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Geochemical investigation of a source rock sample from
well 214/29-1, United Kingdom

by

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Sponsor: Shell Expro London

Code: 774.106.10

investigation: 8BAS0795

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RIJSWIJK, THE NETHERLANDS

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Geochemical investigation of a source rock sample from well 214/29-1, United Kingdom

1.0 Introduction

A geochemical investigation has been carried out on a source rock cuttings extract from 3380-4510 m (Albian/Turonian) in well 214/29-1, United Kingdom (request telex ref. ABX0140064 of 29.04.94). The geochemical parameters are shown on pages 2 to 5, analysis results are presented on the yellow pages.

2.0 Conclusions

1. Source rock analysis

The organic carbon content (1.4%), the Rock Eval data (HI up to 470) and the maceral analysis all indicate the presence of type II(III) source rocks for gas and some oil in interval 3380-4510 m. The high S1 (Rock Eval) values and the high extract/organic carbon ratio of the original sample confirms the impregnated character of this interval. The 'impregnation' is most likely due to mud additives. In an attempt for further typing the extracted sample has been heated. The extract of the heated sample has been analysed.

It should be noted that the gas chromatogram of the heated sample is non-crude oil-like.

2. Maturity

The interval 3380-4510 m has most likely a mature to well-mature character (maceral analysis).

3. Environment of deposition / Type of organic matter

The extract has been derived from a shaly source rock (macerals, high amounts of rearranged steranes, low C29/C30-hopane ratio), that contained predominantly SOM (biomarker distribution). The presence of bisnorhopane suggests a fully marine environment of deposition.

4. Correlation

Although the sample exhibits a non-crude oil-like character (probably caused by mud-additives), an attempt has been carried out to correlate especially the biomarkers of this extract to all previously described crudes from the West Shetlands. (The biomarker fraction, being a heavy fraction, is most likely the least influenced by contamination of - light - additives).

The 214/29-1 source rock extract shows large dissimilarities from these oils (carbon isotope value, 'strange' and non-waxy n-alkane distribution,

absence of 25-nor-hopanes). Therefore, this source rock has not been a major contributor to these oils. However, some similarities such as the presence of bisnorhopane and the overall sterane distribution, do not exclude a minor contribution of this source rock.

Detailed GCMS/MS on the topped extract of the original sample revealed the presence of (low amounts) of 25-norhopanes and Oleananes. The Oleananes indicate an Upper Cretaceous or Tertiary age and concur with the source rock age. If the Oleananes are indigenous, the source rock extract does not match with the West Shetland oils, since these oils do not contain Oleananes.

Summary of the Geochemical Data of the extract from well 214/29-01 (3380 m.), United Kingdom

Gravity and Gross Composition

% Extract :	0.5
% TOC after extract :	1.4
Extract/TOC :	0.36
Gross Composition (W%)	
Saturates :	9
Aromatics :	15
Heterocompounds :	76
Rest (High molecular) :	1
Sulphur (%) :	no data
Vanadium (ppm) :	no data
Nickel (ppm) :	no data

Saturates Distributions (Gaschromatography)

Pristane / Phytane :	2.9
Pristane / n-C17 :	0.0
Phytane / n-C18 :	0.0
ACI :	133
Corr. Coeff. :	-1.0000

C-7 Distributions

(Gaschromatography)

C-7 Alkanes (%)	
Normal C-7 :	no data
Mono Branched :	
Poly Branched :	
C-7 Alkanes / Cyclo Alkanes (%)	
Normal C-7 :	no data
Cyclo Alkanes :	
Branched Alkanes :	
C-7 Alk. / Cyclo Alk. / Aromatics (%)	
Alkanes :	no data
Cyclo Alkanes :	
Aromatics :	

Carbon Isotope Ratios (Mass Spectrometry)

Total Sample (topped) :	no data
Saturates :	-25.6
Aromatics :	no data

Distribution of Ring Compounds

(Field Ionisation Mass Spectrometry)

C-15 Ring Compounds (%)

1 ring :	no data
2 ring :	
3 ring :	

C-30 Ring Compounds (%)

3 ring :	no data
4 ring :	
5 ring :	

C-29 VR/E :	no data
-------------	---------

Sterane and Triterpane Distributions

(Gaschromatography / Mass Spectrometry)

Steranes/Triterpanes (%)

Iso Steranes :	34
Rearranged Steranes :	52
Triterpanes :	14

Steranes (%)

Iso Steranes :	35
Rearranged Steranes :	36
Normal Steranes :	29

Triterpanes (%)

C-30 Hopanes :	100
Oleanane ($\alpha + \beta$) :	0
W + T :	0

Steranes Carbon No. Dist. (%)

