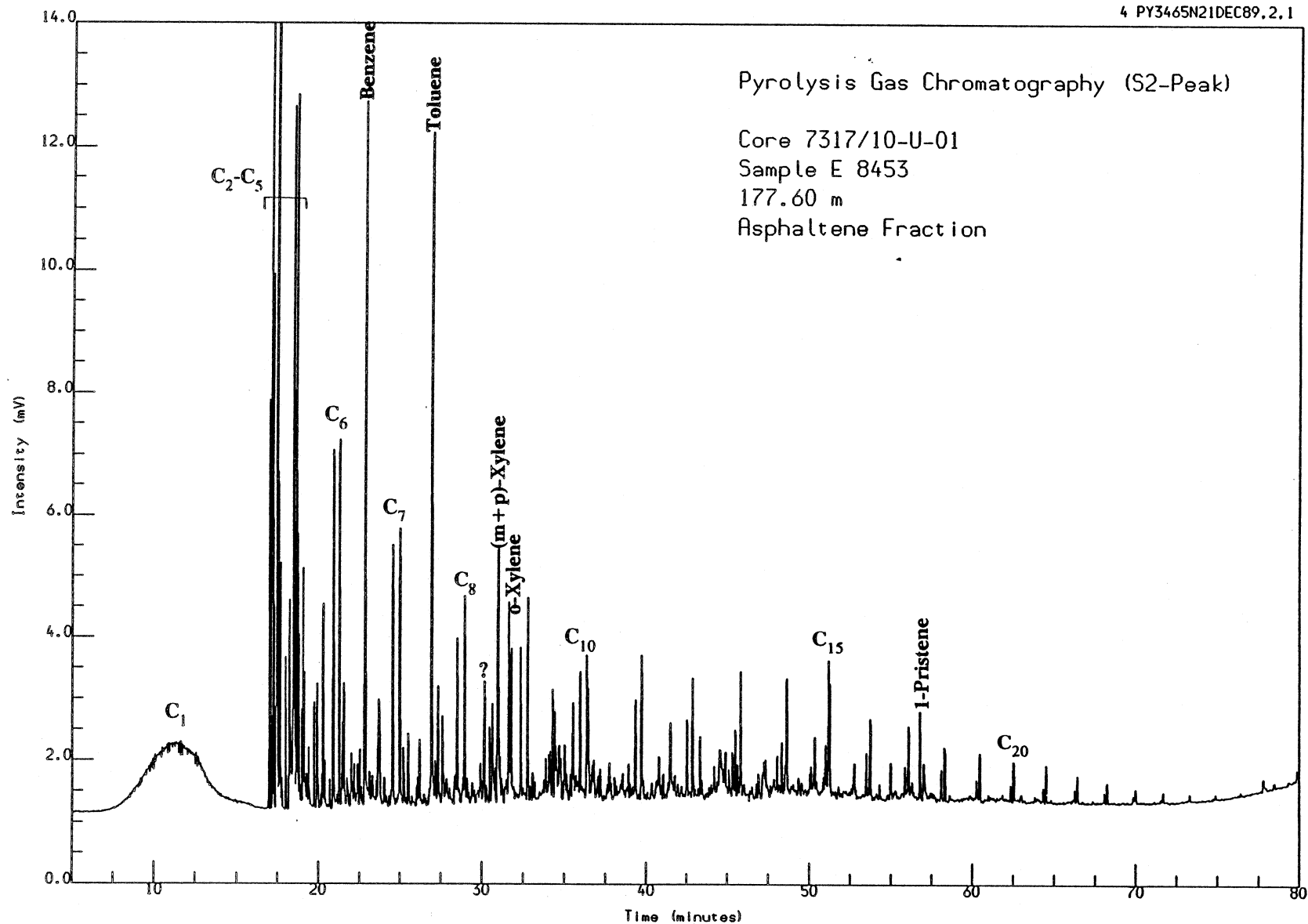


Figure A.I.1.4:

**Pyrolysis-gas chromatograms (S_2 peak):
Asphaltene fraction**



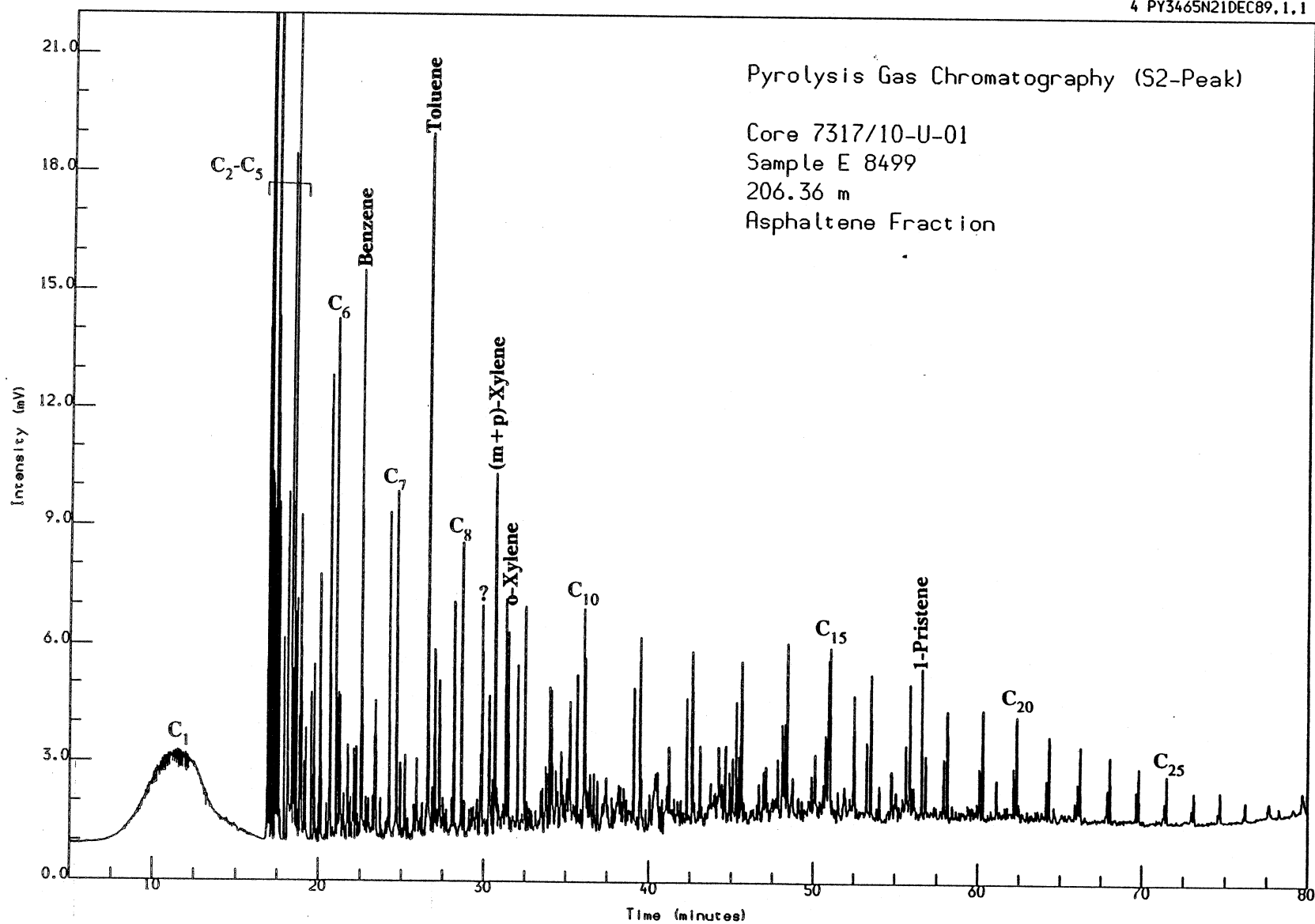
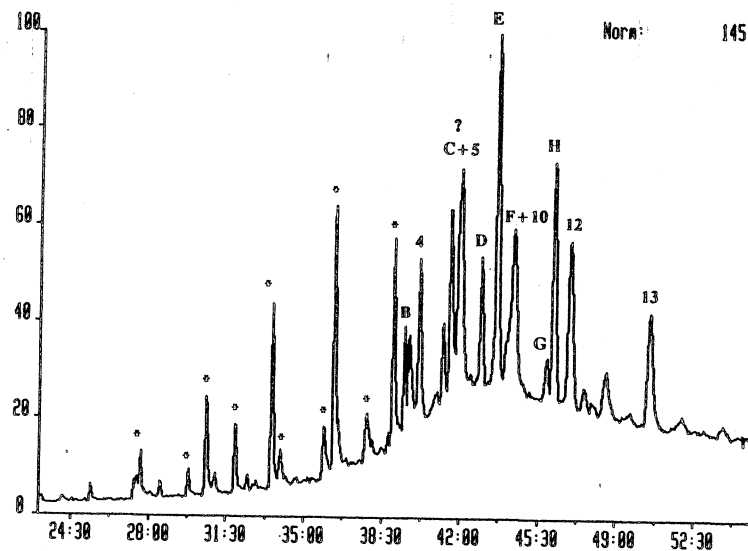


Figure A.I.1.5:

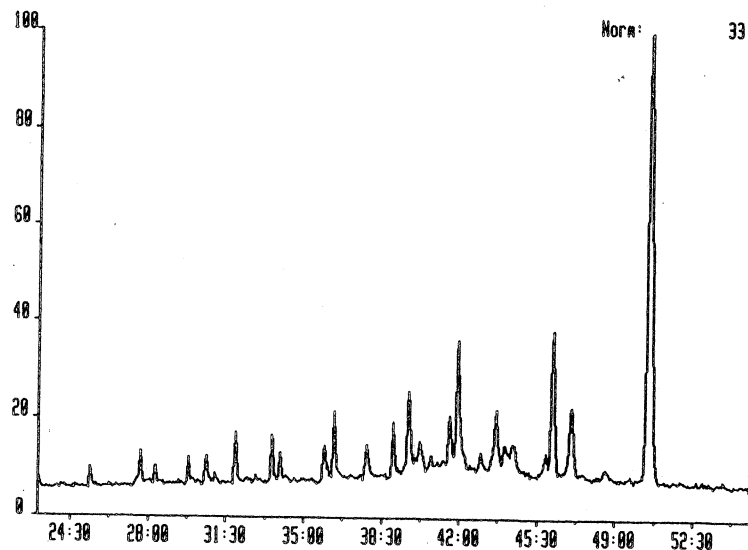
**Mass fragmentograms of m/z 191, 205 (terpanes)
and m/z 217, 218 (steranes)**

For peak identification, see Chapter II

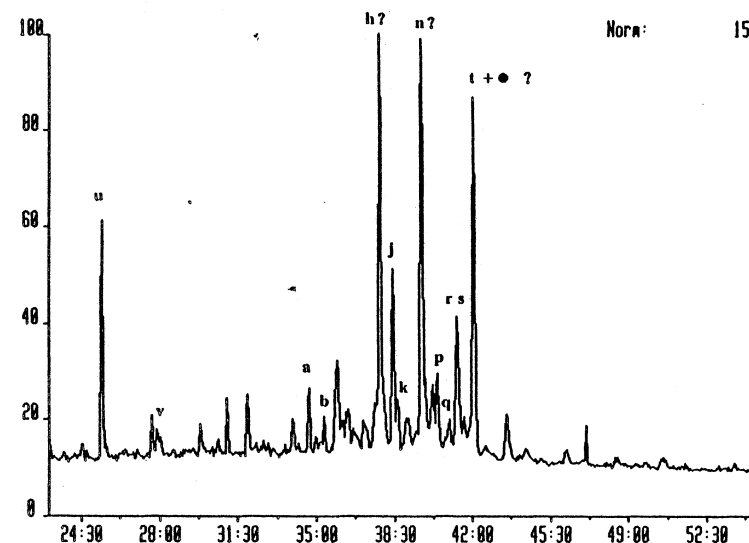
E8453SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 191.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 177.60M, E8453 SAT



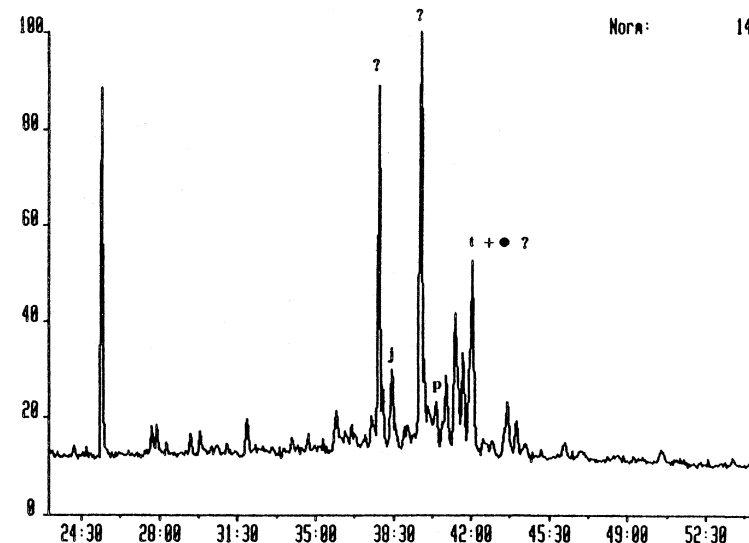
E8453SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 205.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 177.60M, E8453 SAT



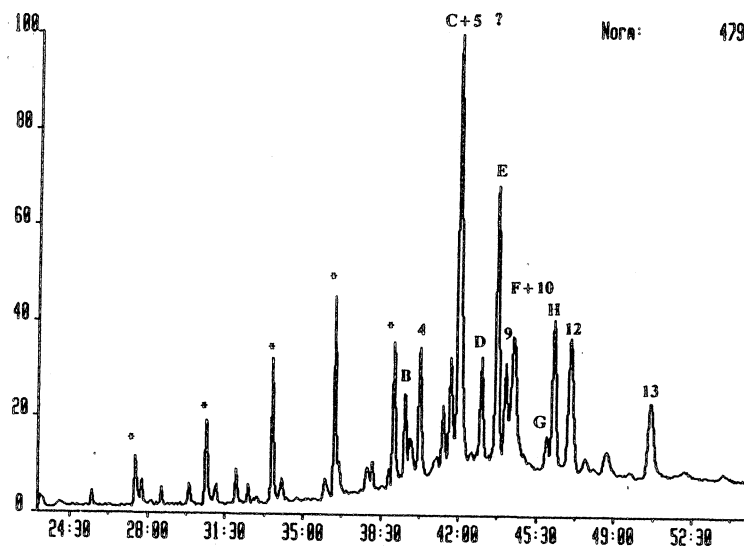
E8453SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 217.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 177.60M, E8453 SAT



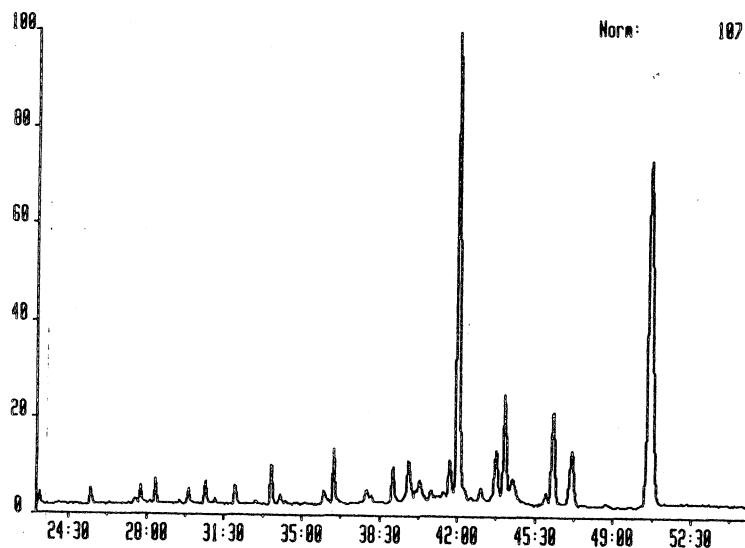
E8453SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 210.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 177.60M, E8453 SAT



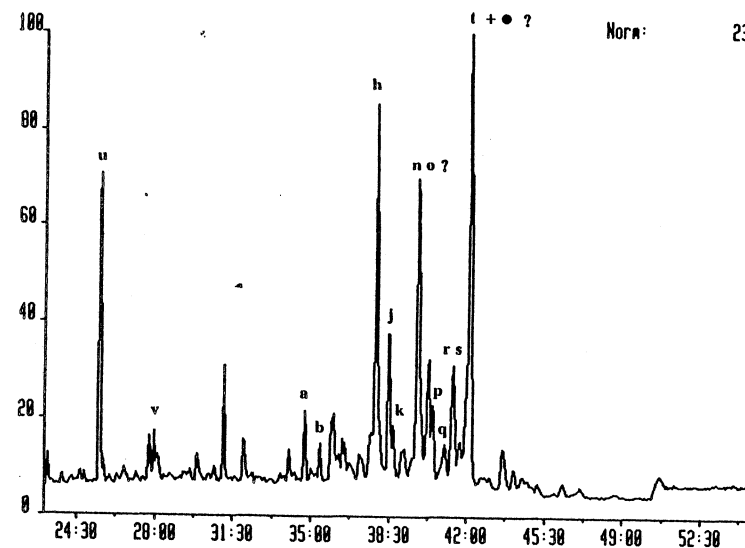
E0499SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 191.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 206.36M, E0499 SAT



E0499SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 205.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 206.36M, E0499 SAT



E0499SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 217.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 206.36M, E0499 SAT



E0499SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 218.1000
 Text:21.3465.23 BJORNOYA VEST, 7317/10-U-01, 206.36M, E0499 SAT

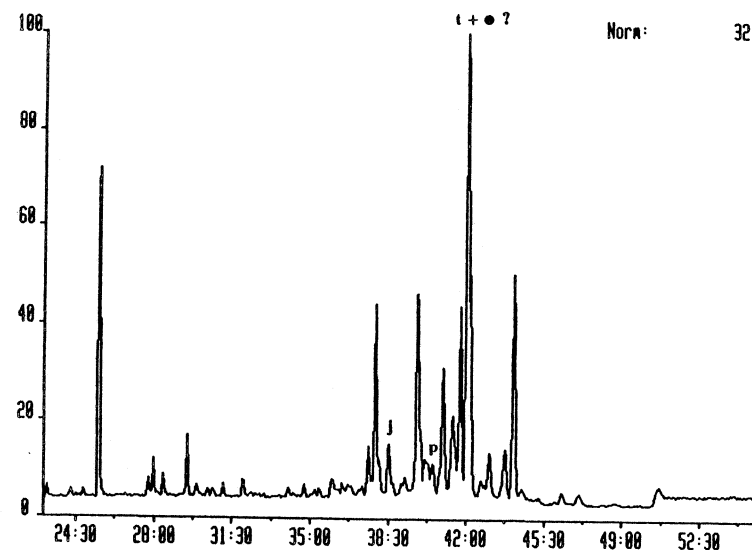
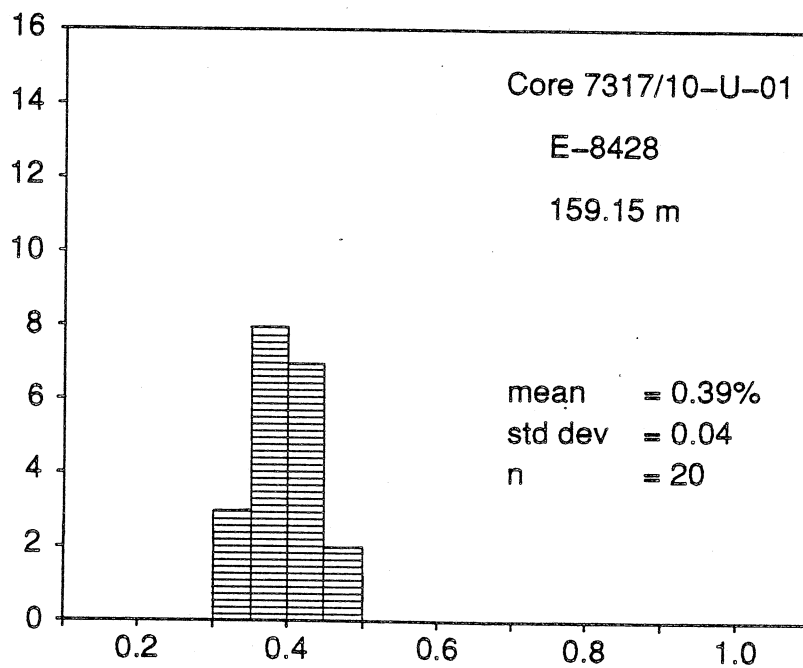
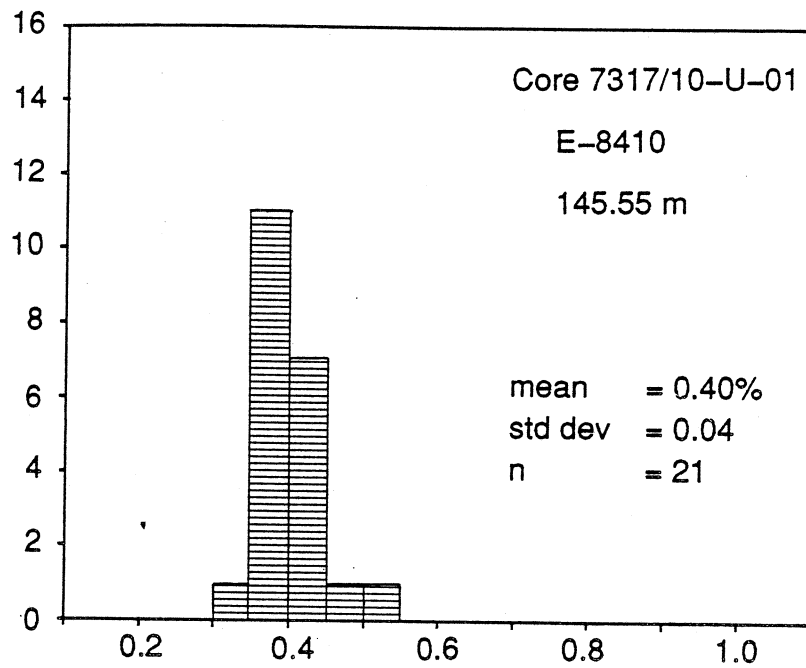
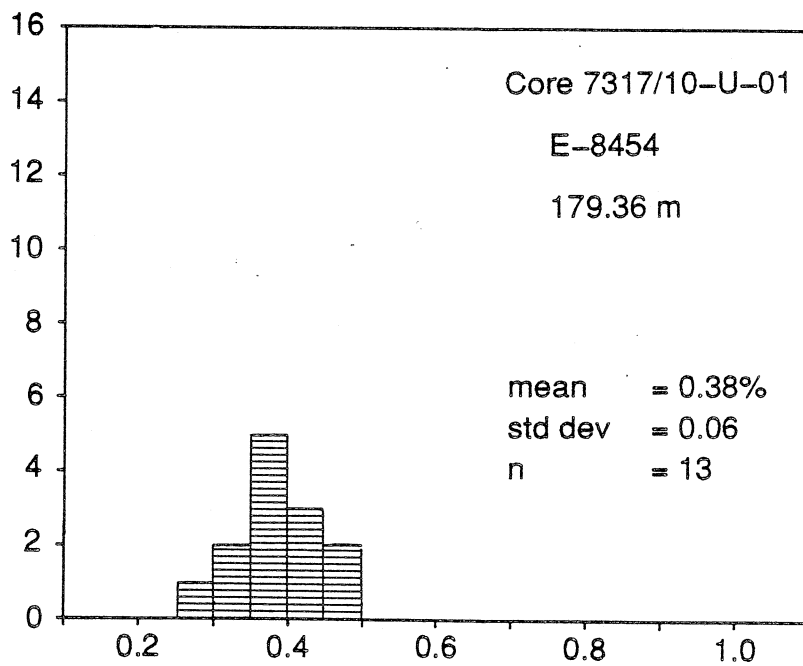
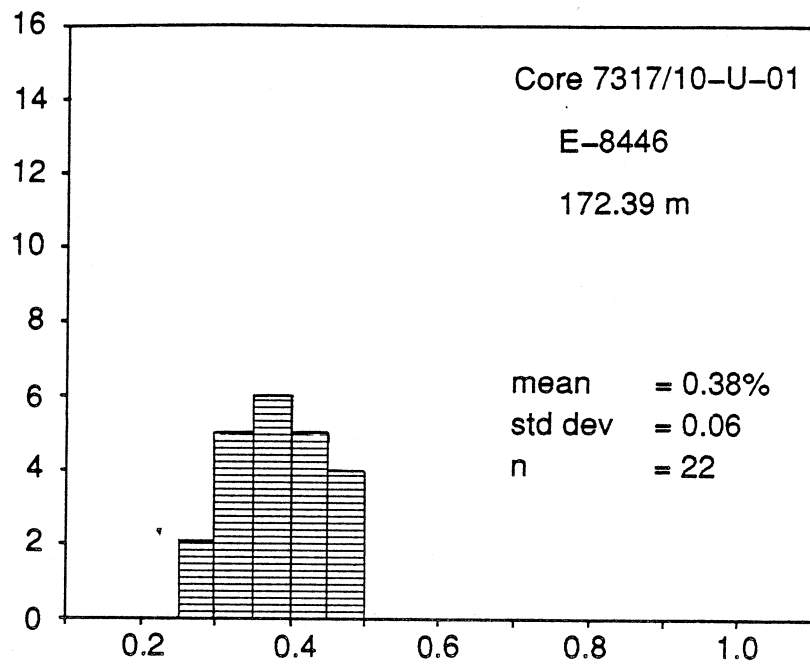
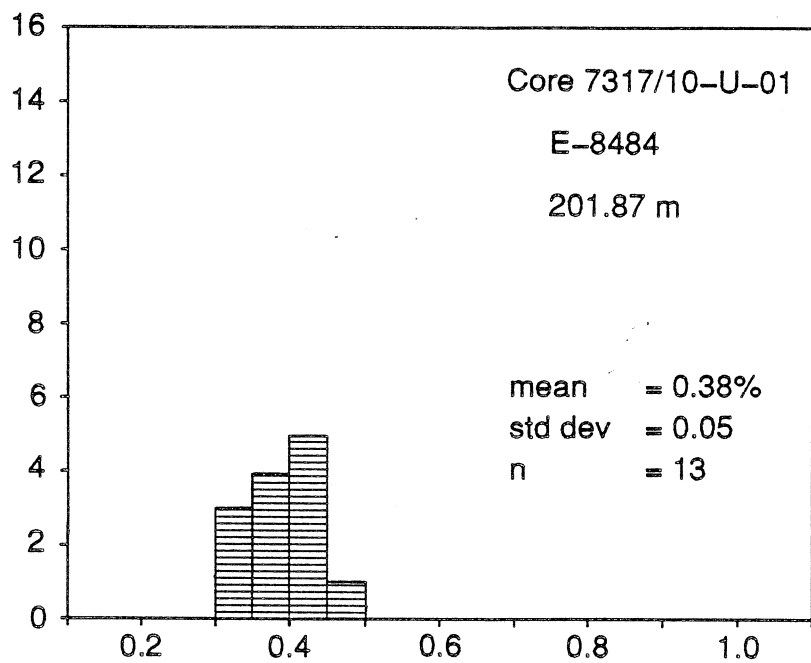
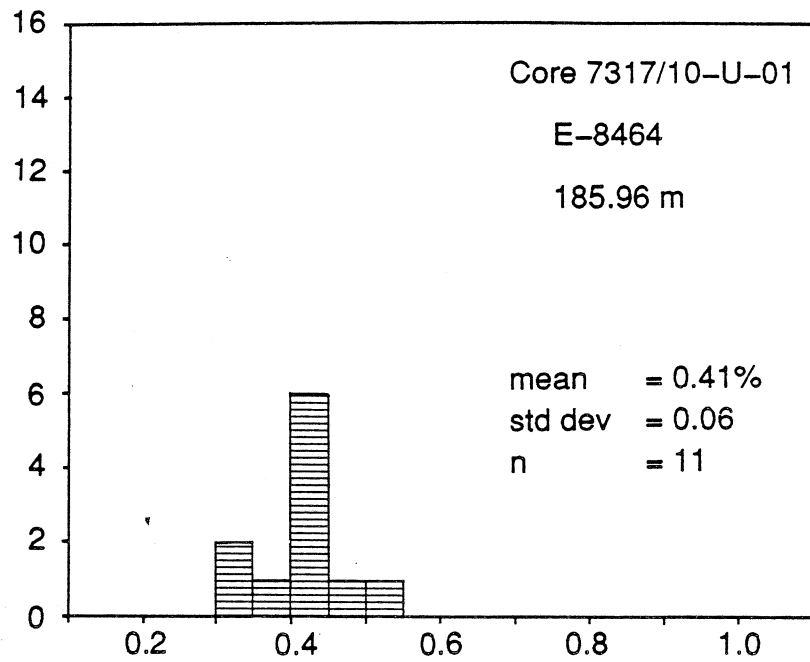


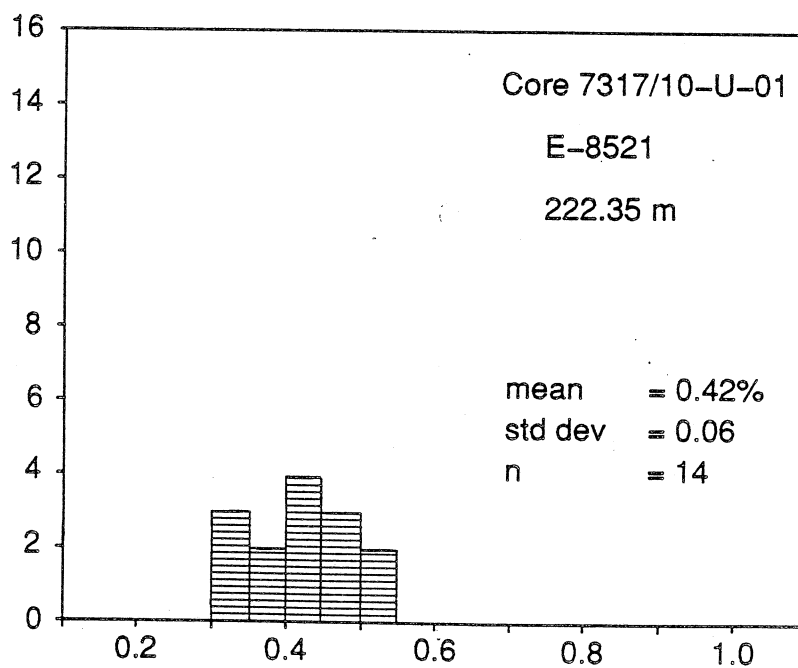
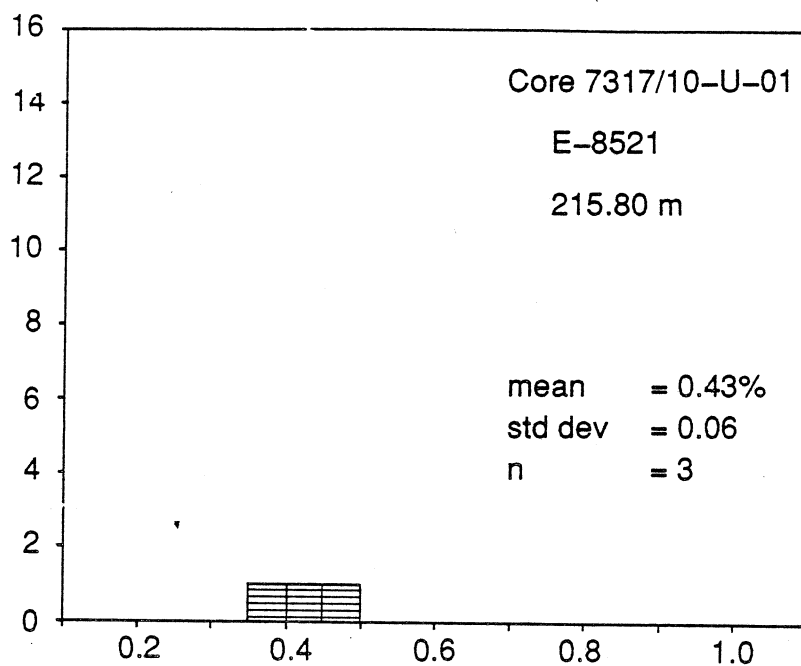
Figure A.I.1.6:

Vitrinite reflectance histograms









APPENDIX I.2

Core 7316/06-U-02

TABLES:

Table A.I.2.1a: Concentration of C ₁ -C ₅ + hydrocarbons in headspace gas.....	43
Table A.I.2.1b: Concentration of C ₁ -C ₅ + hydrocarbons in occluded gas.....	43
Table A.I.2.1c: Concentration of C ₁ -C ₅ + hydrocarbons - summation.....	44
Table A.I.2.2: Stable carbon isotope data for adsorbed gas fractions.....	44
Table A.I.2.3: Total organic carbon content and data from Rock-Eval pyrolysis.....	45
Table A.I.2.4: Data from pyrolysis-gas chromatograms (prog. S ₂).....	47
Table A.I.2.5: Vitrinite reflectance data.....	48
Table A.I.2.6: Visual kerogen analysis.....	49
Table A.I.2.7a: Weight of EOM, asphaltenes and chromatographic fractions.....	52
Table A.I.2.7b: Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	52
Table A.I.2.7c: Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	53
Table A.I.2.7d: Composition of EOM and chromatographic ratios.....	53
Table A.I.2.8: Ratios derived from gas chromatograms of saturated hydrocarbons.....	54
Table A.I.2.9: Molecular ratios from sterane and terpane mass chromatograms.....	55

FIGURES:

Figure A.I.2.1a: $\delta^{13}\text{C}$ composition of methane related to gas composition.....	56
Figure A.I.2.1b: $\delta^{13}\text{C}$ composition of adsorbed methane.....	57
Figure A.I.2.2: Pyrolysis-gas chromatograms (S ₂ peak): whole-rock samples...	58
Figure A.I.2.3: Gas chromatograms of saturated and aromatic hydrocarbons.....	67
Figure A.I.2.4: Pyrolysis-gas chromatograms (S ₂ peak): Asphaltene fraction.....	73
Figure A.I.2.5: Mass fragmentograms of m/z 191, 205 (terpanes) and m/z 217, 218 (steranes).....	76
Figure A.I.2.6: Vitrinite reflectance histograms.....	80

Project no.: 21346500
Location : 7316/06-U-02
Date : 89.09.21

Table A.I.2.1: TABLE OF GAS RESULTS

a: Headspace gas (µl gas per kg rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8216	71.10	48609	0	0	0	0	0	48609	0	0.0	-1.00
E8233	86.38	19767	0	0	0	0	0	19767	0	0.0	-1.00
E8239	89.94	45307	0	0	0	0	0	45307	0	0.0	-1.00
E8248	101.91	43838	0	0	0	0	0	43838	0	0.0	-1.00
E8259	111.25	18681	0	0	0	0	0	18681	0	0.0	-1.00
E8275	120.34	47003	0	0	0	0	0	47003	0	0.0	-1.00
E8285	126.60	57427	105	27	0	0	0	57559	132	0.2	-1.00
E8290	133.50	21203	76	0	0	0	0	21279	76	0.3	-1.00
E8300	144.59	84275	364	90	0	0	0	84729	454	0.5	-1.00
E8316	153.88	65114	400	88	0	0	0	65602	488	0.7	-1.00
E8330	162.87	55349	500	0	0	0	0	55849	500	0.9	-1.00
E8355	172.18	42110	435	106	0	0	0	42651	541	1.2	-1.00
E8367	181.43	35079	460	131	0	0	0	35670	591	1.6	-1.00
E8377	193.81	76376	998	271	0	0	0	77645	1269	1.6	-1.00

b: Occluded gas (µl gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8216	71.10	18376	38	19	0	0	0	18433	57	0.3	-1.00
E8233	86.38	3343	44	19	0	3	0	3409	66	1.9	0.00
E8239	89.94	5387	26	9	0	0	0	5422	35	0.6	-1.00
E8248	101.91	4197	25	8	0	0	0	4230	33	0.7	-1.00
E8259	111.25	3247	33	13	0	0	0	3293	46	1.4	-1.00
E8275	120.34	2884	34	0	0	6	191	2924	40	1.3	0.00
E8285	126.60	6106	42	25	0	0	0	6173	67	1.0	-1.00
E8290	133.50	3572	64	62	0	0	234	3698	126	3.4	-1.00
E8300	144.59	6588	117	126	11	11	390	6853	265	3.8	1.00
E8316	153.88	3568	118	142	6	6	315	3840	272	7.0	1.00
E8330	162.87	2845	134	143	17	17	226	3156	311	9.8	1.00
E8355	172.18	2832	159	153	15	15	214	3174	342	10.7	1.00
E8367	181.43	5087	234	270	41	46	259	5678	591	10.4	0.89
E8377	193.81	6531	422	487	71	81	312	7592	1061	13.9	0.88

Legend

-1 - No data available.

Project no.: 21346500
Location : 7316/06-U-02
Date : 89.09.21

Table A.I.2.1: TABLE OF GAS RESULTS

c: Summation of Headspace and Occluded gas
(μ l gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8216	71.10	66985	38	19	0	0	0	67042	57	0.1	-1.00
E8233	86.38	23110	44	19	0	3	0	23176	66	0.3	0.00
E8239	89.94	50694	26	9	0	0	0	50729	35	0.1	-1.00
E8248	101.91	48035	25	8	0	0	0	48068	33	0.1	-1.00
E8259	111.25	21928	33	13	0	0	0	21974	46	0.2	-1.00
E8275	120.34	49887	34	0	0	6	191	49927	40	0.1	0.00
E8285	126.60	63533	147	52	0	0	0	63732	199	0.3	-1.00
E8290	133.50	24775	140	62	0	0	234	24977	202	0.8	-1.00
E8300	144.59	90863	481	216	11	11	390	91582	719	0.8	1.00
E8316	153.88	68682	518	230	6	6	315	69442	760	1.1	1.00
E8330	162.87	58194	634	143	17	17	226	59005	811	1.4	1.00
E8355	172.18	44942	594	259	15	15	214	45825	883	1.9	1.00
E8367	181.43	40166	694	401	41	46	259	41348	1182	2.9	0.89
E8377	193.81	82907	1420	758	71	81	312	85237	2330	2.7	0.88

Legend

-1 - No data available.

Table A.I.2.2: STABLE CARBON ISOTOPE DATA FOR ADSORBED GAS FRACTIONS

IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	$\delta^{13}\text{C}_1$ (‰) _{PDB}	$\delta^{13}\text{C}_2$ (‰) _{PDB}	$\delta^{13}\text{C}_1$ (‰) _{PDB}
E-8239	89.94	Core	Siltstone	-46.3	na	na
E-8377	193.81	Core	Claystone	-52.0	-29.7	na

Legend:

na: Data not available for this fraction

Project no.: 21346500
 Location : 7316/06-U-02
 Date : 89.12.19

Table A.I.2.3: DATA FROM ROCK EVAL PYROLYSIS

IKUNO	FRAC NAME	DEPTH	SAMPLE TYPE	S1	S2	TOC	HYDRO. INDEX	PETR. POTEN.	PROD. INDEX S1	Tmax
		(m)		(mg/g rock)		(%)	(mg/g TOC)	S1+S2	S1+S2	(°C)
E8212		69.03	CORE	0.04	0.18	0.38	47	0.22	0.18	410
E8216		71.10	CORE			0.45				
E8220		74.43	CORE	0.02	0.11	0.29	38	0.13	0.15	363
E8223		77.96	CORE			0.40				
E8227		82.81	CORE	0.03	0.22	0.55	40	0.25	0.12	419
E8230		83.66	CORE			0.46				
E8542		84.61	CORE	0.02	0.25	0.56	45	0.27	0.07	423
E8232		85.79	CORE	0.02	0.37	0.71	52	0.39	0.05	418
E8233		86.38	CORE	0.11	0.61	0.81	75	0.72	0.15	415
E8239		89.94	CORE			0.70				
E8543		90.38	CORE			0.66				
E8544		91.20	CORE			0.56				
E8240		92.10	CORE	0.03	0.22	0.49	45	0.25	0.12	421
E8545		93.69	CORE			0.50				
E8241		95.37	CORE			0.46				
E8243		97.04	CORE			0.76				
E8244		98.04	CORE	0.03	0.38	0.73	52	0.41	0.07	429
E8248		101.91	CORE			0.75				
E8251		103.80	CORE	0.03	0.28	0.51	55	0.31	0.10	424
E8252		106.16	CORE			0.55				
E8257		109.95	CORE	0.03	0.27	0.55	49	0.30	0.10	423
E8259		111.25	CORE			0.49				
E8264		114.71	CORE	0.04	0.25	0.49	51	0.29	0.14	427
E8546		115.35	CORE			0.65				
E8268		117.13	CORE			0.85				
E8275		120.34	CORE	0.03	0.43	0.73	59	0.46	0.07	420
E8276		122.06	CORE	0.06	0.50	1.19	42	0.56	0.11	418
E8279		124.42	CORE	0.06	0.55	0.82	67	0.61	0.10	414
E8285		126.60	CORE			0.65				
E8286		127.35	CORE			0.66				
E8287		130.52	CORE	0.03	0.36	0.56	64	0.39	0.08	421
E8288		132.12	CORE			0.90				
E8291		133.45	CORE			0.76				
E8290		133.50	CORE			0.64				
E8293		137.41	CORE	0.04	0.60	0.93	65	0.64	0.06	422
E8296		138.74	CORE			0.96				
E8297		139.18	CORE			0.85				
E8298		140.48	CORE			0.90				
E8299		141.40	CORE			0.76				
E8301		142.64	CORE			0.90				
E8302		143.84	CORE	0.05	0.72	0.95	76	0.77	0.06	424
E8300		144.59	CORE	0.04	0.66	0.80	83	0.70	0.06	419
E8308		145.38	CORE			0.80				
E8306		146.17	CORE			0.84				
E8307		147.77	CORE			0.80				

Project no.: 21346500
Location : 7316/06-U-02
Date : 89.12.19

Table A.I.2.3: DATA FROM ROCK EVAL PYROLYSIS
(continued)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	S1 (mg/g rock)	S2	TOC (%)	HYDRO. INDEX (mg/g TOC)	PETR. POTEN. S1+S2	PROD. INDEX S1 S1+S2	Tmax (°C)
E8310		149.51	CORE	0.05	0.66	0.90	73	0.71	0.07	421
E8313		152.27	CORE			0.80				
E8316		153.88	CORE			0.82				
E8317		154.23	CORE	0.07	0.64	0.85	75	0.71	0.10	422
E8319		156.27	CORE			0.83				
E8323		158.38	CORE			0.85				
E8326		160.42	CORE	0.04	0.44	0.79	56	0.48	0.08	409
E8330		162.87	CORE			0.81				
E8332		164.31	CORE			0.81				
E8336		166.45	CORE	0.06	0.55	0.75	73	0.61	0.10	419
E8339		168.44	CORE			0.75				
E8353		170.61	CORE			0.73				
E8355		172.18	CORE	0.03	0.44	0.68	65	0.47	0.06	424
E8359		174.76	CORE			0.72				
E8361		176.05	CORE			0.72				
E8360		177.75	CORE	0.05	0.55	0.75	73	0.60	0.08	421
E8362		180.89	CORE			0.76				
E8367		181.43	CORE			0.70				
E8368		183.77	CORE	0.05	0.48	0.69	70	0.53	0.09	417
E8369		186.13	CORE			0.71				
E8370		187.83	CORE			0.75				
E8371		189.25	CORE	0.05	0.53	0.75	71	0.58	0.09	421
E8372		190.97	CORE			0.78				
E8373		192.35	CORE			0.83				
E8377		193.81	CORE	0.00	0.00	0.90	0	0.00	-1.00	392
E8379		194.95	CORE	0.07	0.68	0.86	79	0.75	0.09	418
E8378		196.35	CORE			0.81				
E8380		197.01	CORE			0.78				
E8384		199.31	CORE	0.06	0.65	0.86	76	0.71	0.08	416

Legend

-1 - No data available.

