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SIEP External Report

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SIEP-97-6101

Geochemical investigation of an impregnation from  
well 27/3-1, United Kingdom

by

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Sponsor: Shell Expro London

investigation: 2354344

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## *Geochemical investigation of an impregnation from well 27/3-1, United Kingdom*

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### 1.0 Introduction

A geochemical investigation has been carried out on an extract from 3290-3310 ft (Zechstein Group) in well 27/3-1, United Kingdom (request ref. e-mail of 08.10.97).

The geochemical parameters are shown on pages 2 to 6, analysis results are presented on the yellow pages.

### 2.0 Conclusions

#### 1. Extract Analysis / Transformation processes

The amount of extract yielded by the sample is very low; therefore not all analysis could be carried out. The low amount of total organic carbon (0.4%) and the low amount of extract indicate that the sample is a very marginal impregnation only.

The shape of the whole oil gas chromatogram and the peculiar gross composition (high amounts of heteros and rest fraction) suggests predominantly contamination from mud additives (diesel oil?). An attempt has been made to analyse the biomarkers, since our experience shows that usually these additives do not contain biomarkers or contain mud-specific biomarkers.

#### 2. Biomarkers

The biomarker distribution is different from a Coppershale fingerprint (high TA-dinosteroid index, no strong C9- and C30-hopane predominance, no triterpane over sterane predominance), but resembles a just- to normal-mature Kimmeridge-type source rock (presence of C28-bisnorhopane and the overall sterane- and triterpane distributions).

In the past an immature Zechstein source rock sample from this well has been reported; the biomarker data of that sample confirm broadly above Coppershale characteristics and do not resemble the 27/3-1 3290 ft extract.

The steranes in the 3290 ft extract do not show the high amounts of normal-steranes often characteristic for diesel oil-based muds. However, low quantities of Oleananes are present (checked with MS/MS) suggesting an Uppermost Cretaceous or younger age. When such a young source rock age is geologically unlikely, the presence of these Oleananes would indicate that the biomarkers are mud contamination-related rather than authochthonous.

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## Correlation table well 27/3-1, United Kingdom

	027/03-01 3290-3310 ft S188712/4	027/03-01 4508 ft S109680/0	027/03-01 4508 ft S109681/0
	impregnation	source rock	heated
% Extract	0.03	0.40	3.20
% TOC after extract	0.4	7.0	3.7
Extract/TOC	0.07	0.06	0.86
Sulphur (%)	no data	3.7	2.8
Vanadium (ppm)	no data	15818.0	no data
Nickel (ppm)	no data	1450.0	no data
Pristane/Phytane	1.39	0.97	1.60
Pristane/n-C17	0.78	0.84	0.85
Phytane/n-C18	0.73	1.36	0.72
AROMATIC FRACTION:			
MNR	1.22	no data	no data
DNR-1	2.46	no data	no data
TNR-1	1.03	no data	no data
TNR-2	2.22	no data	no data
MPI-1	0.65	no data	no data
MPI-2	0.67	no data	no data
F-1	0.54	no data	no data
F-2	0.28	no data	no data
MONOAROMATIC STEROIDS:			
C27	25	no data	no data
C28	26		
C29	49		
C28TA/(C29MA+C28TA)	0.58	no data	no data
MA(I)/MA(I+II)	0.22	no data	no data
TA(I)/TA(I+II)	0.17	no data	no data
MA C27 V/(I+V) 20S	0.50	no data	no data
TA C26 20S/C28 20S	0.42	no data	no data
TA C27 20R/C28 20R	1.09	no data	no data
TA Dinosteroid index	0.72	no data	no data
STERANES/TRITERPANES:			
iso steranes	30	no data	no data
rearranged steranes	45		
triterpanes	25		
STERANE CONVERSION:			
iso steranes	34	no data	no data
rearranged steranes	35		
normal steranes	31		
STERANE CARBON NUMBERS:			
C27 steranes	30	no data	no data
C28 steranes	30		
C29 steranes	40		
3R/(3R+5R) terpanes	0.35	--	--
Ts/Tm	0.74	no data	no data
20S/20(R+S) C29 steranes	0.48	no data	no data
Iso/(iso+normal) C29 steranes	0.57	no data	no data
CARBON ISOTOPE RATIOS (per mil):			
total oil	-27.3	-26.8	-26.4

**Summary of the geochemical data of the extract from  
well 027/03-01 (3290-3310 ft), United Kingdom**

**Gravity and Gross Composition**

% Extract :	0.03
% TOC after extract :	0.4
Extract/TOC :	0.07
Gross Composition (wt%)	
Saturates :	38
Aromatics :	10
Heterocompounds :	47
Rest (high molecular) :	5
Sulphur (%) :	no data
Vanadium (ppm) :	no data
Nickel (ppm) :	no data

**Saturates Distribution**  
(Gas Chromatography)

Pristane / Phytane :	1.39
Pristane / n-C17 :	0.78
Phytane / n-C18 :	0.73
ACI :	34.9
Corr. Coeff. :	-0.9773

**C7 Distribution**  
(Gas Chromatography)

C7 Alkanes (%)	
Normal C7 :	no data
Monobranched :	
Polybranched :	
C7 Alkanes / Cycloalkanes (%)	
Normal C7 :	no data
Cycloalkanes :	
Branched Alkanes :	
C7 Alkanes / Aromatics (%)	
Alkanes :	no data
Cycloalkanes :	
Aromatics :	

**Biomarkers Distribution**

(Gas Chromatography / Mass Spectrometry)

Steranes/Triterpanes (%)	
Iso Steranes :	30
Rearranged Steranes :	45
Triterpanes :	25
Sterane Conversion (%)	
Iso Steranes :	34
Rearranged Steranes :	35
Normal Steranes :	31
Steranes Carbon Numbers (%)	
C27 :	30
C28 :	30
C29 :	40
Triterpanes (%)	
C30 Hopane :	88
Oleanane ( $\alpha + \beta$ ) :	12
W + T :	0
C29 Sterane Ratios	
20S / (20R + 20S) :	0.48
Iso / (Iso + Normal) :	0.57
Triterpane Ratios	
Ts / Tm :	0.74
Ts / (Ts + Tm) :	0.43
3R / (3R + 5R) :	0.35

**Aromatics Distribution**

(Gas Chromatography / Mass Spectrometry)

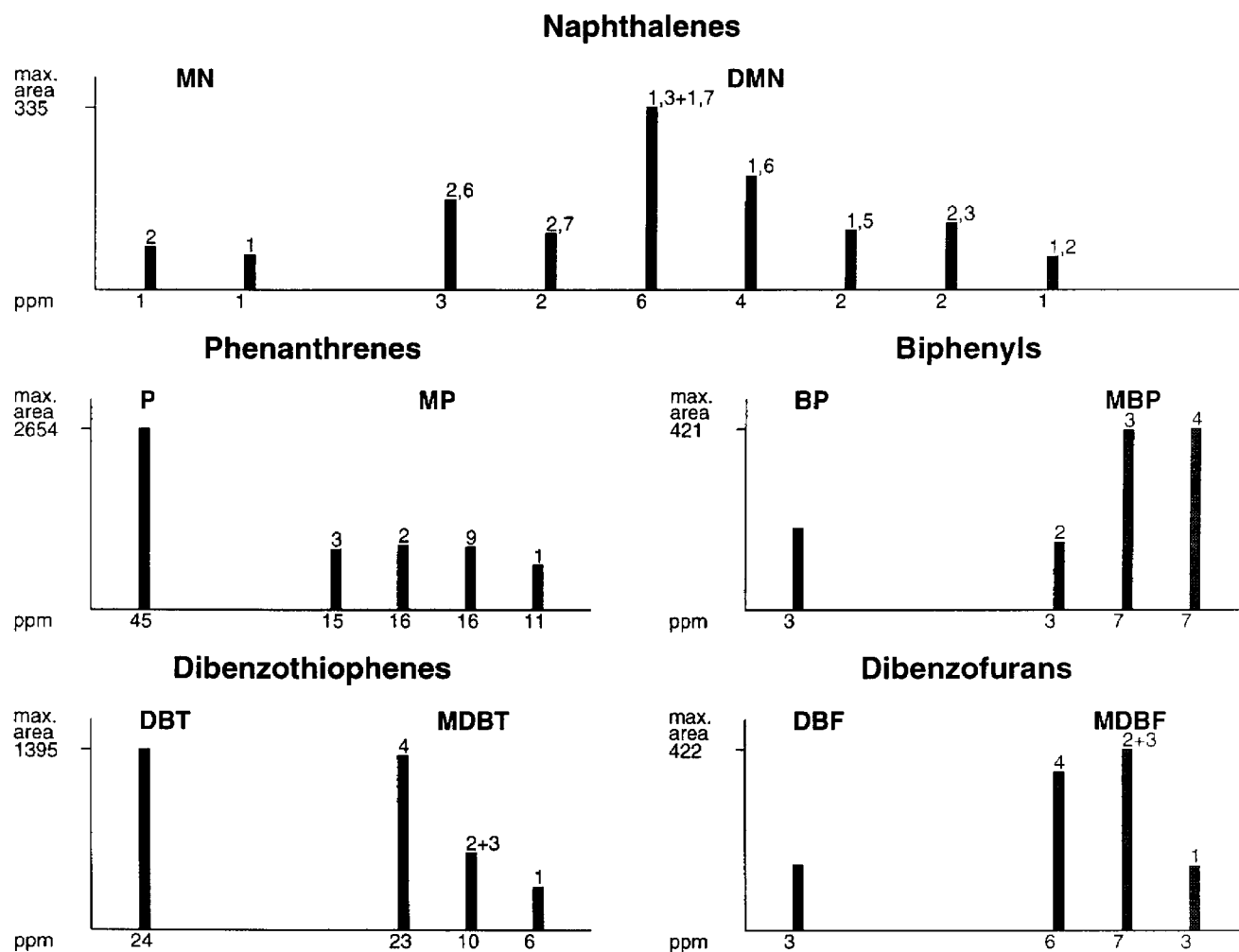
Monoaromatic Steroids (%)	
C27 :	25
C28 :	26
C29 :	49
Phenanthrene Ratios	
MPI-1 :	0.65
F-1 :	0.54
F-2 :	0.28