C-27 :	26
C-28 :	30
C-29 :	44

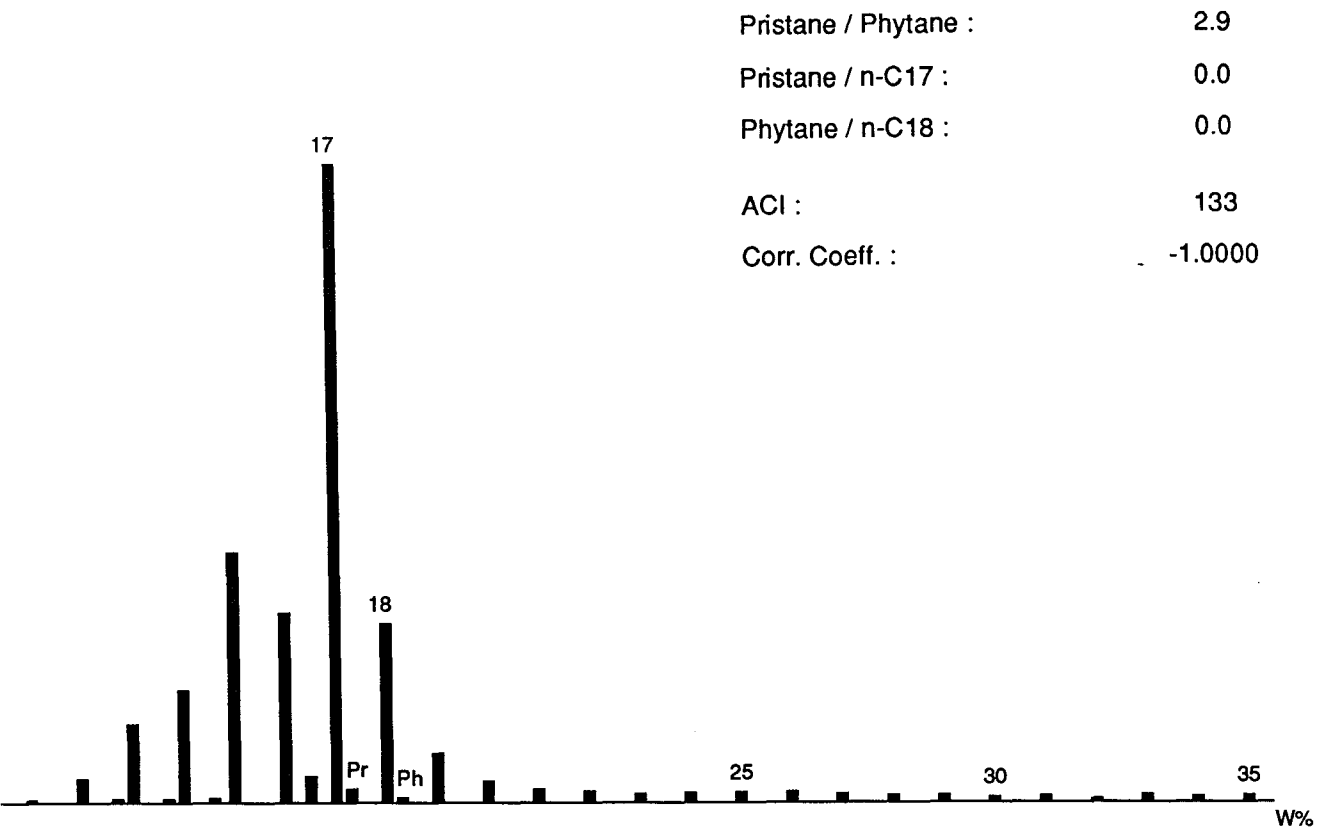
C-29 Sterane Ratios

20S / 20R + 20S :	0.45
Iso / Iso + Normal :	0.46

Triterpane Ratios

TS / TM :	0.61
3R / 3R + 5R :	0.15

Bar diagram of Normal-alkanes & Isoprenoids of the extract from well 214/29-01 (3380 m.), United Kingdom



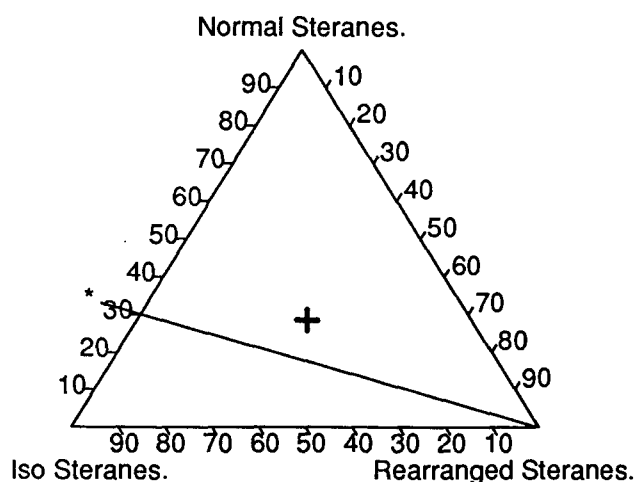
Pristane / Phytane : 2.9
Pristane / n-C17 : 0.0
Phytane / n-C18 : 0.0
ACI : 133
Corr. Coeff. : -1.0000

Conclusions based on saturated hydrocarbon fraction :

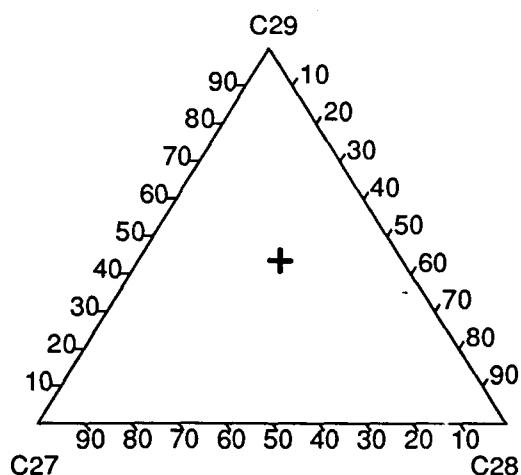
1 : the n-alkane distribution has a highly mature character

GCMS Sterane typing of the extract from well 214/29-01 (3380 m.), United Kingdom

Sterane Conversion Diagram



Sterane Typing Diagram



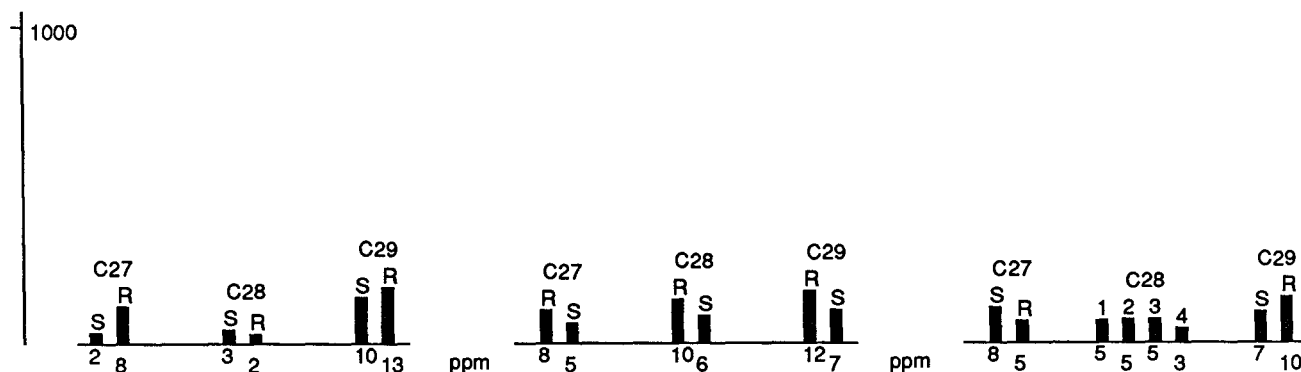
* The line of complete sterane isomerisation indicating a mature character

Sterane Distribution

normal steranes

iso steranes

rearranged steranes



STERANE DISTRIBUTION	(ppm)	(%)
Iso Steranes :	48	35
Rearranged Steranes :	50	36
Normal Steranes :	39	29

CARBON NUMBER DISTRIBUTION

C-27 :	36	26
C-28 :	40	30
C-29 :	60	44

C-29 STERANE CONVERSION RATIOS

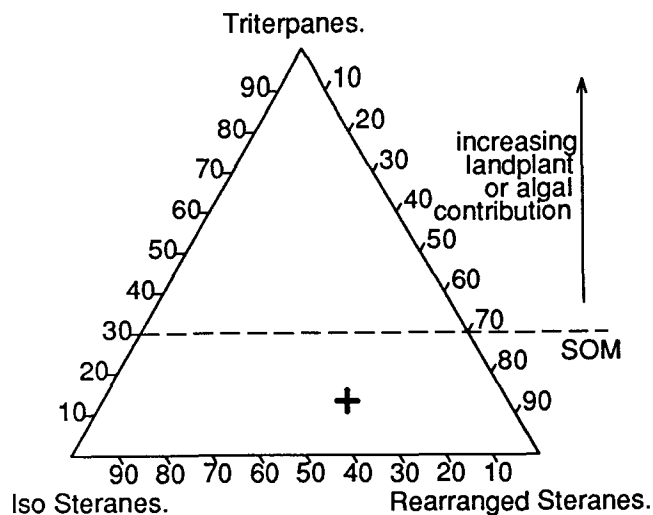
20S / 20R + 20S :	0.45
Iso / Iso + Normal :	0.46

Conclusions based on steranes :

1 : the incomplete sterane isomerisation is probably caused by the heating experiment

GCMS Triterpane typing of the extract from well 214/29-01 (3380 m.), United Kingdom