Table A.I.2.4: DATA FROM PYROLYSIS-GAS CHROMATOGRAMS (PROG. S₂)

IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	C ₁ (percent of peak area)	C ₂ -C ₅	C ₆ -C ₁₅	C ₁₅ +
<u>Whole rock</u>							
E-8227	82.81	Core	Claystone	16.7	47.0	34.7	1.4
E-8233	86.38	Core	Siltstone	8.3	21.6	63.4	6.2
E-8244	98.04	Core	Siltstone	0.7	28.1	59.4	0.7
E-8276	122.06	Core	Siltstone	7.0	23.6	61.0	2.8
E-8293	137.41	Core	Siltstone	5.8	31.5	57.1	4.9
E-8317	154.23	Core	Claystone	7.1	25.0	63.7	3.3
E-8360	177.75	Core	Claystone	7.1	30.9	55.2	4.6
E-8379	194.95	Core	Claystone	6.5	35.1	55.0	2.0
<u>Asphaltenes</u>							
E-8377	193.81	Core	Claystone	8.9	20.6	33.3	37.2
E-8379	194.95	Core	Claystone	8.8	21.3	42.8	27.1

Core number: 7316/06-U-02
Reference number: 21.3465.23
(1/1)

Table A.I.2.5: VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE** REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
E-8212	-----	69.03	0.39 (8)	P	0.05	3-4
E-8233	-----	86.38	0.37 (20)	G	0.06	3-4
E-8264	-----	114.71	0.39 (9)	F	0.04	3-4
E-8276	-----	122.06	0.35 (13)	F	0.06	3-4
E-8300	-----	144.59	0.37 (11)	F	0.05	3-4
E-8317	-----	154.23	0.37 (4)	P	0.07	3-4
E-8360	-----	177.75	0.37 (2)	P	0.01	3-4
E-8384	-----	199.31	0.40 (2)	P	0.02	3-4

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

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.2.6
WELL NO.: 7316/06-U-02

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8227	82.81	Am: 5% Lm: 25-30% W: 65-70% C:	F-M-L	Fair-Good	<2.0	Comparable to sample E-8052.
E-8233	86.38	Am: 15-20% Lm: 10-15% W: 65-70% C	F-M-L	Fair-Good	<2.0	Mainly comparable to sample E-8052, but with a somewhat increased proportion of amorphous material (i.e. large degraded amorphous bundles specked with small woody/coaly fragments and some pyrite).
E-8245	98.03	Am: <5% Lm: 10% W: 85-90% C:	F-M-L	Fair	<2.0	Organic residue completely dominated by brown structured woody phytoclasts, together with black coaly angular fragments. Evidence of reworked Mid-Cretaceous material.
E-8277	122.06	Am: 5% Lm: 10-15% W: 75-80% C:	F-M-L	Fair-Good	<2.0	Comparable to sample E-8245.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.2.6 (ctd.)
WELL NO.: 7316/06-U-02

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index *	Remarks
E-8295	137.40	Am: 5% Lm: 10-15% W: 75-80% C:	F-M-L	Fair-Good	<2.0	As per sample E-8277, but with an increased proportion of structured woody material relative to the coaly fragments.
E-8320	156.23	Am: <5% Lm: 20% W: 75-80% C:	F-M-L	Fair-Good	<2.0	Comparable to samples above, but with a slightly increased fraction of liptinitic material (cuticle sheets).
E-8360	177.75	Am: 5-10% Lm: 30-35% W: 55-60% C:	F-M-L	Fair-Good	<2.0	Organic residue dominated by reworked woody and coaly phytoclasts.

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.2.6 (ctd.)
WELL NO.: 7316/06-U-02

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index *	Remarks
E-8379	194.95	Am: 10-15% Lm: 30-35% W: 50-55% C:	F-M-L	Fair-Good	<0.2	Comparable to sample E-8360.
E-8584	199.45	Am: 10-15% Lm: 15-20% W: 60% C: 10-15%	F-M-L	Fair-Good	<2.0	Organic residue with a higher proportion of amorphous matter relative to the samples above. The woody/coaly fraction contains mostly structured brown to dark brown woody phytoclasts. Evidences of recycled Cretaceous material.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

Project no.: 21346500
Location : 7316/06-U-02
Date : 89.11.21

Table A.I.2.7a: WEIGHT OF CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ROCK EXTR. (g)	EOM (mg)	ASPH (mg)	SAT HC (mg)	ARO HC (mg)	POLAR COMP. (mg)	HC (mg)	NONHC (mg)	TOC (%)
E8233		86.38	CORE	13.6	5.9	2.1	0.8	1.2	1.9	2.0	3.9	0.81
E8300		144.59	CORE	24.6	4.9	1.5	0.5	0.2	2.8	0.7	4.2	0.80
E8317		154.23	CORE	6.4	1.8	0.8	0.7	0.4	0.4	1.1	0.7	0.85
E8377		193.81	CORE	20.0	7.1	3.3	0.5	0.8	2.5	1.3	5.8	0.90
E8379		194.95	CORE	61.0	14.6	8.8	0.8	1.2	2.8	2.0	12.6	0.86

Legend:

- * - Not all the available EOM was used for MPLC.
- ? - MPLC results assumed more EOM than originally extracted.
- 1- No data available.

Table A.I.2.7b: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8233		86.38	CORE	434	154	62	89	142	151	283
E8300		144.59	CORE	199	61	20	10	113	30	169
E8317		154.23	CORE	280	124	112	56	56	168	112
E8377		193.81	CORE	355	165	24	42	126	66	289
E8379		194.95	CORE	239	144	14	20	46	34	205

Legend:

- 1- No data available.

Project no.: 21346500
Location : 7316/06-U-02
Date : 89.11.21

Table A.I.2.7c: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8233		86.38	CORE	53.5	19.0	7.7	11.0	17.5	18.7	34.8
E8300		144.59	CORE	24.9	7.6	2.5	1.2	14.1	3.7	21.2
E8317		154.23	CORE	32.9	14.6	13.2	6.6	6.6	19.8	13.1
E8377		193.81	CORE	39.4	18.3	2.7	4.7	14.0	7.4	32.0
E8379		194.95	CORE	27.8	16.8	1.6	2.3	5.3	3.9	23.9

Legend:

-1- No data available.

Table A.I.2.7d: COMPOSITION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ASPH EOM (%)	SAT EOM (%)	ARO EOM (%)	HC EOM (%)	POLAR EOM (%)	SAT ARO x 100	HC NONHC x 100
E8233		86.38	CORE	35.6	14.3	20.5	34.8	32.7	70.0	53.3
E8300		144.59	CORE	30.6	9.8	4.9	14.7	56.5	200.0	17.3
E8317		154.23	CORE	44.4	40.1	20.0	60.1	20.0	200.0	150.6
E8377		193.81	CORE	46.5	6.8	11.9	18.7	35.6	57.1	22.9
E8379		194.95	CORE	60.3	5.8	8.3	14.1	19.0	70.0	16.4

Legend:

-1- No data available.

Project no.: 21346500
 Location : 7316/06-U-02
 Date : 89.12.19

Table A.I.2.8: RATIOS DERIVED FROM GAS CHROMATOGRAMS OF SATURATED HYDROCARBONS

IKUNO FRAC NAME	DEPTH	Pri	Pri	Phy	A	n-C17	n-C31	CPI 1	CPI 2
		Phy	A=----- n-C17	B=----- n-C18	B	n-C27	n-C19		
E8233	86.38	0.8	1.0	1.2	0.8	-1.0	0.0	-1.0	-1.0
E8300	144.59	0.6	0.6	0.7	0.9	0.3	1.3	2.4	2.4
E8317	154.23	0.5	0.6	0.7	1.0	0.1	2.7	2.0	1.9
E8377	193.81	0.7	0.9	1.0	0.9	0.2	3.6	2.1	2.6
E8379	194.95	0.8	0.7	0.9	0.8	0.2	3.5	2.7	2.8

-1 = No data available

Legend:

$$\text{CPI 1} = \frac{1}{2} \cdot \left(\frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{24}+C_{26}+C_{28}+C_{30}} + \frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{26}+C_{28}+C_{30}+C_{32}} \right)$$

$$\text{CPI 2} = \frac{2 \cdot C_{27}}{C_{26}+C_{28}}$$

Ratios involving pristane and phytane are calculated from peak areas.
 All other ratios are calculated from peak heights.

Table A.1.2.9

*Molecular ratios from sterane and terpane mass chromatograms.
Core 7316/06-U-02.*

Code	Depth (m)	$\alpha\beta/\alpha\beta+\beta\alpha^{1)}$	%22S ²⁾	% $\beta\beta^3)$	%20S ⁴⁾	30:1/30:0 ⁵⁾	a/a+j ⁶⁾
E-8233	86.38	47.7	61.8	38.1	-	0.63	
E-8300	144.59	0.59	6.7	33.3	2.3	-	0.18
E-8377	193.81	0.45	10.0	-	-	0.14	0.05

¹⁾ E/(E+F) in m/z 191 (note coelution with peak 10).

²⁾ Average % distribution between first and second eluting isomers of extended hopanes (G, H, J).

³⁾ $100 * 2(r+s)/(q+t+2(r+s))$ in m/z 217.

⁴⁾ $100 * q/(q+t)$ in m/z 217.

⁵⁾ 9/E in m/z 191.

⁶⁾ Relative abundance of diasteranes in m/z 217.

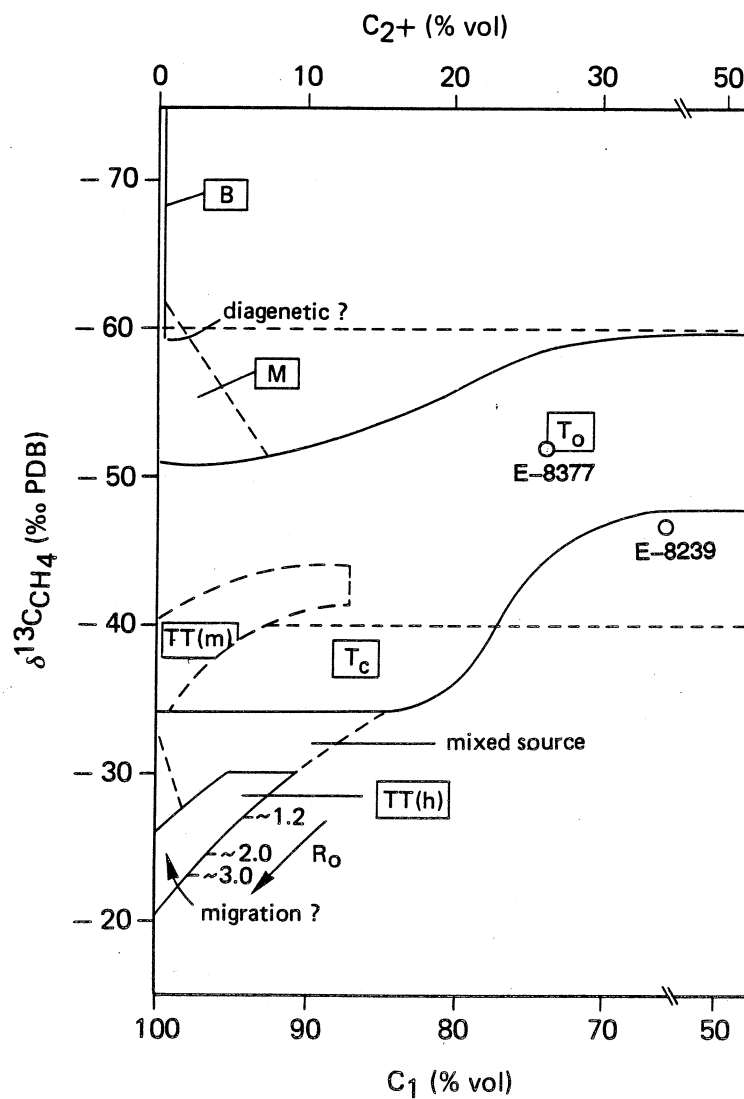


Figure A.I.2.1a

$\delta^{13}\text{C}$ isotopic composition of adsorbed methane in relation to gas composition for selected samples from core 7316/06-U-02 (after Schoell 1983).

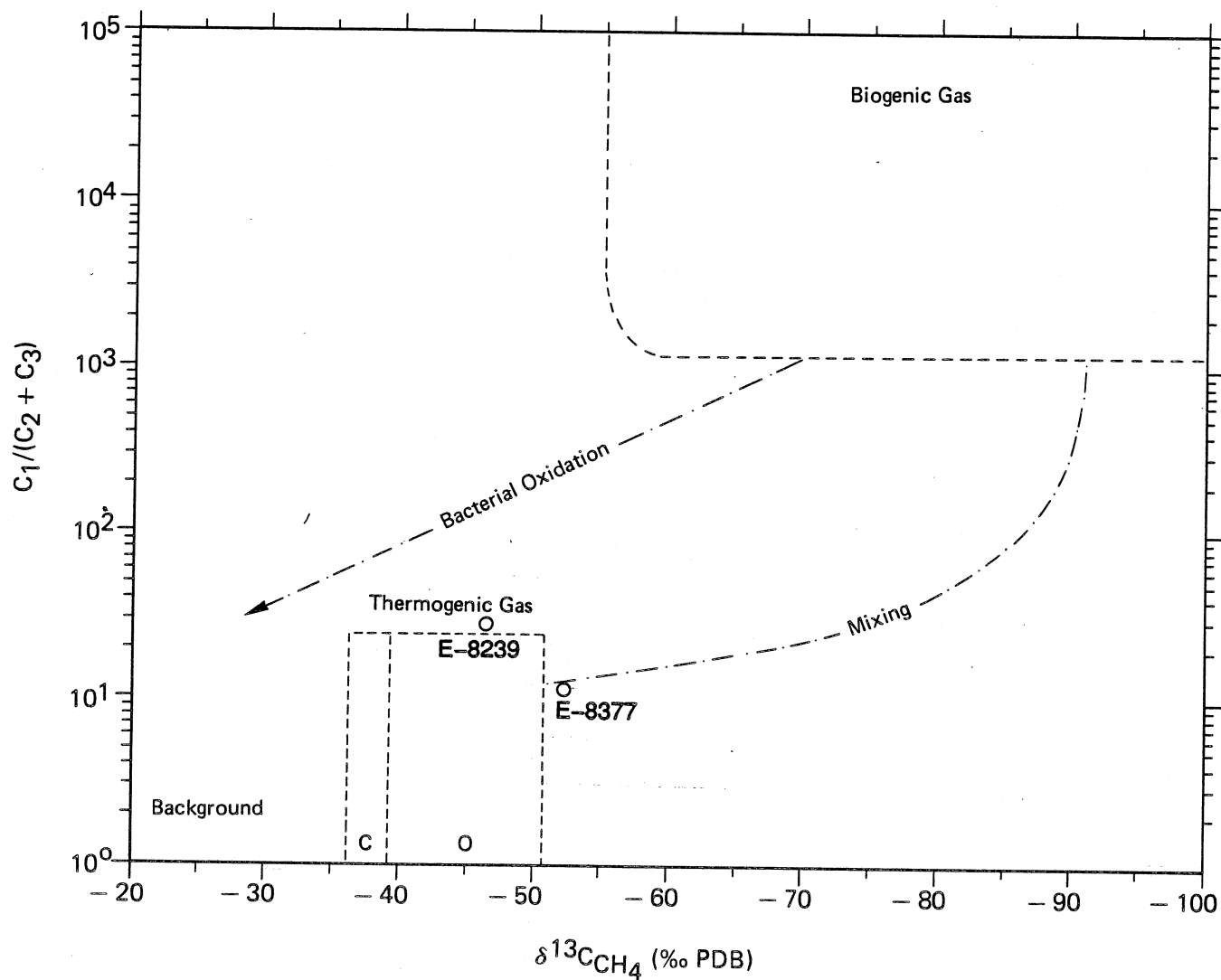
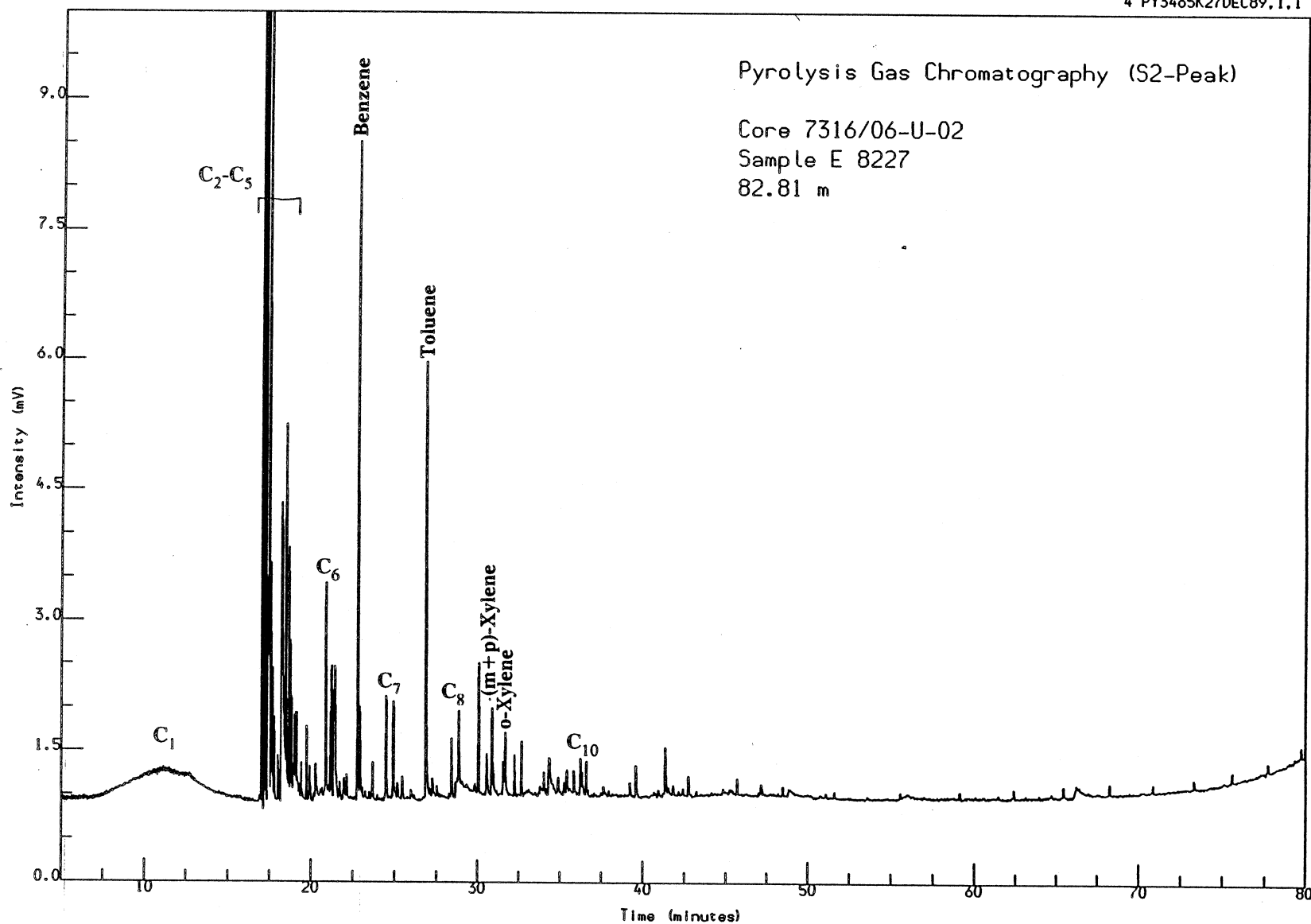


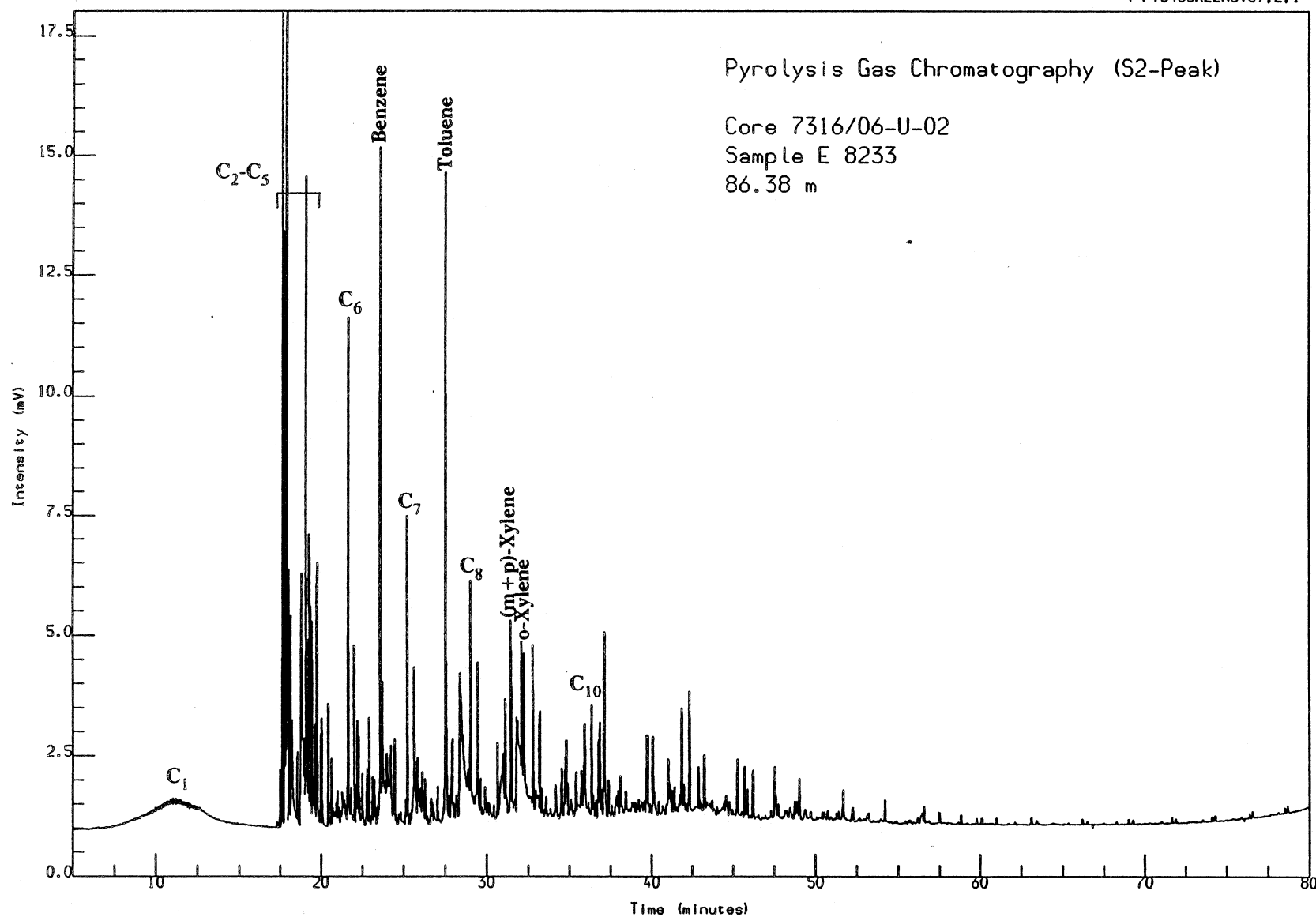
Figure A.1.2.1b

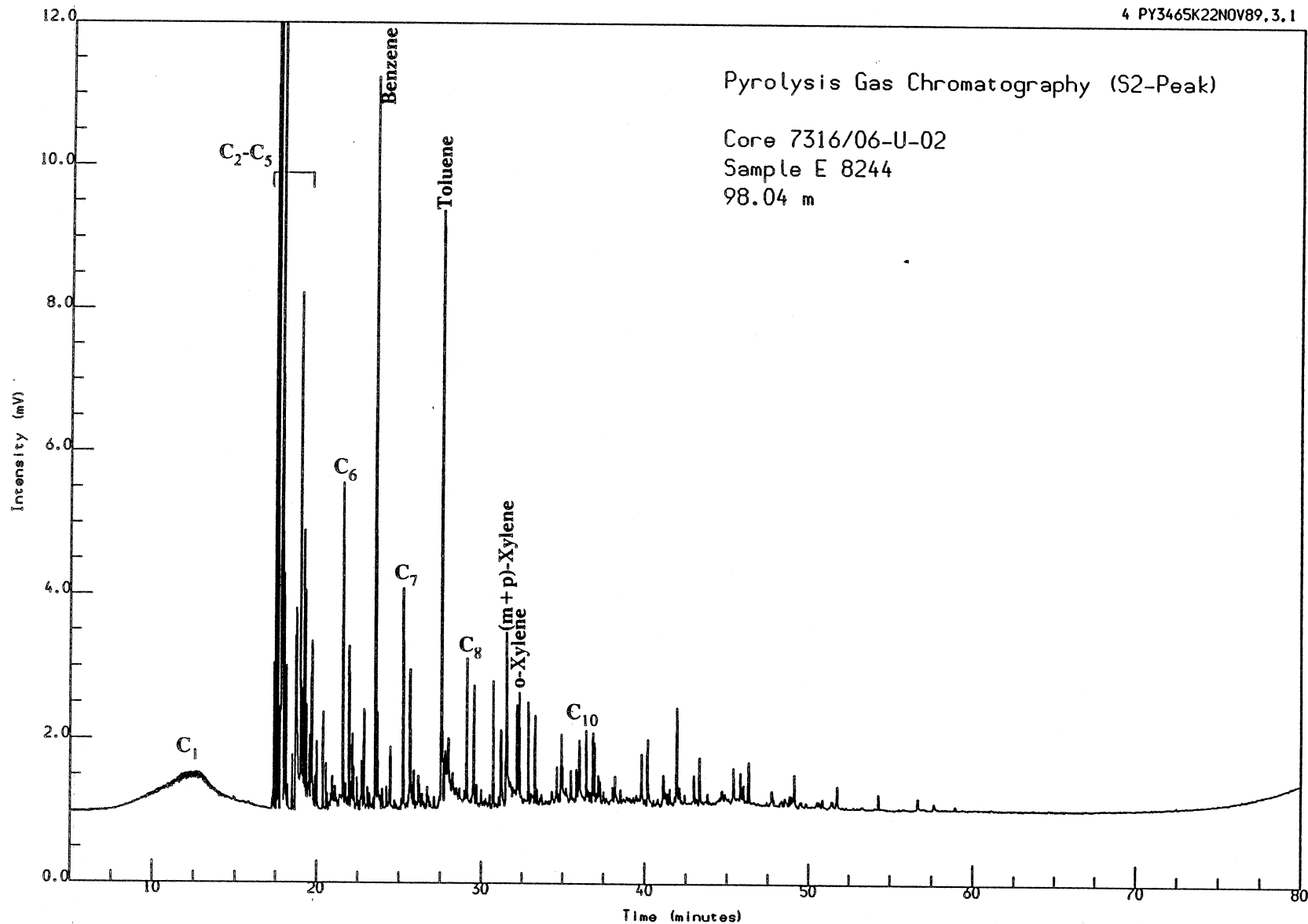
$\delta^{13}C$ isotopic composition of adsorbed methane for selected samples from core 7316/06-U-02 (after Schoell 1983).

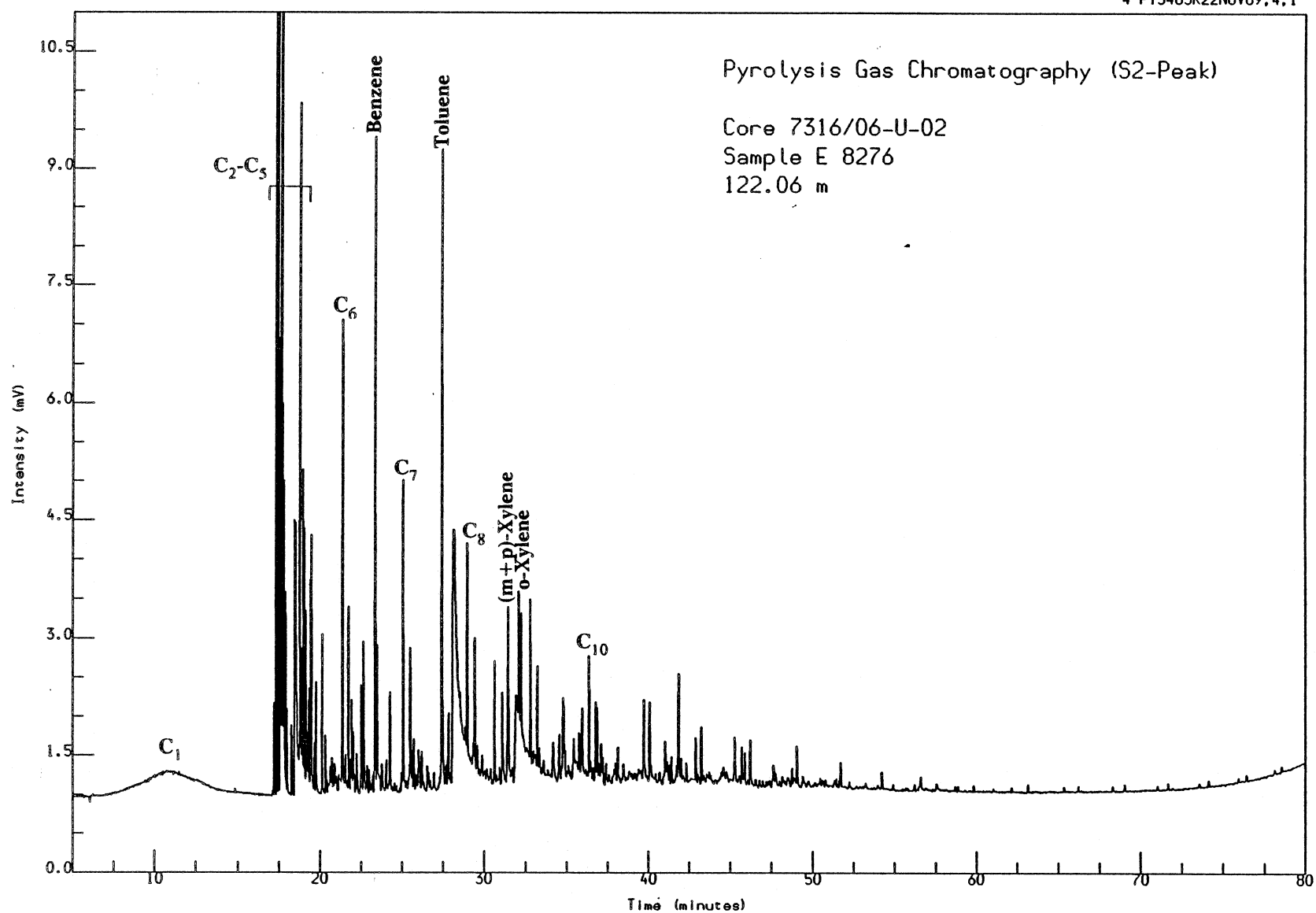
Figure A.I.2.2:

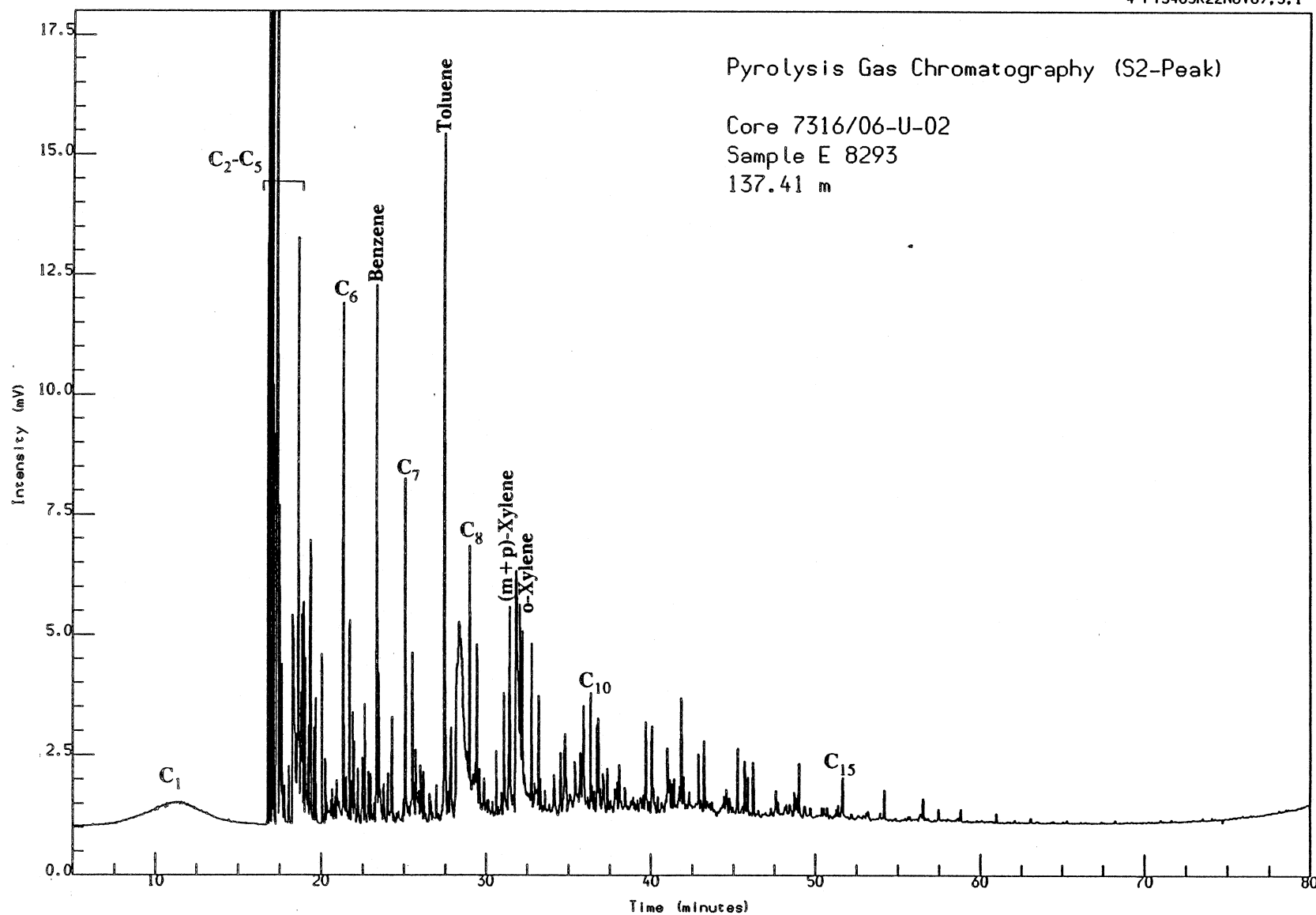
Pyrolysis-gas chromatograms (S_2 peak):
Whole-rock samples