**Carbon Isotope Ratios**

(Mass Spectrometry)

Total Oil (topped) :	-27.3
Saturates :	no data
Aromatics :	no data

# GC/MS of the aromatic fraction of the extract from well 027/03-01 (3290-3310 ft), United Kingdom



## Conclusions based on aromatic fraction :

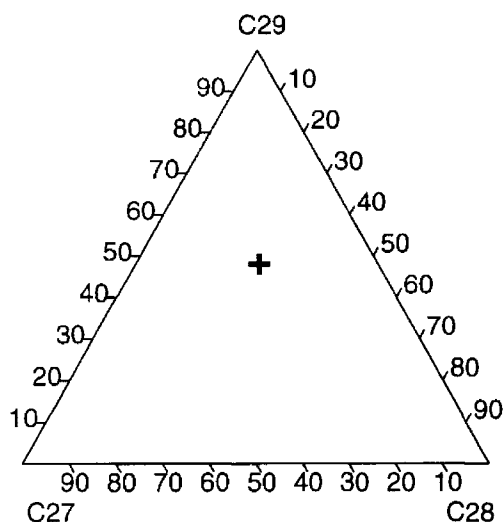
1 : See conclusions on page 1.

RATIOS	(value)	(VR/E*)
<i>Naphthalenes</i>		
MNR :	1.22	1.03
DNR-1 :	2.46	1.00
TNR-1 :	1.03	1.02
TNR-2 :	2.22	no data
<i>Phenanthrenes</i>		
MPI-1 :	0.65	0.76
MPI-2 :	0.67	0.75
F-1 :	0.54	1.04
F-2 :	0.28	0.93
<i>Overall ratios</i>		
Biphenyls/Naph. :	0.92	
Dibenzothiophenes/Naph. :	2.84	
Dibenzofurans/Naph. :	0.85	

\* Calibration based on literature values

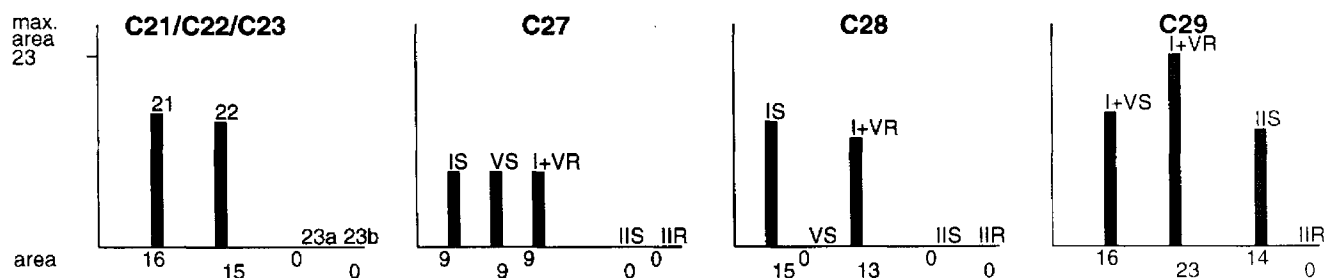
## GC/MS of the aromatic steroids of the extract from well 027/03-01 (3290-3310 ft), United Kingdom

### Monoaromatic Steroids

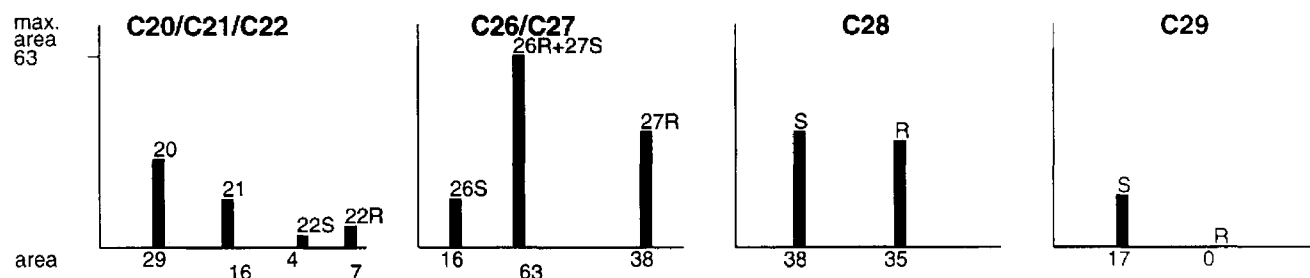


MONOAROMATIC STEROIDS	(ppm)	(%)
C27 :		25
C28 :		26
C29 :		49
<b>RATIOS</b>		
C28TA/(C29MA+C28TA) :		0.58
MA(I)/MA(I+II) :		0.22
TA(I)/TA(I+II) :		0.17
MA C27 V/(I+V) 20S :		0.50
TA C26 20S/C28 20S :		0.42
TA C27 20R/C28 20R :		1.09
3MeTA C28 20R/C29 20R :		0.92
(3/(3+4))MeTA C29 20R :		0.57
(3+4)MeTA C27 20S/C29 20S :		0.82
(3+4)MeTA C28 20R/C29 20R :		1.09
TA Dinosteroid index :		0.72

### Monoaromatic Steroids



### Triaromatic Steroids

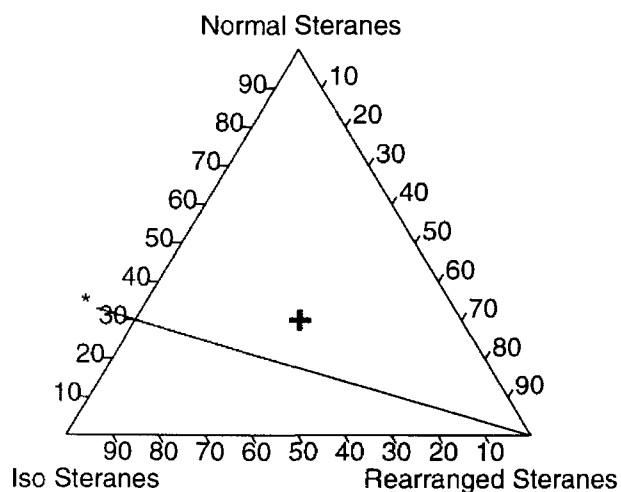


### Conclusions based on aromatic steroids data :

1 : See conclusions on page 1.

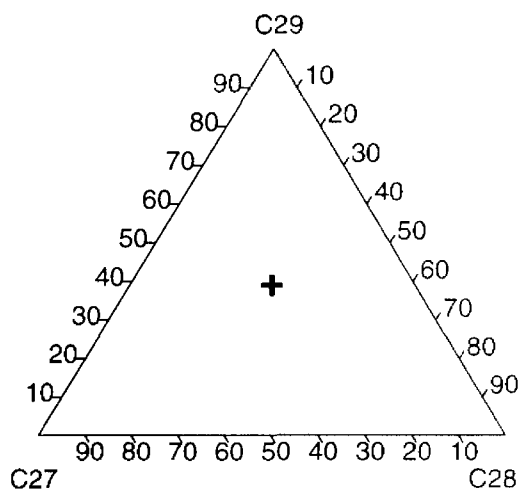
## GC/MS sterane typing of the extract from well 027/03-01 (3290-3310 ft), United Kingdom