Sterane/Triterpane Diagram



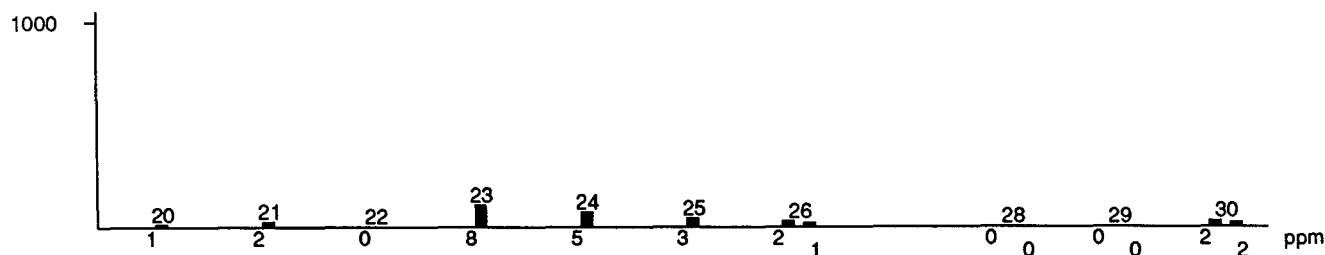
STERANES/TRITERPANES (calculated %)

Iso Steranes :	34
Rearranged Steranes :	52
Triterpanes :	14

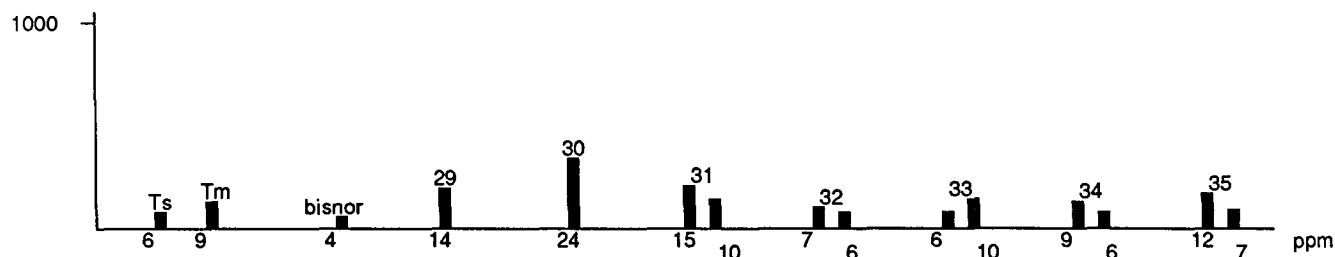
TRITERPANE CONVERSION RATIOS

TS / TM :	0.61
3R / 3R + 5R :	0.15
C30 Hopane (ppm) :	24

Tricyclic Terpanes



Pentacyclic Terpanes

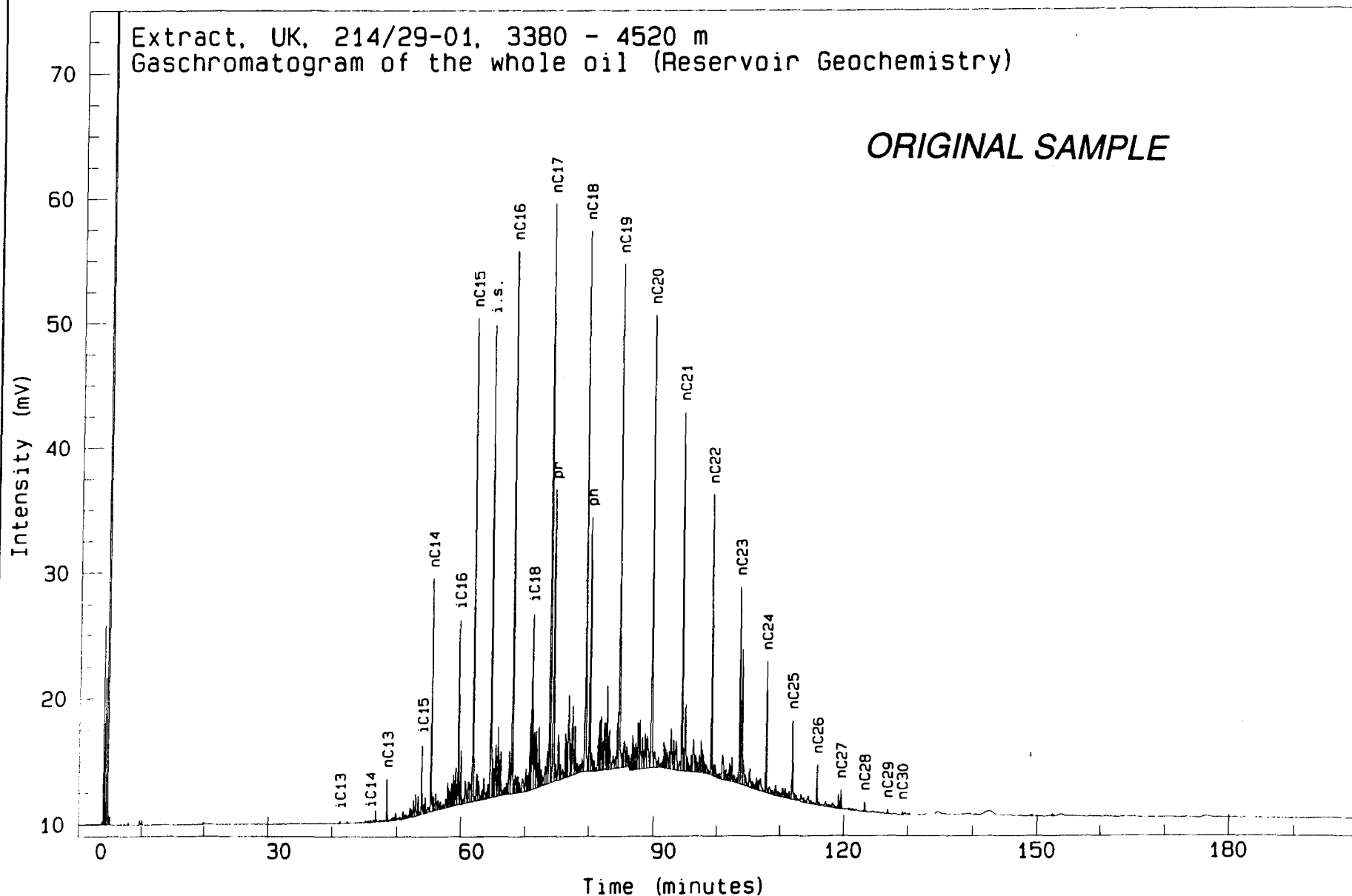


Conclusions based on triterpanes :

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

ANALYTICAL DATA
well 214/29-01 (3380 m.), United Kingdom

Gas chromatogram of the whole oil sample from well 214/29-01 (3380 m.), United Kingdom