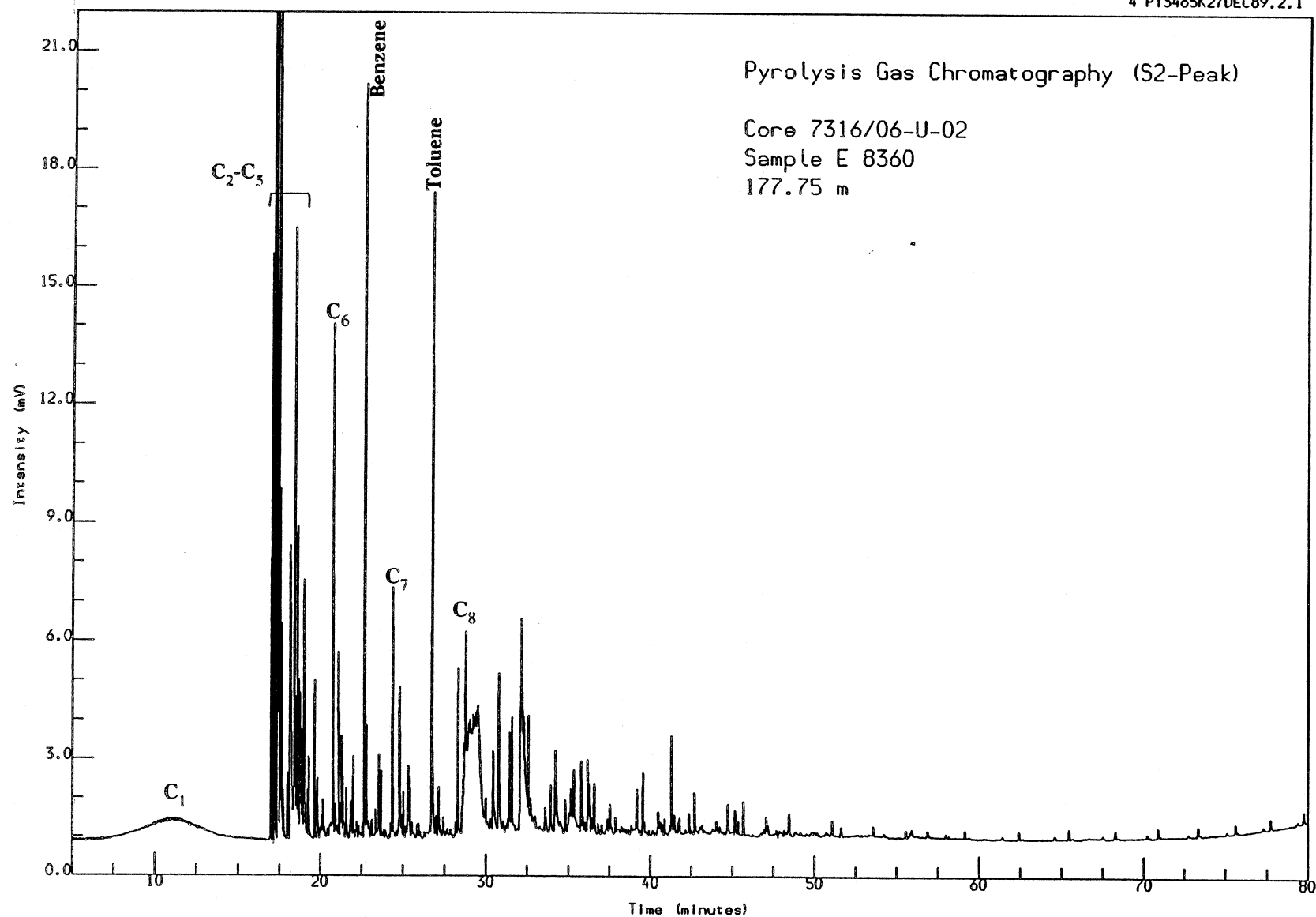


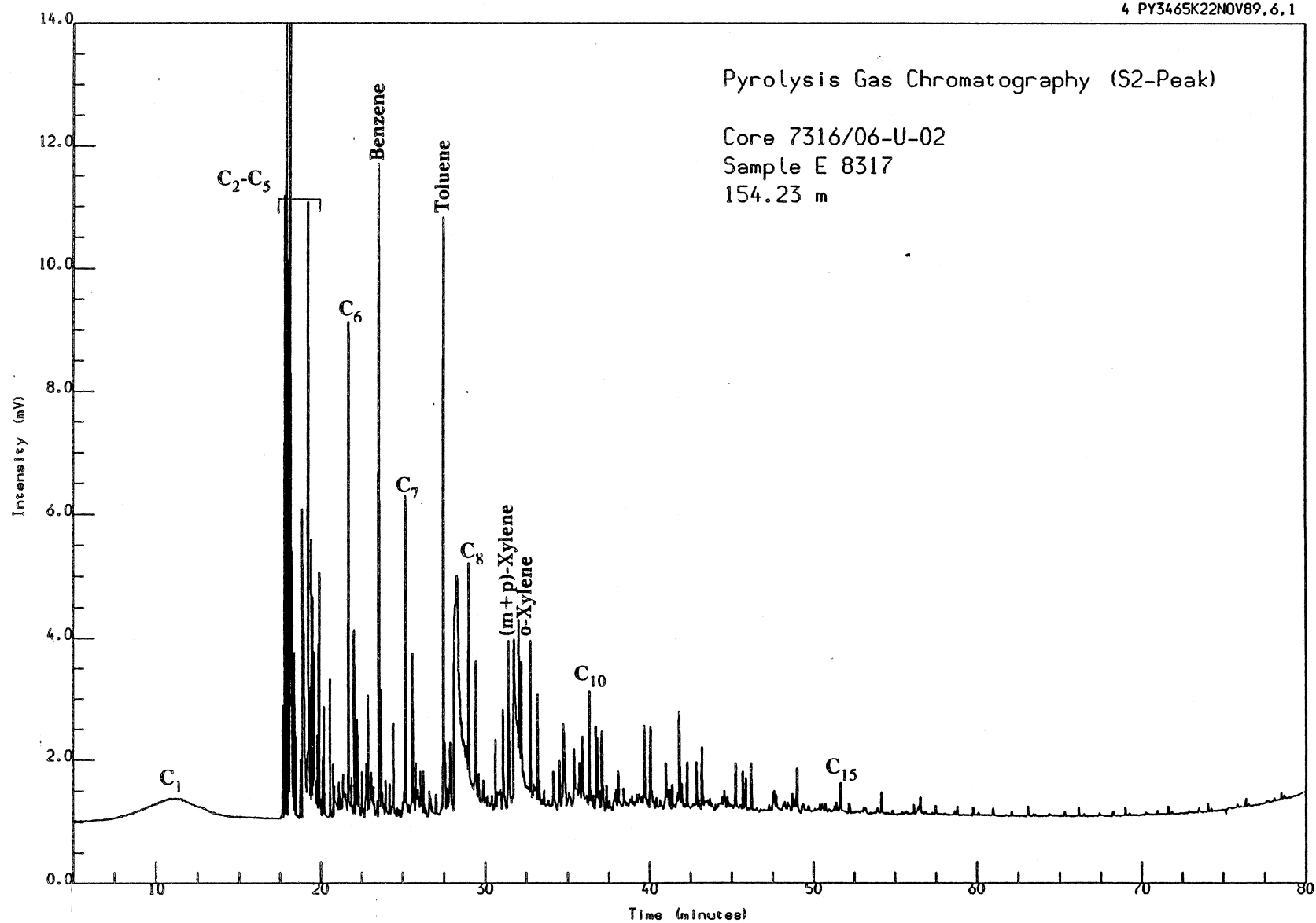












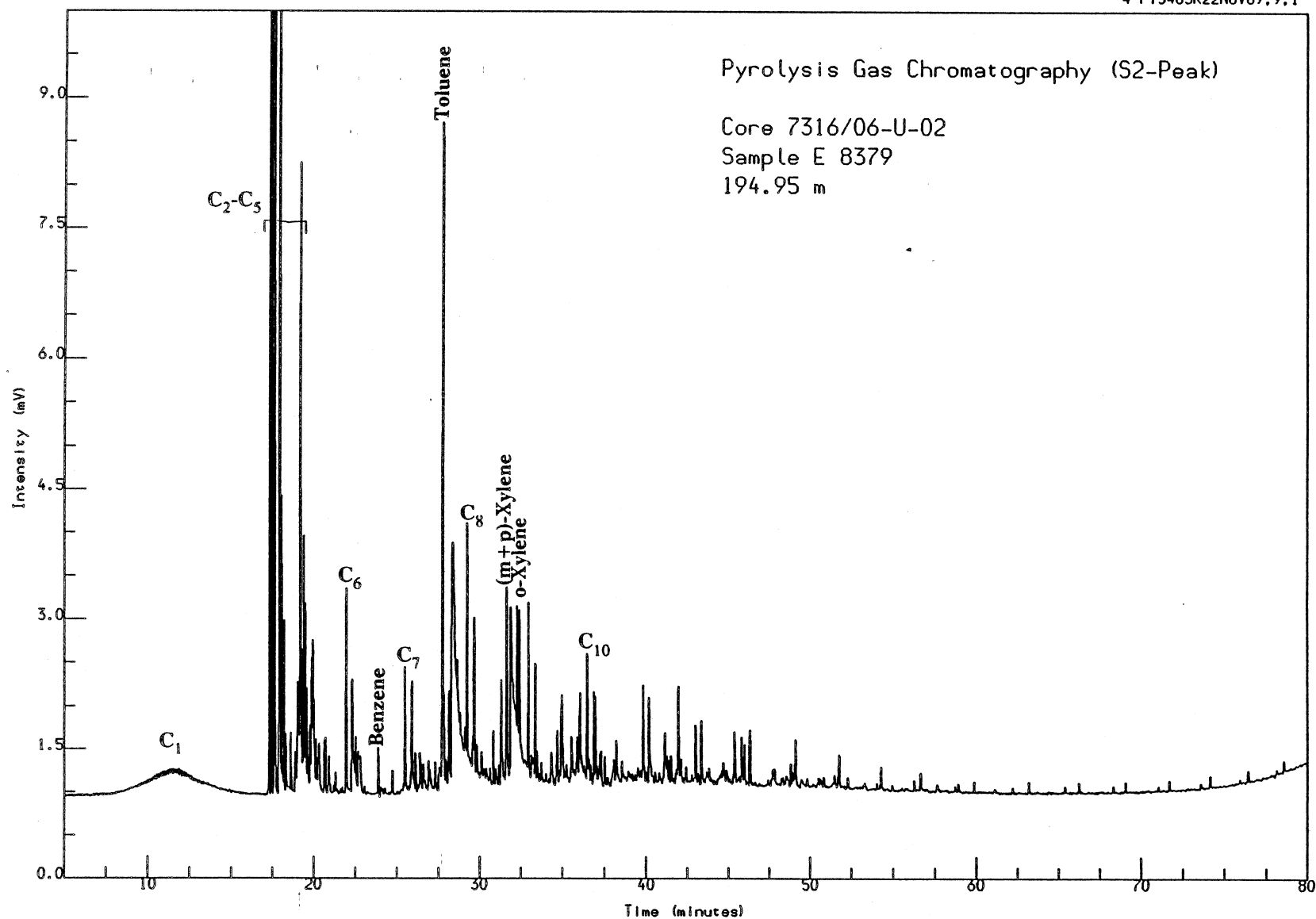


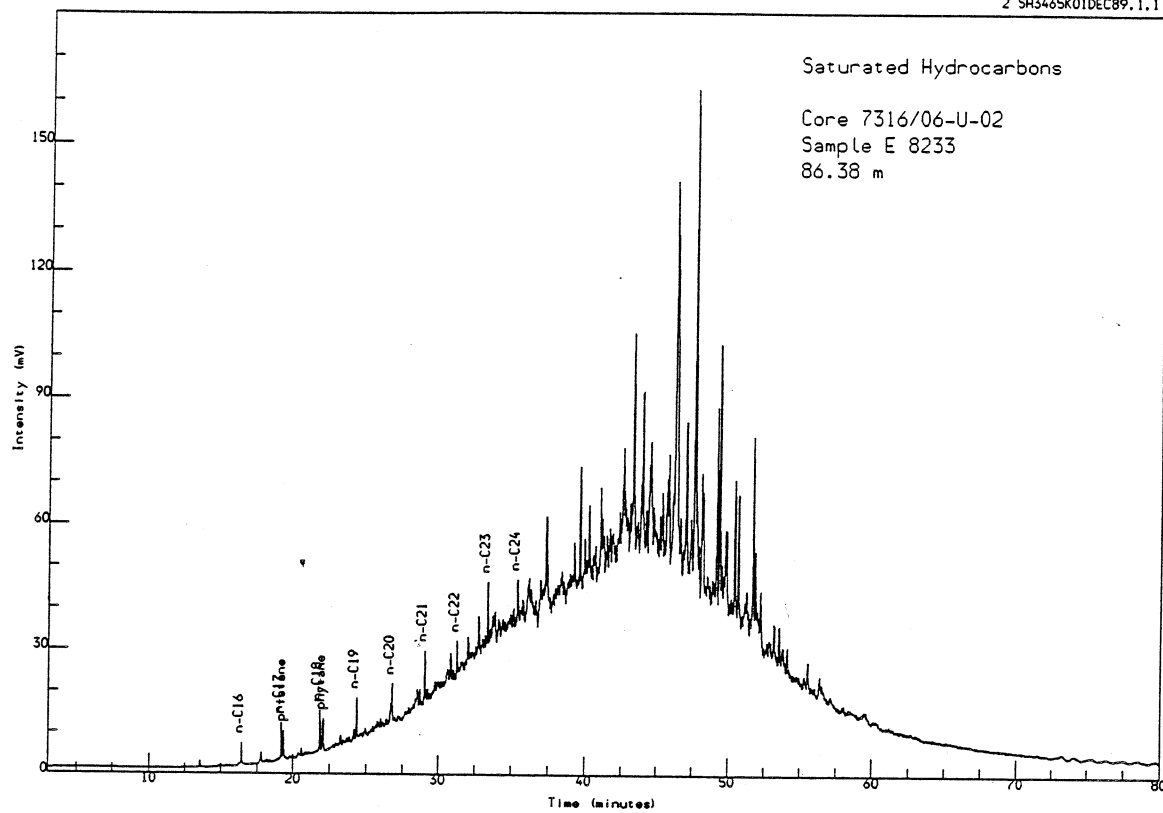
Figure A.I.2.3:

Gas chromatograms of saturated and aromatic hydrocarbons

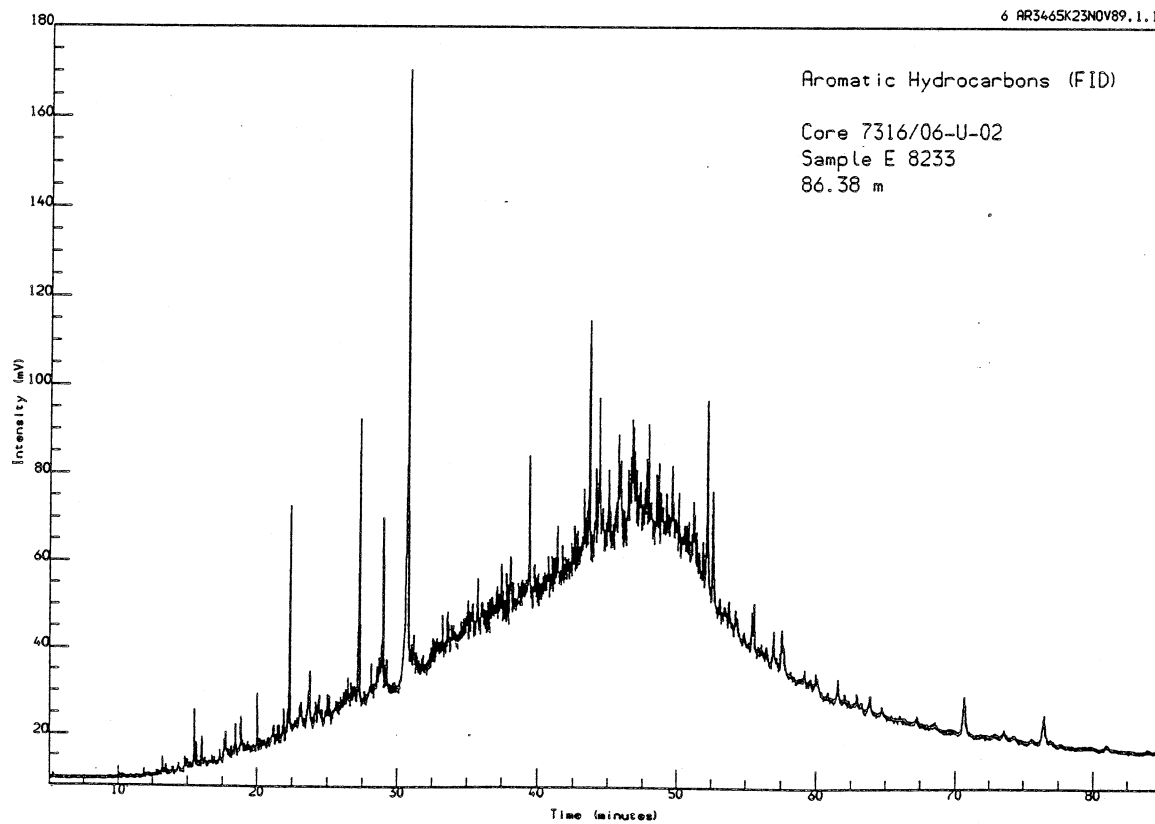
nC₁₅, etc. - n-alkanes

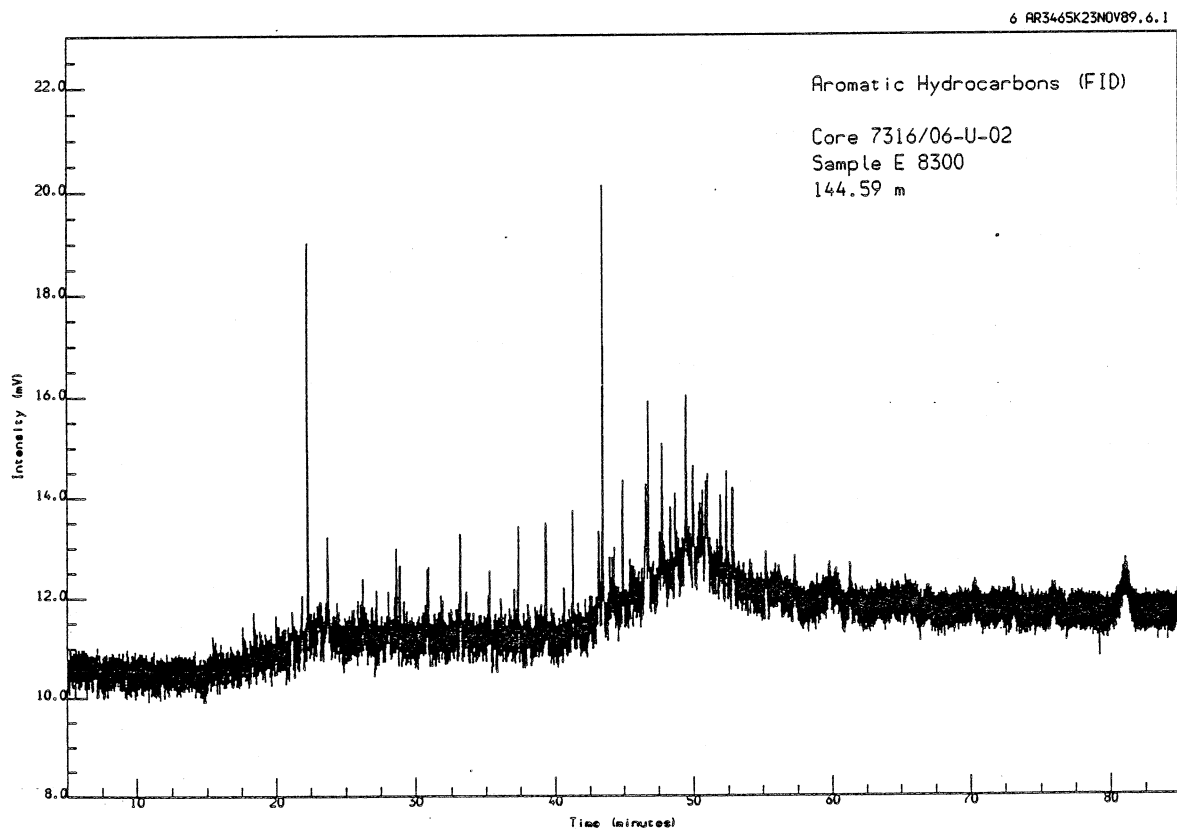
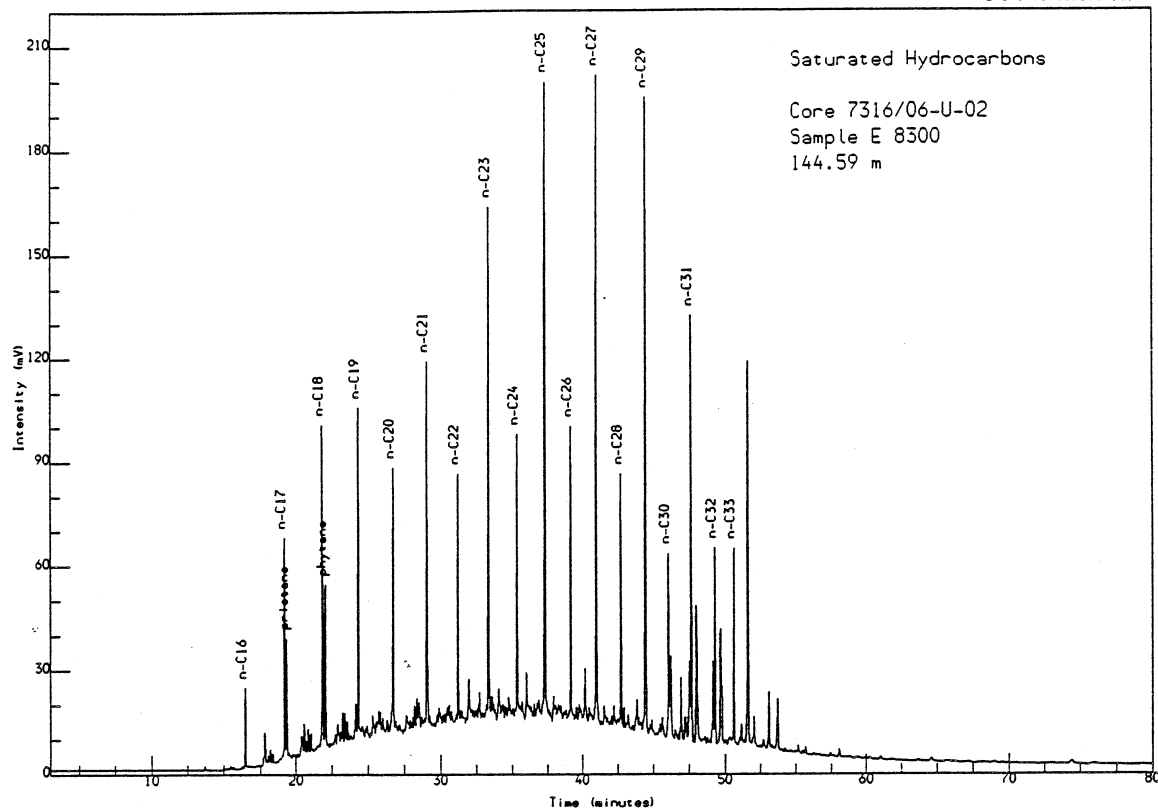
N	- Naphthalene
MN	- Methylnaphthalenes
DMN	- Dimethylnaphthalenes
TMN	- Trimethylnaphthalenes
P	- Phenanthrene
MP	- Methylphenanthrenes
DMP	- Dimethylphenanthrenes

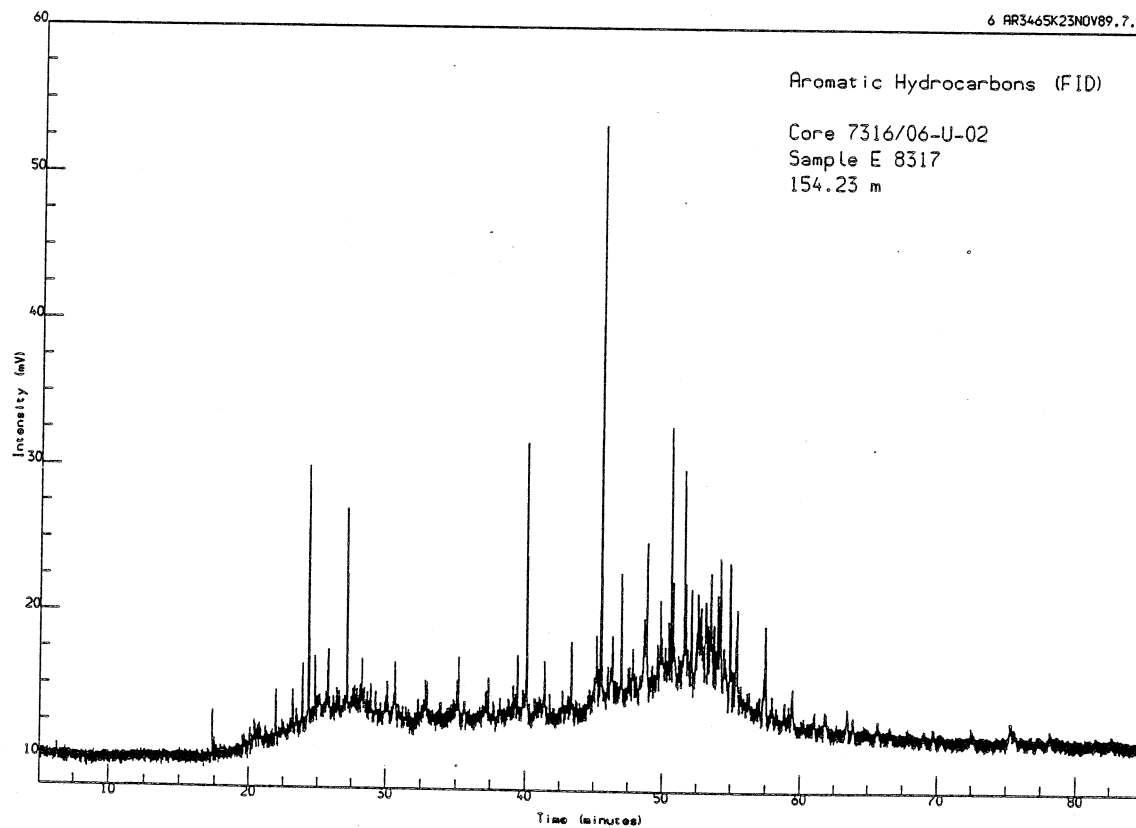
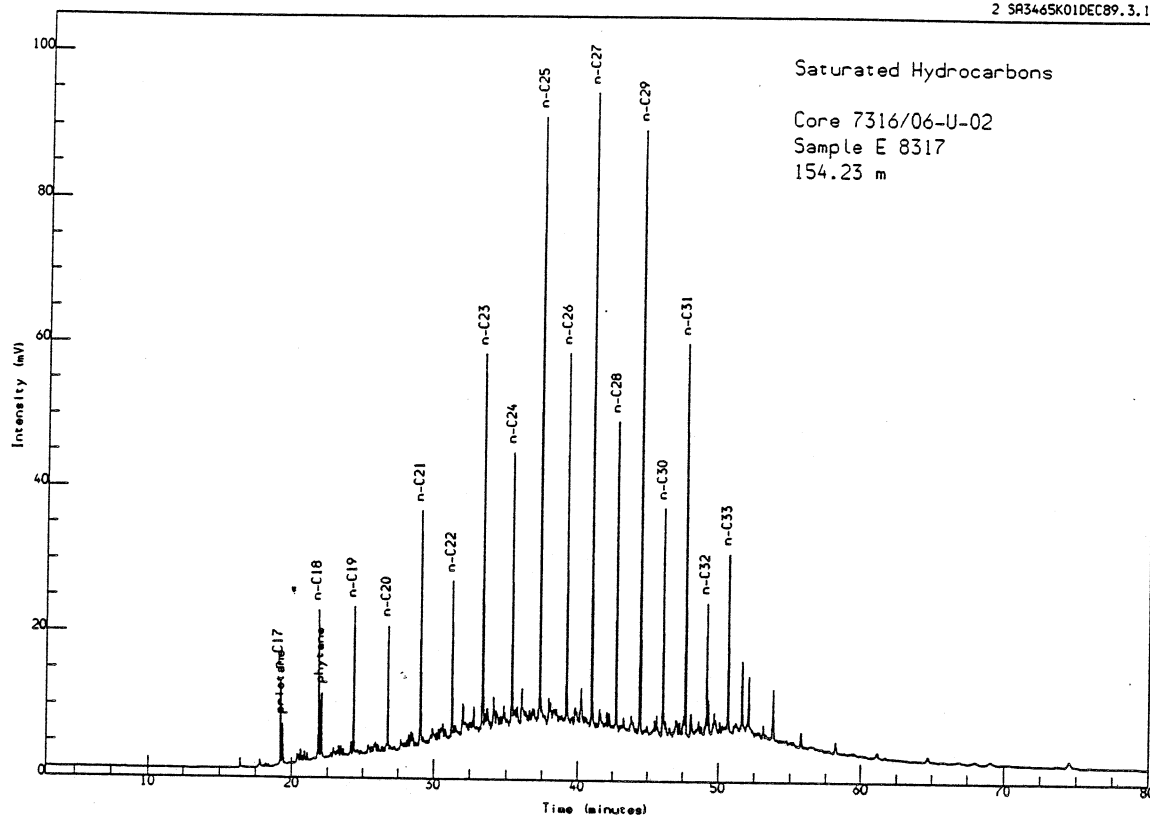
2 SR346SK01DEC89.1.1

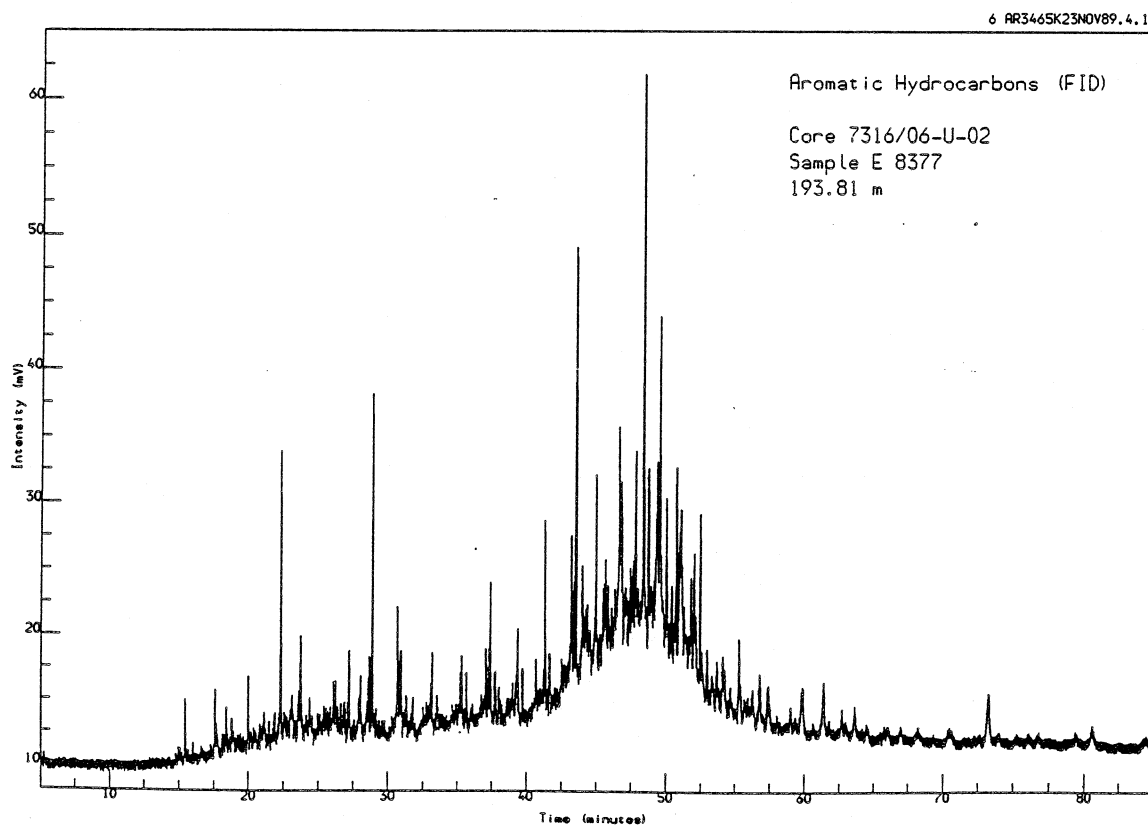
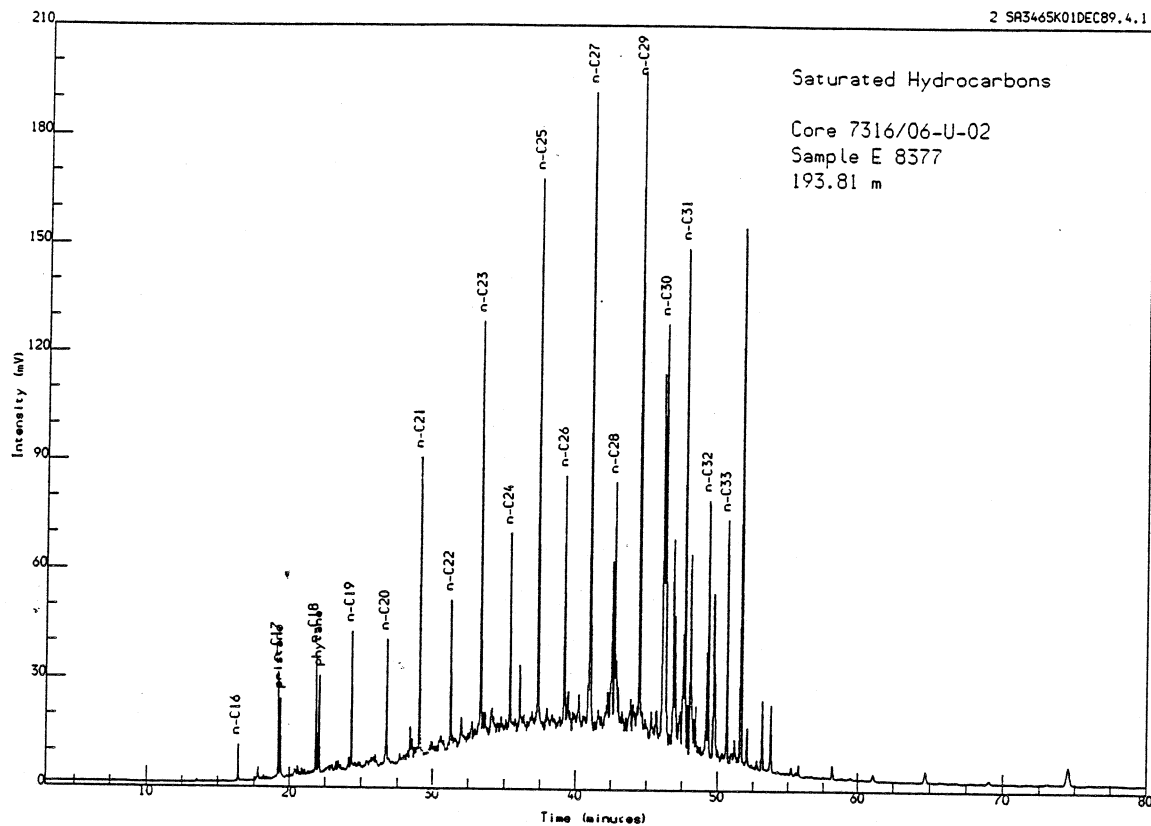


6 AR346SK23NOV89.1.1









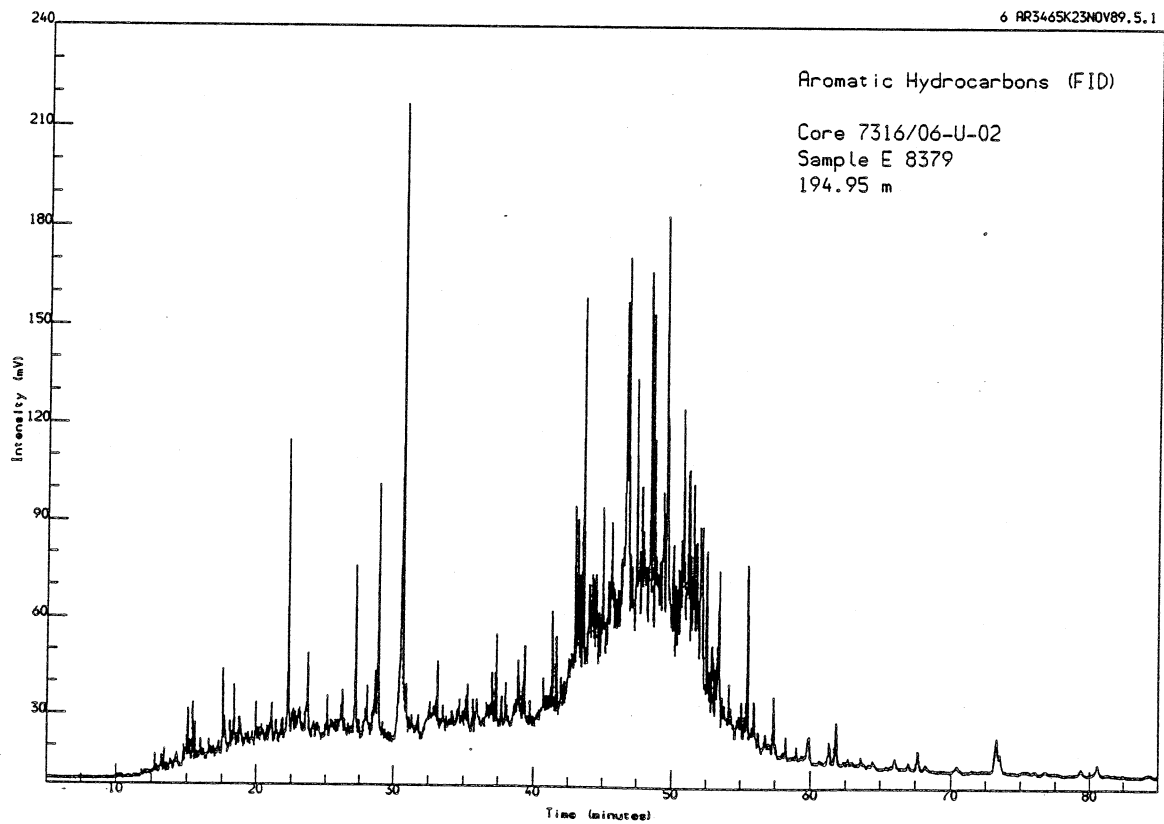
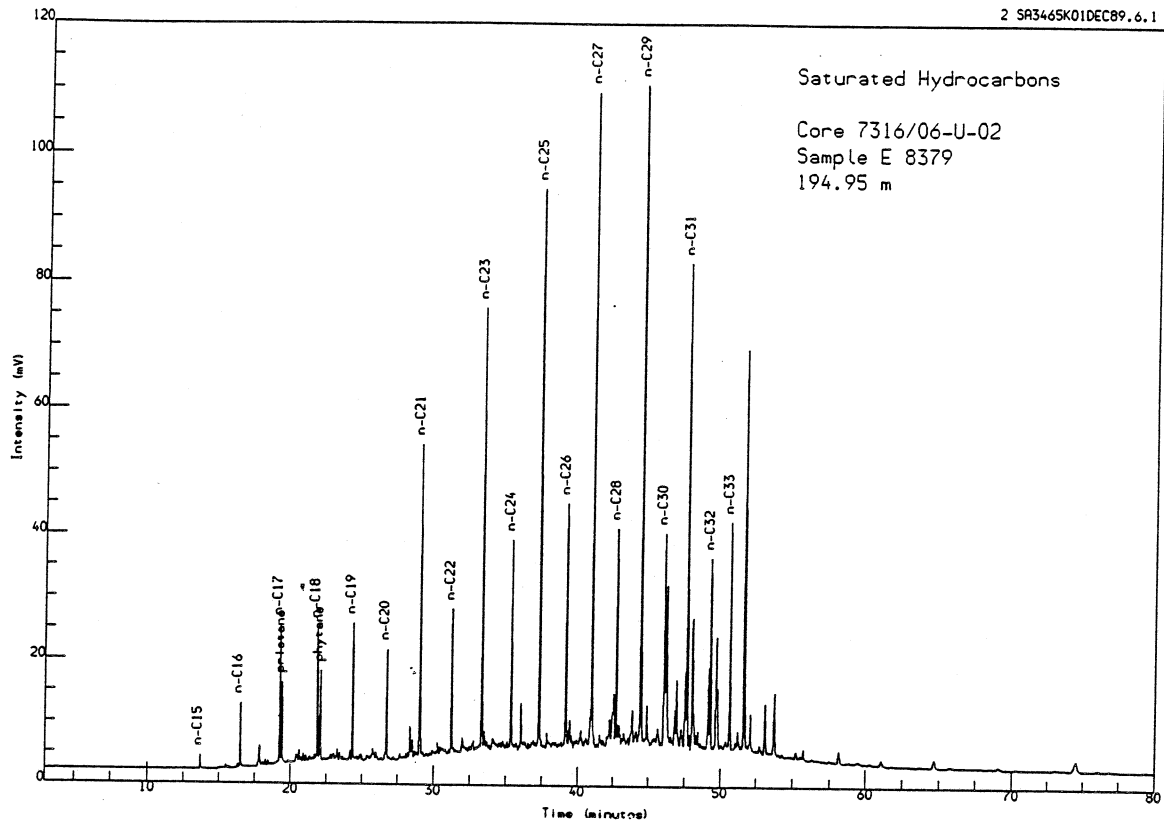
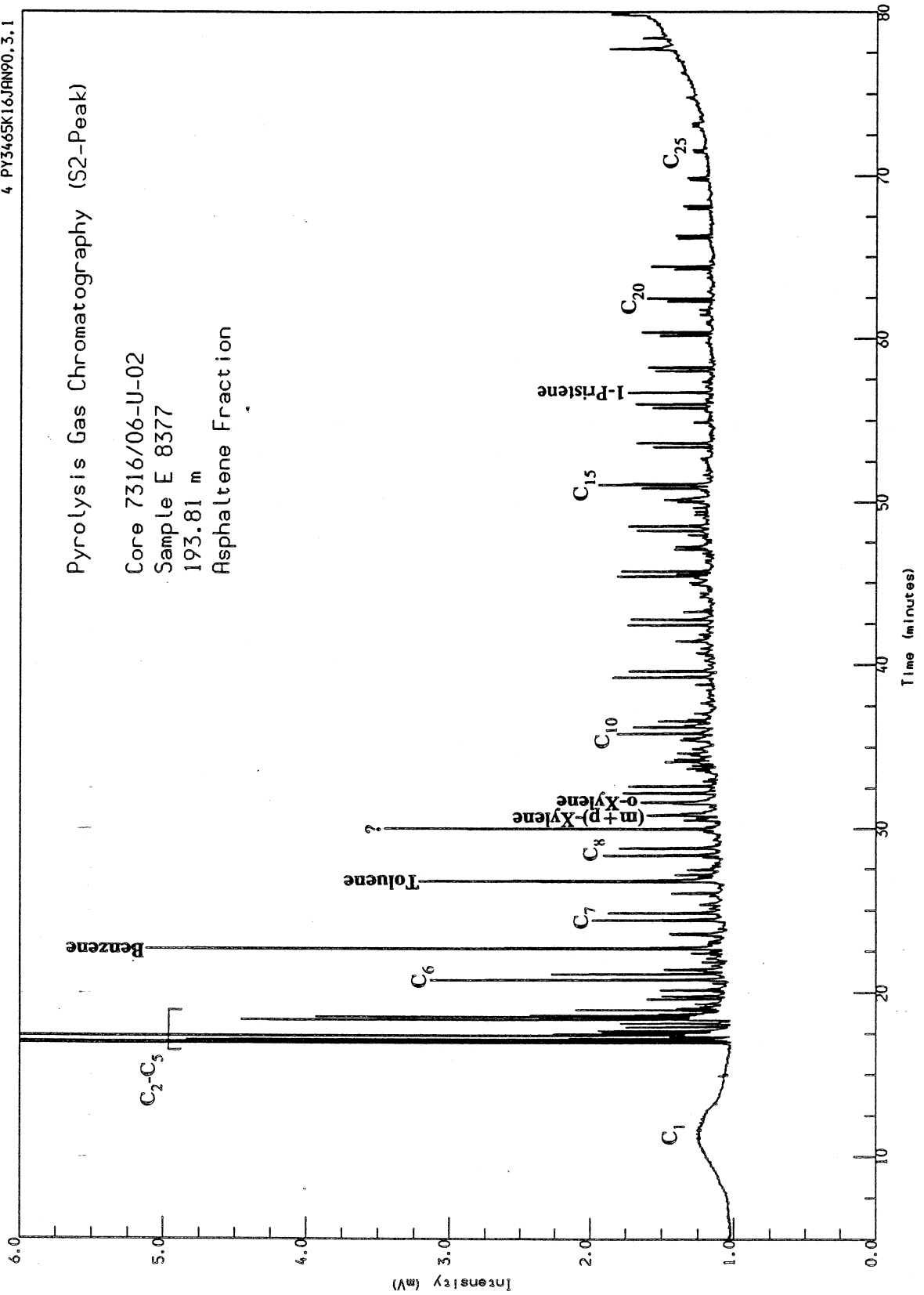