### Sterane Conversion Diagram

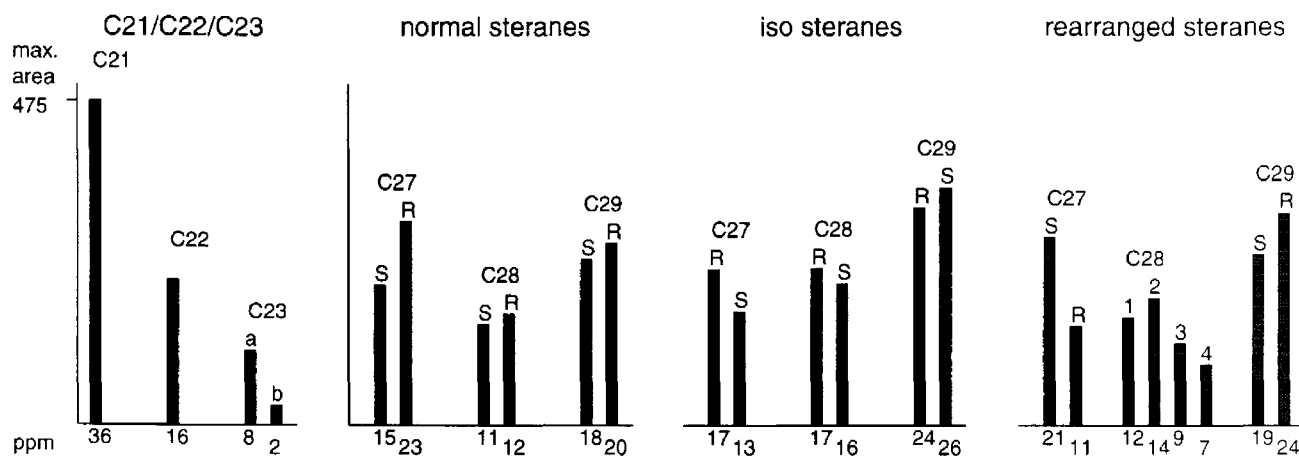


\* The line of complete sterane isomerisation indicating a mature character

### Sterane Typing Diagram



### Sterane Distribution



STERANE DISTRIBUTION	(ppm)	(%)
Iso Steranes :	113	34
Rearranged Steranes :	116	35
Normal Steranes :	100	31

#### CARBON NUMBER DISTRIBUTION

C27 :	100	30
C28 :	98	30
C29 :	131	40

#### C29 STERANE CONVERSION RATIOS

20S / (20R + 20S) :	0.48
Iso / (Iso + Normal) :	0.57

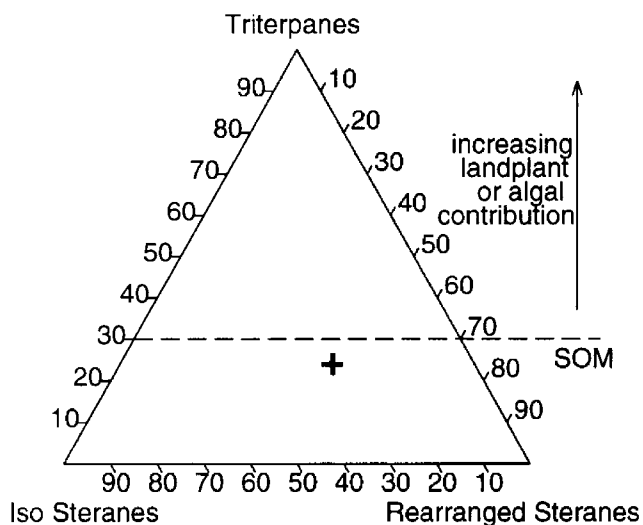
#### Conclusions based on steranes :

- 1 : the complete sterane isomerisation indicates that this oil has been expelled from a mature source rock
- 2 : it is likely that the steranes indicate a shaly source rock



## GC/MS triterpane typing of the extract from well 027/03-01 (3290-3310 ft), United Kingdom

### Sterane/Triterpane Diagram



#### STERANES/TRITERPANES (calculated %)

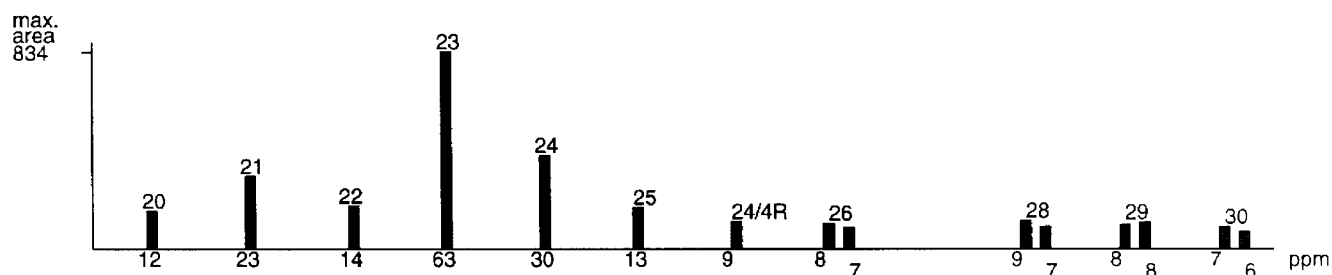
Iso Steranes :	30
Rearranged Steranes :	45
Triterpanes :	25

#### TRITERPANE CONVERSION RATIOS

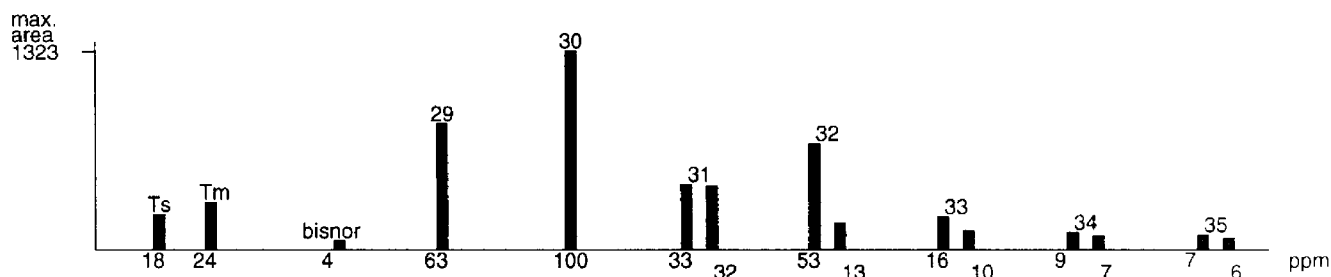
Ts / Tm :	0.74
Ts / (Ts + Tm) :	0.43
3R / (3R + 5R) :	0.35

C30 Hopane (ppm) :	100
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### Tri- and Tetracyclic Terpanes



### Pentacyclic Terpanes

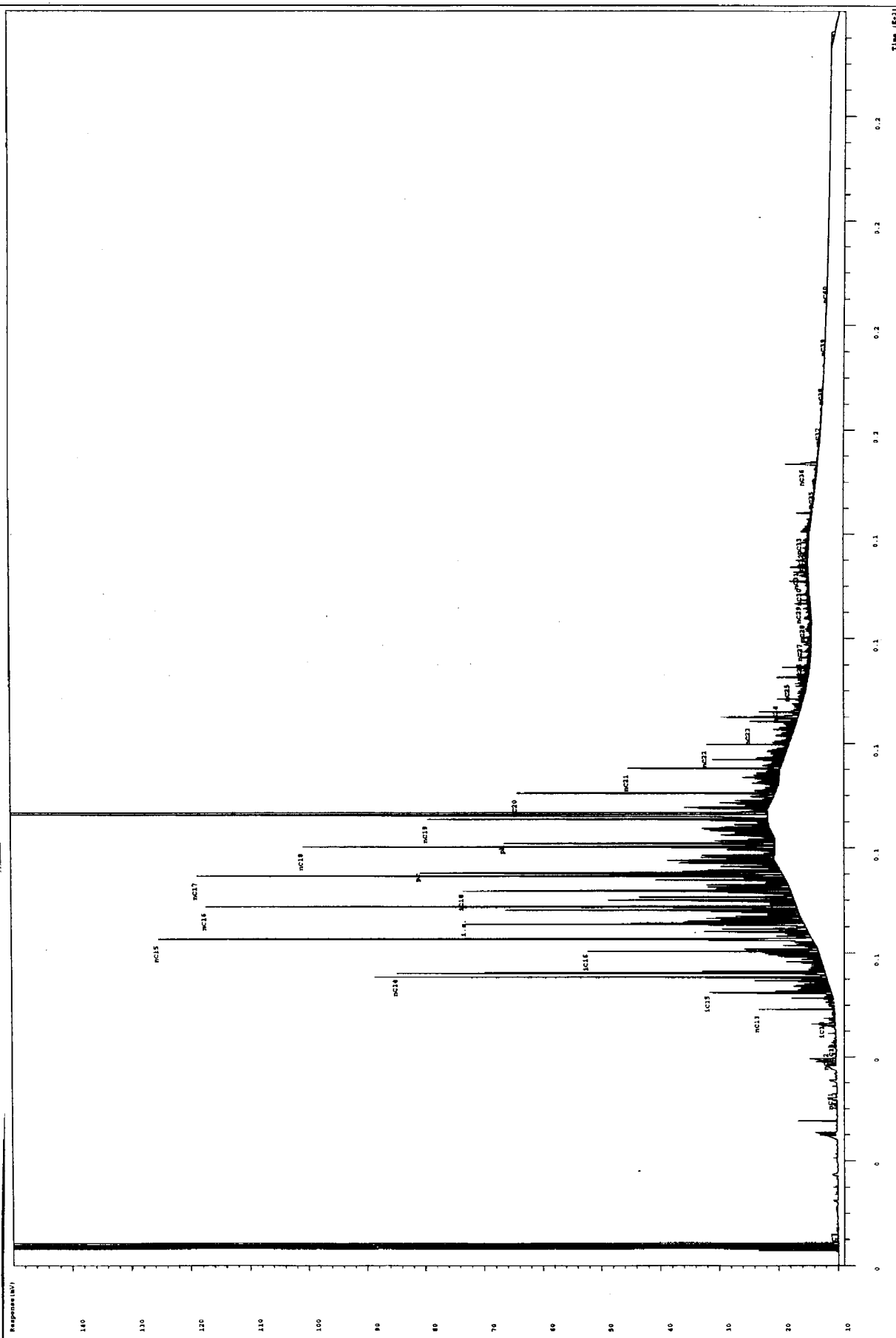


### Conclusions based on triterpanes :

- 1 : the triterpane distribution indicates a source rock containing predominantly structureless organic matter