ANALYTICAL DATA
well 214/29-01 (3380 m.), United Kingdom

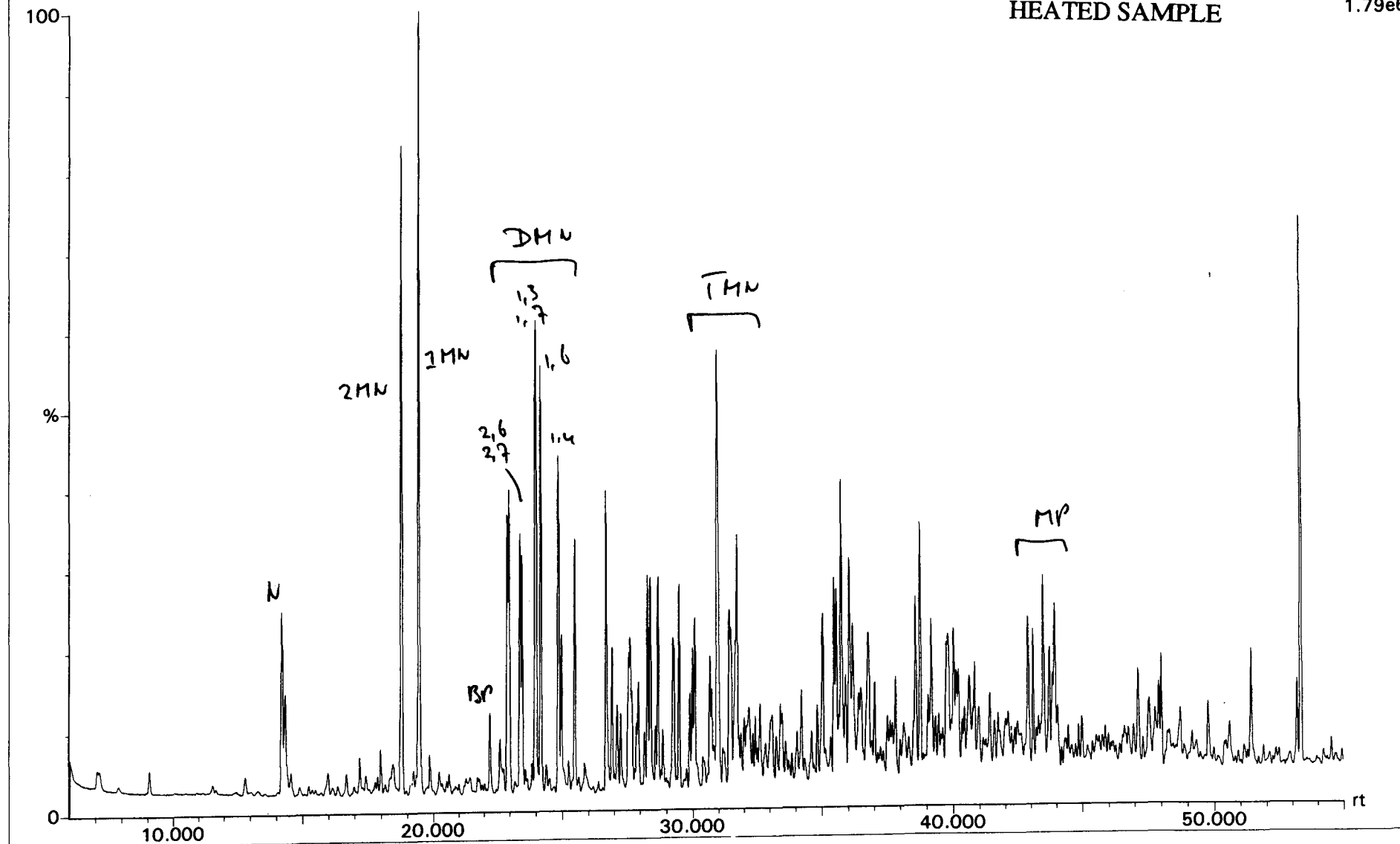
HEATED SAMPLE

K.S.E.P.L.
02-Nov-1994 12:30:35
1680092

U.K. 214/29-01 3380-4520 m cutting

MD-800
RON
Scan EI+
TIC
1.79e6

HEATED SAMPLE



GCMS data of the aromatic fraction well 214/29-01 (3380 m.), United Kingdom

HEATED SAMPLE

Report of sample: U.K. 214/29-01 3380-i4520 m cutting
Acquired at : 02-Nov-1994

Standard used for calculations: PDP
Discrimination factor : 1.95

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

2-MN/1-MN (MNR) 0.85
2,6+2,7-DMN/1,5-DMN (DNR-1) 1.28
2,3,6-TMN/1,3,5+1,4,6-TMN (TNR-1) 0.92
2,3,6-TMN/1,2,5-TMN (TNR-2) 1.21
2,3,6-TMN/THN 25.43
2,3,6-TMN/Cadelene n.d.

II) PHENANTHRENES

a) Concentrations (ppm)

P
3-MP
2-MP
9-MP
1-MP

Total Phenantrenes

b) Parameters

2-MP/1-MP 1.00
1.5*(2+3-MP/(P+1+9-MP)) (MPI-1) 0.63
3*(2-MP/(P+1+9-MP)) (MPI-2) 0.69
2+3-MP/1+9-MP 1.01
2+3-MP/1+9+2+3-MP 0.50

III) DIBENZOTHIOPHENES

a) Concentrations (ppm)

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

Total Dibenzothiophenes

b) Parameters

1338 4-MDBT/2+3-MDBT 1.39
1570 4-MDBT/1-MDBT 3.32
712 2+3-MDBT/1-MDBT 2.38
628 4-MDBT/DBT 1.05
554 2+3-MDBT/DBT 0.76
291 1-MDBT/DBT 0.32
268

IV) BIPHENYLS

a) Concentrations (ppm)

84 BP 154
11 BP n.d.
2-MBP 20
3-MBP 165
4-MBP 76
Total Biphenyls 415

b) Parameters

0.92 3-MBP/BP 1.07
1.21 3-MBP/4-MBP 2.16
25.43 3-MBP/2-MBP 8.25
n.d.

V) DIBENZOFURANS

a) Concentrations (ppm)

DBF 72
555 4-MDBF 73
179 2+3-MDBF 88
216 1-MDBF 34
175 Total Dibenzofurans 267
216

b) Parameters

4-MDBF/2+3-MDBF 0.83
4-MDBF/1-MDBF 2.17
1.00 2+3-MDBF/1-MDBF 2.61
0.63 4-MDBF/DBF 1.02
0.69 2+3-MDBF/DBF 1.23
1.01 1-MDBF/DBF 0.47
0.50

VI) OVERALL RATIOS

Biphenyls/NAPH* 0.23
Dibenzothiophenes/NAP 0.13
79 Dibenzofurans/NAPH* 0.15

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 = phenantrene
MP = methylphenanthrene
DBT = dibenzothiophene
MDBT= methyldibenzothiophene
BP = biphenyl
MBP = methylbiphenyl

**GCMS data of the aromatic fraction
well 214/29-01 (3380 m.), United Kingdom**

HEATED SAMPLE

VII) Misc. NAPHTHALENES

a) Concentrations (ppm)