Figure A.I.2.4:

**Pyrolysis-gas chromatograms (S_2 peak):
Asphaltene fraction**

4 PY346SK16JAN90.3.1



4 PY3465K16JAN90, 1.1

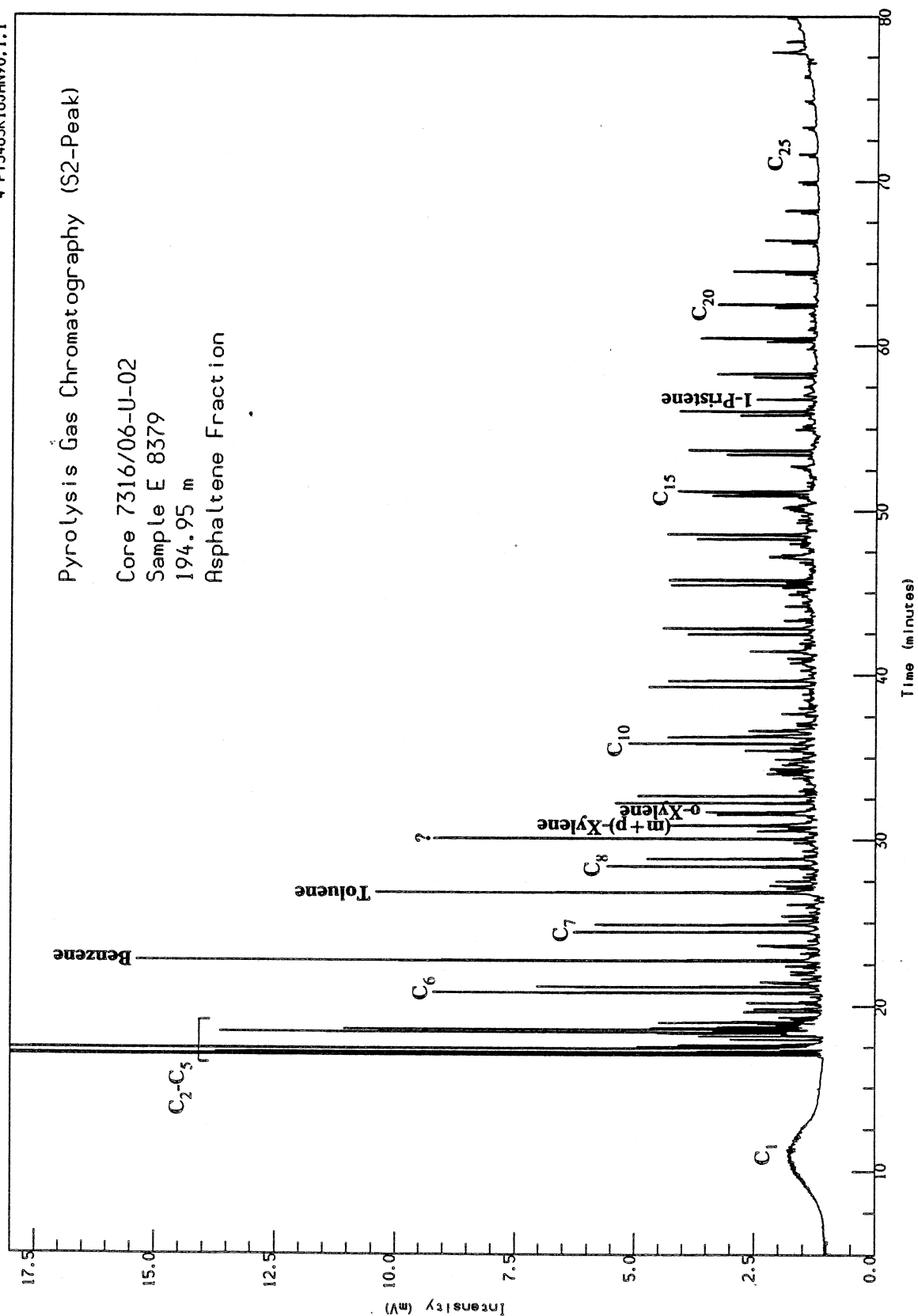
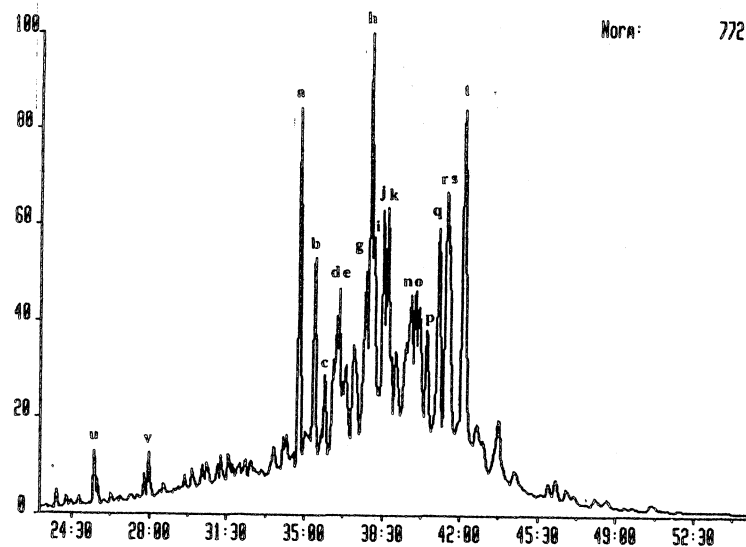


Figure A.I.2.5:

Mass fragmentograms of m/z 191, 205 (terpanes)
and m/z 217, 218 (steranes)

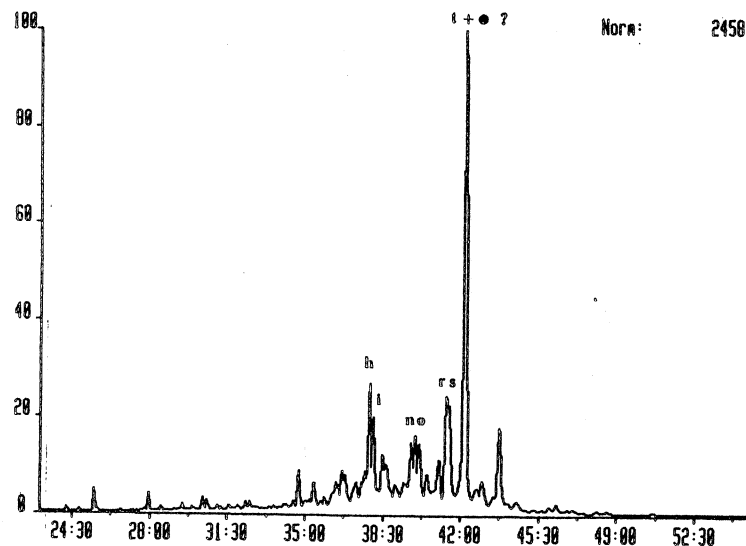
For peak identification, see Chapter II

E0233SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 217.1000
 Text:21.3465.23 BJORNOYA VEST, 7316/06-U-02, 06.30M, E-0233 SAT



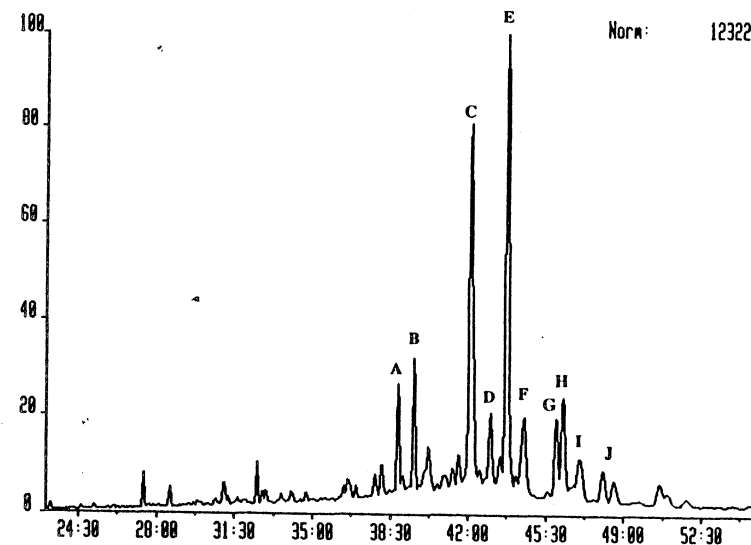
Norm: 772

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 Sample 1 Injection 1 Group 1 Mass 218.1000
 Text:21.3465.23 BJORNOYA VEST, 7316/06-U-02, 06.30M, E-0233 SAT



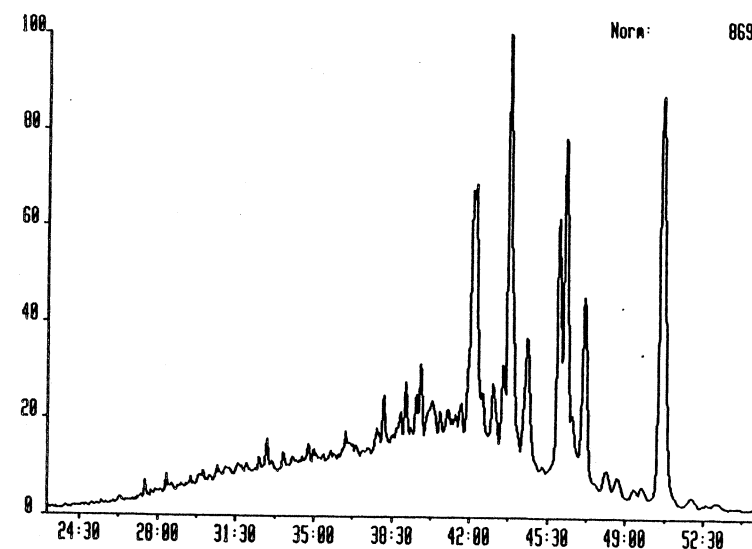
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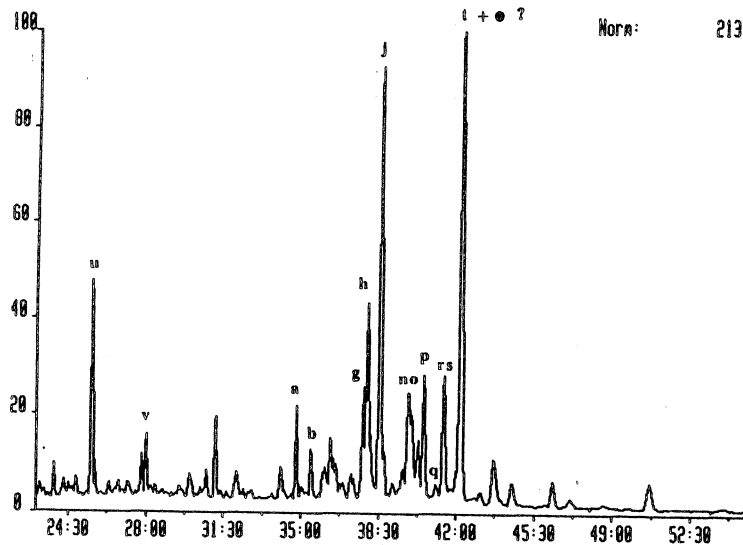
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 Text:21.3465.23 BJORNOYA VEST, 7316/06-U-02, 06.30M, E-0233 SAT

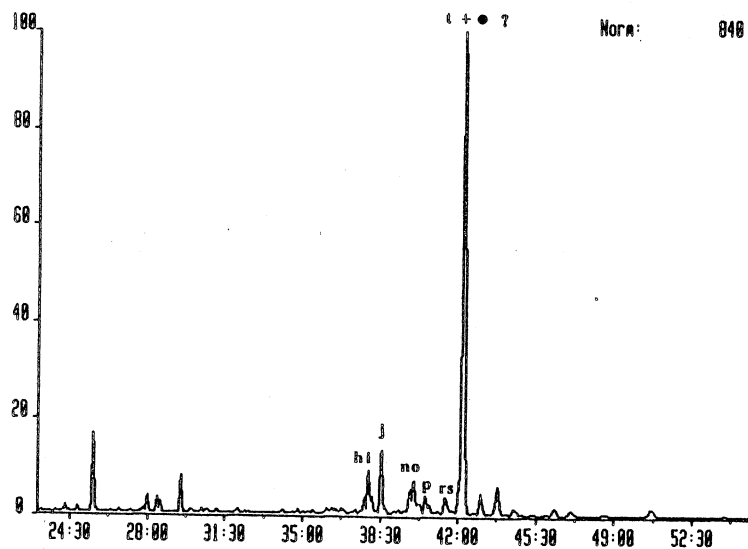


Norm: 869

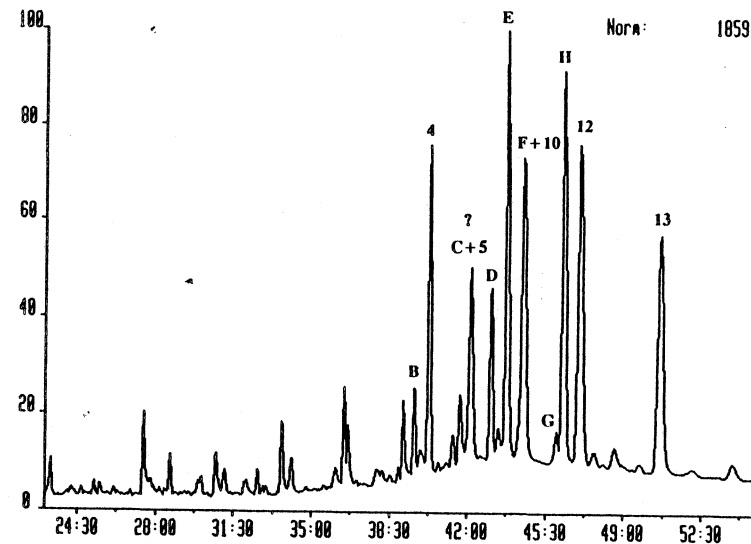
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 Sample 1 Injection 1 Group 1 Mass 217.1000
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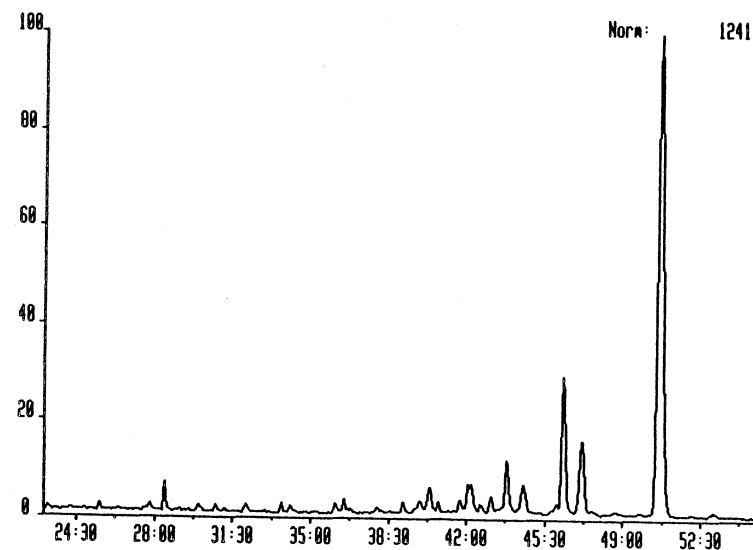
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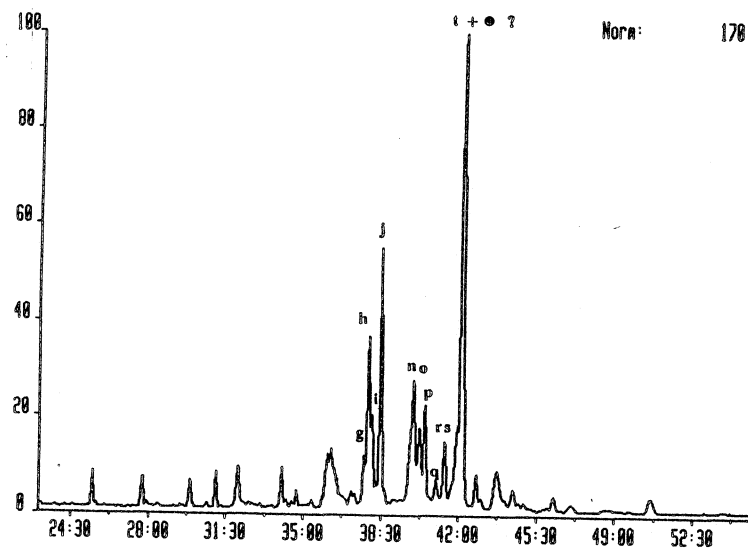
E8300SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 191.1000
 Text:21.3465.23 BJORNOYA VEST, 7316/86-U-02, 144.59M, E-8300 SAT



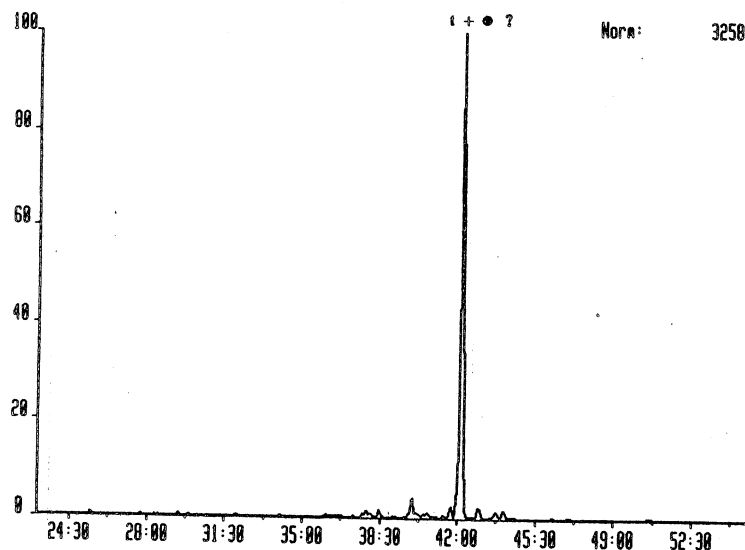
E8300SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 205.1000
 Text:21.3465.23 BJORNOYA VEST, 7316/86-U-02, 144.59M, E-8300 SAT



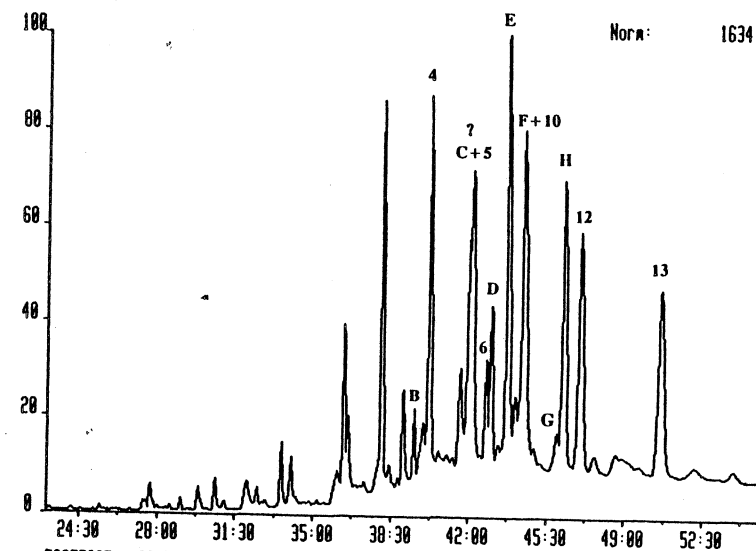
E8377SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 217.1000
 Text:21.3465.23 BJORNOYA VEST,7316/06-U-02, 193.81M, E-8377 SAT



E8377SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 218.1000
 Text:21.3465.23 BJORNOYA VEST,7316/06-U-02, 193.81M, E-8377 SAT



E8377SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 191.1000
 Text:21.3465.23 BJORNOYA VEST,7316/06-U-02, 193.81M, E-8377 SAT



E8377SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
 Sample 1 Injection 1 Group 1 Mass 205.1000
 Text:21.3465.23 BJORNOYA VEST,7316/06-U-02, 193.81M, E-8377 SAT

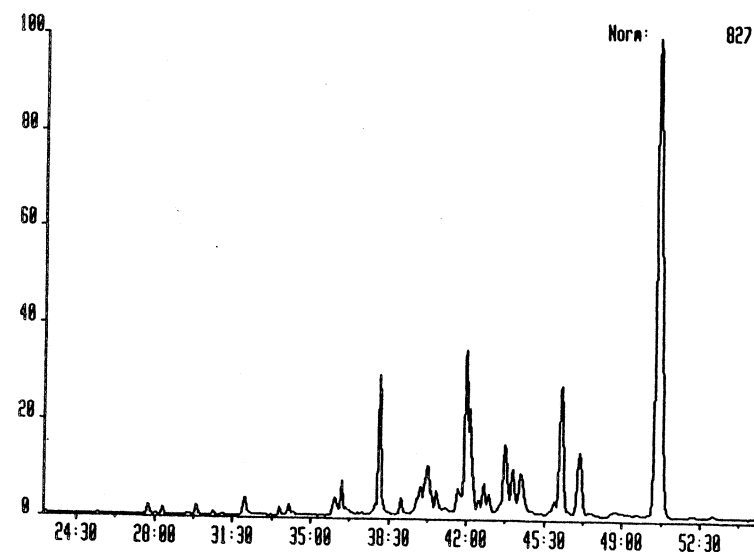
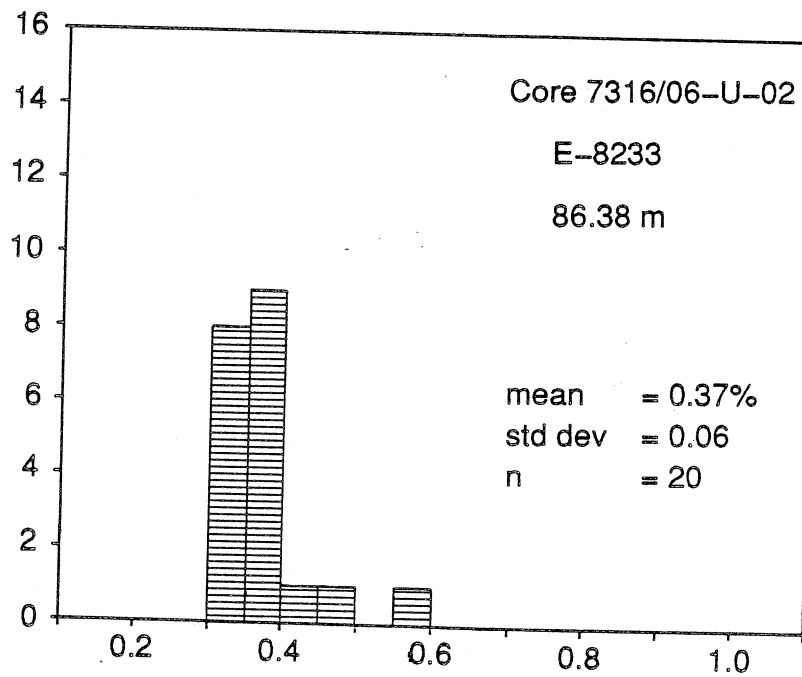
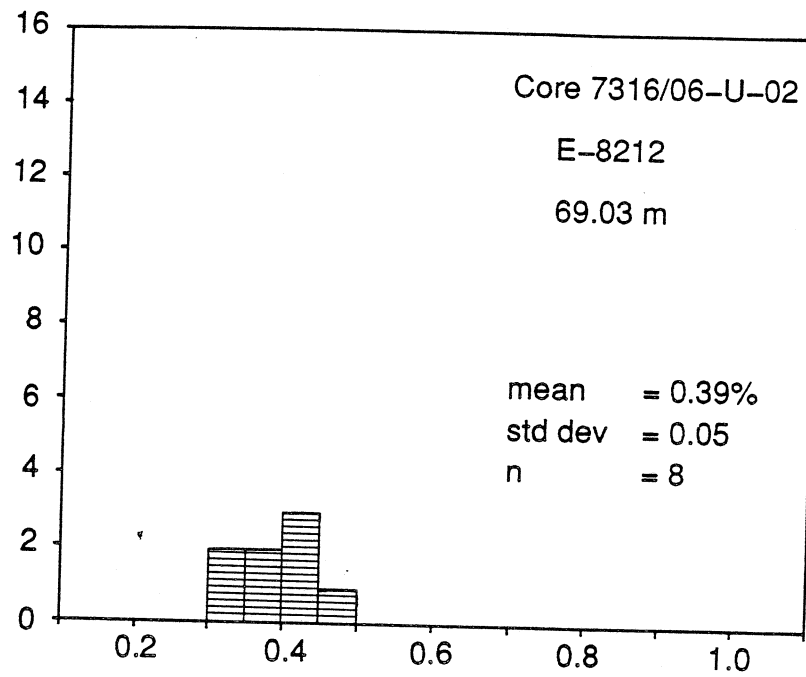
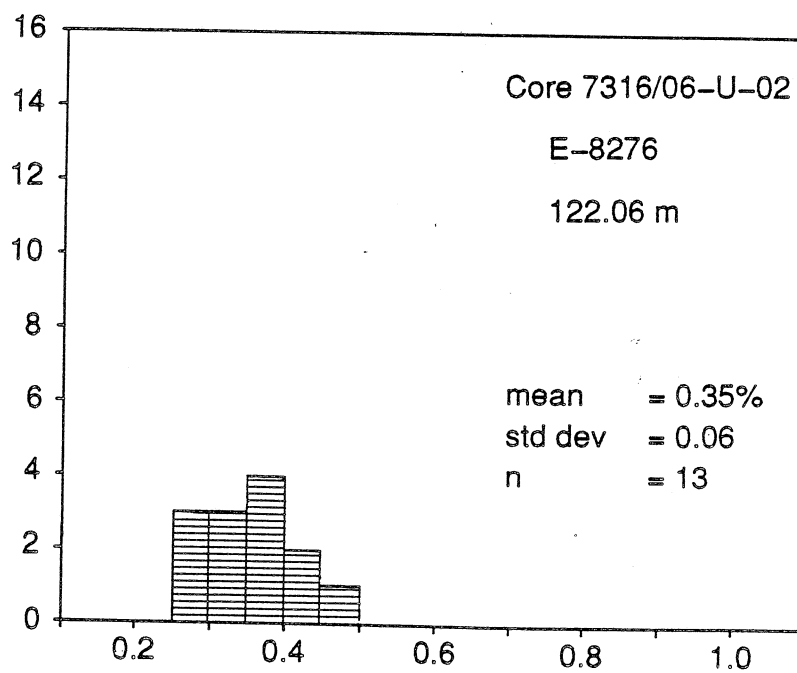
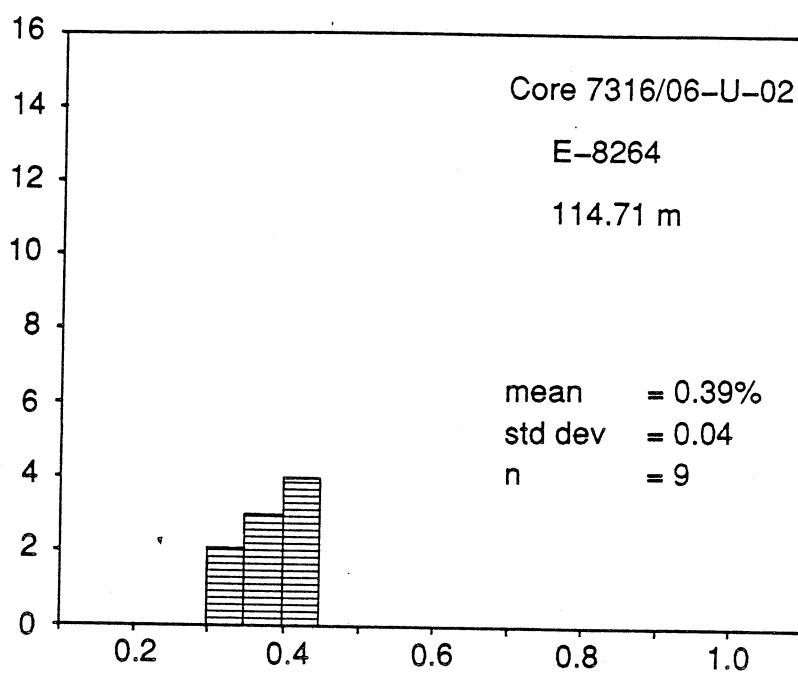
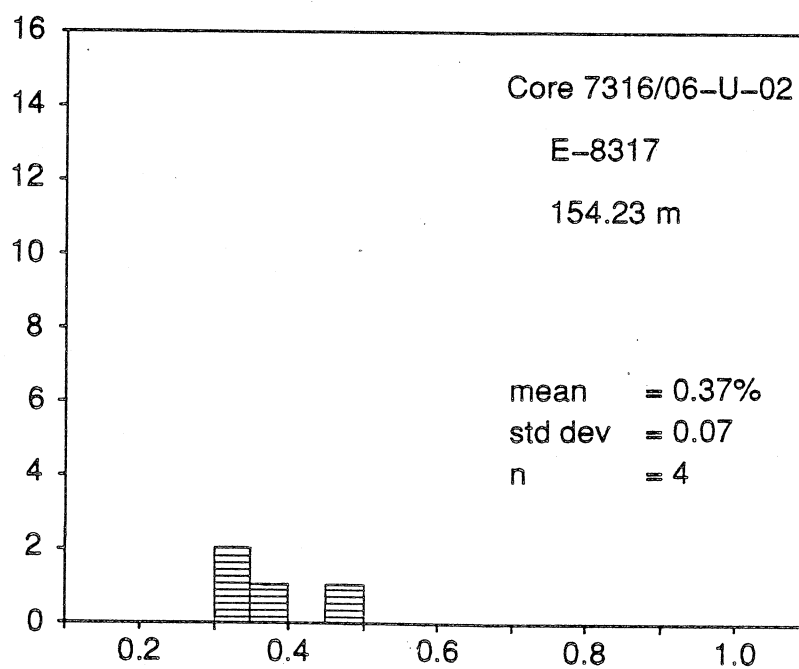
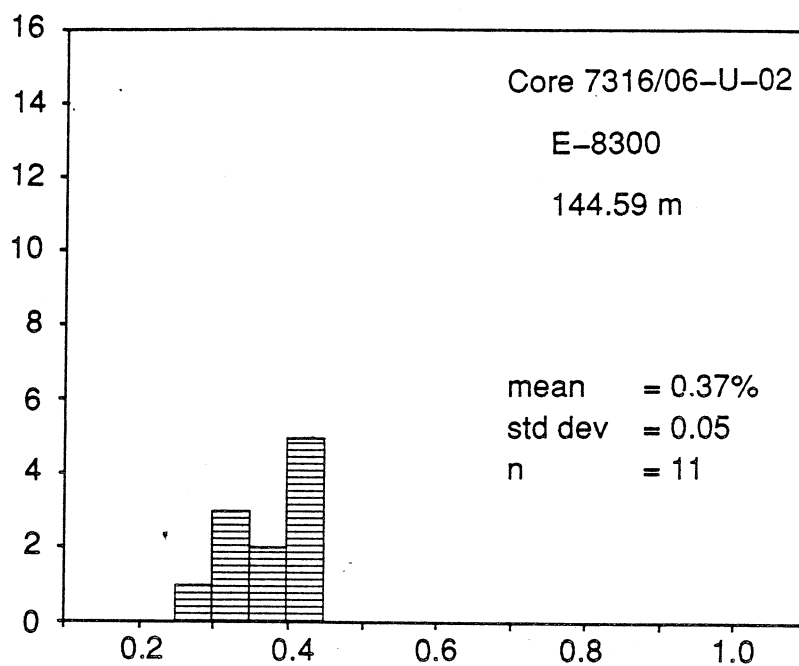


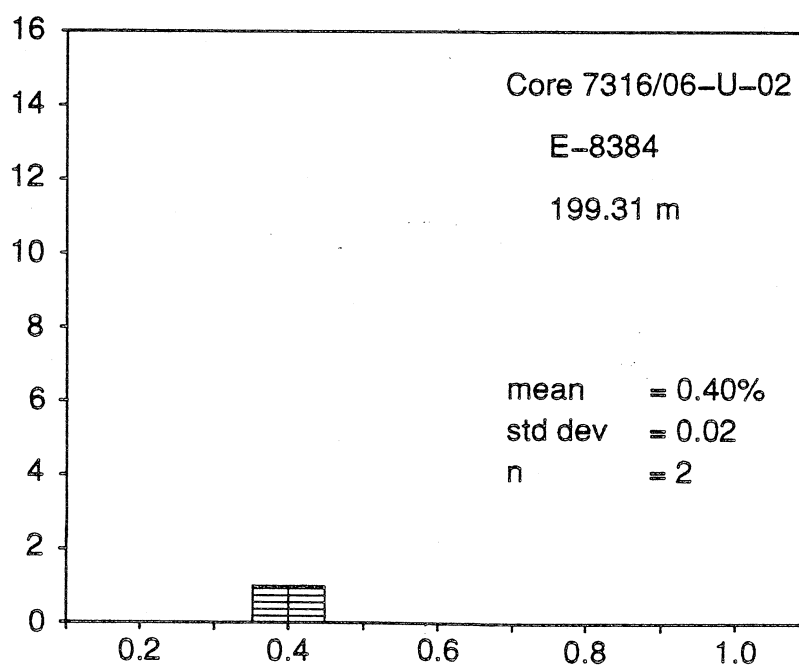
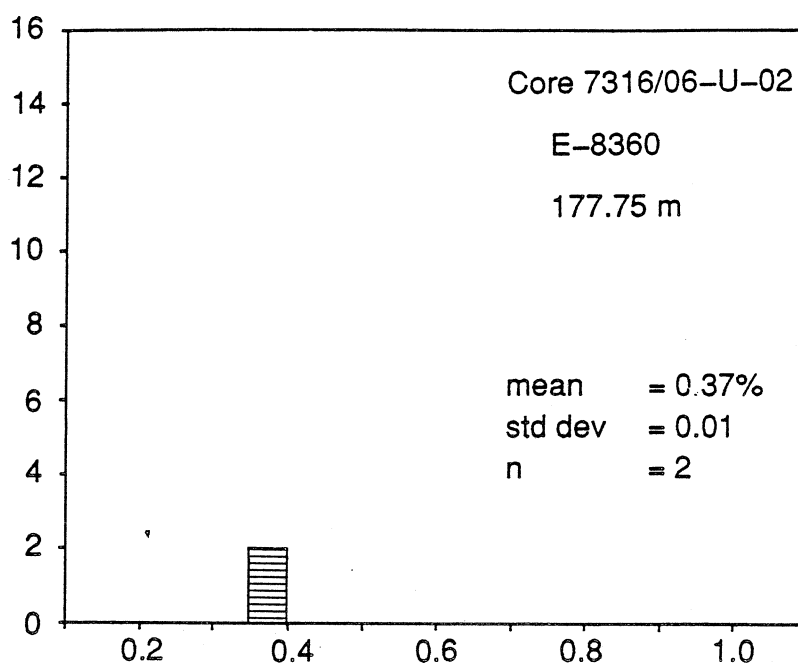
Figure A.I.2.6:

Vitrinite reflectance histograms









APPENDIX I.3

Core 7316/06-U-01

TABLES:

Table A.I.3.1:	Total organic carbon content and data from Rock-Eval pyrolysis.....	86
Table A.I.3.2:	Vitrinite reflectance data.....	87

FIGURES:

Figure A.I.3.1:	Vitrinite reflectance histograms.....	88
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Project no.: 21346500
Location : 7316/06-U-01
Date : 90.01.12

Table A.I.3.1: DATA FROM ROCK EVAL PYROLYSIS

IKUNO	FRAC NAME	DEPTH	SAMPLE TYPE	S1	S2	TOC	HYDRO. INDEX	PETR. POTEN.	PROD. INDEX S1	Tmax
		(m)		(mg/g rock)		(%)	(mg/g TOC)	S1+S2	----- S1+S2	(°C)
G0800		44.90	CORE	0.00	0.01	0.68	1	0.01	0.00	424
G0801		45.50	CORE	0.08	0.19	0.84	23	0.27	0.30	418
G0802		46.50	CORE	0.02	0.25	1.05	24	0.27	0.07	419
G0803		47.29	CORE	0.05	0.23	1.09	21	0.28	0.18	418
E8188		47.78	CORE	0.04	0.24	1.08	22	0.28	0.14	419
G0804		48.50	CORE	0.02	0.19	0.92	21	0.21	0.10	419
G0805		49.70	CORE	0.03	0.22	1.04	21	0.25	0.12	418
G0806		52.70	CORE	0.07	0.23	0.48	48	0.30	0.23	455
E8197		71.62	CORE			0.13				
E8539		90.22	CORE			0.13				
E8540		95.00	CORE			0.11				
E8201		98.65	CORE			0.11				
E8203		101.10	CORE			0.12				
E8205		103.60	CORE			0.11				
E8541		106.50	CORE			0.11				

Legend

-1 - No data available.