**ANALYTICAL DATA**  
**well 027/03-01 (3290-3310 ft), United Kingdom**

*Gas chromatogram of the whole oil sample from  
well 027/03-01 (3290-3310 ft), United Kingdom*



518871204

# GC/MS chromatogram of the aromatic fraction from well 027/03-01 (3290-3310 ft), United Kingdom

SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

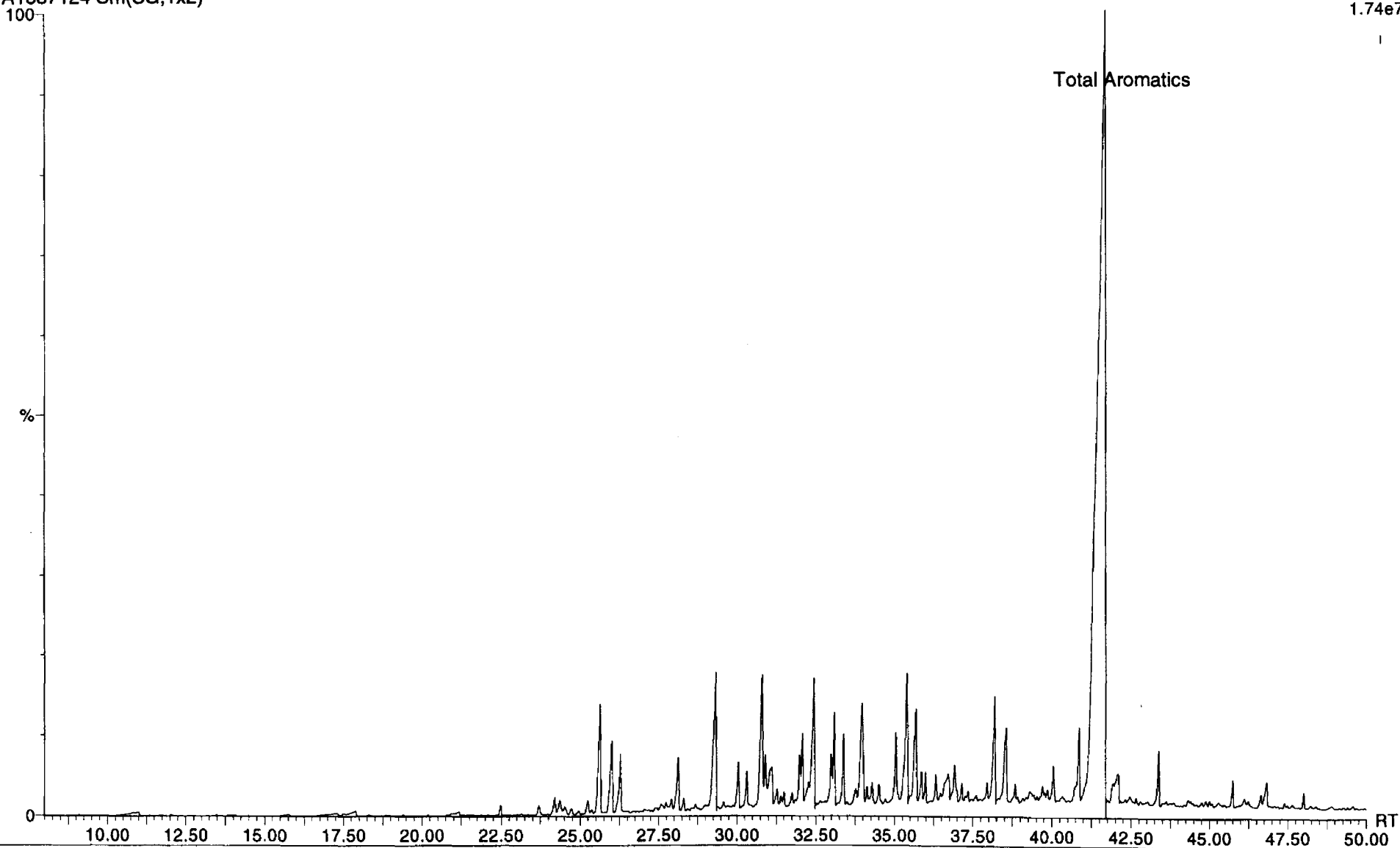
Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 19-Jan-1998 at 12:51:37

Operator : Ron

TIC

1.74e7



SIEP-97-6101

Confidential

# GC/MS data of the aromatic fraction from well 027/03-01 (3290-3310 ft), United Kingdom

Report of sample: U.K. 027/03-01 3290-3310 ft whole extract

Acquired at : 19-Jan-1998

Standard used for calculations: PDP  
Discrimination factor : 0.32

## I) NAPHTHALENES

### a) Concentrations (ppm)

2-MN  
1-MN  
2,6+2,7-DMN  
1,6-DMN  
1,5-DMN  
1,3,5+1,4,6-TMN  
2,3,6-TMN  
1,2,5-TMN  
C4-NAPH  
THN  
CAD  
Total Naphthalenes

### b) Parameters

1 4-MDBT/2+3-MDBT 2.26  
1 4-MDBT/1-MDBT 4.03  
5 2+3-MDBT/1-MDBT 1.78  
4 4-MDBT/DBT 0.97  
2 2+3-MDBT/DBT 0.43  
8 1-MDBT/DBT 0.24  
8

## IV) BIPHENYLS

### a) Concentrations (ppm)

2 BP 3  
n.d. 2-MBP 3  
36 3-MBP 7  
4-MBP 7  
Total Biphenyls 20

### b) Parameters

1.22  
2.47  
1.03 3-MBP/BP 2.19  
2.23 3-MBP/4-MBP 0.99  
3.41 3-MBP/2-MBP 2.66  
n.d.

### b) Parameters

2-MN/1-MN (MNR) 1.22  
2,6+2,7-DMN/1,5-DMN (DNR-1) 2.47  
2,3,6-TMN/1,3,5+1,4,6-TMN (TNR-1) 1.03  
2,3,6-TMN/1,2,5-TMN (TNR-2) 2.23  
2,3,6-TMN/THN 3.41  
2,3,6-TMN/Cadelene n.d.

## II) PHENANTHRENES

### a) Concentrations (ppm)

P  
3-MP  
2-MP  
9-MP  
1-MP  
Total Phenantrenes

## V) DIBENZOFURANS

### a) Concentrations (ppm)

DBF 3  
45 4-MDBF 6  
15 2+3-MDBF 7  
16 1-MDBF 3  
16 Total Dibenzofurans 19  
11

### b) Parameters

4-MDBF/2+3-MDBF 0.88  
4-MDBF/1-MDBF 2.46  
1.45 2+3-MDBF/1-MDBF 2.80  
0.65 4-MDBF/DBF 2.44  
0.67 2+3-MDBF/DBF 2.78  
1.17 1-MDBF/DBF 0.99  
0.54

## III) DIBENZOTHIOPHENES

### a) Concentrations (ppm)

DBT  
4-MDBT  
2+3-MDBT  
1-MDBT  
Total Dibenzothiophenes

## VI) OVERALL RATIOS

Biphenyls/NAPH\* 0.92  
Dibenzothiophenes/NAP 2.84  
24 Dibenzofurans/NAPH\* 0.85  
23  
10  
6  
63

MN = methylnaphthalene  
DMN = dimethylnaphthalene  
TMN = trimethylnaphthalene  
THN = tetrahyronaphthalene  
DBF = methyldibenzofuran  
MDBF = methyldibenzofuran  
NAPH\* = 2,6+2,7-DMN + 1,5-DMN + 1,4,6+1,3,5-TMN + 2,3,6-TMN  
P = phenanthrene  
MP = methylphenanthrene  
DBT = dibenzothiophene  
MDBT = methyldibenzothiophene  
BP = biphenyl  
MBP = methylbiphenyl