2,6-DMN	367	4,5-DMP	19
2,7-DMN	345	2,6+3,6-DMP	33
1,3+1,7-DMN	926	3,5-DMP	45
1,6-DMN	628	2,7-DMP	28
1,4-DMN	n.d.	3,9-DMP	168
2,3-DMN	207	1,6+2,5+2,9-DMP	72
1,5-DMN	554	1,7-DMP	177
1,2-DMN	265	1,9+4,9-DMP	33
1,4+2,3-DMN	207	1,5-DMP	n.d.
		1,8-DMP	20
		1,2-DMP	n.d.
		9,10-DMP	n.d.
1,3,7-TMN	293	1,2,6-TMP	n.d.
1,3,6-TMN	301	1,2,5-TMP	10
1,3,5+1,4,6-TMN	291	1,2,9-TMP	17
2,3,6-TMN	268	1,2,7-TMP	n.d.
1,2,7-TMN	102	1,2,8-TMP	n.d.
1,6,7-TMN	195		
1,2,6-TMN	174		
1,2,4-TMN	129		
1,2,5-TMN	222		
1,3,5,7-TeMN	68		
1,3,6,7-TeMN	124		
1,2,4,7-TeMN	88		
1,2,5,7-TeMN	55		
2,3,6,7-TeMN	49		
1,2,6,7-TeMN	31		
1,2,5,6-TeMN (C4-NAPH)	84		

b) Parameters

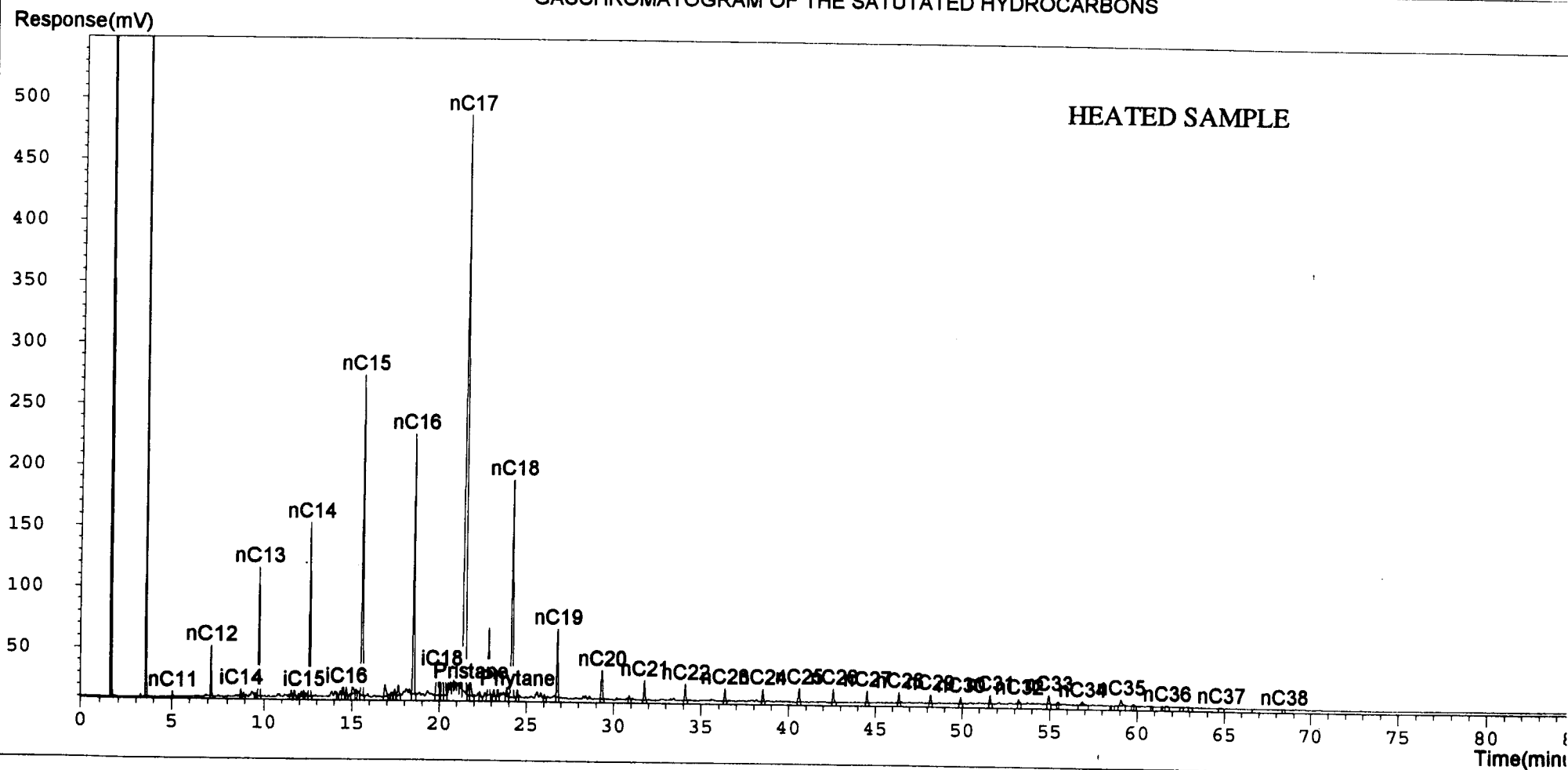
1,2,5-TMN/1,3,6-TMN	0.74
1,2,7-TMN/1,3,7-TMN	0.35

The assignment of some of these peaks is tentative

*Gas chromatogram of the saturated hydrocarbons of the extract from
well 214/29-01 (3380 m.), United Kingdom*

GASCHROMATOGRAM OF THE SATUTATED HYDROCARBONS

HEATED SAMPLE

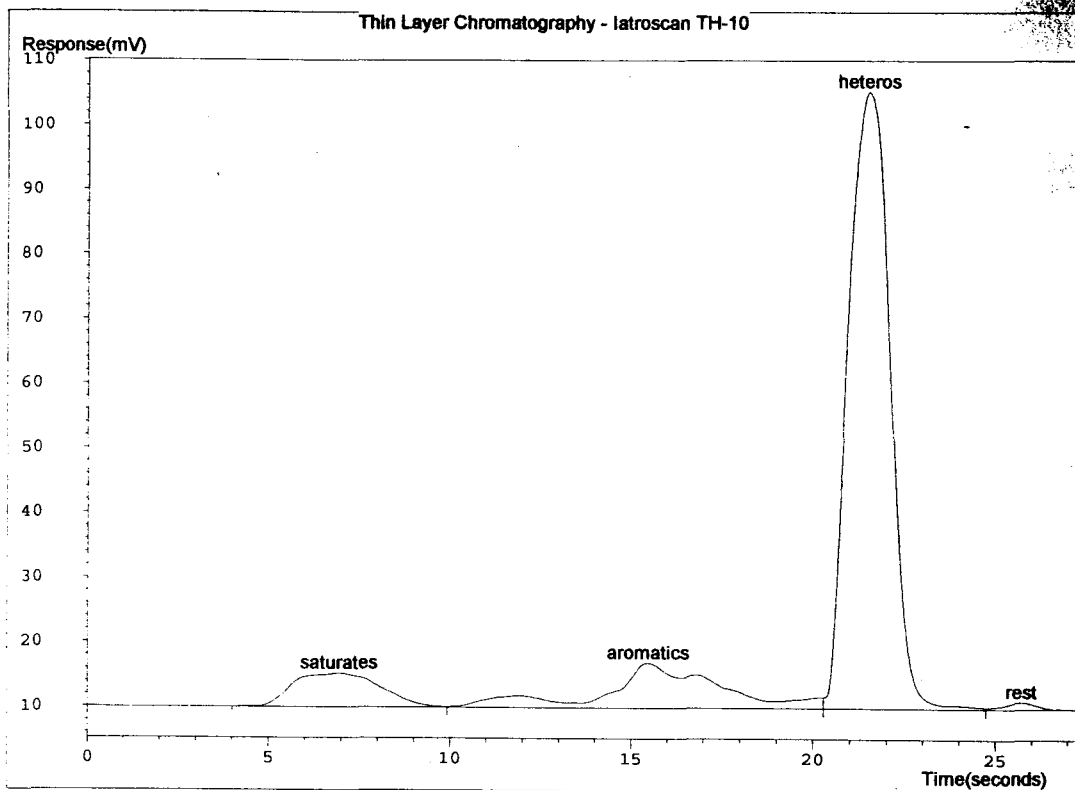


Gross Composition of the extract from
well 214/29-01 (3380 m.), United Kingdom

HEATED SAMPLE

Printed at 09:59am on 05 October 1994
Project: defproj Instrument: channel4
Sample: S 168009/2

Page 1
Analysis: o629-1
Injection: 1



Analyst Name mb
Analysis Name SHELL
Comment Thin Layer Chromatografie / GC-Iatroscan bepaling.