Core number: 7316/06-U-01
Reference number: 21.3465.23
(1/1)

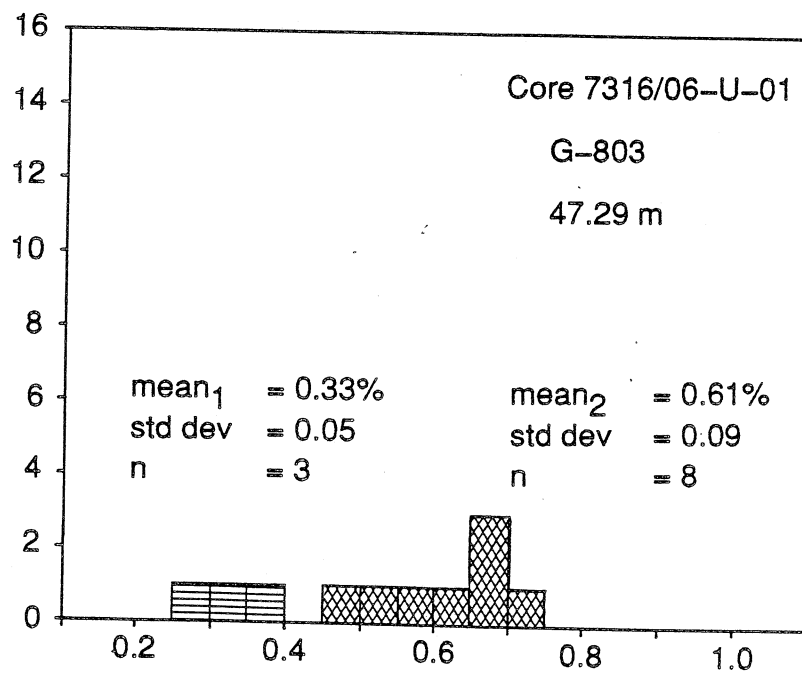
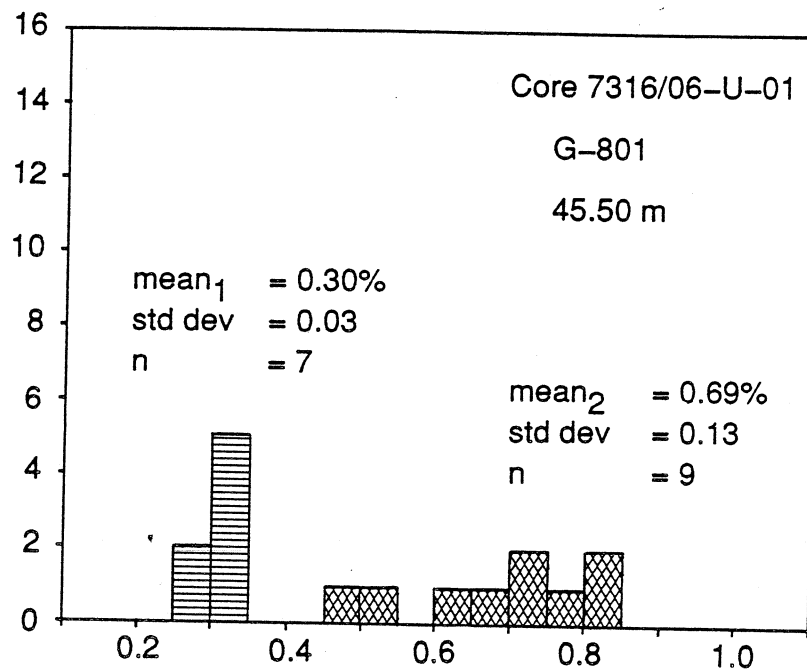
Table A.I.3.2: VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
G-0801	-----	45.50	0.30 (7) 0.69 (9)	P R	0.03 0.13	2
G-0803	-----	47.29	0.33 (3) 0.61 (8)	P R	0.05 0.09	2
E-8541	-----	106.50	N.D.P.	-	--	abs

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

Figure A.I.3.1:

Vitrinite reflectance histograms



APPENDIX I.4

Core 7316/03-U-01

TABLES:

Table A.I.4.1a:	Concentration of C ₁ -C ₅ + hydrocarbons in headspace gas.....	91
Table A.I.4.1b:	Concentration of C ₁ -C ₅ + hydrocarbons in occluded gas.....	91
Table A.I.4.1c:	Concentration of C ₁ -C ₅ + hydrocarbons - summation.....	92
Table A.I.4.2:	Stable carbon isotope data for adsorbed gas fractions.....	92
Table A.I.4.3:	Total organic carbon content and data from Rock-Eval pyrolysis.....	93
Table A.I.4.4:	Data from pyrolysis-gas chromatograms (prog. S ₂).....	95
Table A.I.4.5:	Vitrinite reflectance data.....	96
Table A.I.4.6:	Visual kerogen analysis.....	97
Table A.I.4.7a:	Weight of EOM, asphaltenes and chromatographic fractions....	101
Table A.I.4.7b:	Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	101
Table A.I.4.7c:	Concentration of EOM, asphaltenes and chromatographic fractions, related to TOC content.....	102
Table A.I.4.7d:	Composition of EOM and chromatographic ratios.....	102
Table A.I.4.8:	Ratios derived from gas chromatograms of saturated hydrocarbons.....	103
Table A.I.4.9:	Molecular ratios from sterane and terpane mass chromatograms.....	104

FIGURES:

Figure A.I.4.1a:	δ ¹³ C composition of methane related to gas composition.....	105
Figure A.I.4.1b:	δ ¹³ C composition of adsorbed methane.....	106
Figure A.I.4.2:	Pyrolysis-gas chromatograms (S ₂ peak).....	107
Figure A.I.4.3:	Gas chromatograms of saturated and aromatic hydrocarbons.....	117
Figure A.I.4.4:	Pyrolysis-gas chromatograms (S ₂ fraction): Asphaltene fraction.....	125
Figure A.I.4.5:	Mass fragmentograms of m/z 191, 205 (terpanes) and m/z 217, 218 (steranes).....	129
Figure A.I.4.6:	Vitrinite reflectance histograms.....	133

Project no.: 21346500
Location : 7316/03-U-01
Date : 89.09.21

Table A.I.4.1: TABLE OF GAS RESULTS

a: Headspace gas (µl gas per kg rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8186	40.80	3190	0	0	0	0	0	3190	0	0.0	-1.00
E8021	52.25	11990	0	0	0	0	0	11990	0	0.0	-1.00
E8034	62.35	25038	0	0	0	0	0	25038	0	0.0	-1.00
E8046	72.93	20287	0	0	0	0	0	20287	0	0.0	-1.00
E8047	75.30	37143	0	0	0	0	0	37143	0	0.0	-1.00
E8063	85.58	49571	0	0	0	0	0	49571	0	0.0	-1.00
E8076	92.82	20368	0	0	0	0	0	20368	0	0.0	-1.00
E8085	106.30	10923	0	0	0	0	0	10923	0	0.0	-1.00
E8525	111.05	29631	0	0	0	0	0	29631	0	0.0	-1.00
E8113	125.92	14799	0	0	0	0	0	14799	0	0.0	-1.00
E8126	136.87	8218	0	0	0	0	0	8218	0	0.0	-1.00
E8132	144.55	25018	0	0	0	0	0	25018	0	0.0	-1.00
E8146	160.15	8126	0	0	0	0	0	8126	0	0.0	-1.00
E8154	169.12	3088	0	0	0	0	0	3088	0	0.0	-1.00
E8156	173.06	1743	0	0	0	0	0	1743	0	0.0	-1.00

b: Occluded gas (µl gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8186	40.80	3338	36	18	0	0	0	3392	54	1.5	-1.00
E8021	52.25	8313	26	10	0	0	0	8349	36	0.4	-1.00
E8034	62.35	8985	30	16	0	0	0	9031	46	0.5	-1.00
E8046	72.93	2684	29	16	0	0	0	2729	45	1.6	-1.00
E8047	75.30	6862	22	9	0	0	0	6893	31	0.4	-1.00
E8063	85.58	4794	10	15	0	0	0	4819	25	0.5	-1.00
E8076	92.82	3171	18	7	0	0	0	3196	25	0.7	-1.00
E8085	106.30	5516	53	21	0	0	0	5590	74	1.3	-1.00
E8525	111.05	8559	36	16	0	0	0	8611	52	0.6	-1.00
E8113	125.92	14347	38	16	0	0	0	14401	54	0.3	-1.00
E8126	136.87	11265	65	35	0	0	0	11365	100	0.8	-1.00
E8132	144.55	13989	58	20	0	0	0	14067	78	0.5	-1.00
E8146	160.15	9199	100	45	0	12	157	9356	157	1.6	0.00
E8154	169.12	3447	128	67	0	11	126	3653	206	5.6	0.00
E8156	173.06	1974	61	20	0	9	83	2064	90	4.3	0.00

Legend

-1 - No data available.

Project no.: 21346500
Location : 7316/03-U-01
Date : 89.09.21

Table A.I.4.1: TABLE OF GAS RESULTS

c: Summation of Headspace and Occluded gas
(μ l gas per kg dry rock)

IKUNO	DEPTH (m)	C1	C2	C3	iC4	nC4	C5+	SUM C1-C4	SUM C2-C4	WET- NESS (%)	iC4 --- nC4
E8186	40.80	6528	36	18	0	0	0	6582	54	0.8	-1.00
E8021	52.25	20303	26	10	0	0	0	20339	36	0.2	-1.00
E8034	62.35	34023	30	16	0	0	0	34069	46	0.1	-1.00
E8046	72.93	22971	29	16	0	0	0	23016	45	0.2	-1.00
E8047	75.30	44005	22	9	0	0	0	44036	31	0.1	-1.00
E8063	85.58	54365	10	15	0	0	0	54390	25	0.0	-1.00
E8076	92.82	23539	18	7	0	0	0	23564	25	0.1	-1.00
E8085	106.30	16439	53	21	0	0	0	16513	74	0.4	-1.00
E8525	111.05	38190	36	16	0	0	0	38242	52	0.1	-1.00
E8113	125.92	29146	38	16	0	0	0	29200	54	0.2	-1.00
E8126	136.87	19483	65	35	0	0	0	19583	100	0.5	-1.00
E8132	144.55	39007	58	20	0	0	0	39085	78	0.2	-1.00
E8146	160.15	17325	100	45	0	12	157	17482	157	0.9	0.00
E8154	169.12	6535	128	67	0	11	126	6741	206	3.1	0.00
E8156	173.06	3717	61	20	0	9	83	3807	90	2.4	0.00

Legend

-1 - No data available.

Table A.I.4.2: STABLE CARBON ISOTOPE DATA FOR ADSORBED GAS FRACTIONS

CORE 7316/03-U-01

IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	$\delta^{13}C_1$ (‰) _{PDB}	$\delta^{13}C_2$ (‰) _{PDB}	$\delta^{13}C_1$ (‰) _{PDB}
E-8063	85.58	Core	Siltstone	-47.6	na	na
E-8154	169.12	Core	Sandstone	-30.4	na	na

Legend:

na: Data not available for this fraction

Project no.: 21346500
Location : 7316/03-U-01
Date : 90.01.12

Table A.I.4.3: DATA FROM ROCK EVAL PYROLYSIS

IKUNO	FRAC NAME	DEPTH	SAMPLE TYPE	S1	S2	TOC	HYDRO. INDEX	PETR. POTEN.	PROD. INDEX S1	Tmax
		(m)		(mg/g rock)		(%)	(mg/g TOC)	S1+S2	----- S1+S2	(°C)
E8001		35.15	CORE	0.02	0.12	0.61	20	0.14	0.14	404
E8006		38.45	CORE			0.19				
E8186		40.80	CORE	0.02	0.15	0.32	47	0.17	0.12	428
E8009		43.06	CORE			0.29				
E8014		46.10	CORE	0.01	0.10	0.33	30	0.11	0.09	419
E8018		48.65	CORE			0.47				
E8022		50.20	CORE	0.00	0.05	0.47	11	0.05	0.00	307
E8021		52.25	CORE			0.36				
E8025		55.30	CORE	0.00	0.07	0.39	18	0.07	0.00	341
E8029		57.85	CORE			0.25				
E8031		59.53	CORE	0.02	0.06	0.28	21	0.08	0.25	330
E8034		62.35	CORE			0.56				
E8037		65.90	CORE	0.01	0.07	0.32	22	0.08	0.13	333
E8042		68.50	CORE			0.36				
E8043		70.12	CORE	0.01	0.07	0.25	28	0.08	0.13	337
E8526		71.45	CORE	0.02	0.13	0.43	30	0.15	0.13	402
E8527		71.55	CORE	0.03	0.37	0.82	45	0.40	0.08	420
E8528		71.65	CORE	0.04	0.15	0.58	26	0.19	0.21	409
E8045		71.88	CORE	0.05	0.44	1.06	42	0.49	0.10	419
E8046		72.93	CORE	0.07	0.95	1.41	67	1.02	0.07	431
E8048		74.11	CORE	0.08	1.18	1.65	72	1.26	0.06	422
E8529		74.50	CORE	0.12	1.45	1.80	81	1.57	0.08	423
E8530		75.00	CORE			2.37				
E8530		75.00	CORE	0.21	2.29	2.15	107	2.50	0.08	416
E8047		75.30	CORE	0.08	2.61	2.09	125	2.69	0.03	431
E8531		75.80	CORE	0.02	0.31	0.67	46	0.33	0.06	419
E8532		76.60	CORE	0.01	0.07	0.32	22	0.08	0.13	407
E8533		77.72	CORE			0.14				
E8534		78.75	CORE			0.15				
E8052		79.85	CORE			0.79				
E8052		79.85	CORE	0.05	0.19	0.78	24	0.24	0.21	409
E8054		80.44	CORE			0.54				
E8056		82.98	CORE	0.04	0.28	0.89	31	0.32	0.13	423
E8058		83.88	CORE	0.03	0.15	1.03	15	0.18	0.17	412
E8061		85.58	CORE			0.71				
E8063		85.58	CORE	0.05	0.28	0.84	33	0.33	0.15	421
E8065		86.98	CORE			0.84				
E8069		88.31	CORE	0.04	0.21	0.71	30	0.25	0.16	415
E8071		89.75	CORE			0.85				
E8072		91.45	CORE	0.03	0.24	0.73	33	0.27	0.11	425
E8075		92.66	CORE			0.88				
E8076		92.82	CORE	0.03	0.26	0.85	31	0.29	0.10	418
E8535		93.80	CORE			0.65				
E8078		94.44	CORE	0.01	0.08	0.35	23	0.09	0.11	381
E8079		96.85	CORE			0.20				

Project no.: 21346500
Location : 7316/03-U-01
Date : 90.01.12

Table A.I.4.3: DATA FROM ROCK EVAL PYROLYSIS
(continued)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	S1 (mg/g rock)	S2 (mg/g rock)	TOC (%)	HYDRO. INDEX (mg/g TOC)	PETR. POTEN. S1+S2	PROD. INDEX S1 ----- S1+S2	Tmax (°C)
E8084		104.99	CORE	0.01	0.10	0.34	29	0.11	0.09	378
E8085		106.30	CORE			0.42				
E8088		108.42	CORE			0.42				
E8089		110.12	CORE	0.01	0.16	0.37	43	0.17	0.06	423
E8525		111.05	CORE			0.38				
E8091		113.00	CORE			0.42				
E8095		116.15	CORE	0.02	0.14	0.34	41	0.16	0.13	423
E8099		117.95	CORE			0.36				
E8100		119.25	CORE			0.42				
E8108		122.20	CORE	0.02	0.14	0.44	32	0.16	0.13	415
E8111		124.62	CORE			0.42				
E8113		125.92	CORE			0.43				
E8115		126.72	CORE	0.01	0.15	0.37	41	0.16	0.06	424
E8116		129.78	CORE			0.43				
E8121		132.85	CORE	0.02	0.19	0.41	46	0.21	0.10	419
E8122		134.45	CORE			0.43				
E8126		136.87	CORE	0.03	0.37	0.41	90	0.40	0.08	482
E8127		141.95	CORE	0.01	0.17	0.32	53	0.18	0.06	426
E8132		144.55	CORE			0.38				
E8135		148.35	CORE	0.02	0.22	0.27	81	0.24	0.08	427
E8140		151.90	CORE			0.28				
E8141		154.15	CORE	0.00	0.12	0.26	46	0.12	0.00	395
E8143		157.99	CORE			0.26				
E8536		160.10	CORE			0.11				
E8146		160.15	CORE	0.08	0.94	0.19	495	1.02	0.08	427
E8537		160.20	CORE			0.12				
E8538		162.40	CORE			0.19				
E8149		164.40	CORE			0.20				
E8150		168.15	CORE			0.18				
E8154		169.12	CORE	0.01	0.15	0.20	75	0.16	0.06	432
E8156		173.06	CORE			0.15				
E8161		176.45	CORE	0.00	0.12	0.19	63	0.12	0.00	439
E8163		184.35	CORE			0.15				

Legend

-1 - No data available.

Table A.I.4.4: DATA FROM PYROLYSIS-GAS CHROMATOGRAMS (PROG. S₂)

CORE 7316/03-U-01

IKU No.	DEPTH (m)	SAMPLE TYPE	LITHOLOGY	C ₁ (percent of peak area)	C ₂ -C ₅	C ₆ -C ₁₅	C ₁₅ +
<u>Whole rock</u>							
E-8528	71.65	Core	Claystone	0.3	46.4	44.4	0.0
E-8048	74.11	Core	Siltstone	8.4	20.3	57.5	13.8
E-8530	75.00	Core	Claystone	12.2	44.9	41.0	0.0
E-8047	75.30	Core	Siltstone	8.5	16.6	59.0	16.0
E-8532	76.60	Core	Claystone	0.4	26.4	72.8	0.3
E-8052	79.85	Core	Claystone	13.6	29.2	56.9	0.4
E-8089	110.12	Core	Siltstone	10.4	34.4	55.3	0.0
E-8126	136.87	Core	Siltstone	12.5	34.2	51.7	0.1
<u>Asphaltenes</u>							
E-8045	71.88	Core	Siltstone	12.6	30.4	35.2	21.8
E-8530	75.00	Core	Claystone	4.5	6.9	26.7	61.8
E-8052	79.85	Core	Claystone	9.0	15.7	46.2	26.2

Core number: 7316/03-U-01
Reference number: 21.3465.23
(1/1)

Table A.I.4.5: VITRINITE REFLECTANCE DATA

IKU NO	LOCATION	DEPTH (M)	VITRINITE REFLECTANCE	REL RAT	STANDARD DEVIATION	FLUORE- SCENCE
E-8186	-----	40.80	0.32 (2)	P	0.01	3
E-8034	-----	62.35	0.34 (20)	G	0.08	3
E-8530	-----	75.00	0.39 (21)	G	0.05	3-4
E-8047	-----	75.30	0.31 (20)	G	0.03	3-4
E-8058	-----	83.88	0.36 (7)	F	0.02	3
E-8063	-----	85.58	0.36 (20)	G	0.03	3
E-8072	-----	91.45	0.41 (4)	P	0.03	3
E-8141	-----	154.15	0.42 (6)	P	0.05	3

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

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.4.6
WELL NO.: 7316/03-U-01

Sample	Depth (m)	Composition of residue	Particle size	Preservation palynomorphs	Thermal maturation index *	Remarks
E-8007	40.37	Am: 20-25% Lm: 30% W: 40-45% C:	F-M-L	Good-Fair	<2.0	In addition to the organic matter, the residue contains abundant pyrite. Evidence of reworked Mid-Cretaceous material.
E-8565	51.95	Am: 5-10% Lm: 25-30% W: 60-65% C:	F-M-L	Good-Fair	<2.0	Organic residue with common woody phytoclasts and abundant angular black coaly fragments.
E-8044	71.88	Am: 5-10% Lm: 15-20% W: 65-70% C:	F-M-L	Fair	<2.0	Organic residue dominated by small coaly fragments. Evidence of recycled Mid-Cretaceous material. Sieved residue contains dominantly liptinitic and woody material.
E-8048	74.11	Am: 5% Al: 5% Lm: 45-50% W: 35-40% C:	F-M-L	Good-Fair	<2.0	Dominantly reworked Paleogene material. Fresh-water algae (Botryococcus) present.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.4.6 (ctd.)
WELL NO.: 7316/03-U-01

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8530	75.00	Am: 5% Al: 5% Lm: 35-40% W: 35-40% C: 10%	F-M-L	Good-Fair	<2.0	Comparable to sample E-8548, but with a slightly increased fraction of woody material relative to the liptinitic fraction.
E-8047	75.30	Am: 5% Al: 5% Lm: 40-45% W: 30-35% C: 10%	F-M-L	Good-Fair	<2.0	Comparable to sample E-8530.
E-8052	79.85	Am: 5% Lm: 25-30% W: 65-70% C:	F-M-L	Fair-Good	<2.0	Sieved organic residue dominated by dark brown to black woody and coaly fragments.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Estimates based on sieved residue.

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.4.6 (ctd.)
WELL NO.: 7316/03-U-01

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8566	80.15	Am: 5-10% Lm: 15-20% W: 70-75% C:	F-M-L	Fair	<2.0	Comparable to sample E-8044 (but the sieved residue of this sample is enriched in larger woody/coaly prices).
E-8060	85.56	Am: 10-15% Lm: 15-20% W: 65-70% C:	F-M-L	Fair-Good	<2.0	Comparable to sample E-8566.
E-8068	88.31	Am: 15-20% Lm: 10-15% W: 65-70% C:	F-M-L	Good-Fair	<2.0	Comparable to samples E-8044 and E-8566, but containing an increased relative proportion of amorphous matter.
E-8567	93.81	Am: 10-15% Lm: 10-15% W: 65-70% C:	F-M-L	Fair	<2.0	Comparable to sample E-8044.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

VISUAL KEROGEN ANALYSIS

TABLE NO.: A.I.4.6 (ctd.)

WELL NO.: 7316/03-U-01

Sample	Depth (m)	Compo- sition of residue	Particle size	Preser- vation palyno- morphs	Thermal maturation index *	Remarks
E-8044	104.99	Am: 10-15% Lm: 10-15% W: 65-70% C:	F-M-L	Good-Fair	<2.0	Comparable to sample E-8044. Common pyrite.
E-8129	141.95	Am: 20% Lm: 10-15% W: 60-65% C:	F-M-L	Fair	<2.0	Mainly comparable to sample E-8044, but with a higher proportion of amorphous organic matter.
E-8150	168.15	Am: 10-15% Al: 10% Lm: 10-15% W: 55-60% C:	F-M-L	Good-Fair	<2.0	Organic residue mainly comparable to samples above, but also containing a significant proportion of prasinophycean algae. (Tasmanitids).
E-8573	183.25	Am: 30-35% Lm: 5% W: 55-60% C:	F-M-L	Fair	<2.0	Organic residue containing mainly small black coaly fragments, but also with a relatively high proportion of brown/greyish degraded amorphous matter.

ABBREVIATIONS:

Am = Amorphous
Al = Algae
W = Woody material
C = Coaly fragments
Lm = Liptinitic material
+ = Present in traces

F = Fine
M = Medium
L = Large

* New TAI (1-10 scale; see experimental).

¹ Only sieved residue available.

Project no.: 21346500
Location : 7316/03-U-01
Date : 89.12.19

Table A.I.4.7a: WEIGHT OF CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ROCK EXTR. (g)	EOM (mg)	ASPH (mg)	SAT HC (mg)	ARO HC (mg)	POLAR COMP. (mg)	HC (mg)	NONHC (mg)	TOC (%)
E8528		71.65	CORE	8.2	4.0	1.4	0.5	0.5	0.8	1.0	3.0	0.58
E8045		71.88	CORE	15.9	9.0	3.8	2.0	0.6	3.0	2.6	6.4	1.06
E8530		75.00	CORE	9.7	12.3	4.6	0.7	0.8	4.6	1.5	10.8	2.15
E8052		79.85	CORE	13.0	4.2	1.0	0.4	0.2	1.6	0.6	3.6	0.78
E8063		85.58	CORE	17.5	4.2	2.1	0.1	0.8	1.1	0.9	3.3	0.84
E8126		136.87	CORE	13.7	2.6	2.1	0.6	0.2	1.2	0.8	1.8	0.41
E8146		160.15	CORE	25.2	3.0	1.0	0.6	0.2	0.4	0.8	2.2	0.19

Legend:

- * - Not all the available EOM was used for MPLC.
- ? - MPLC results assumed more EOM than originally extracted.
- 1- No data available.

Table A.I.4.7b: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm of rock)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8528		71.65	CORE	491	172	59	59	103	118	373
E8045		71.88	CORE	566	239	129	38	189	167	399
E8530		75.00	CORE	1264	473	75	87	472	162	1102
E8052		79.85	CORE	322	77	28	18	120	46	276
E8063		85.58	CORE	240	120	7	48	62	55	185
E8126		136.87	CORE	190	154	44	18	88	62	128
E8146		160.15	CORE	119	40	24	10	14	34	85

Legend:

- 1- No data available.

Project no.: 21346500
Location : 7316/03-U-01
Date : 89.12.19

Table A.I.4.7c: CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	EOM	ASPH	SAT HC	ARO HC	POLAR COMP.	HC	NONHC
E8528		71.65	CORE	84.6	29.6	10.2	10.2	17.8	20.4	64.2
E8045		71.88	CORE	53.4	22.5	12.1	3.6	17.9	15.7	37.7
E8530		75.00	CORE	58.8	22.0	3.5	4.0	22.0	7.5	51.3
E8052		79.85	CORE	41.3	9.8	3.5	2.4	15.4	5.9	35.4
E8063		85.58	CORE	28.6	14.3	0.8	5.7	7.4	6.5	22.1
E8126		136.87	CORE	46.4	37.5	10.7	4.3	21.5	15.0	31.4
E8146		160.15	CORE	62.6	20.9	12.5	5.0	7.5	17.5	45.1

Legend:

-1- No data available.

Table A.I.4.7d: COMPOSITION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKUNO	FRAC NAME	DEPTH (m)	SAMPLE TYPE	ASPH	SAT	ARO	HC	POLAR	SAT	HC
				EOM (%)	EOM (%)	EOM (%)	EOM (%)	EOM (%)	ARO x 100	NONHC x 100
E8528		71.65	CORE	35.0	12.0	12.0	24.0	21.0	100.0	31.7
E8045		71.88	CORE	42.2	22.7	6.7	29.4	33.5	340.0	41.7
E8530		75.00	CORE	37.4	5.9	6.9	12.8	37.3	85.7	14.6
E8052		79.85	CORE	23.8	8.6	5.7	14.3	37.2	150.0	16.7
E8063		85.58	CORE	50.0	2.9	20.1	23.0	25.8	14.3	29.7
E8126		136.87	CORE	80.8	23.1	9.2	32.3	46.2	250.0	47.8
E8146		160.15	CORE	33.3	20.0	8.0	28.0	12.0	250.0	39.0

Legend:

-1- No data available.

Project no.: 21346500
Location : 7316/03-U-01
Date : 89.12.19

Table A.I.4.8: RATIOS DERIVED FROM GAS CHROMATOGRAMS OF SATURATED HYDROCARBONS

IKUNO	FRAC NAME	DEPTH	Pri	Pri	Phy	A	n-C17	n-C31	CPI 1	CPI 2
			Phy	A= n-C17	B= n-C18	B	n-C27	n-C19		
E8528		71.65	0.7	0.7	0.7	1.1	0.1	2.3	2.1	2.1
E8045		71.88	0.9	0.5	0.5	0.9	0.1	10.7	1.4	1.8
E8530		75.00	1.2	0.6	0.6	1.1	0.2	7.7	1.5	2.1
E8052		79.85	0.9	0.7	0.7	1.0	1.3	0.7	2.6	2.8
E8063		85.58	0.8	0.4	0.6	0.7	0.3	1.7	2.5	2.5
E8126		136.87	0.8	0.5	0.2	2.1	1.1	1.0	1.4	1.1
E8146		160.15	0.7	0.5	0.6	0.8	3.1	0.4	1.5	1.3

-1 = No data available

Legend:

$$\text{CPI 1} = \frac{1}{2} \cdot \left(\frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{24}+C_{26}+C_{28}+C_{30}} + \frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{26}+C_{28}+C_{30}+C_{32}} \right)$$

$$\text{CPI 2} = \frac{2 \cdot C_{27}}{C_{26}+C_{28}}$$

Ratios involving pristane and phytane are calculated from peak areas.
All other ratios are calculated from peak heights.

Table A.I.4.9

*Molecular ratios from sterane and terpane mass chromatograms.
Core 7316/03-U-01.*

Code	Depth (m)	$\alpha\beta/\alpha\beta+\beta\alpha^{1)}$	%22S ²⁾	% $\beta\beta^3)$	%20S ⁴⁾	30:1/30:0 ⁵⁾	a/a+j ⁶⁾
E-8045	71.88	0.54	4.0	-	-	-	-
E-8530	75.00	0.36	-	-	-	-	-
E-8126	160.15	-	-	-	-	-	-

¹⁾ E/(E+F) in m/z 191 (note coelution with peak 10).

²⁾ Average % distribution between first and second eluting isomers of extended hopanes (G/G+H).

³⁾ $100 * 2(r+s)/(q+t+2(r+s))$ in m/z 217.

⁴⁾ $100 * q/(q+t)$ in m/z 217.

⁵⁾ 9/E in m/z 191.

⁶⁾ Relative abundance of diasteranes in m/z 217.

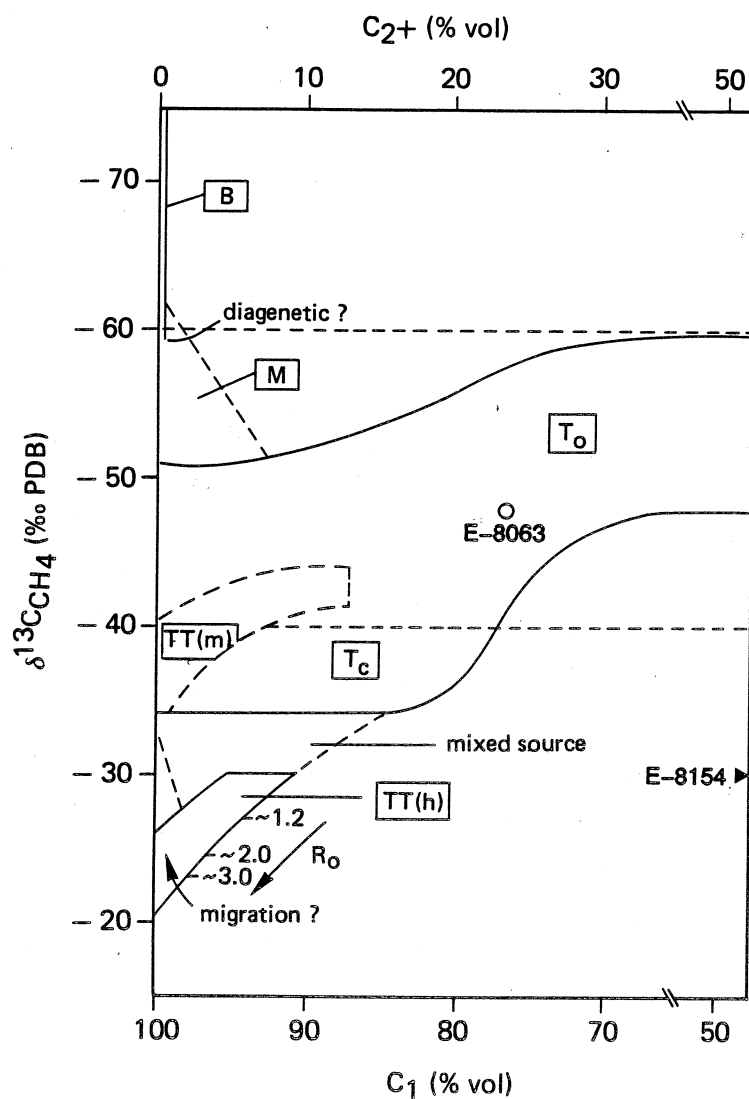


Figure A.I.4.1a

$\delta^{13}\text{C}$ isotopic composition of adsorbed methane in relation to gas composition for selected samples from core 7316/03-U-01 (after Schoell, 1983).

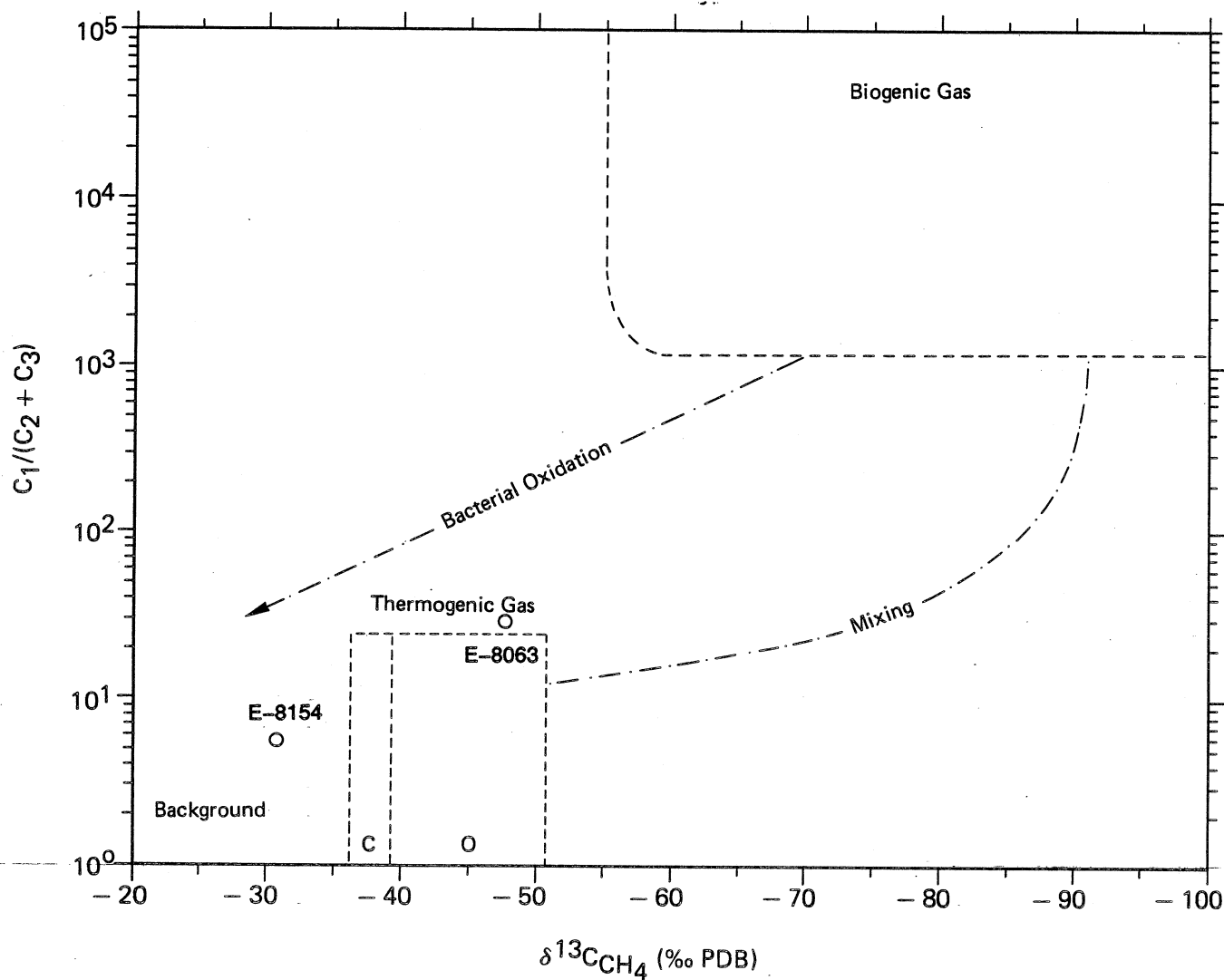
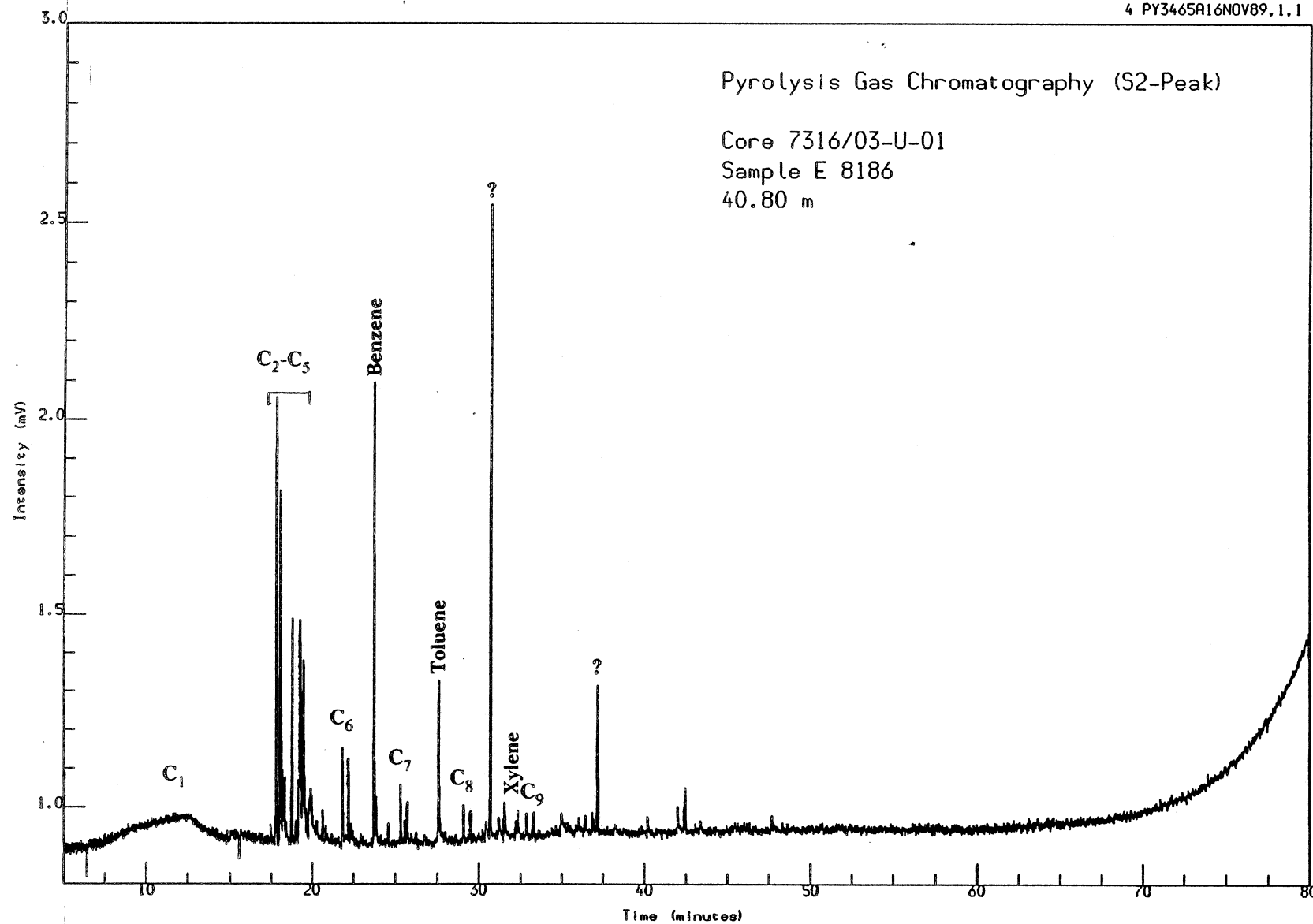


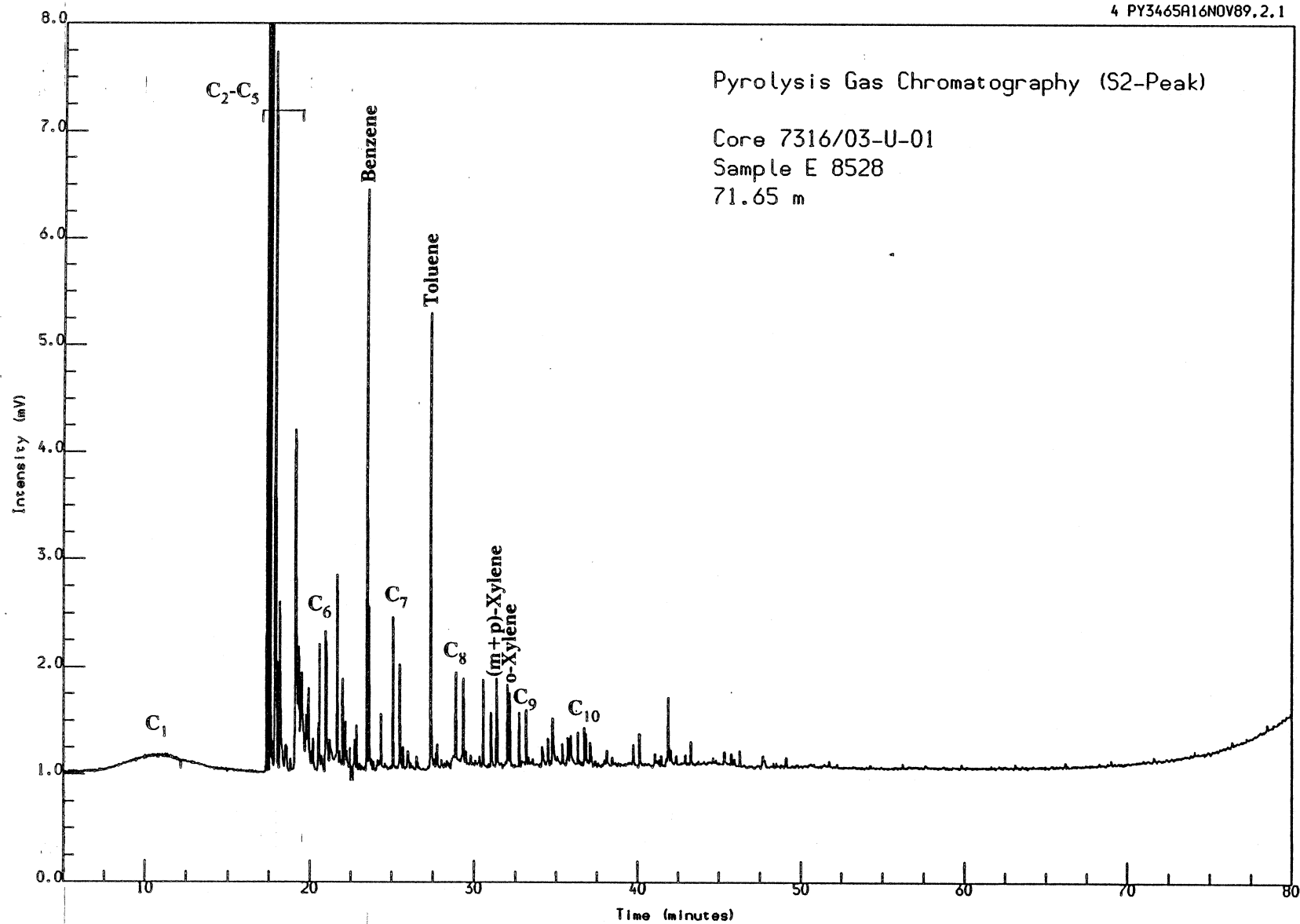
Figure A.1.4.1b

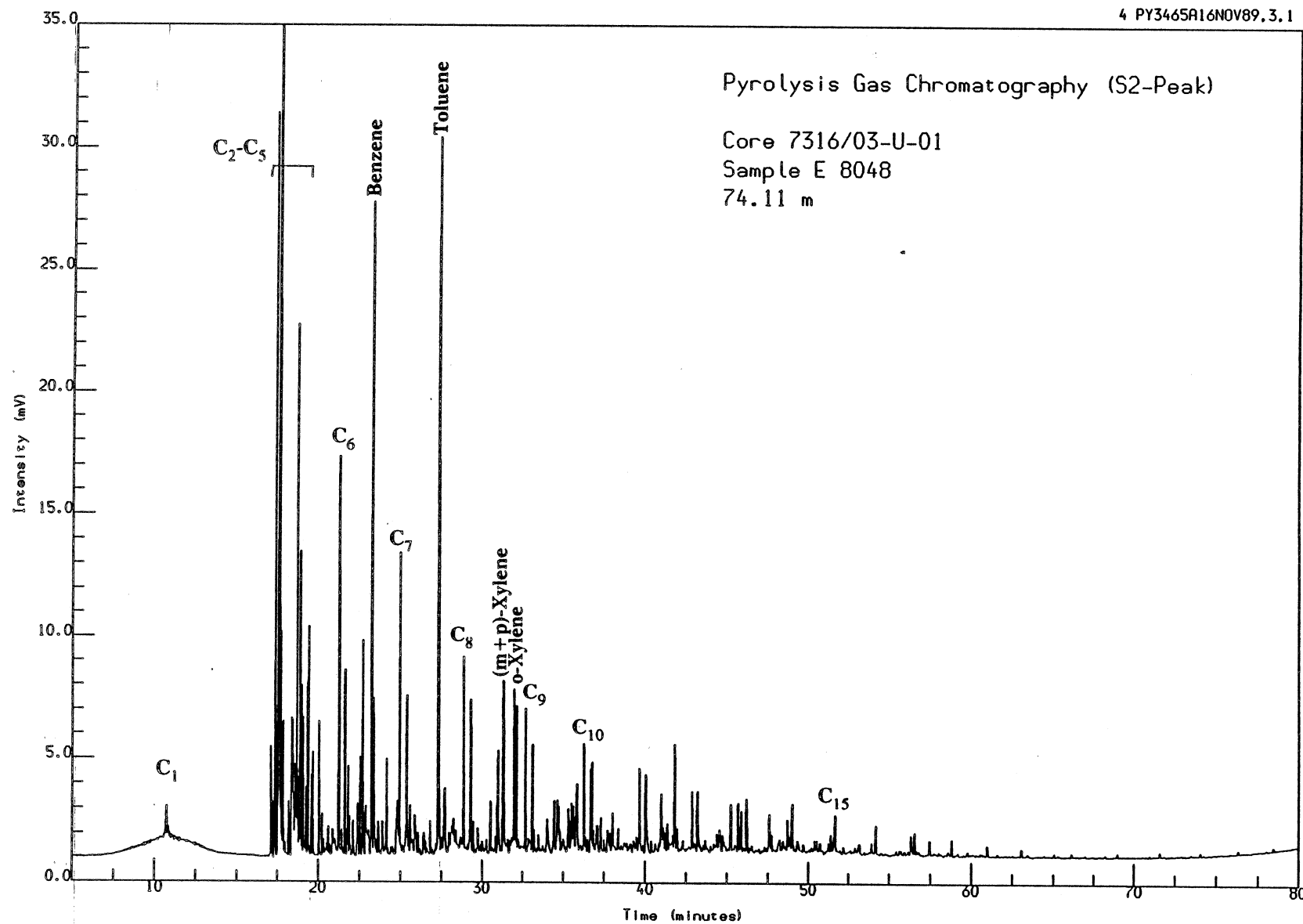
$\delta^{13}C$ isotopic composition of adsorbed methane for selected samples from core 7316/03-U-01 (after Schoell 1983).