# GC/MS data of the aromatic fraction from well 027/03-01 (3290-3310 ft), United Kingdom

## VII ) Misc. NAPHTHALENES

## a) Concentrations (ppm)

2,6-DMN	3	4,5-DMP	0
2,7-DMN	2	2,6+3,6-DMP	4
1,3+1,7-DMN	6	3,5-DMP	5
1,6-DMN	4	2,7-DMP	2
1,4-DMN	n.d.	3,9-DMP	16
2,3-DMN	2	1,6+2,5+2,9-DMP	7
1,5-DMN	2	1,7-DMP	5
1,2-DMN	1	1,9+4,9-DMP	5
1,4+2,3-DMN	2	1,5-DMP	n.d.
		1,8-DMP	1
		1,2-DMP	1
		9,10-DMP	n.d.
1,3,7-TMN	10	1,2,6-TMP	0
1,3,6-TMN	10	1,2,5-TMP	1
1,3,5+1,4,6-TMN	8	1,2,9-TMP	0
2,3,6-TMN	8	1,2,7-TMP	n.d.
1,2,7-TMN	0	1,2,8-TMP	2
1,6,7-TMN	8		
1,2,6-TMN	0		
1,2,4-TMN	0		
1,2,5-TMN	4		
1,3,5,7-TeMN	5		
1,3,6,7-TeMN	8		
1,2,4,7-TeMN	1		
1,2,5,7-TeMN	2		
2,3,6,7-TeMN	1		
1,2,6,7-TeMN	4		
1,2,5,6-TeMN (C4-NAPH)	2		

## b) Parameters

1,2,5-TMN/1,3,6-TMN 0.35

1,2,7-TMN/1,3,7-TMN 0.03

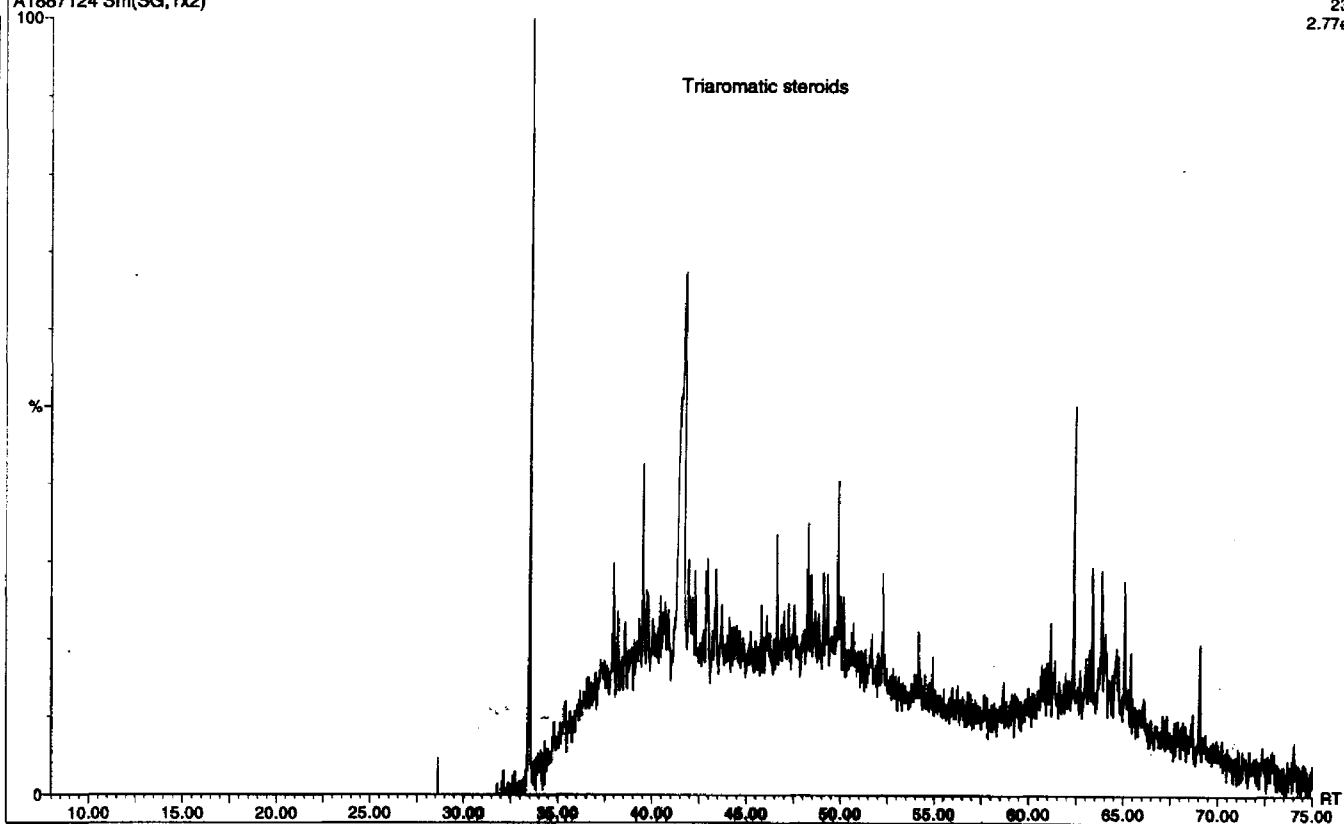
The assignment of some of these peaks is tentative

# GC/MS fragmentograms of the aromatic steroids from well 027/03-01 (3290-3310 ft), United Kingdom

SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

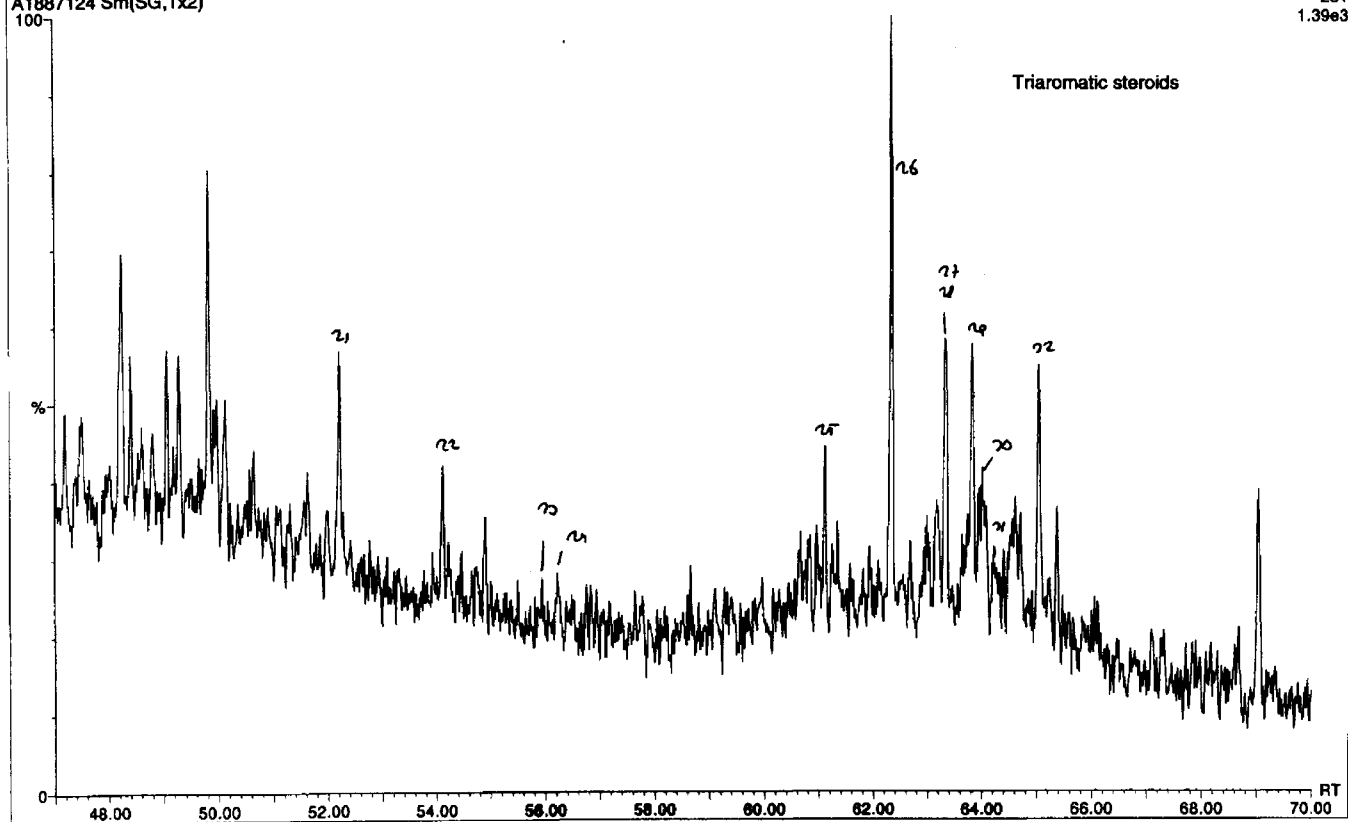
Acquired on 19-Jan-1998 at 12:51:37  
Operator : Ron  
231  
2.77e3



SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 19-Jan-1998 at 12:51:37  
Operator : Ron  
231  
1.39e3

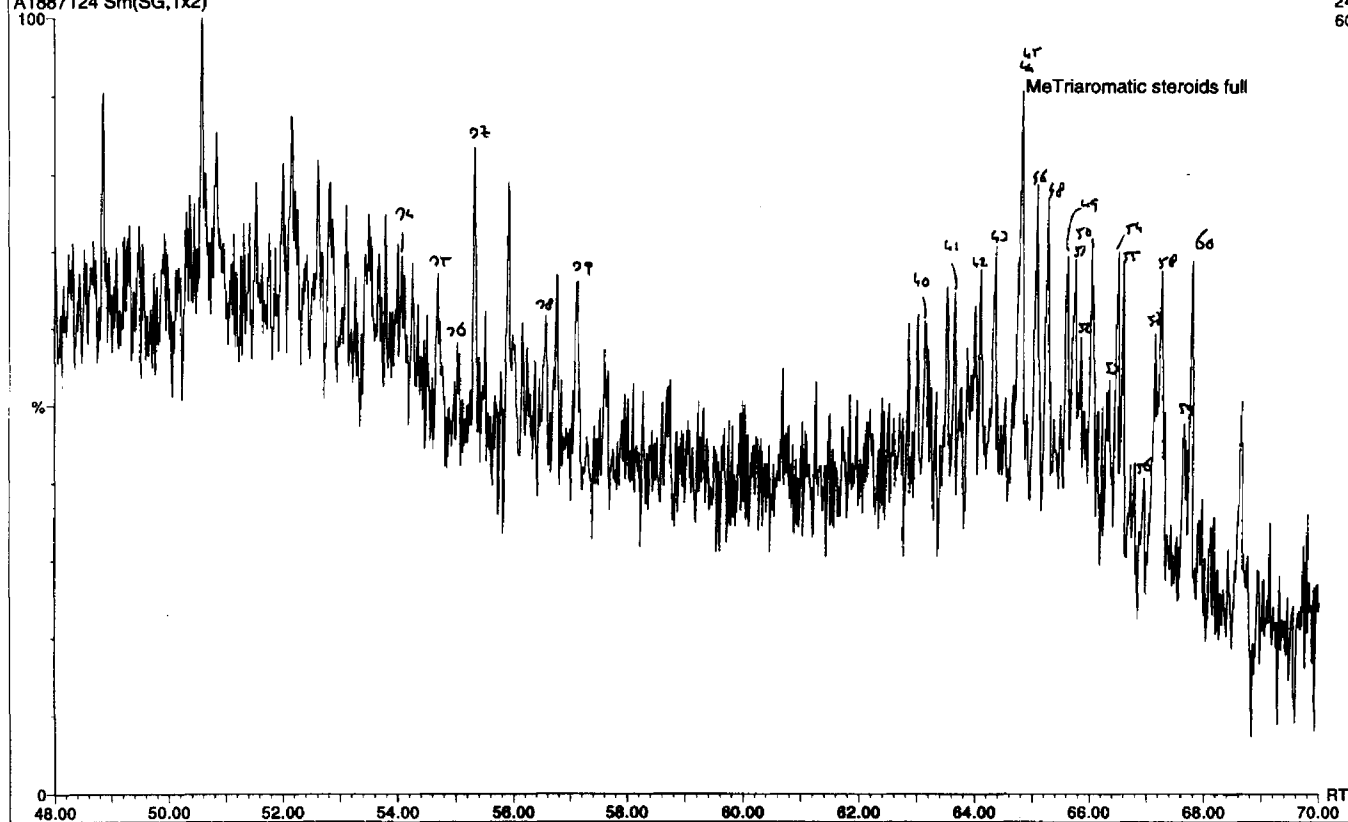


# GC/MS fragmentograms of the aromatic steroids from well 027/03-01 (3290-3310 ft), United Kingdom

SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

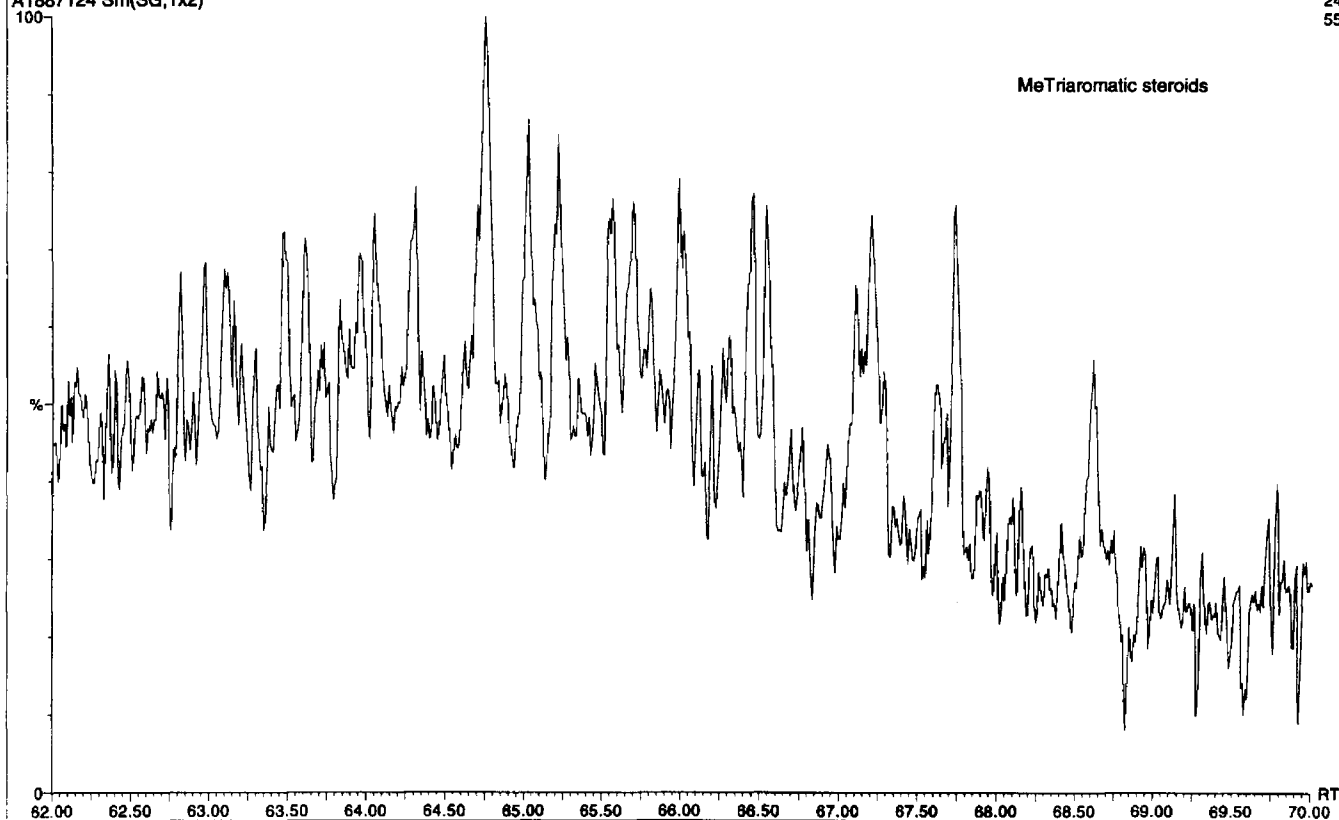
Acquired on 19-Jan-1998 at 12:51:37  
Operator : Ron  
245  
608



SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 19-Jan-1998 at 12:51:37  
Operator : Ron  
245  
551