Peak information:

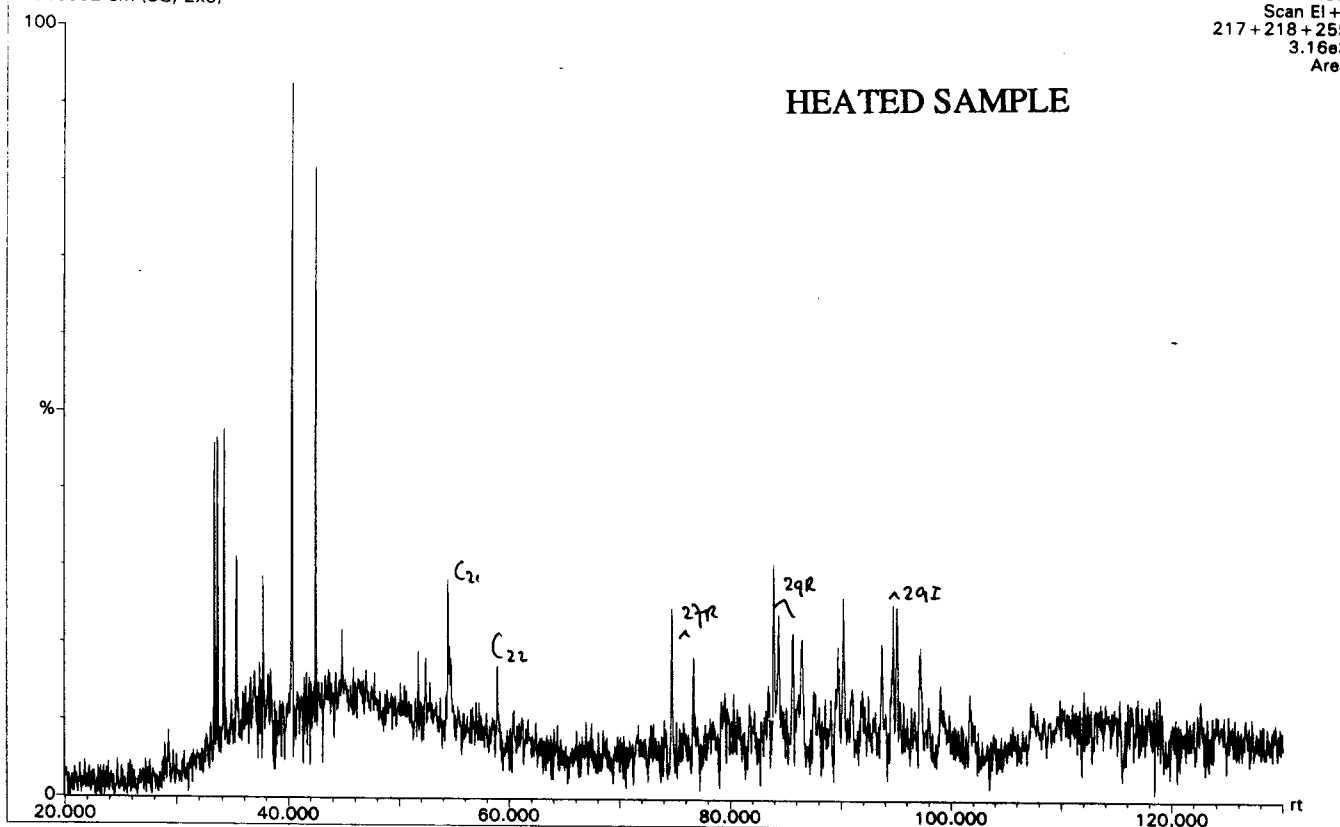
Peak No.	Peak Nam	Amount N	Area
1	saturate	8.70	14.47
2	aromatic	14.93	24.83
3	heteros	75.67	125.85
4	rest	0.70	1.16

Sterane Fragmentograms of the extract from well 214/29-01 (3380 m.), United Kingdom

KSEPL
17-Nov-1994 19:20:56
S1680092 Sm (SG, 2x3)

U.K. 214/29-01 3380-4520 M CUTTING I.S. = 27.3(33.4) PPM

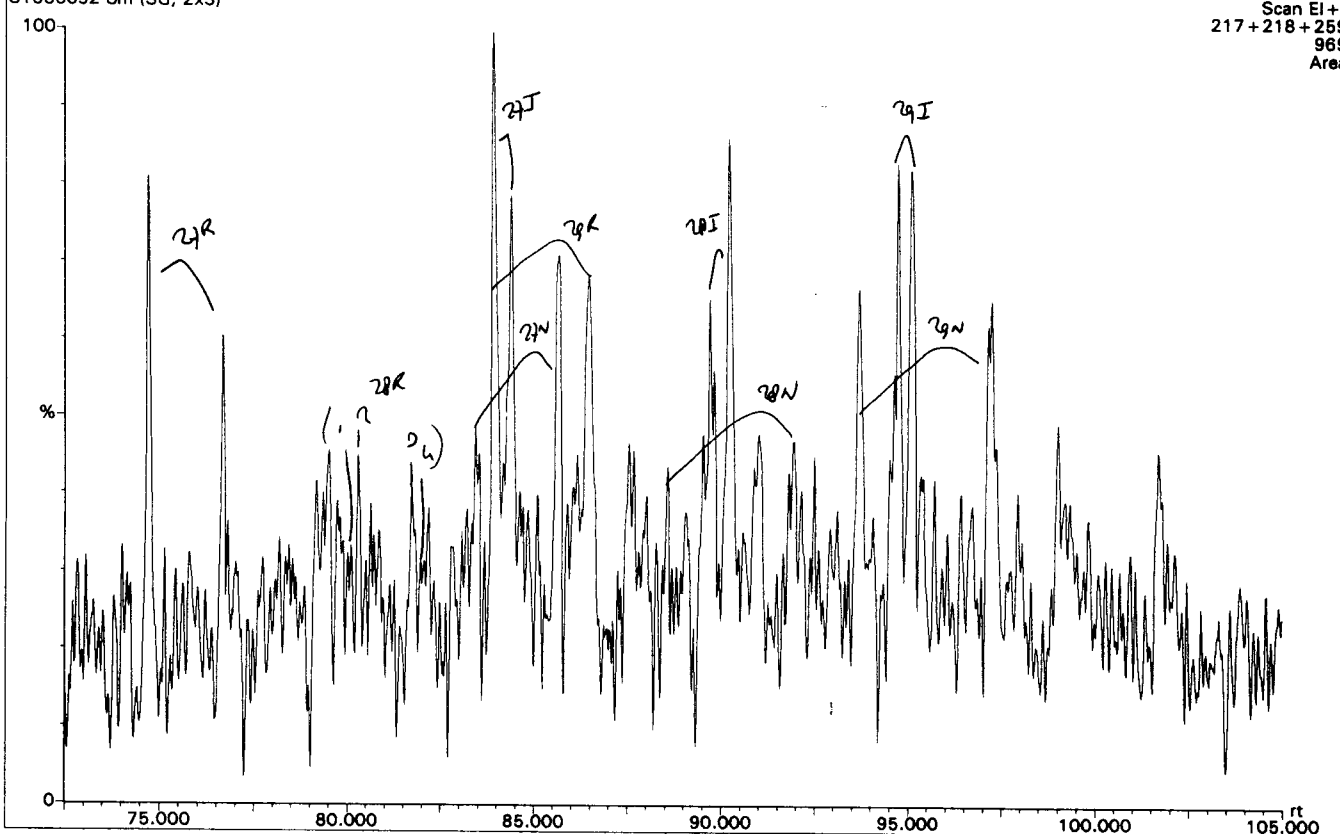
TRIO1000
RON
Scan EI +
217 + 218 + 259
3.16e3
Area