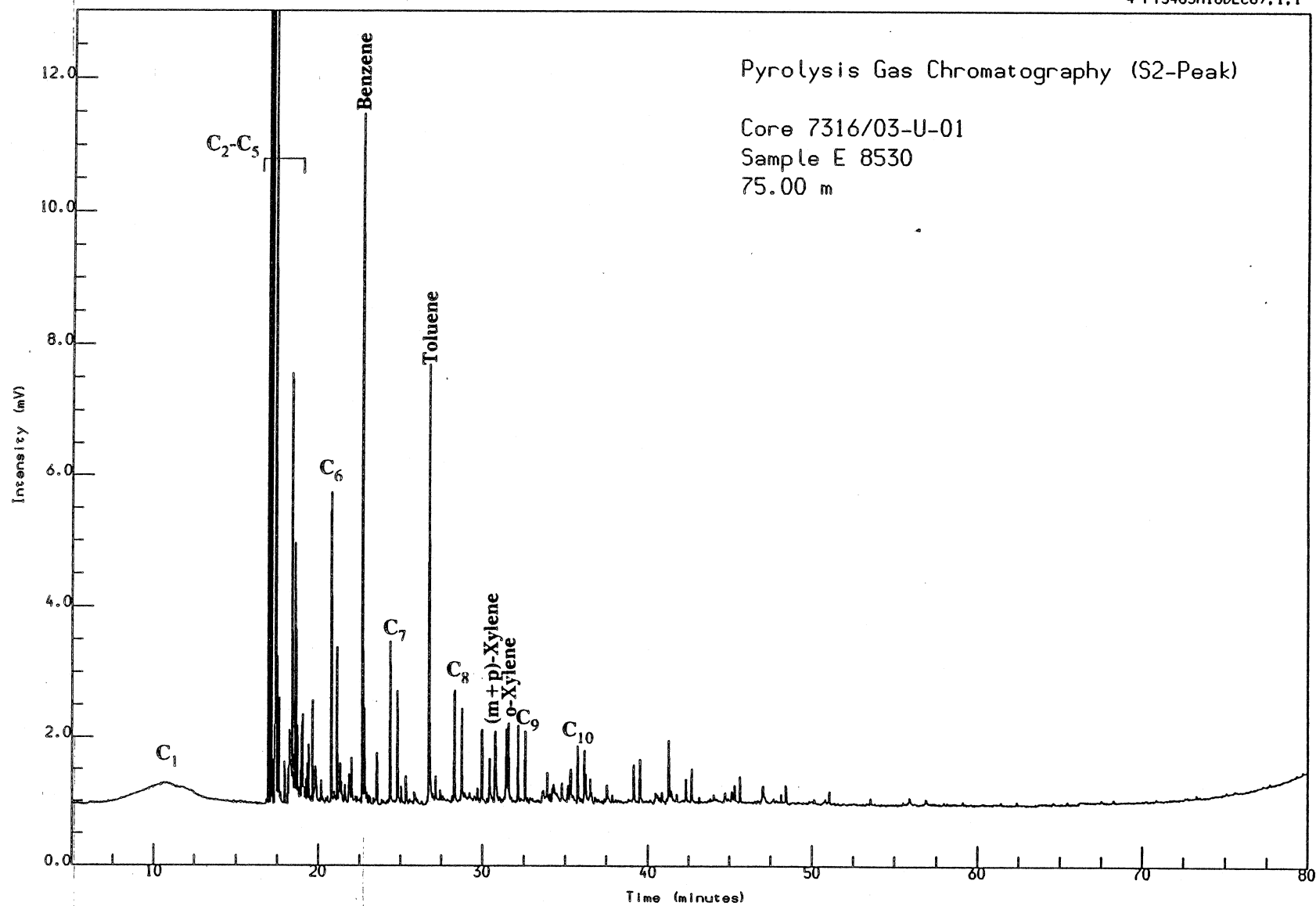
Figure A.I.4.2:

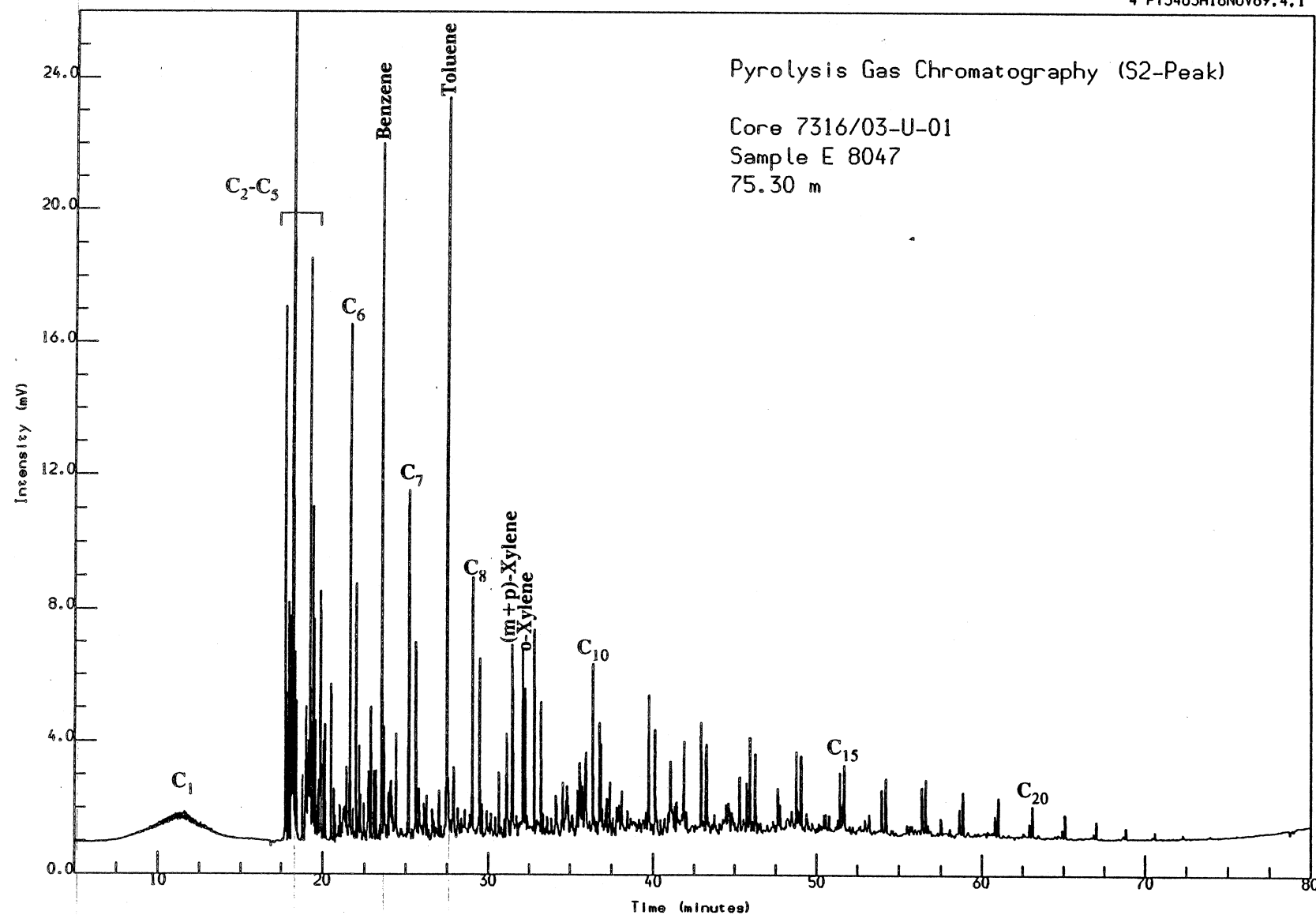
Pyrolysis-gas chromatograms (S_2 peak):
Whole-rock samples

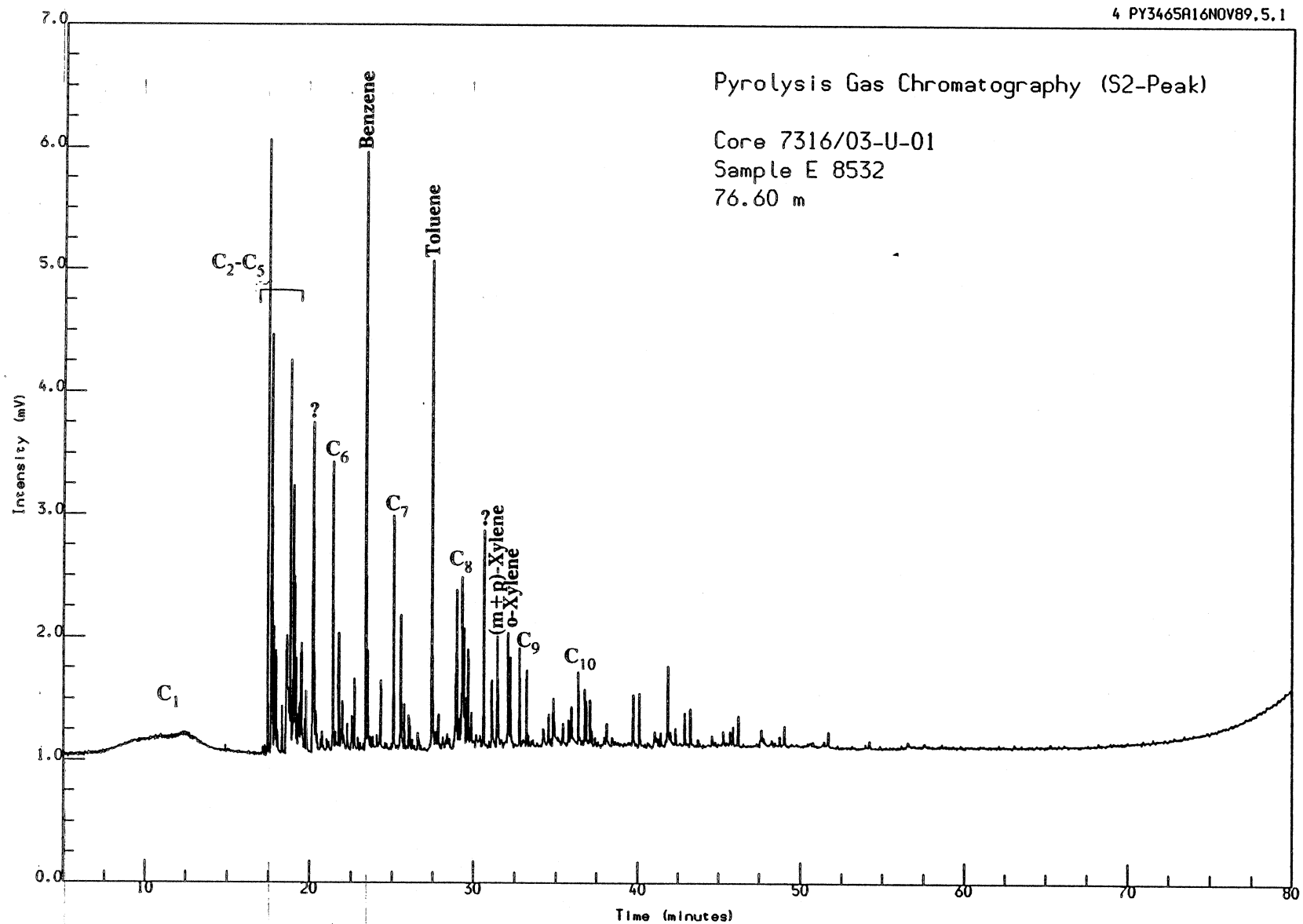


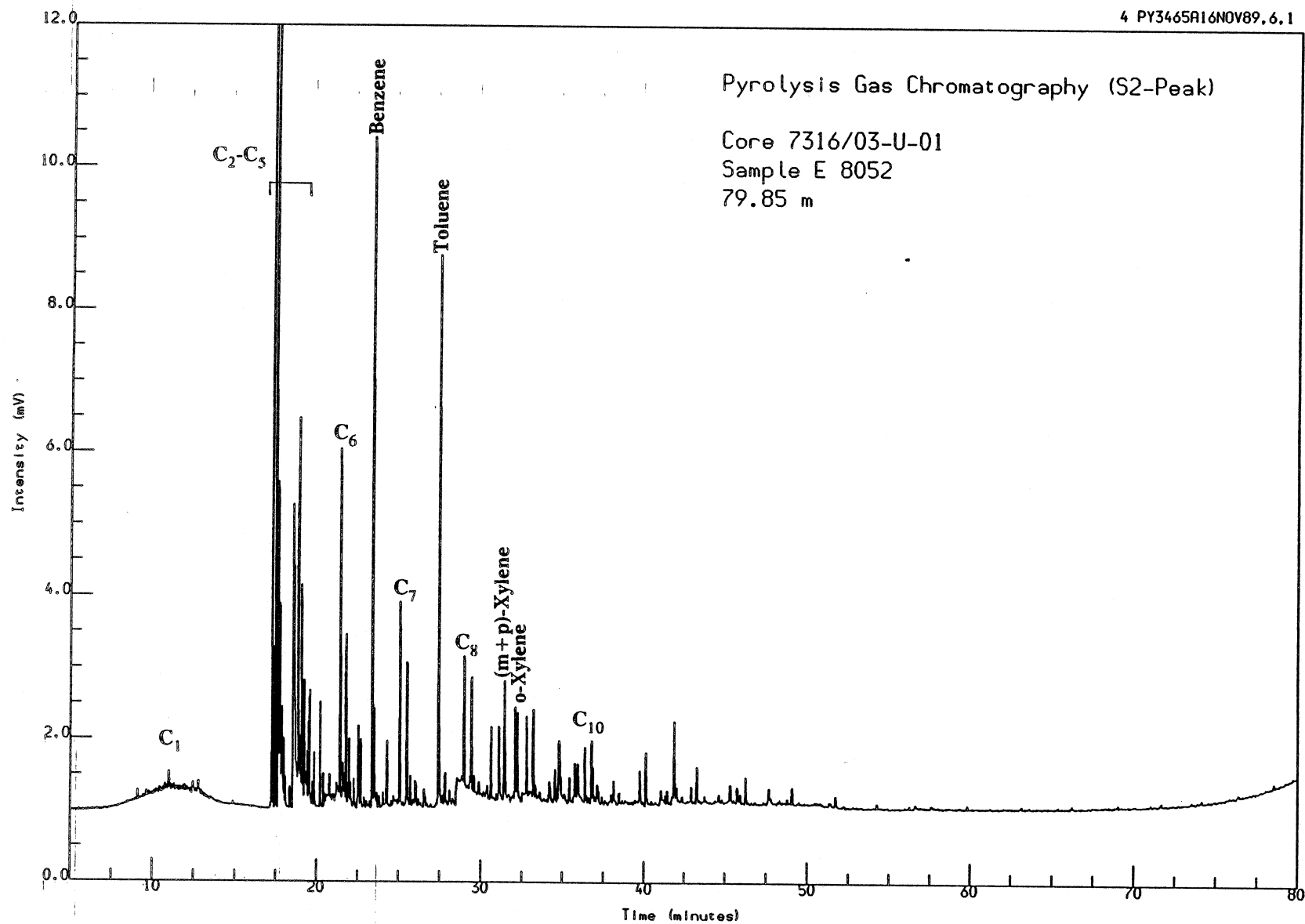


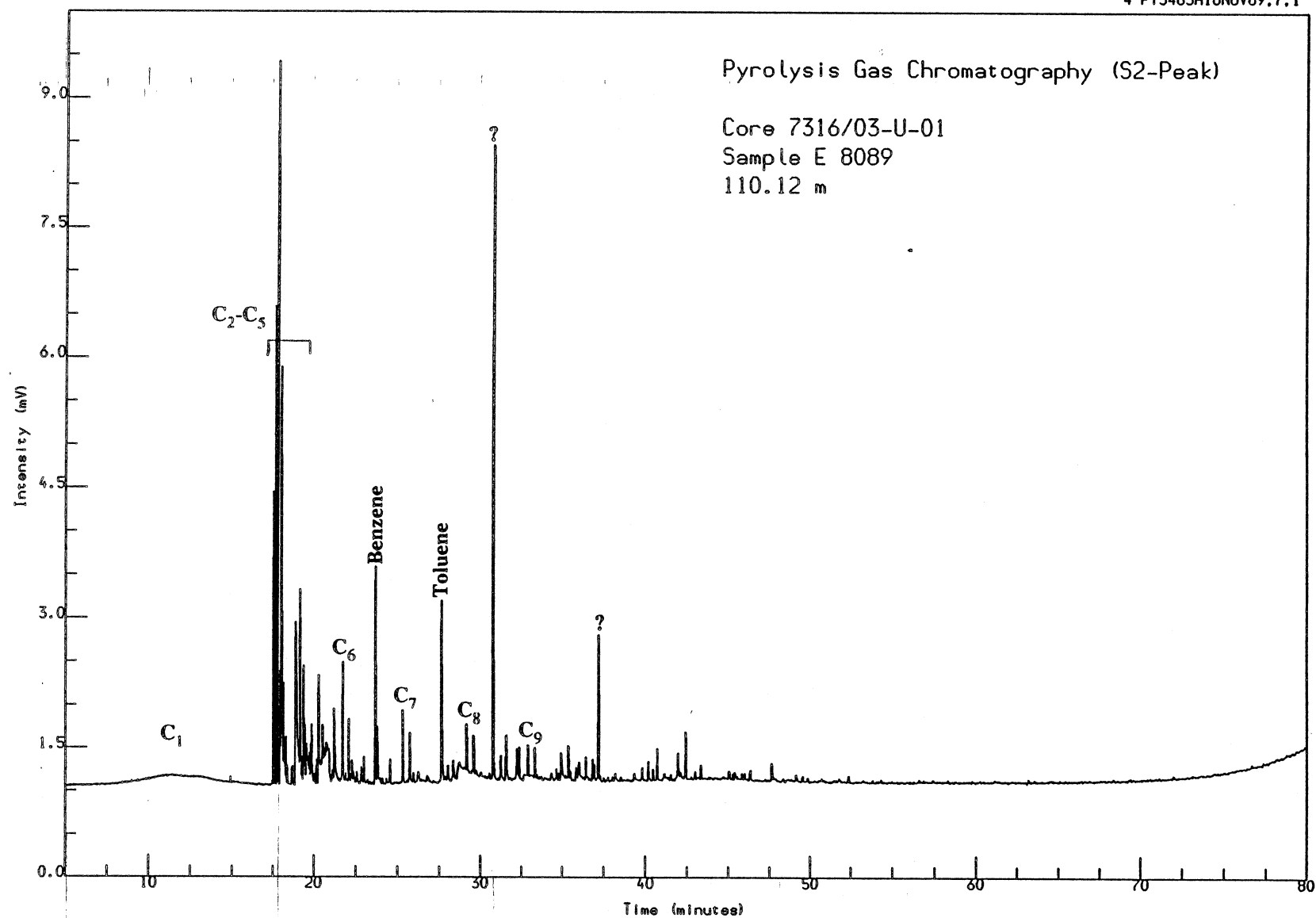












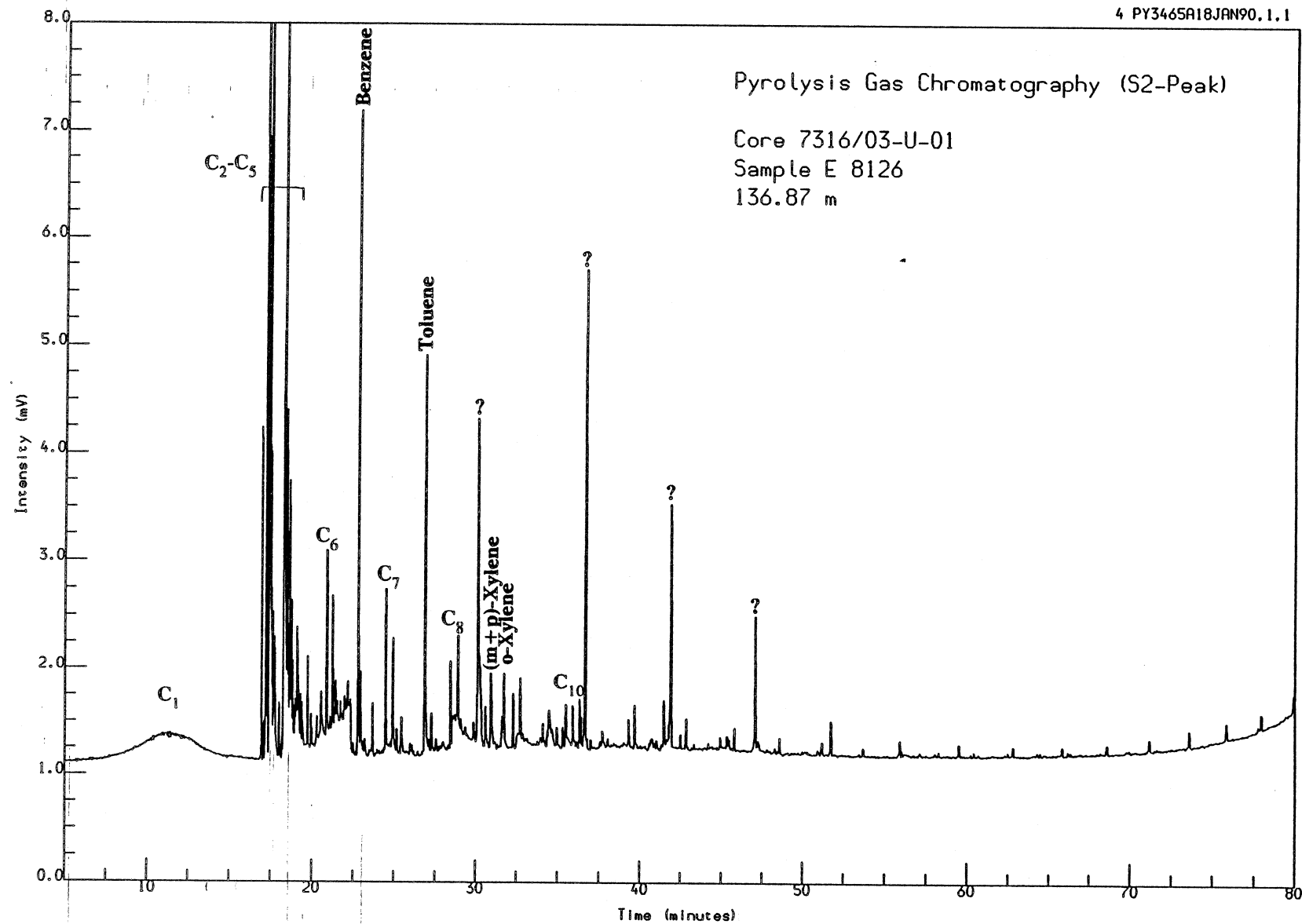
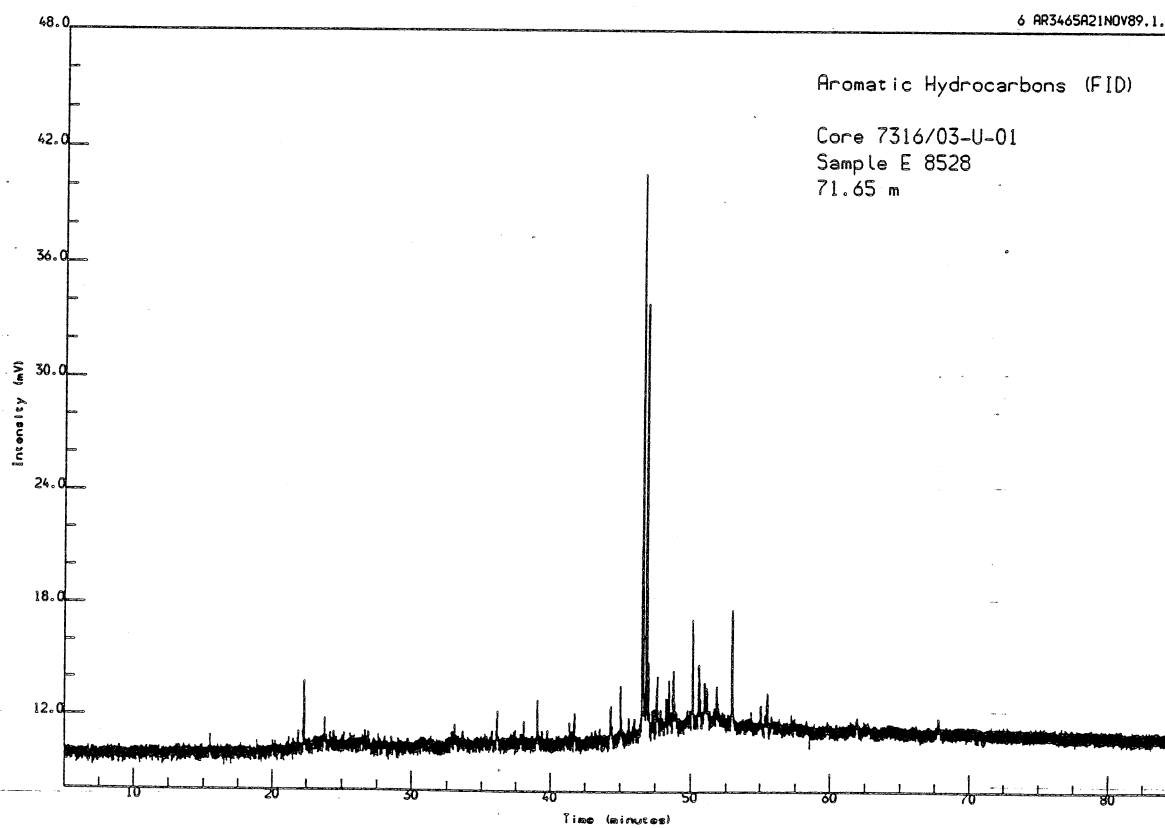
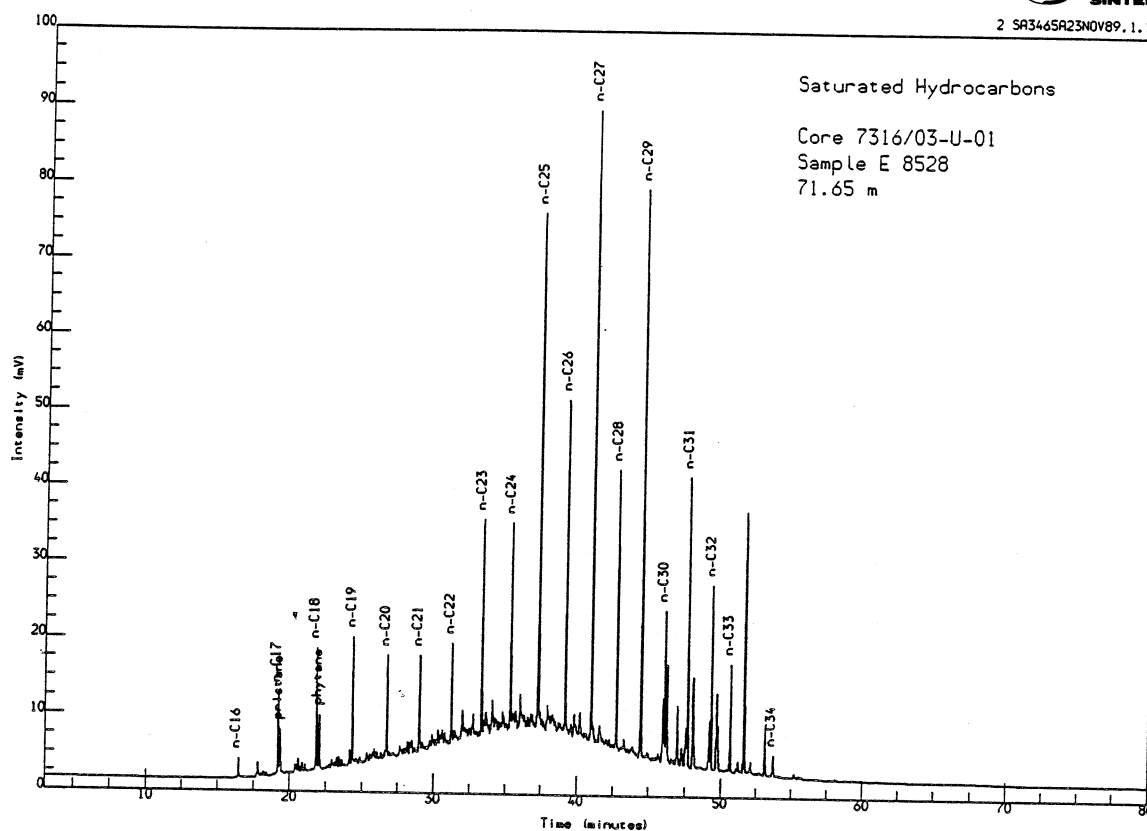


Figure A.I.4.3:

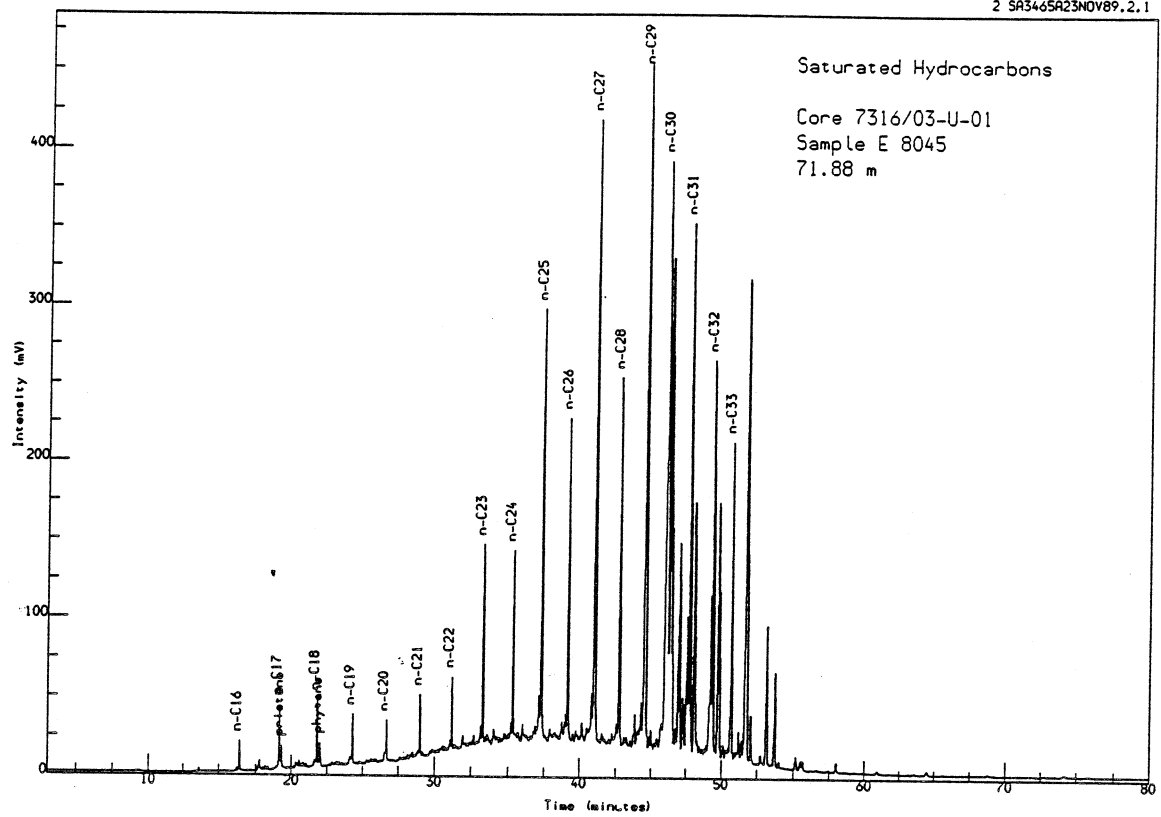
Gas chromatograms of saturated and aromatic hydrocarbons

nC₁₅, etc. - n-alkanes

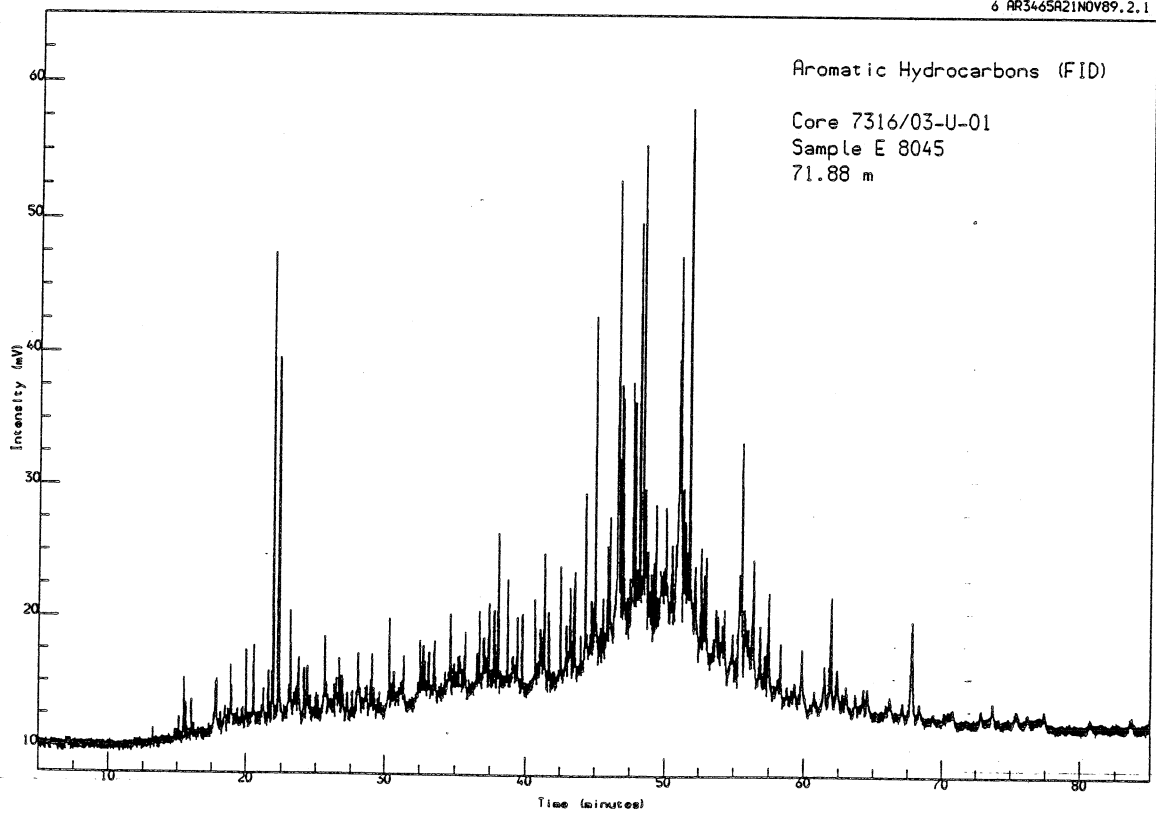
N	- Naphthalene
MN	- Methylnaphthalenes
DMN	- Dimethylnaphthalenes
TMN	- Trimethylnaphthalenes
P	- Phenanthrene
MP	- Methylphenanthrenes
DMP	- Dimethylphenanthrenes