# GC/MS fragmentograms of the aromatic steroids from well 027/03-01 (3290-3310 ft), United Kingdom

SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

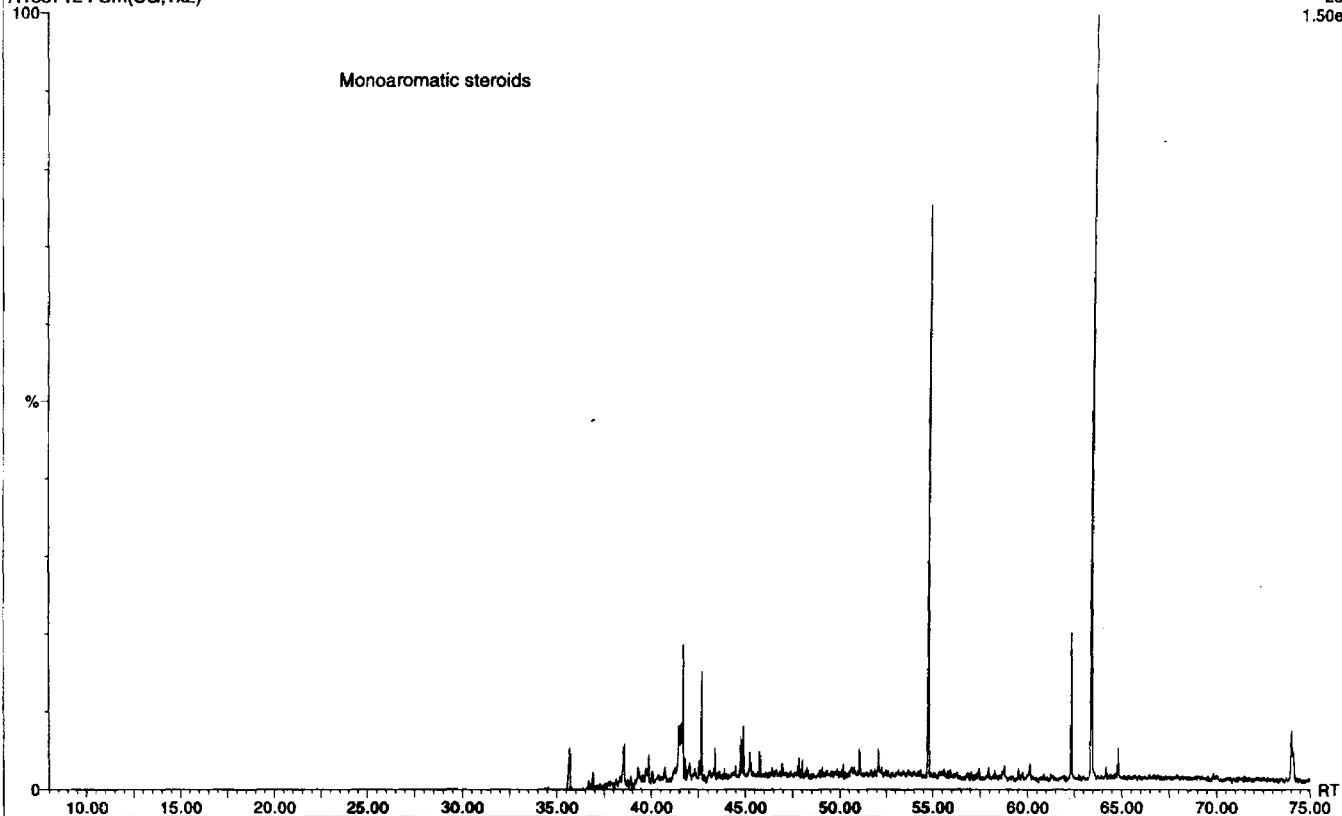
Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 19-Jan-1998 at 12:51:37

Operator : Ron

253

1.50e4



SIEP-RTS EPT-HM  
Instrument : MD-800  
A1887124 Sm(SG,1x2)

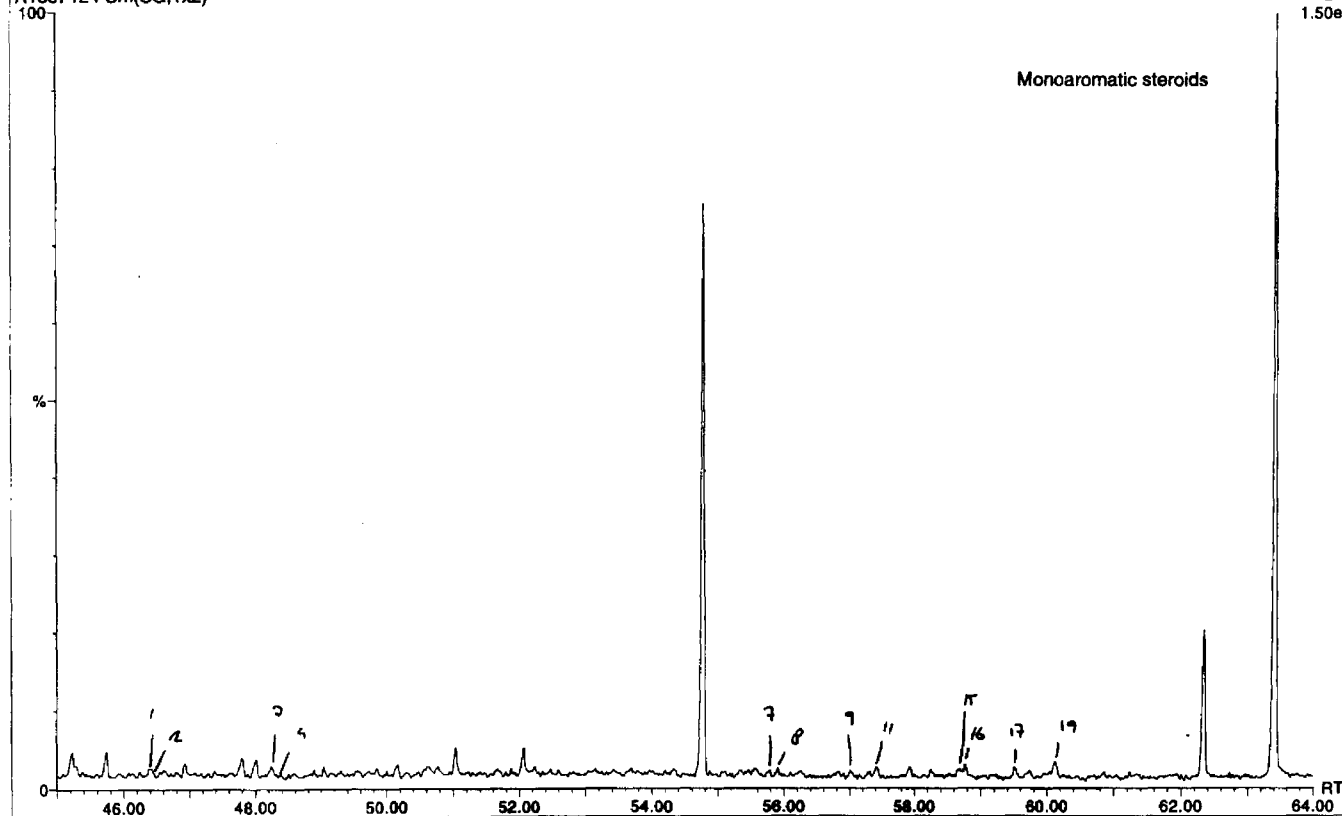
Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 19-Jan-1998 at 12:51:37

Operator : Ron

253

1.50e4



# GC/MS data of the aromatic steroids from well 027/03-01 (3290-3310 ft), United Kingdom

Report of sample: U.K. 027/03-01 3290-3310 ft whole extract

Acquired at : 19-Jan-1998

Standard used for calculations: First  
Discrimination factor : 0.43

## I) Monoaromatic steroids Intensities (arbitrary units)

MA C21 a ?	70
MA C21 b ?	30
MA C22 a ?	100
MA C22 b ??	12
MA C23 a ?	n.d.
MA C23 b ?	n.d.
MA C27 I 20S	56
MA C27 V 20S	62
MA C27 I 20R + MA C27 V 20R	57
MA C27 II 20S	n.d.
MA C28 I 20S	96
MA C28 V 20S	n.d.
MA C27 II 20R	n.d.
MA C28 II 20S	n.d.
MA C28 I 20R + MA C28 V 20R	85
MA C29 I 20S + MA C29 V 20S	107
MA C29 II 20S	90
MA C28 II 20R	n.d.
MA C29 I 20R + MA C29 V 20R	152
MA C29 II 20R	n.d.

## II) Triaromatic steroids Intensities (arbitrary units)

TA C20	191
TA C21	107
TA C22 20S	25
TA C22 20R	46
TA C26 20S	107
TA C26 20R + TA C27 20S	420
TA C28 20S	248
TA C28 20S	n.d.
TA C27 20R	254
TA C29 20S	74
TA C29 20S	42
TA C28 20R	232
TA C29 20R	n.d.