KSEPL
17-Nov-1994 19:20:56
S1680092 Sm (SG, 2x3)

U.K. 214/29-01 3380-4520 M CUTTING I.S. = 27.3(33.4) PPM

TRIO1000
RON
Scan EI +
217 + 218 + 259
969
Area

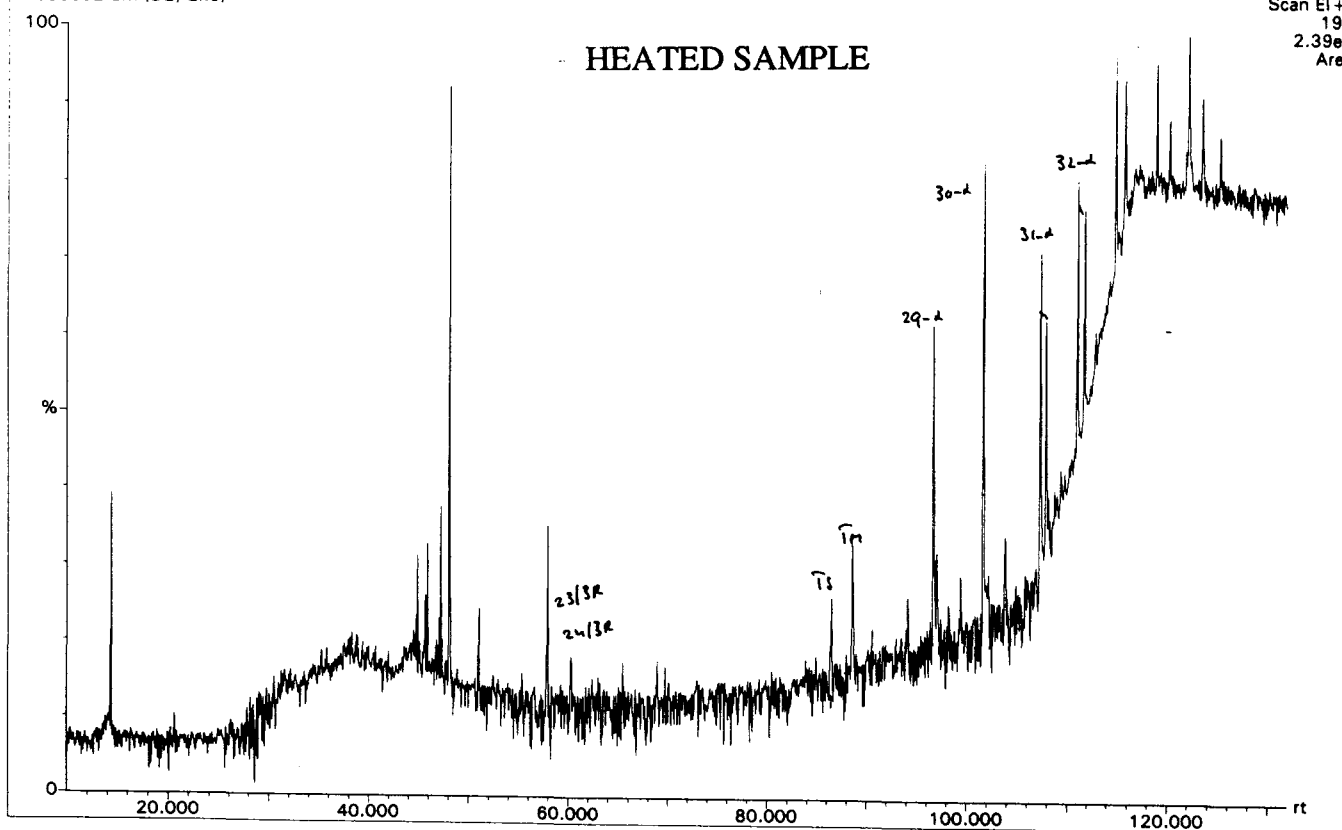


Triterpane Fragmentograms of the extract from well 214/29-01 (3380 m.), United Kingdom

KSEPL
17-Nov-1994 19:20:56
S1680092 Sm (SG, 2x3)