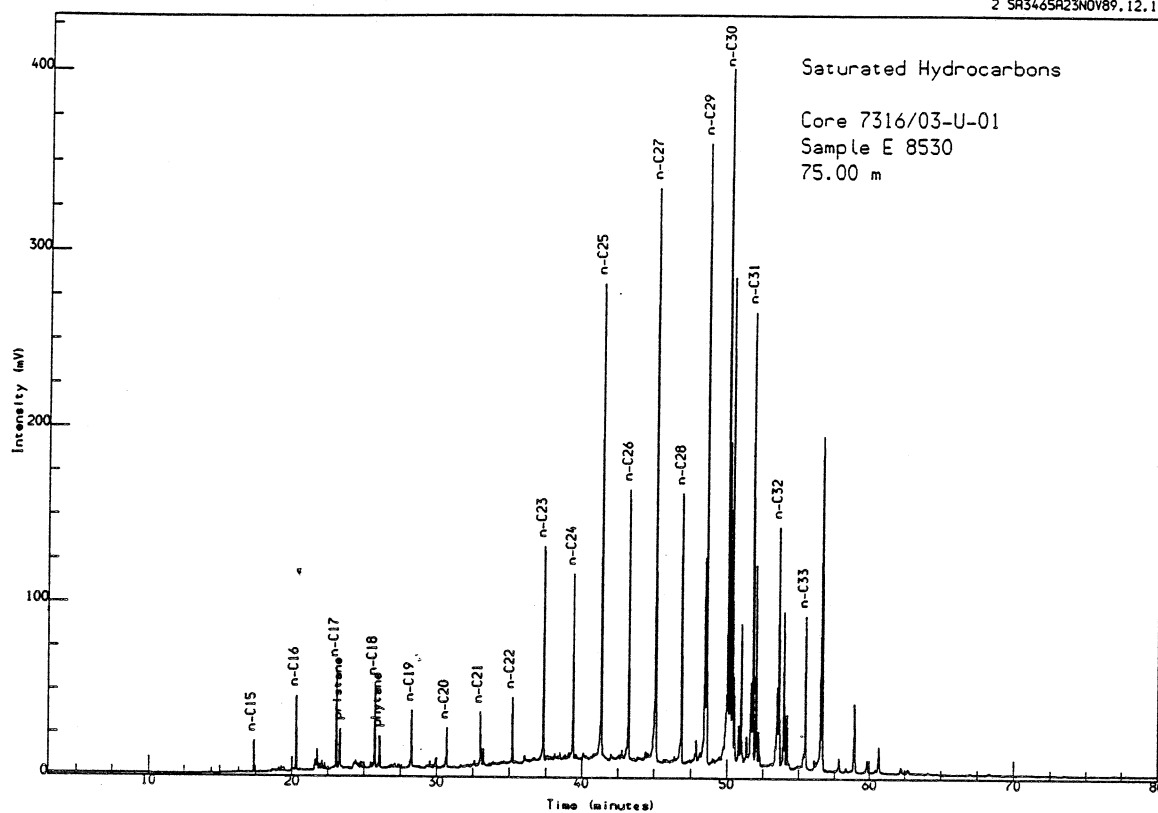
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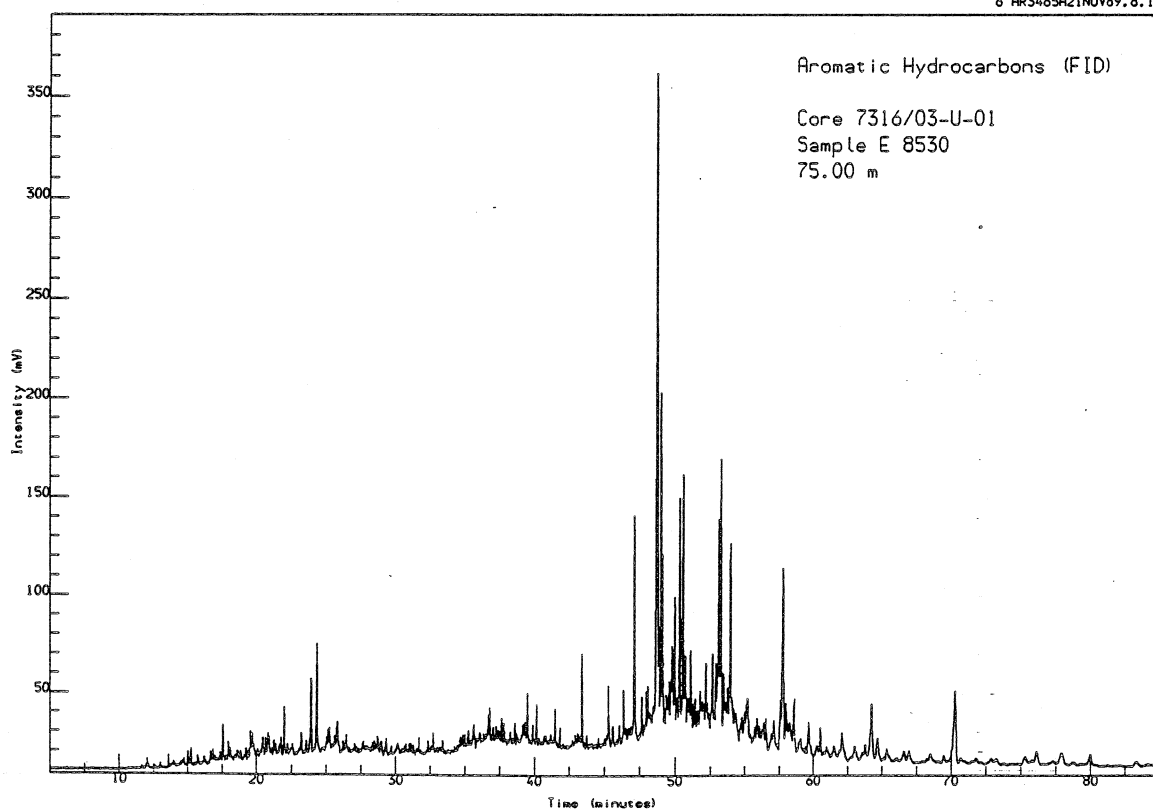
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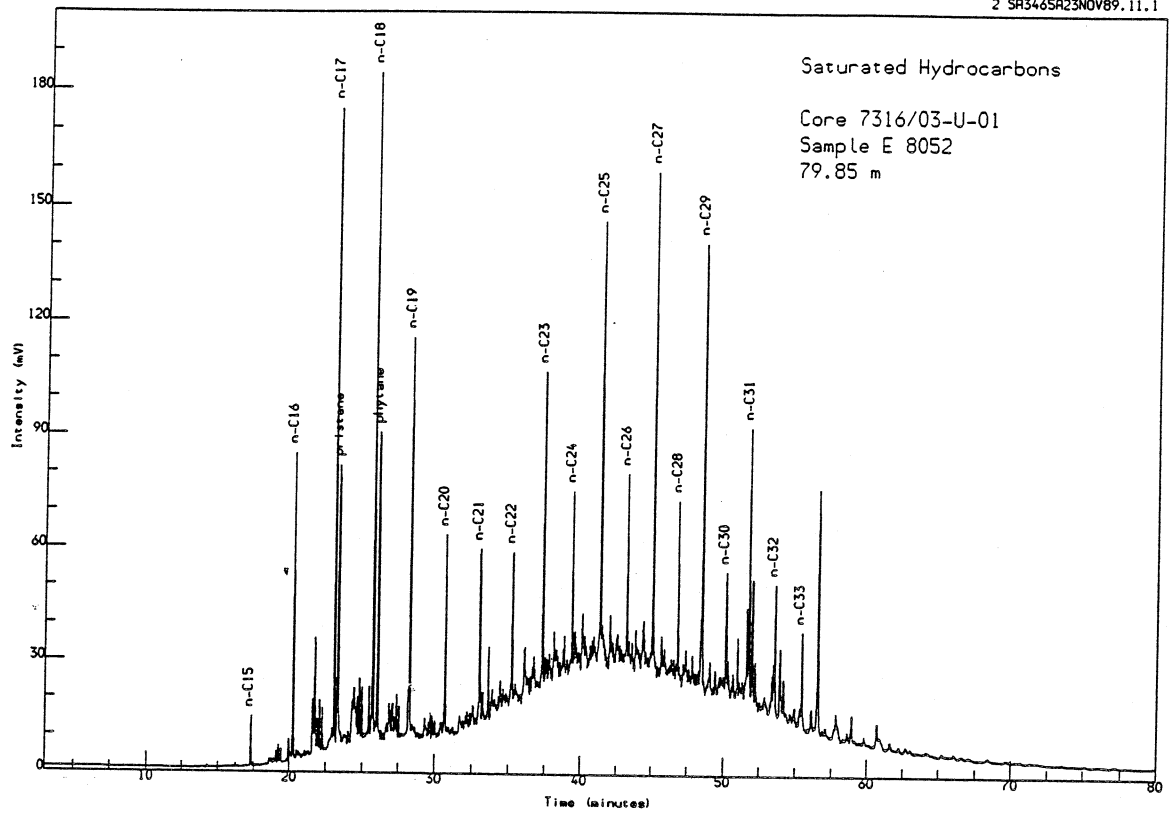
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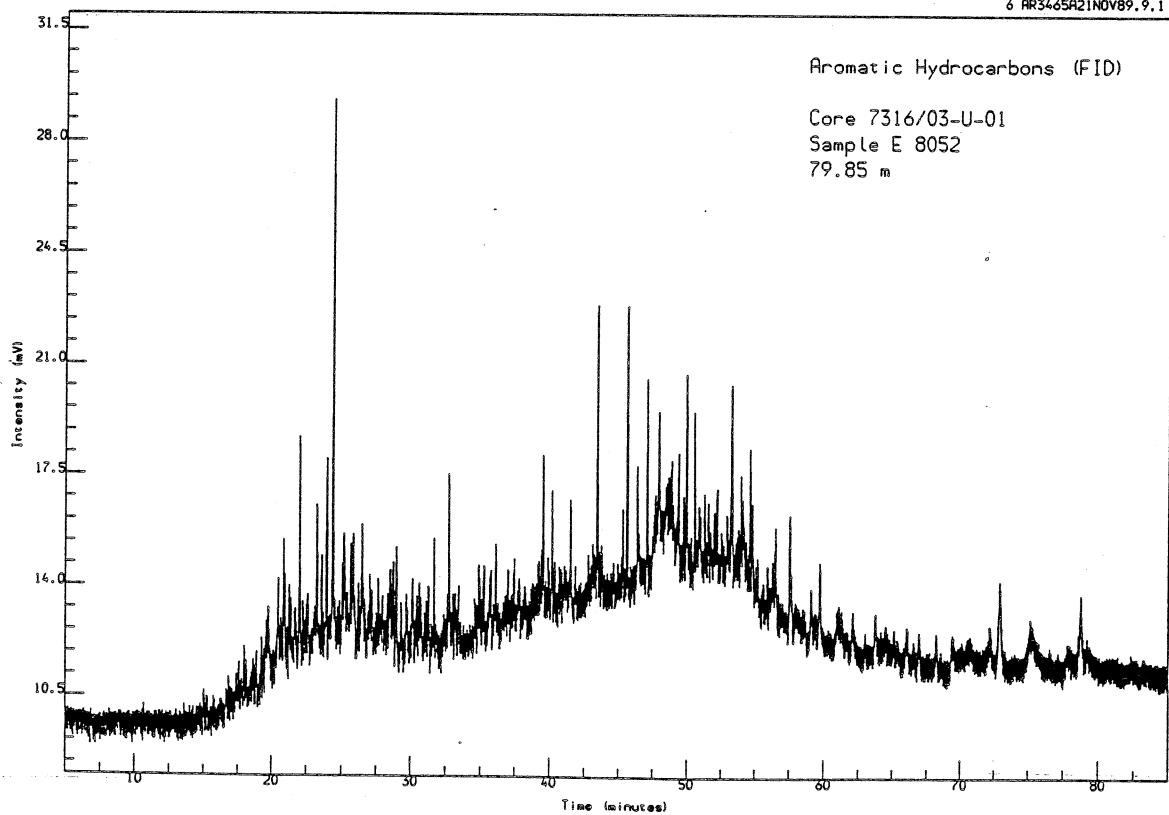
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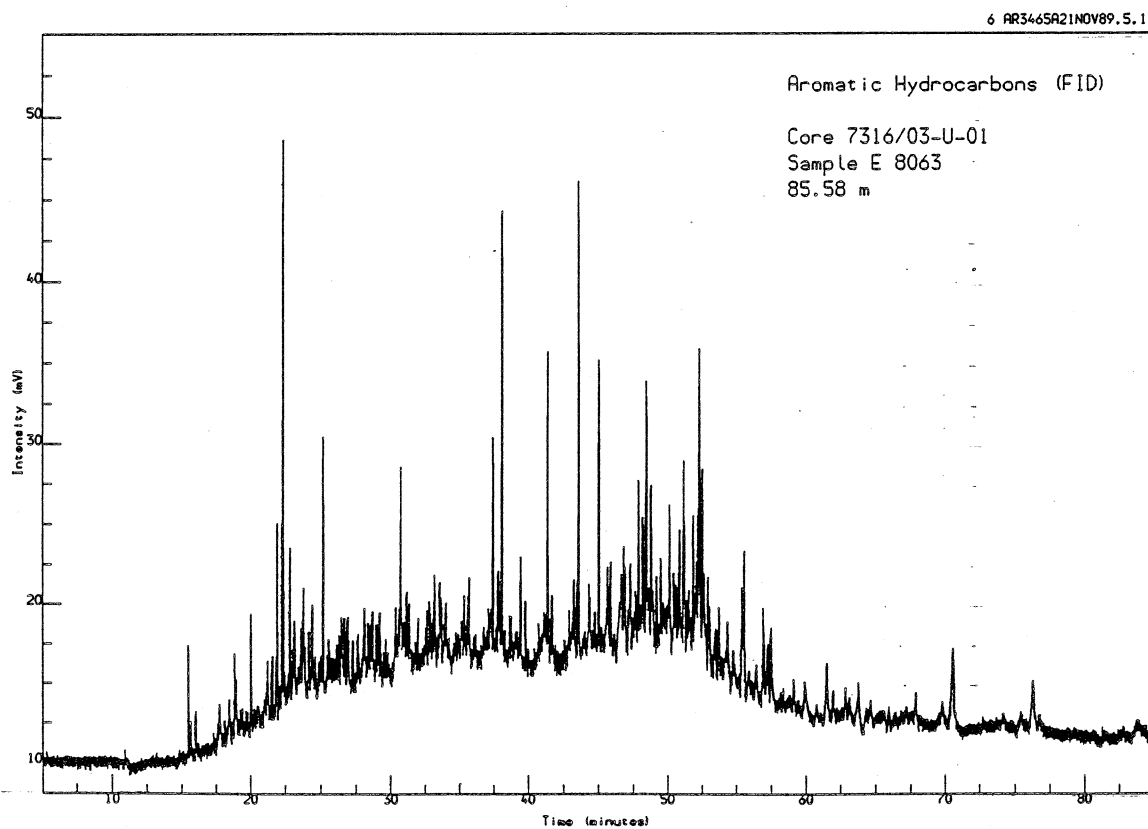
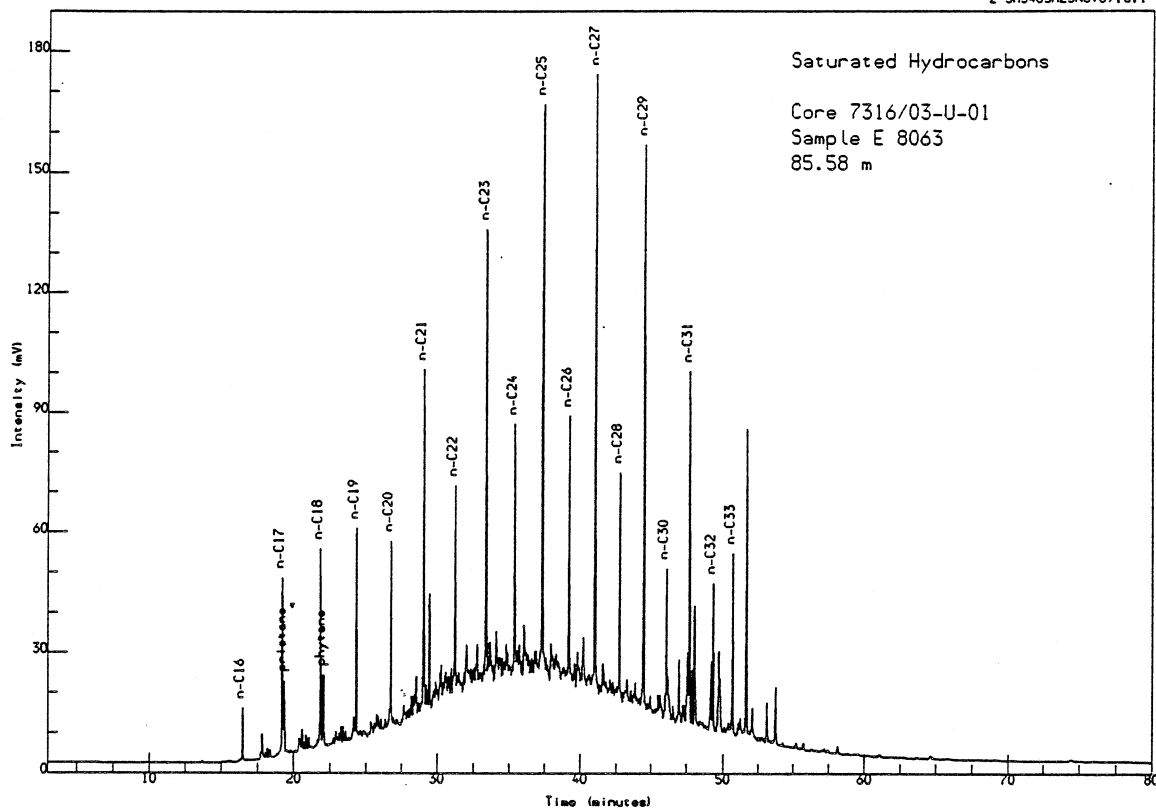


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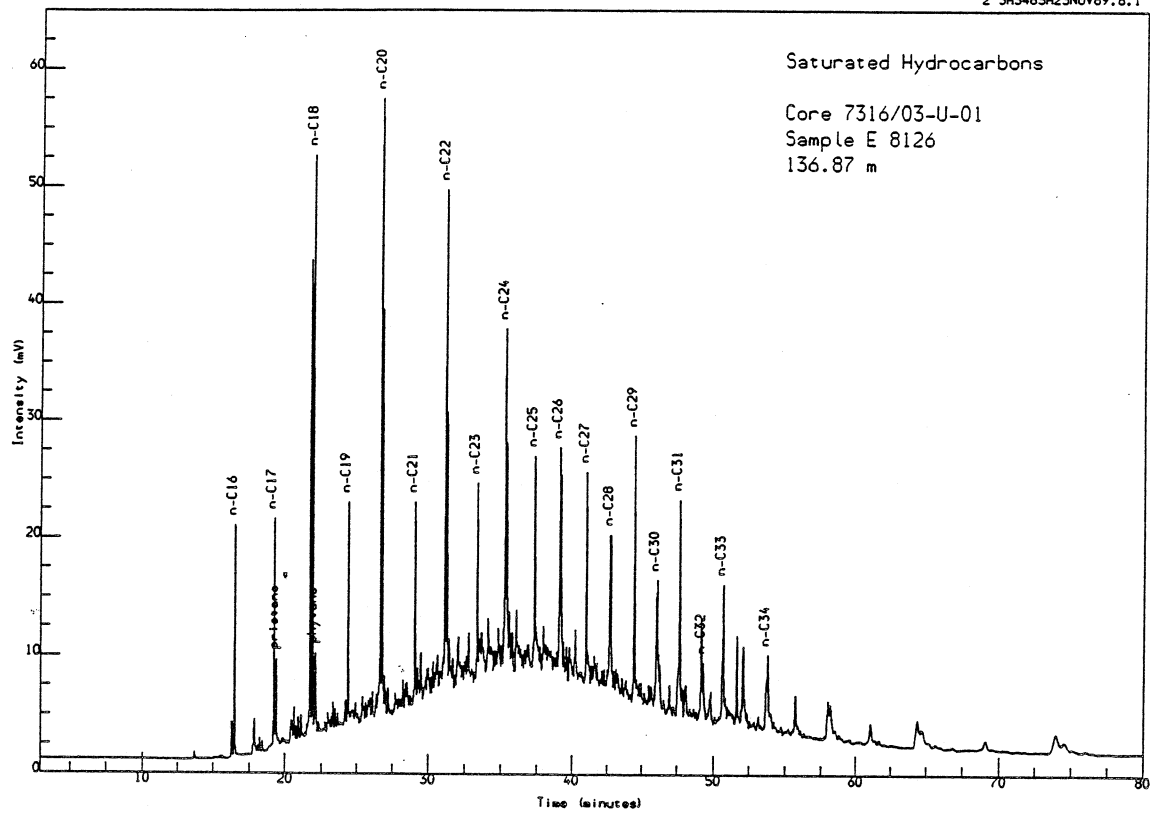


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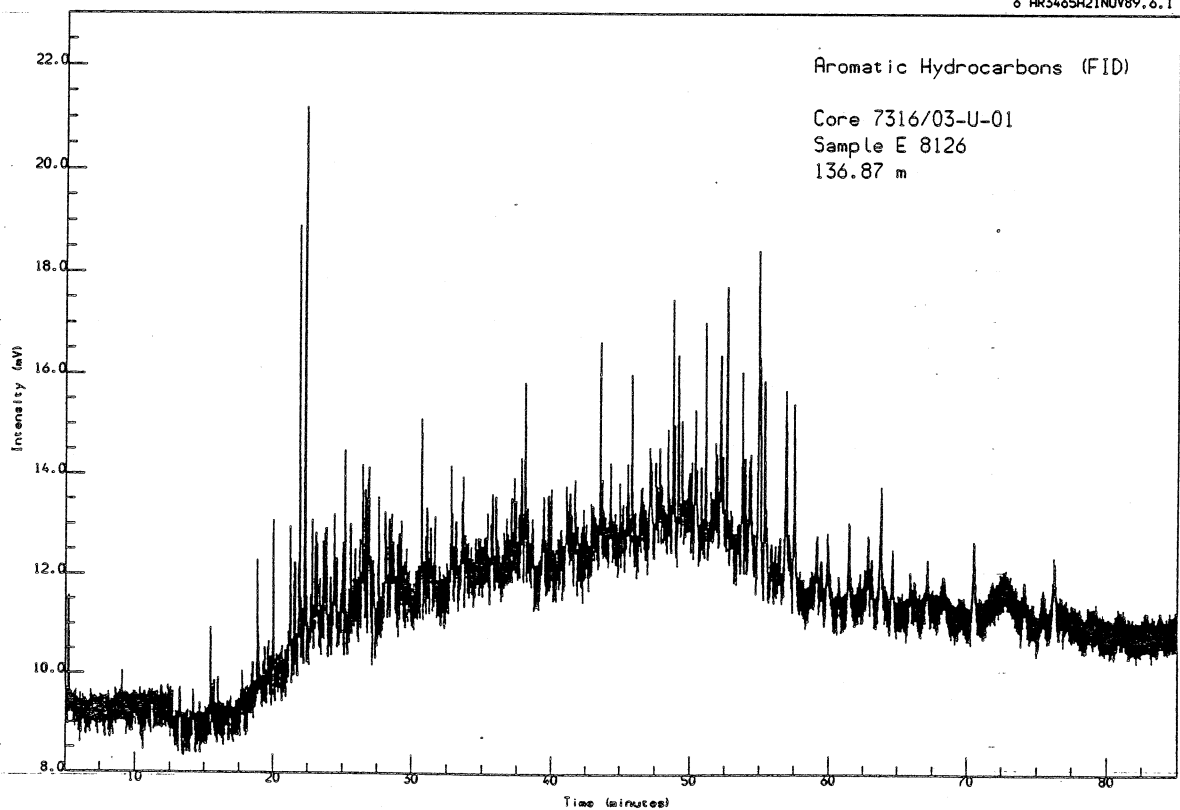




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6 AR3465A21NOV89.6.1



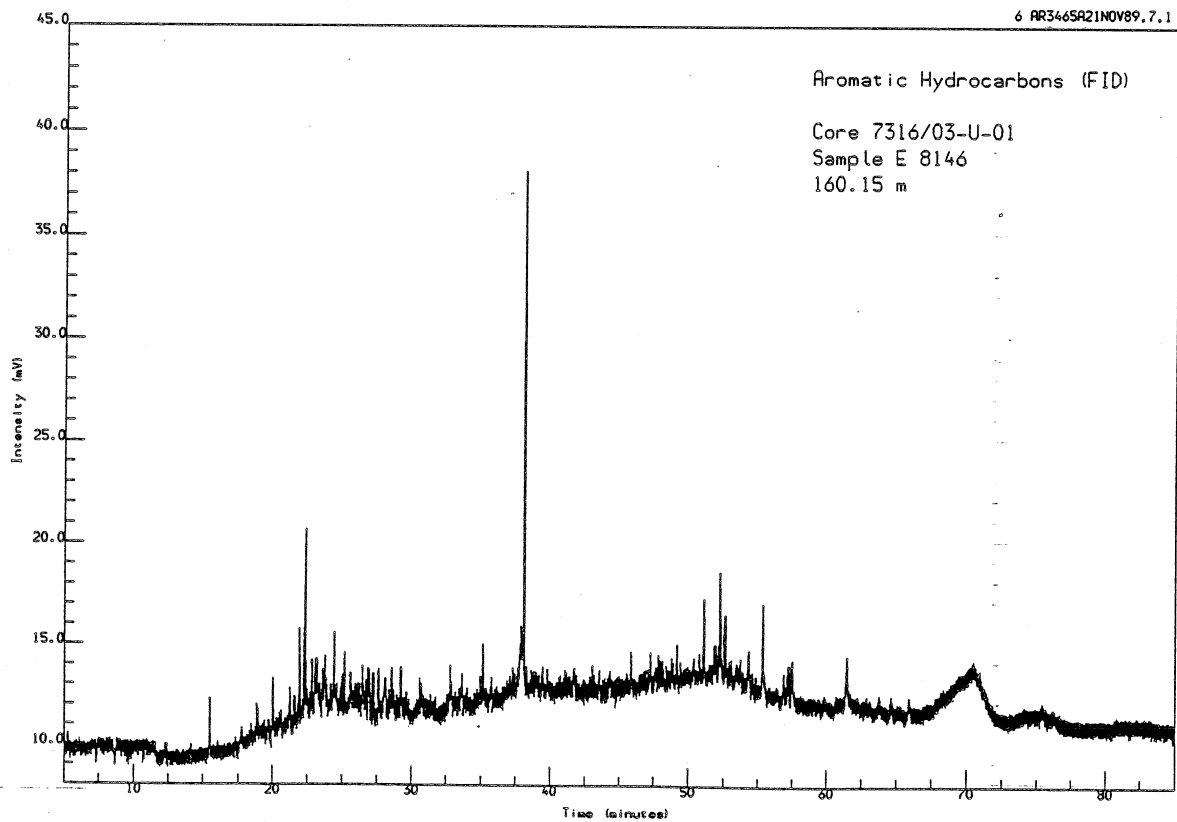
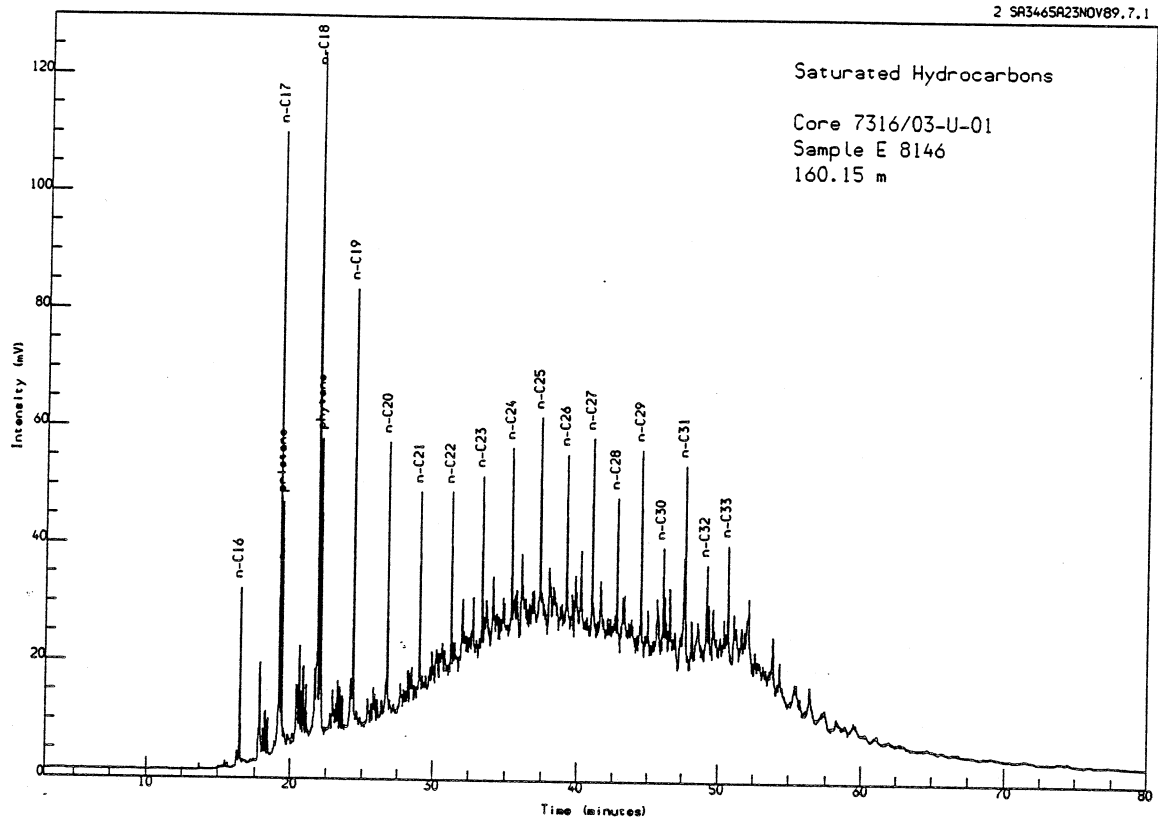
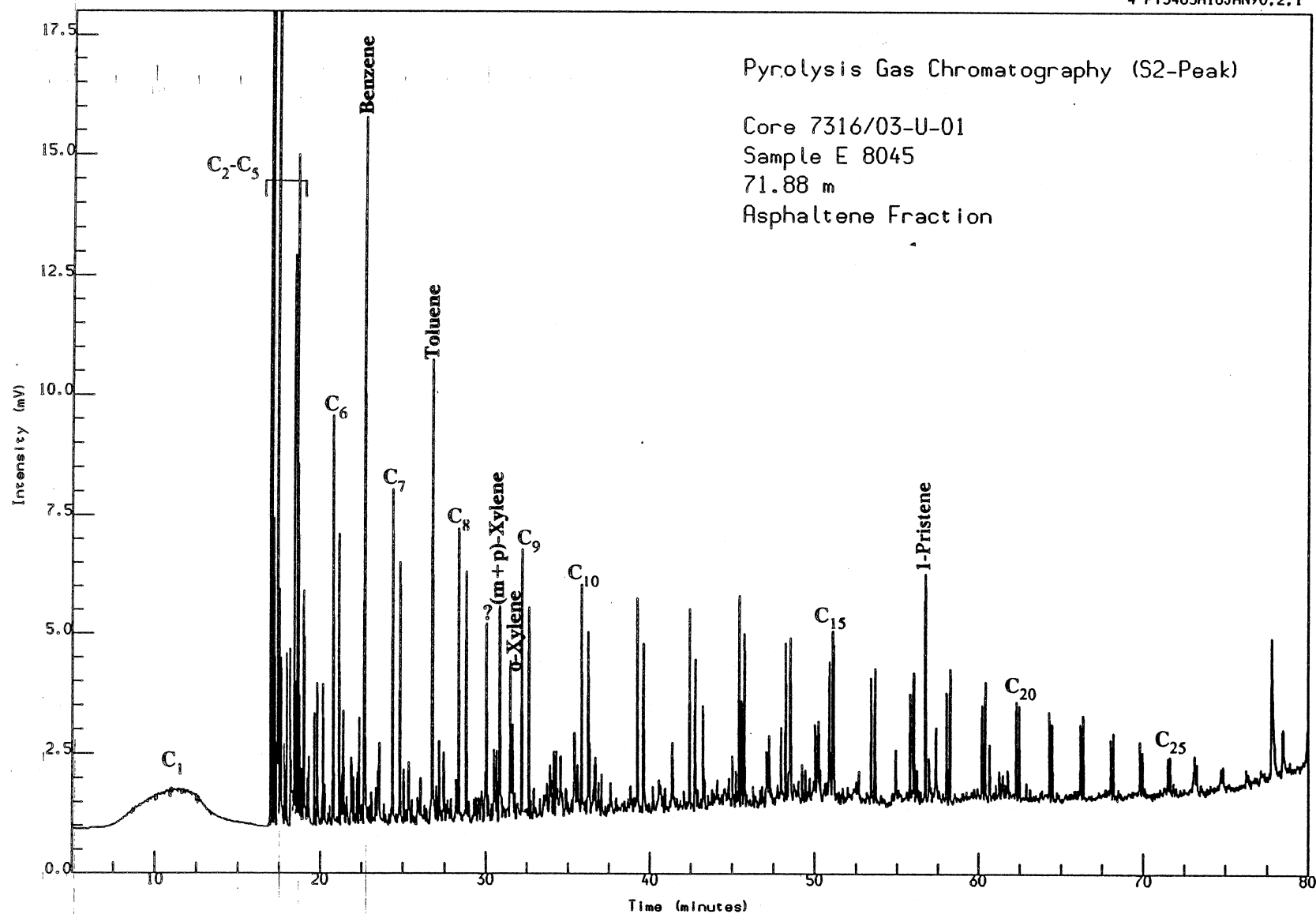
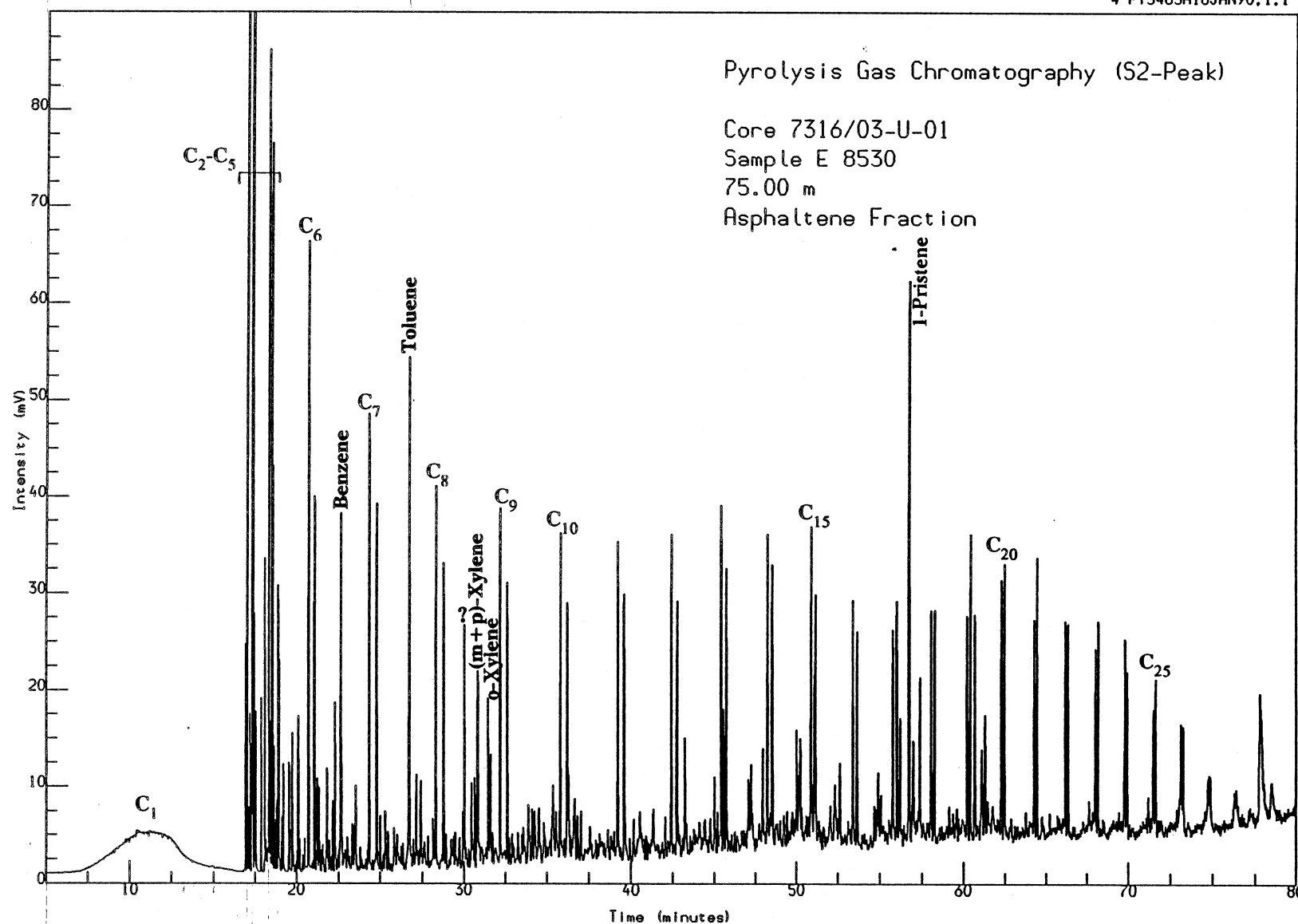


Figure A.I.4.4:

**Pyrolysis-gas chromatograms (S_2 peak):
Asphaltene fraction**





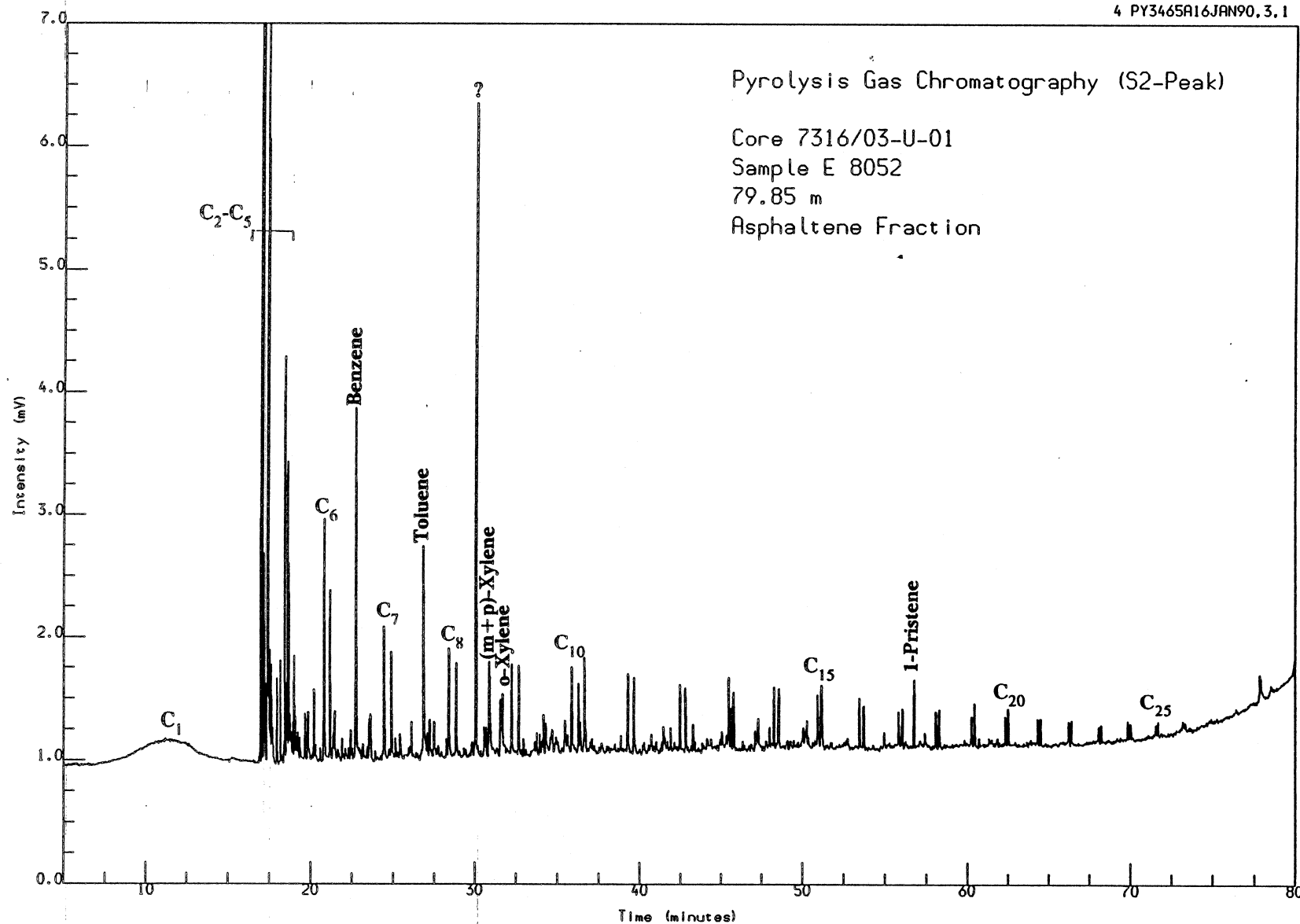
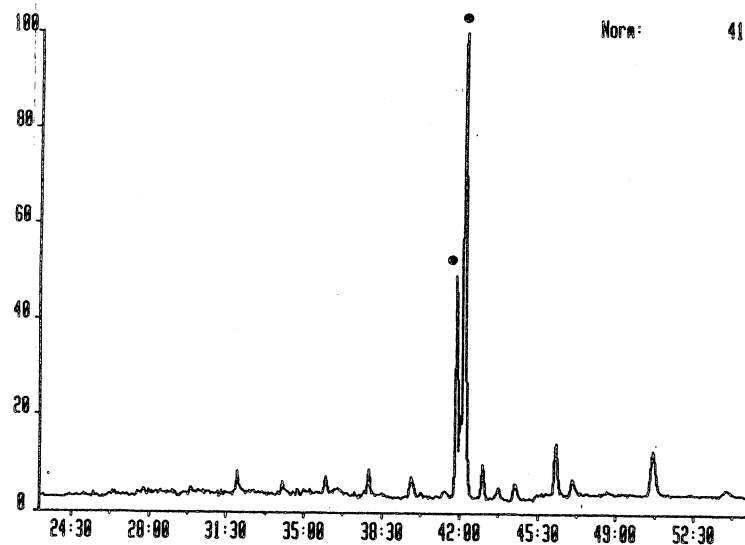


Figure A.I.4.5:

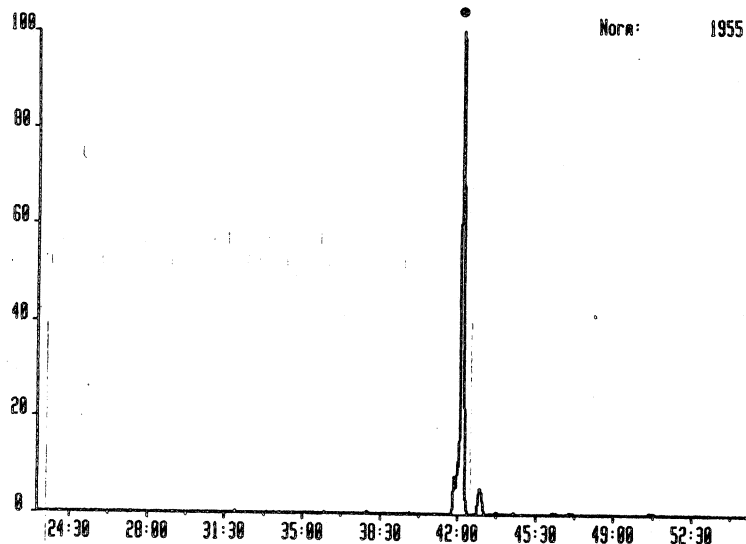
**Mass fragmentograms of m/z 191, 205 (terpanes)
and m/z 217, 218 (steranes)**