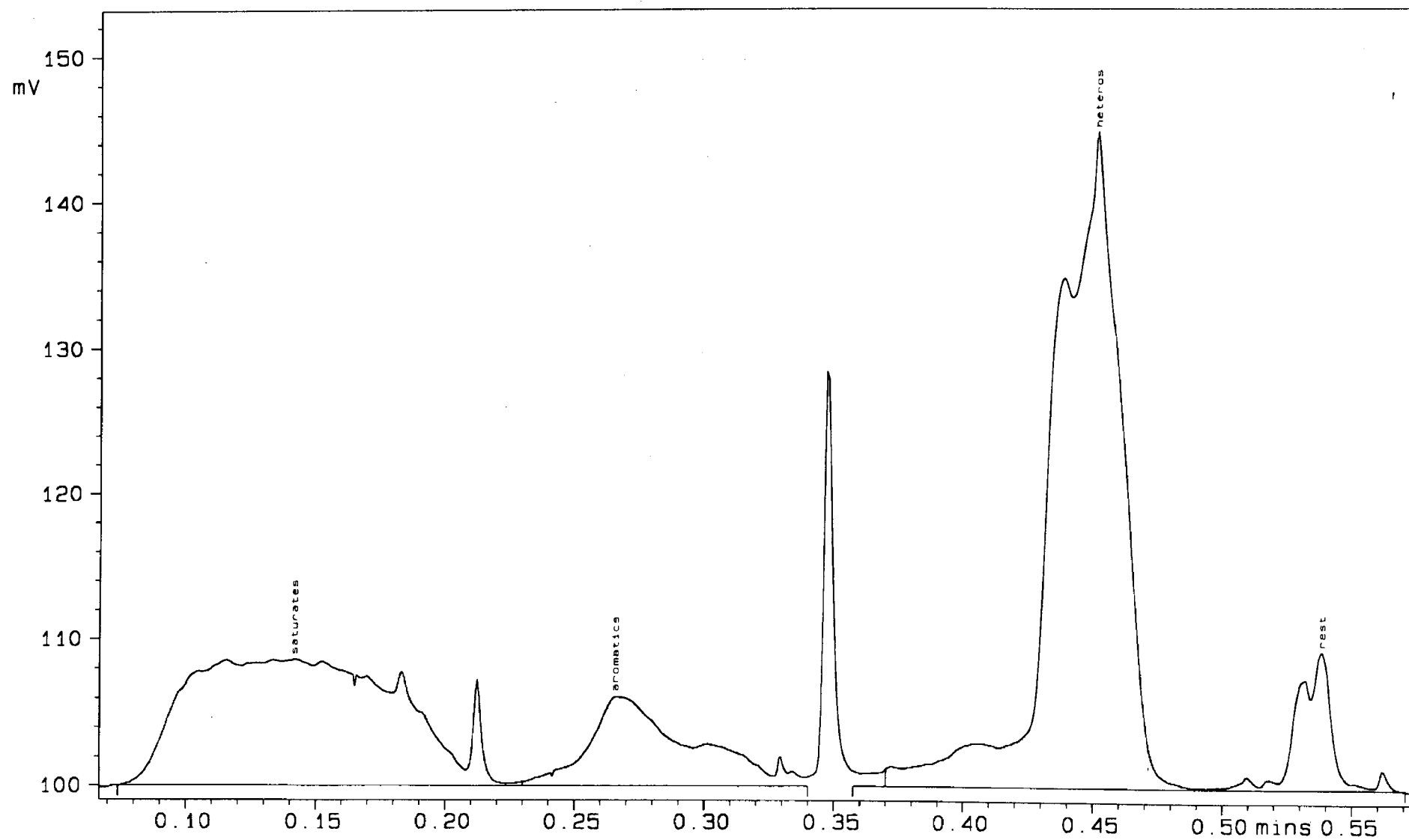
## III) Methylated Triaromatic steroids Intensities (arbitrary units)

1Me TA C21 ?	39
3Me TA C21	48
6Me TA C21 ?	23
4Me TA C21	90
3Me TA C22	54
4Me TA C22	75
3Me TA C27 20S	57
4Me TA C27 20S	60
2Me TA C28 20S	72
3Me TA (C27 + C28) 20S	99
4Me TA (C27 + C28) 20S ?	215
4Me TA (C27 + C28) 20S ?	n.d.
2Me TA C29 20S	146
TA dinosteroid D1	n.d.
3Me TA C29 20S	145
TA dinosteroid D2	114
2Me TA C28 20R	108
4Me TA C29 20S	n.d.
3Me TA C28 20R	77
4Me TA C28 20R	85
TA dinosteroid D3	103
TA dinosteroid D4	96
2Me TA C29 20R	23
3Me TA C29 20R	88
TA dinosteroid D5	125
4Me TA C29 20R	65
TA dinosteroid D6	107

## IV) Parameters

% MA C27	24.81
% MA C28	25.66
% MA C29	49.53
TA C28/(MA C29 + TA C28)	0.58
MA(I)/MA(I+II)	0.23
TA(I)/TA(I+II)	0.18
MA C27 V 20S/(MA C27 (I+V) 2	0.52
TA C26 20S/TA C28 20S	0.43
TA C27 20R/TA C28 20R	1.10
3Me TA C28 20R/3Me TA C29 20	0.87
3Me TA C29 20R/(3+4)Me TA C2	0.58
TA (3+4)Me C27 20S/(3+4)Me C	0.81
TA (3+4)Me C28 20R/(3+4)Me C	1.06

*Gross composition of the extract from  
well 027/03-01 (3290-3310 ft), United Kingdom*



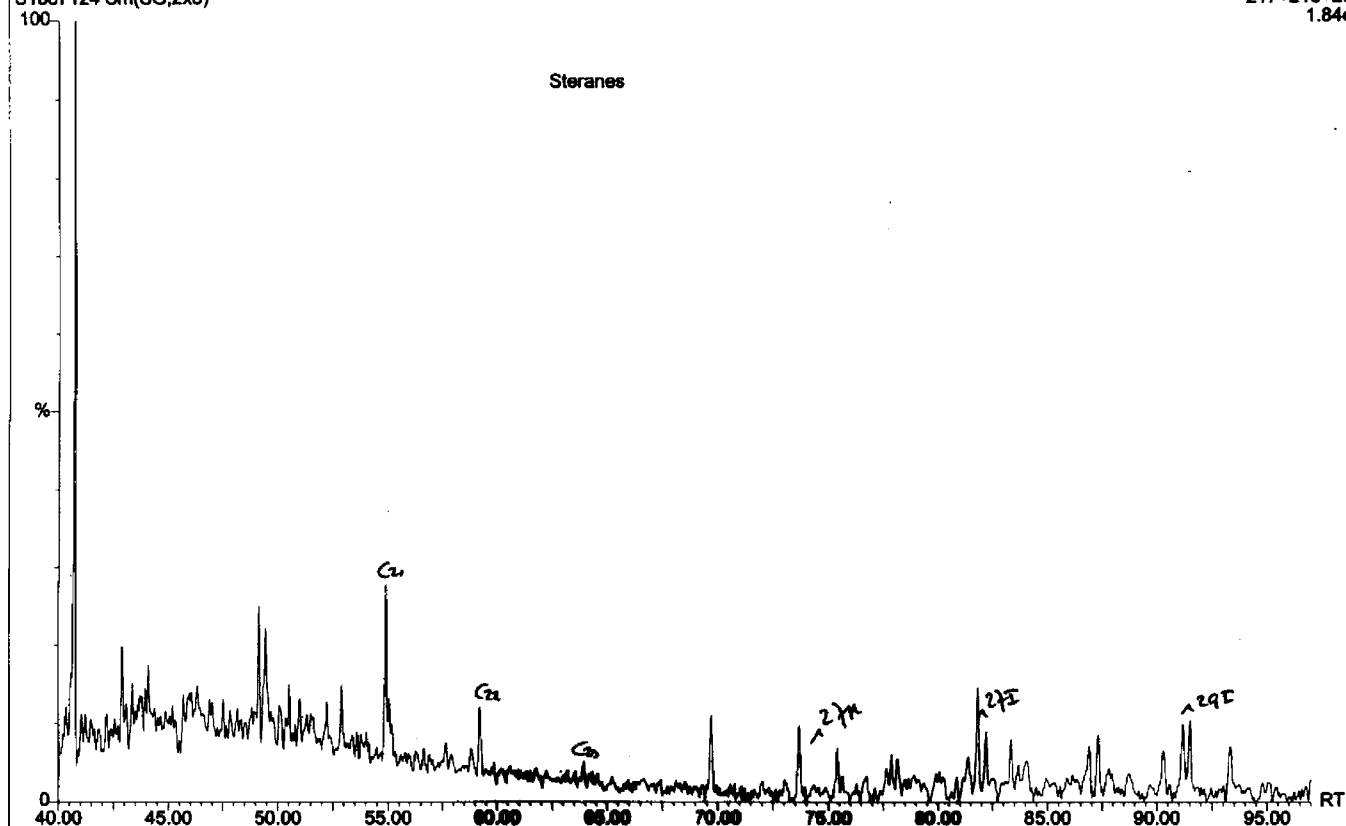
# GC/MS fragmentograms of the steranes of the extract from well 027/03-01 (3290-3310 ft), United Kingdom

SIEP-RTS EPT-HM  
TRIO-1000  
S1887124 Sm(SG,2x3)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 22-Nov-1997 at 19:24:32

Ron  
217+218+259  
1.84e4



SIEP-RTS EPT-HM  
TRIO-1000  
S1887124 Sm(SG,2x3)

Sample ID : U.K. 027/03-01 3290-3310 ft whole extract

Acquired on 22-Nov-1997 at 19:24:32

Ron  
217+218+259  
2.67e3