For peak identification, see Chapter II

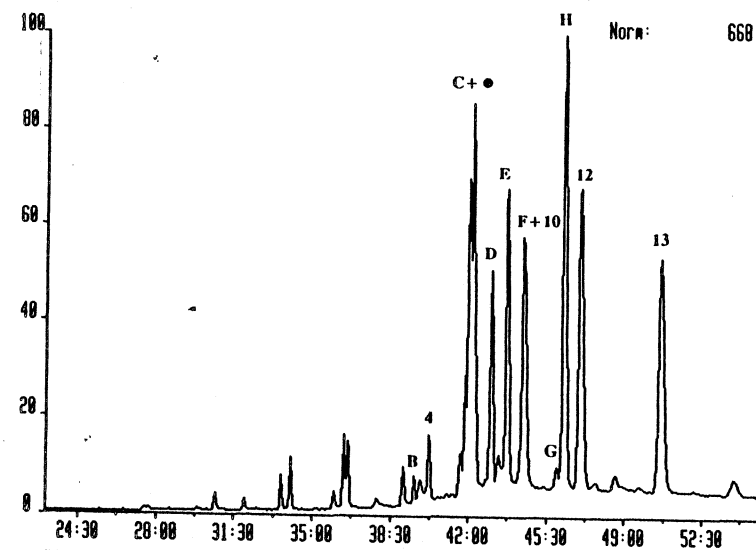
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 Sample 1 Injection 1 Group 1 Mass 217.1000
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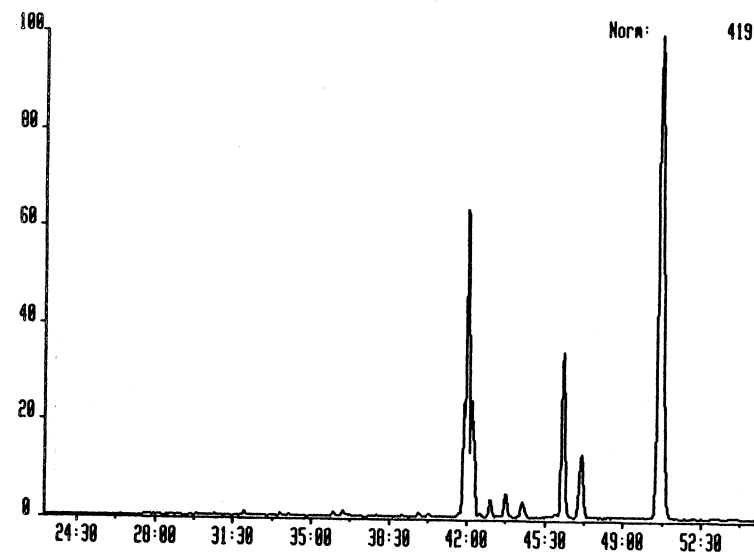
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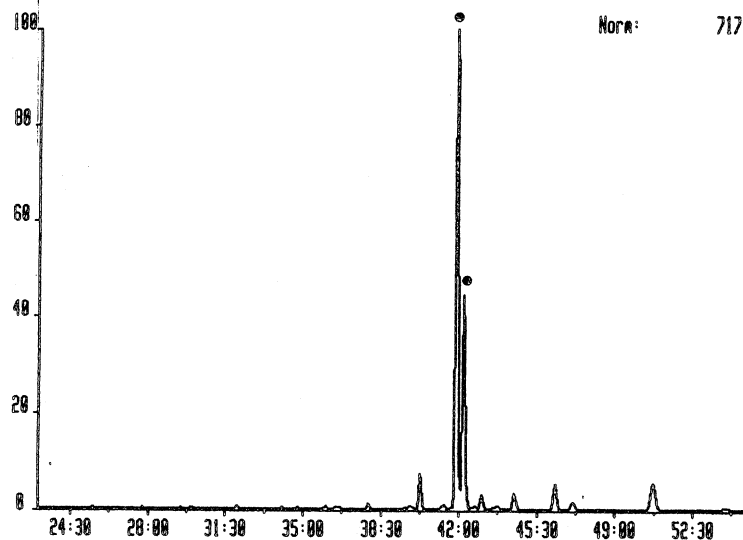
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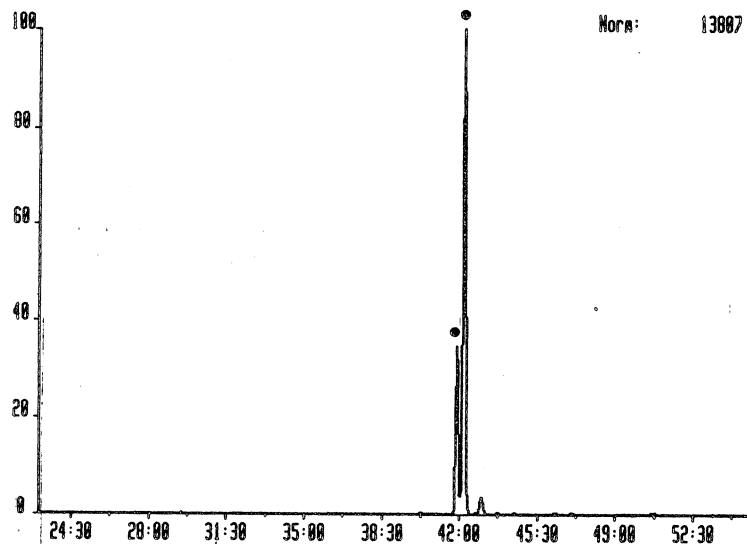
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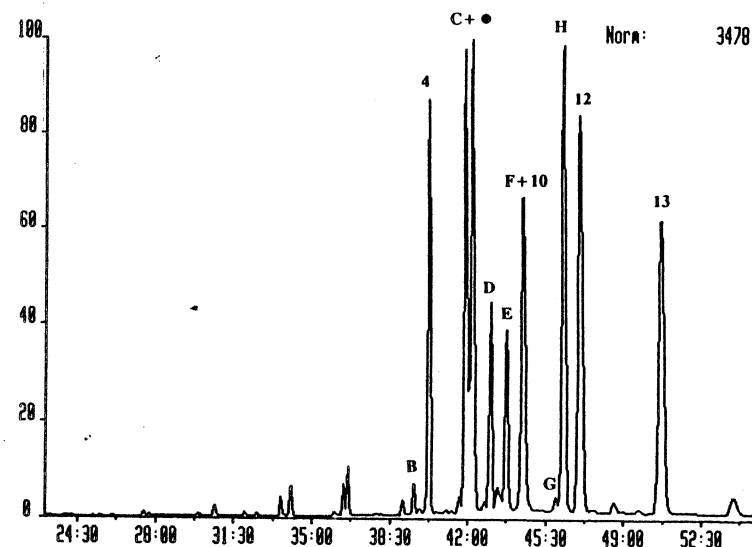
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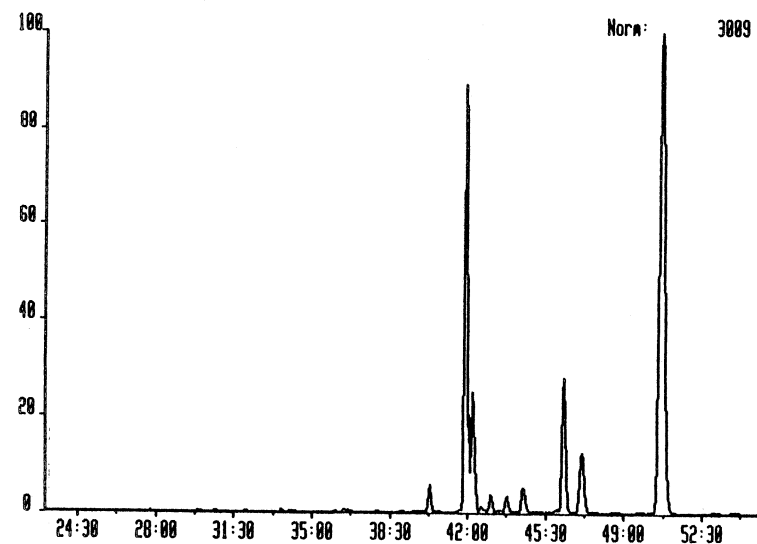
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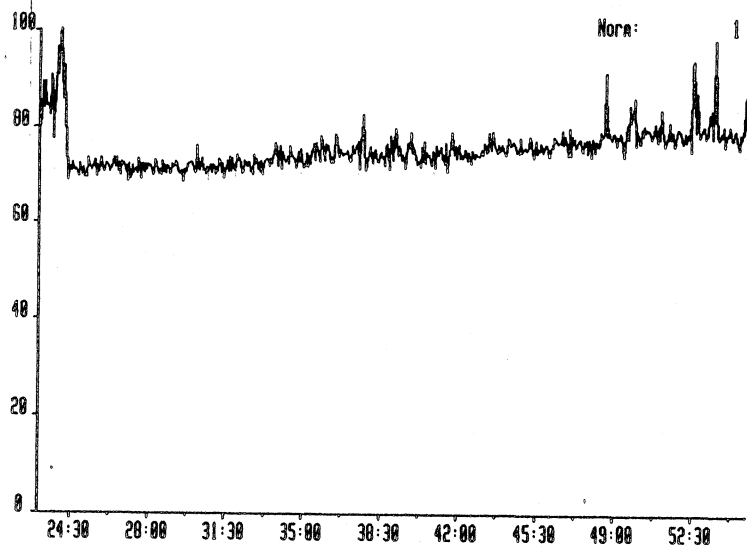
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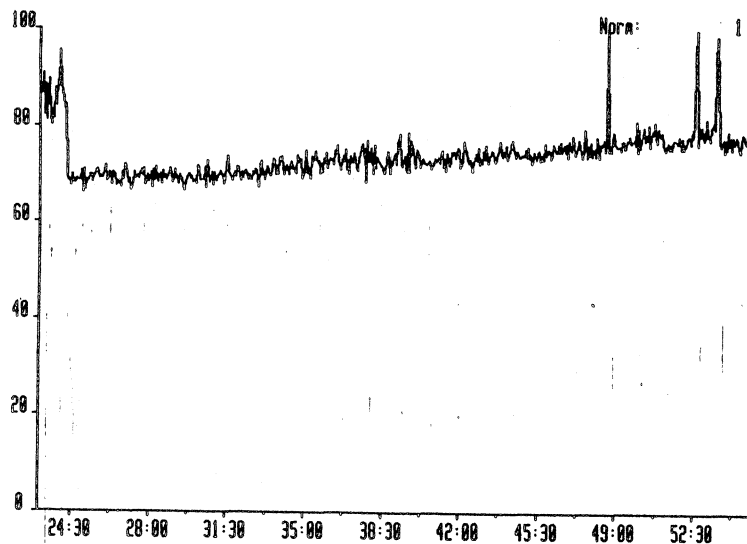
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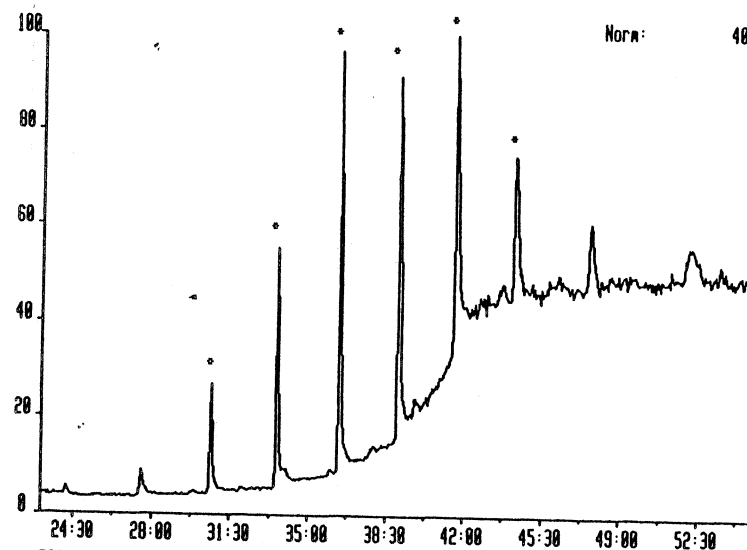
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E8126SAT 29-DEC-89 Sir:Voltage 70H Sys: BIOMARKER
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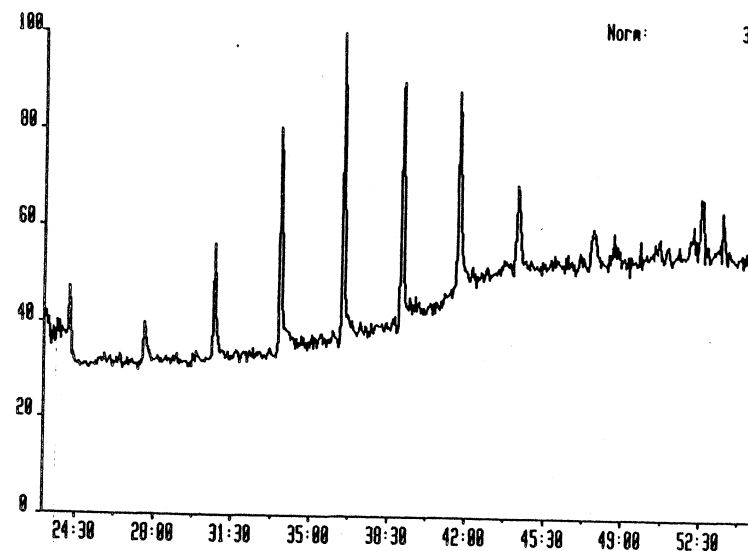
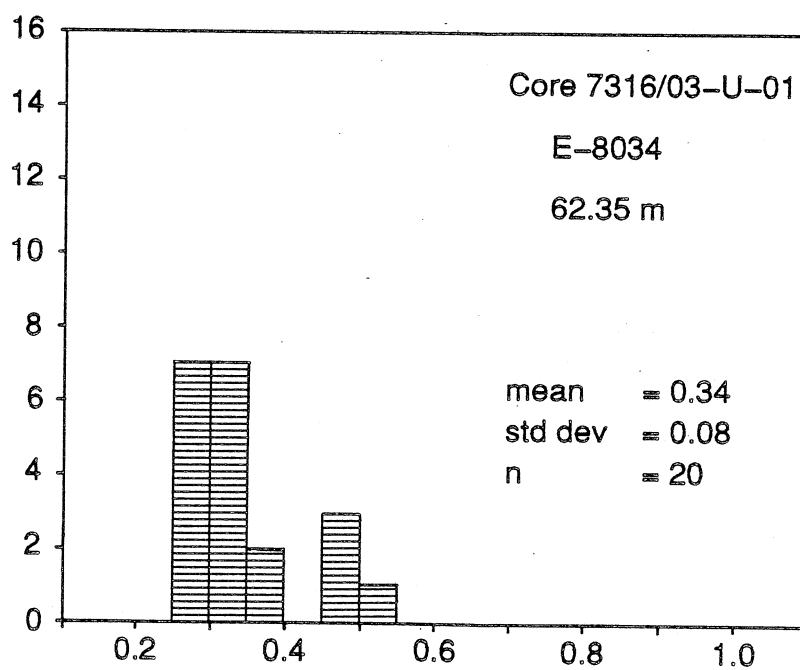
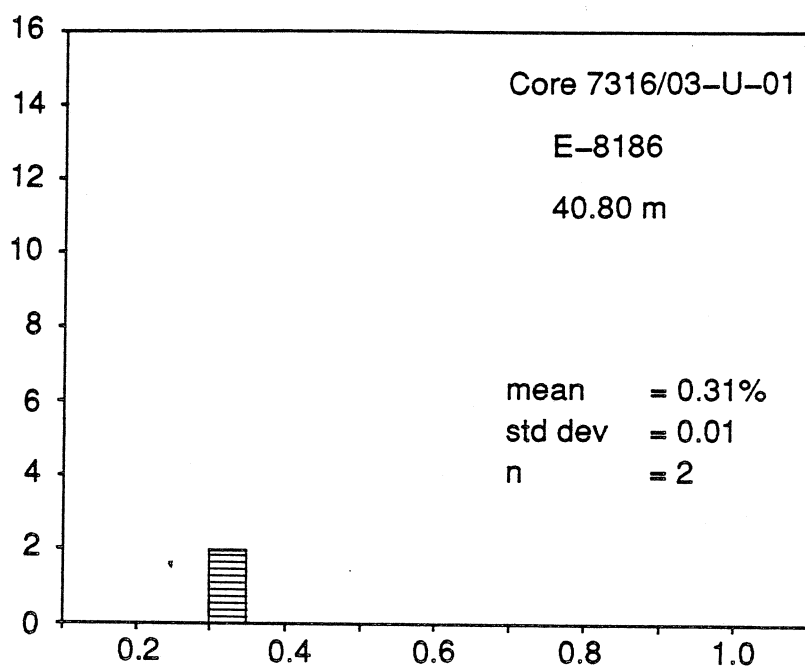
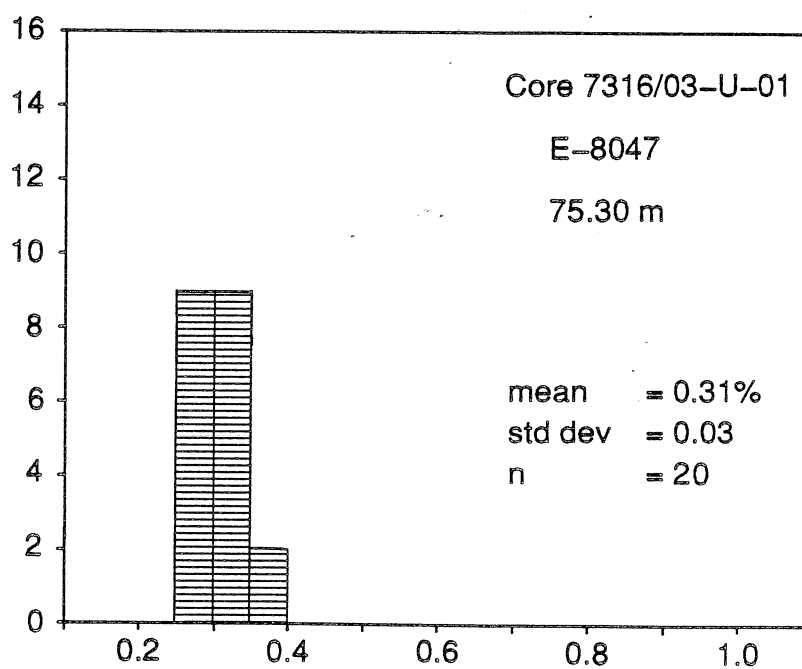
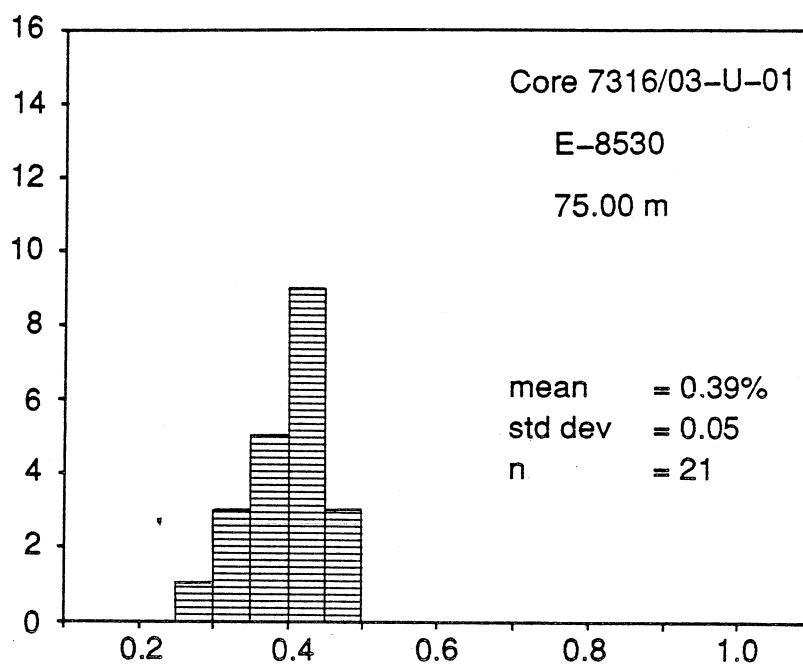
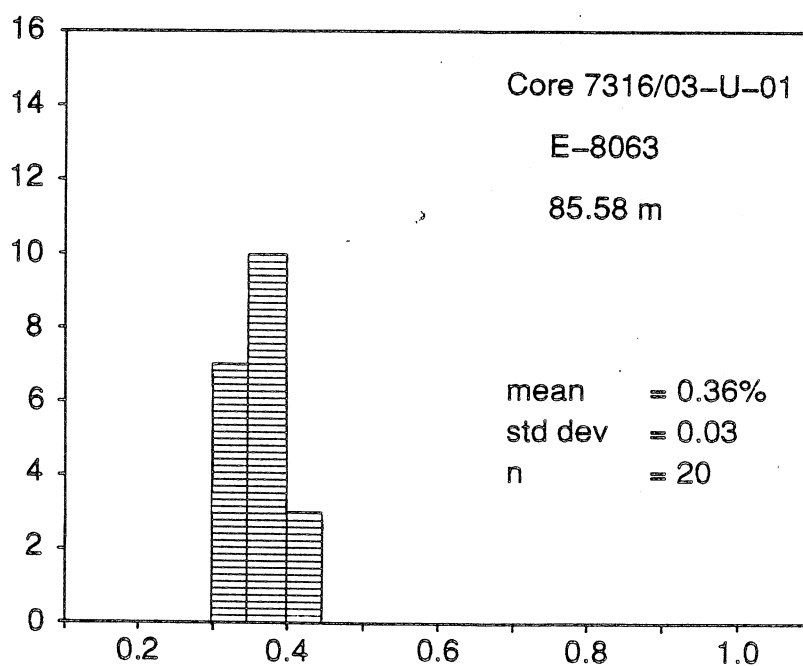
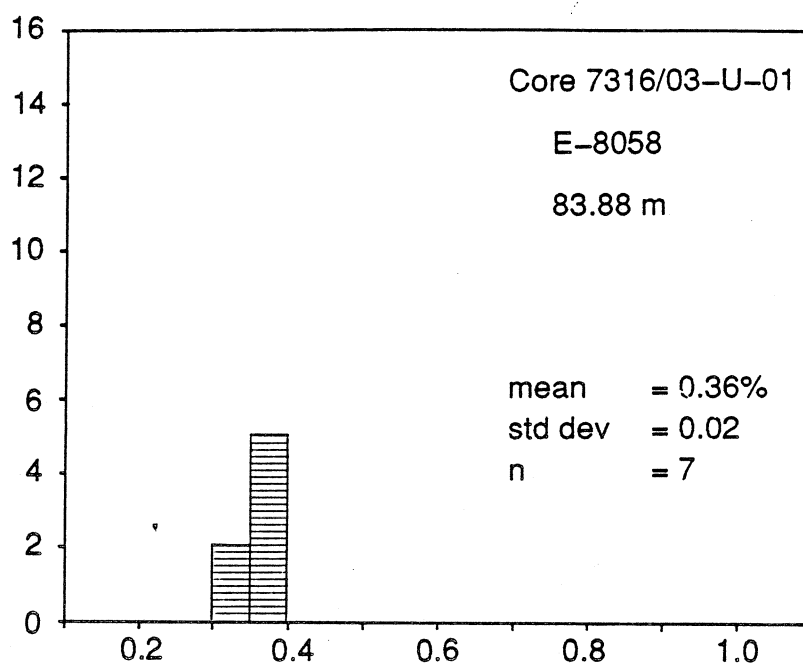


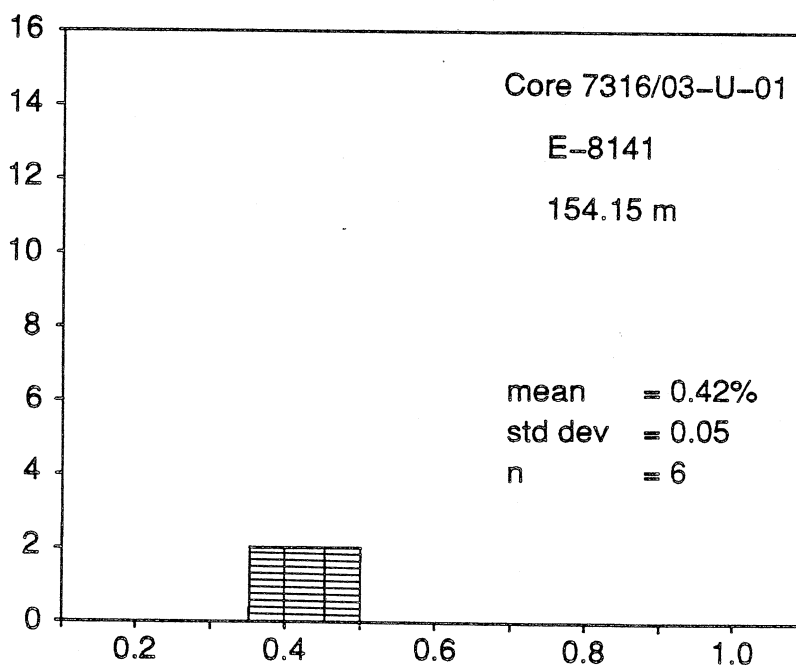
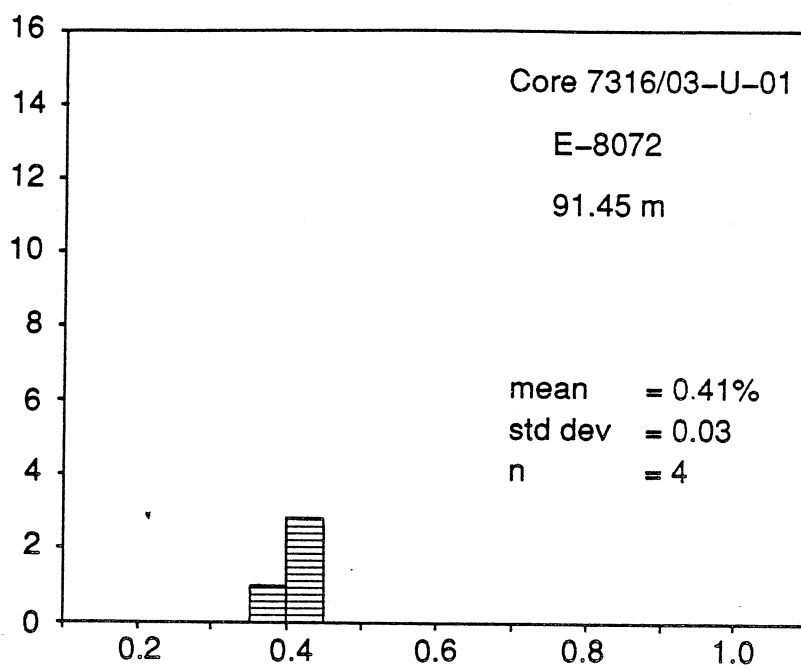
Figure A.I.4.6:

Vitrinite reflectance histograms









CHAPTER A.II

PEAK IDENTIFICATIONS FOR M/Z 191, 217 AND 218 GC-MS MASS CHROMATOGRAMS

Table A.III.1 Pentacyclic compounds identified in m/z 191 mass fragments.

A series of unusual peaks occur on the m/z 191 mass chromatograms of certain extracts. A new identification system was therefore adopted and is outlined below. This new identification system includes elements of the previously established IKU system, where necessary.

Peak N°.	Identification	
1	C ₂₇ hopene	(C ₂₇ :1)
A	18 α (H)-trishomohopane (Ts)	(C ₂₇ H ₄₆)
B	17 α (H)-trishomohopane (Tm)	(C ₂₇ H ₄₆)
4	17 β (H)-trishomohopane	(C ₂₇ H ₄₆)
E	17 α (H)-norhopane	(C ₂₉ H ₅₀)
6	hop- $\Delta^{17(21)}$ -ene	(C ₃₀ :1)
D	17 β (H), 21 α (H)-norhopane	(C ₂₉ H ₅₀)
E	17 α (H), 21 β (H)-hopane	(C ₃₀ H ₅₂)
9	hop- $\Delta^{13(18)}$ -ene	(C ₃₀ :1)
10	17 β (H), 21 β (H)-norhopane	(C ₂₉ :0)
	+ 17 β (H), 21 α (H)-hopane	(C ₃₀ :0)
F	17 β (H)-moretane	(C ₃₀ H ₅₂)
G	17 α (H), 21 β (H)-homohopane (22S)	(C ₃₁ H ₅₄)
H	17 α (H), 21 β (H)-homohopane (22R) + unknown triterpane	(C ₃₁ H ₅₄)
12	17 β (H), 21 β (H)-hopane	(C ₃₀ :0)
I	17 β (H)-homomoretane	(C ₃₁ H ₅₄)
J	17 α (H)-bishomohopane (22S, 22R)	(C ₃₂ H ₅₆)
13	17 β (H), 21 β (H)-homohopane	(C ₃₁ :0)
K	17 α (H)-trishomohopane (22S, 22R)	(C ₃₃ H ₅₈)
L	17 α (H)-tetrakishomohopane (22S, 22R)	(C ₃₄ H ₆₀)
M	17 α (H)-pentakishomohopane (22S, 22R)	(C ₃₅ H ₆₂)
P	C ₂₃ tricyclic terpane	
Q	C ₂₄ tricyclic terpane	
R	C ₂₅ tricyclic terpane (17R, 17S)	
S	C ₂₄ tetracyclic terpane	
T	C ₂₆ tricyclic terpane (17R, 17S)	
*	Contaminants	

Table A.IV.3 Sterane peaks recognised on m/z 217 and m/z 218 mass chromatograms

Peak N°.	Identification	
u	5 α (H)-sterane	(C ₂₁ H ₃₆)
v	5 α (H)-sterane	(C ₂₂ H ₃₈)
a	13 β (H),17 α (H)-diasterane (20S)	(C ₂₇ H ₄₈)
b	13 β (H),17 α (H)-diasterane (20R)	(C ₂₇ H ₄₈)
c	13 α (H),17 β (H)-diasterane (20S)	(C ₂₇ H ₄₈)
d	13 α (H),17 β (H)-diasterane (20R)	(C ₂₇ H ₄₈)
e	13 β (H),17 α (H)-diasterane (20S)	(C ₂₈ H ₅₀)
f	13 β (H),17 α (H)-diasterane (20R)	(C ₂₈ H ₅₀)
g	13 α (H),17 β (H)-diasterane (20S)	(C ₂₈ H ₅₀)
	+ 14 α (H),17 α (H)-sterane (20S)	(C ₂₇ H ₄₈)
h	13 β (H),17 α (H)-diasterane (20S)	(C ₂₉ H ₅₂)
	+ 14 β (H),17 β (H)-sterane (20R)	(C ₂₇ H ₄₈)
i	14 β (H),17 β (H)-sterane (20S)	(C ₂₇ H ₄₈)
	+ 13 α (H),17 β (H)-diasterane (20R)	(C ₂₈ H ₅₀)
j	14 α (H),17 α (H)-sterane (20R)	(C ₂₇ H ₄₈)
k	13 β (H),17 α (H)-diasterane (20R)	(C ₂₉ H ₅₂)
l	13 α (H),17 β (H)-diasterane (20S)	(C ₂₉ H ₅₂)
m	14 α (H),17 α (H)-sterane (20S)	(C ₂₈ H ₅₀)
n	13 α (H),17 β (H)-diasterane (20R)	(C ₂₉ H ₅₂)
	+ 14 β (H),17 β (H)-sterane (20R)	(C ₂₈ H ₅₀)
o	14 β (H),17 β (H)-sterane (20S)	(C ₂₈ H ₅₀)
p	14 α (H),17 α (H)-sterane (20R)	(C ₂₈ H ₅₀)
q	14 α (H),17 α (H)-sterane (20S)	(C ₂₉ H ₅₂)
r	14 β (H),17 β (H)-sterane (20R)	(C ₂₉ H ₅₂)
	+ unknown sterane	
s	14 β (H),17 β (H)-sterane (20S)	(C ₂₉ H ₅₂)
t	14 α (H),17 α (H)-sterane (20R)	(C ₂₉ H ₅₂)
•	Unusual pentacyclic triterpanes	

CHAPTER III

EXPERIMENTAL METHODS AND INTERPRETATION LEVELS

EXPERIMENTAL METHODS AND INTERPRETATION LEVELS

Gas analyses

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 , $i-C_4$, nC_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 Porapak 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 Stable Carbon Isotope values from Adsorbed Gas Samples

Rock samples selected for analysis of stable carbon and deuterium isotope content were sent to GCA in West Germany. There the adsorbed gas fraction was extracted from the rock and the required compounds analysed.

Total Organic Carbon

Bulk samples were crushed in a disk mill or mortar. Aliquots of the samples were then weighed into Leco crucibles, then treated three times with hot 10% HCl in order to remove carbonate, and finally washed four times with distilled water in order 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 CS 244 carbon/sulphur analyser.

The instrument was calibrated using a sediment standard containing 2.72 wt% carbon. 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.; temperature programme: 300°C (3 min.) - 25°C/min. - 550°C).

Pyrolysis Gas Chromatography (Py-GC Programmed)

Pyrolysis-Gas Chromatography (S2)

The thermo-extracted sample was pyrolysed in a helium atmosphere using a furnace type pyrolyser as described by Solli et al. (1984). The pyrolysis temperature program was 340°C - 50°C/min. - 550°C. The outlet of the furnace was directly connected to a splitter (30:1) which enabled the pyrolysis products to be simultaneously recorded as a bulk "S2" peak by an FID and passed into a gas chromatograph. The pyrolysis products were trapped on the chromatographic column by cooling the front part of the column with liquid nitrogen. On completion of the pyrolysis programme, the collected pyrolysis products were injected on to the column by removing the nitrogen bath. The GC conditions are outlined below.

GC conditions

Column: 30 m DB-1, i.d. 0.32 mm, fused silica capillary column.

Carrier gas: Helium, inlet pressure 7.5. psi; flow rate 1.5 ml/min.

Temp. programme: -10°C (16 min.) - 5°C/min. - 320°C (10 min.)

Extractable Organic Matter

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

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

The potential contaminants were extracted in a beaker using dichloromethane. In the case of "Super Mix", methanol was used in addition.

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

Medium-pressure liquid chromatography (MPLC)

The EOM or oil (>210°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. Then they were transferred to glass vials. The remaining solvent was removed.

Gas chromatographic analysis

The saturated fractions were diluted with n-hexane and analysed on an HP 5730A gas chromatograph equipped with a 15 m DB-1 fused silica column. Hydrogen was used as a carrier gas with a flow rate of about 1.5 ml/min. Injections were performed in split mode (split ratio 1:10). The temperature program used was 80°C (2 min.) - 4°C/min. - 280°C.

The total aromatic fractions were diluted with n-hexane and analysed on a Varian 3700 gas chromatograph, fitted with a DB-5 fused silica column (30 m x 0.25 mm i.d.), and equipped with an FID and a sulphur-specific dual-flame FPD detector. Hydrogen with a flow rate of 2.5 ml/min was used as carrier gas. The injection split ratio was 1:10. The temperature programme used was 60°C (2 min.) - 4°C/min. - 280°C.

All the data from the GC analyses were processed on a VG Multichrom lab data system.

Gas chromatography - mass spectrometry (GC-MS)

GC-MS analyses were performed on a VG Micromass 70-70H GC-MS-DS system. A Varian Series 3700 GC was fitted with a fused silica DB-5 capillary column (30 m x 0.32 mm i.d.). Helium (1.5 ml/min.) was used as a carrier gas. Saturated fractions were injected in split mode (1.5 µl, split ratio 1:15), aromatic fractions in splitless mode.

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

The hydrocarbons were analysed in multiple ion mode (MID) at a scan cycle time of approximately 2 secs. 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.

Vitrinite Reflectance

Vitrinite reflectance measurements were carried out on whole-rock samples as follows: the rock samples were broken up if necessary, and mounted in a fast-setting synthetic resin. Temperatures in excess of 50°C were avoided as these can result in alteration of the organic material. Once the resin was set, the sample plugs 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, then water was used.

After coarse grinding, the samples are polished on Selvyt-covered laps using 5/20 and gamma grade alumina powder. Following polishing, the surface of the sample plugs was carefully cleaned to remove any traces of the polishing powders.

Reflectance measurements were carried out using a Leitz MPV-Compact microscope and photo-multiplier 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 vitrinite particles, and measurements were taken on these. The reflectance of a 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 was taken on each sample. Coals and carbonaceous claystone samples provide the most reliable data, while sandstones and carbonates provide the least reliable data.

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 kerogen. A scale comparing vitrinite reflectance measurements and sporinite fluorescence to thermal maturity is shown in Table 3 of the interpretation levels.

Evaluation of kerogen type and thermal maturity in transmitted light

The rock samples were crushed and treated with hydrochloric acid and hydrofluoric acid in order to remove the mineral matter and isolate the kerogen. The isolated kerogen was mounted in glycerine jelly on microscope slides as a strew-mount. The treatment of the isolated kerogen varied according to the requirements and preservation of the samples.

This included:

T-slide: total acid residue.

O-slide: kerogen debris remaining after flotation in ZnBr_2 to remove heavy minerals.

Si-slide: sieved residue.

X-slide: oxidised residue.

T- and/or O-slides were necessary in order to evaluate the kerogen composition/palynofacies of the samples.

Si- and/or X-slides were required if it was necessary to concentrate larger kerogen fragments or spores/pollen for spore colouration and/or age determination, respectively, (N.B.: oxidised residue is not used for spore colour determination as oxidation will alter the colour).

The samples were examined using a Leitz Dialux microscope with a white halogen light source. Objective lenses of 10x and 63x magnification were used. The higher magnification allowed a more detailed description of the kerogen, with resolution down to $2\mu\text{m}$ diameter.

Thermal alteration indices (TAI) were measured from the colour of spores and pollen. The techniques used for this are adapted from Staplin (1969) and Burgess (1974). IKU has used a 1-10 scale for thermal alteration index (TAI)/Spore colouration index (SCI) since December, 1986.

Kerogen terminology

The following kerogen terminology is used:

1. Amorphous material - degraded, unstructured material of unidentified origin.
2. Algal material - particles of recognisably algal origin.
3. Liptinitic material - recognisable spores, pollen, cuticle and cysts.
4. Woody material - structured and unstructured woody tissue.
5. Coaly material - black, reworked or oxidised material.

Comparison of microscopic thermal maturation systems at IKU

(Only approximate guide and not intended to indicate absolute limits.)

MATURATION LEVEL	SPORE COLOUR TAI (old)	SPORE COLOUR TAI (new)	VITRINITE REFLECTANCE %Ro	SPORINITE FLUORESCENCE
IMMATURE	1 - 2-	1.0 - 3.5	0.25 - 0.40	1 - 4
EARLY MATURITY	2- - 2	3.5 - 4.0	0.40 - 0.60	4 - 6
MODERATE MATURITY	2 - 2+	4.0 - 4.5	0.60 - 0.80	6 - 7
MATURITY	2+ - 3-	4.5 - 5.5	0.80 - 1.00	7 - 8
LATE MATURITY	3- - 3	5.5 - 6.0	1.00 - 1.20	8 - 9
POST-MATURE	3 - 5	6.0 - 10.0	>1.20	Absent

At IKU, TAI determination is generally undertaken on bisaccates.

Relation between fluorescence colour and sporinite fluorescence zones:

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

INTERPRETATION LEVELS

The following interpretation levels are used as approximate guidelines but not intended to indicate absolute limits.

1 TOTAL ORGANIC CARBON (TOC)

TOC (wt%)	Richness of source rock
<0.5	Poor Source Rock
0.5-1	Fair Source Rock
1-2	Good Source Rock
>2	Rich Source Rock

2 ROCK-EVAL PYROLYSIS

a) Data Supplied

S1	Free hydrocarbons (mg/g rock).
S2	Potential or pyrolysable hydrocarbons of kerogen (mg/g rock).
S3	Oxygen content of kerogen (mg CO ₂ /g rock).
Hydrogen Index	S2/TOC x 100 (mg hydrocarbons/g TOC).
Oxygen Index	S3/TOC x 100 (mg CO ₂ /g TOC).
Petroleum Potential	S1+S2 (mg HC/g rock).
Production Index	S1/(S1+S2).
Tmax	Temperature at which the S2 peak is at maximum (°C).

b) Interpretation

Kerogen type	Hydrogen Index (mg HC/g TOC)
Type I	>650
Type II	400-650
Type II/III	200-400
Type III	50-200
Type IV	<50

N.B.

Hydrogen index is affected by organic carbon and carbonate mineral contents. Thus decreasing TOC contents, where the same organic matter type is present, can result in reduced hydrogen indices (Katz 1983 and Espitalié et al. 1984).

Petroleum Potential	S1+S2 (mg HC/g rock)
Poor	<1
Fair	1-5
Good	5-10
Rich	>10

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

Production Index	S1/(S1+S2)
Primary bitumen	<0.1
Generated or migrated hydrocarbons	0.1-0.5
Predominantly migrated Hydrocarbons or stain	>0.5

Tmax

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

Tmax (°C)	Maturity stages of type II kerogens	Equivalent vitrinite reflectance in coals (% Ro)
425	Immature	0.5
435		0.7
450	Oil generation zone	1.0
>450	Gas generation zone	

3 EXTRACTABLE ORGANIC MATTER (OR SOLUBLE BITUMEN)

a) Data Supplied

Weight of extracted rock	(g)
EOM extractable organic matter	(mg, mg/g of rock, mg/g TOC)
Sat saturated hydrocarbons	(mg, mg/g of rock, mg/g TOC, wt% of EOM)
Aro aromatic hydrocarbons	(mg, mg/g of rock, mg/g TOC, wt% of EOM)
HC/EOM = (Sat+Aro)/EOM	(wt%)
Non-HC/EOM	(wt%)
HC/non-HC x 100	
Sat/Aro x 100	

b) Interpretation of source-rock richness based on hydrocarbon content.

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

Source rock richness	HC (ppm of rock)
Poor	<100
Fair	100-250
Good	250-500
Rich	>500

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Appendix
volume 3

Organic
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data



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