U.K. 214/29-01 3380-4520 M CUTTING I.S. = 27.3(33.4) PPM

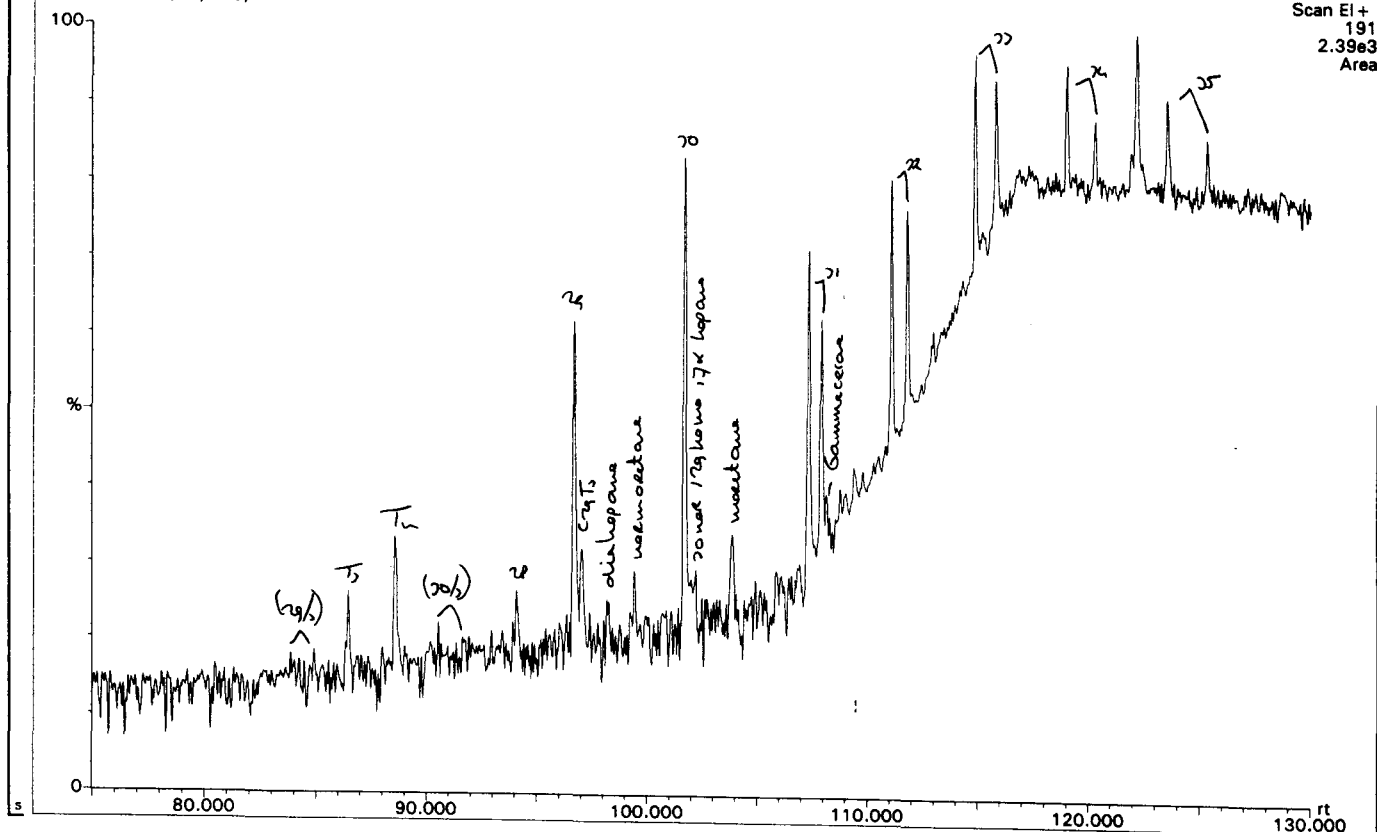
TRIO1000
RON
Scan EI+
191
2.39e3
Area



KSEPL
17-Nov-1994 19:20:56
S1680092 Sm (SG, 2x3)

U.K. 214/29-01 3380-4520 M CUTTING I.S. = 27.3(33.4) PPM

TRIO1000
RON
Scan EI+
191
2.39e3
Area



MACERAL DESCRIPTION
well 214/29-01 (3380 m.), United Kingdom

G F S - Geochemical Filing System

Listing of Pyrolysis sniffing and Organic Carbon data

Country : United Kingdom

Well/Outcrop : 214/29-01

Depth (m)	Sample Type	Formation name	Pyrolysis sniffing		TOC (w%)	Additional Analyses
			bef.	aft.		
3170.00	C		-	-	1.2	
3380.00	C		-	-	1.4	REV
3380.00	C		-	-	1.4	REV
3480.00	C		-	-	1.5	
3610.00	C		-	-	1.6	REV MAC
3610.00	C		-	-	1.6	REV
3795.00	C		-	-	0.8	
3820.00	C		-	-	1.1	
3820.00	D C		-	-	1.0	
3850.00	C		-	-	1.4	
3860.00	C		-	-	2.2	REV
3860.00	C		-	-	2.2	REV
3890.00	C		-	-	1.8	
3960.00	C		-	-	2.1	REV MAC
3960.00	C		-	-	2.1	REV
4000.00	C		-	-	2.1	
4165.00	C		-	-	1.8	
4245.00	C		-	-	1.7	REV
4245.00	C		-	-	1.7	REV
4300.00	C		-	-	1.9	
4355.00	C		-	-	2.1	REV MAC
4355.00	C		-	-	2.1	REV
4375.00	C		-	-	1.8	
4375.00	D C		-	-	1.7	
4425.00	C		-	-	2.0	REV
4425.00	C		-	-	2.0	REV
4480.00	C		-	-	1.9	
4520.00	C		-	-	2.5	REV MAC
4520.00	C		-	-	2.5	REV
4600.00	C		-	-	2.0	REV
4600.00	C		-	-	2.0	REV

G F S - Geochemical Filing System

Listing of samples with Rock Eval data

Country : United Kingdom

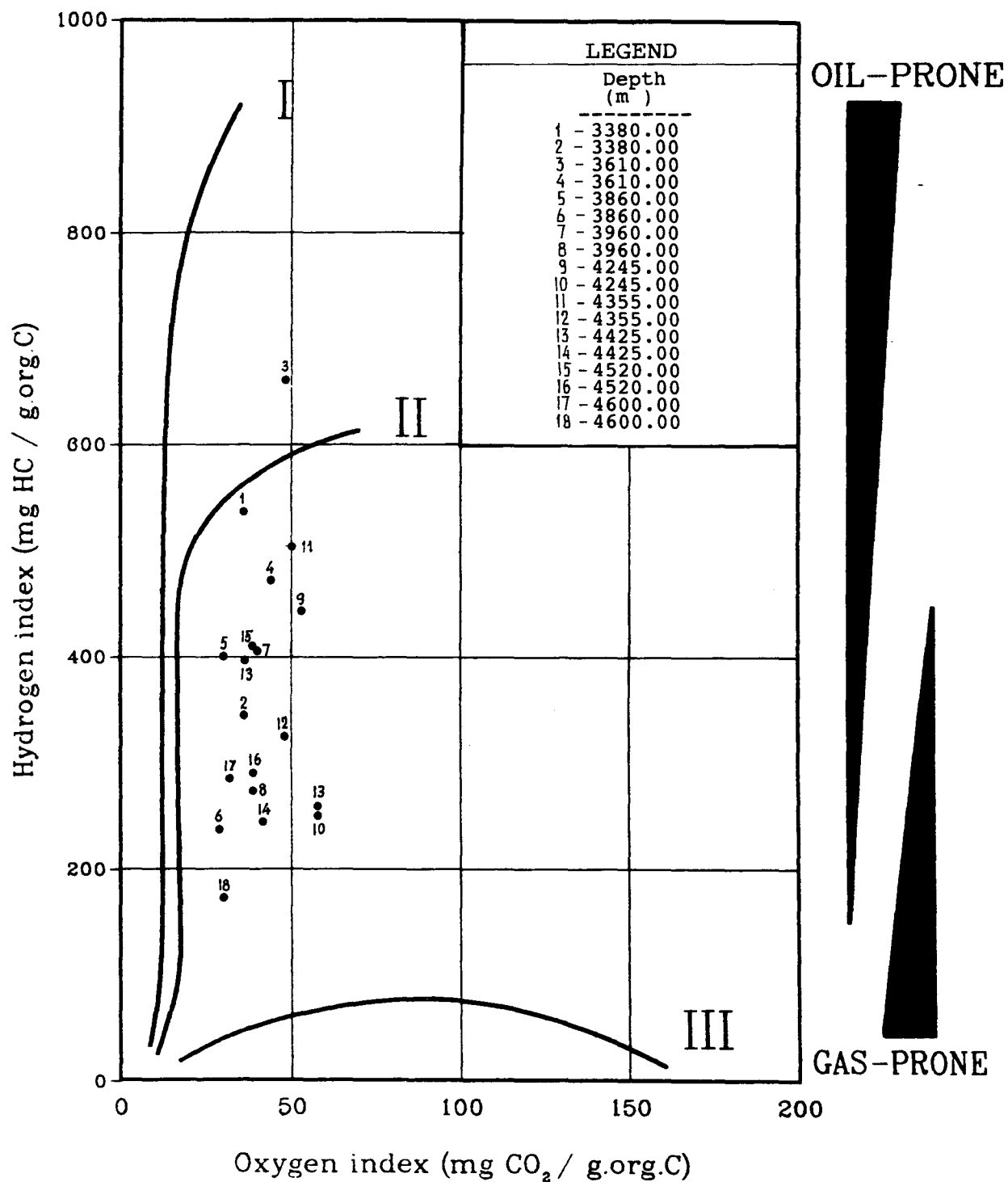
Well/Outcrop : 214/29-01

Depth (m)	Sample Type	Formation name	TOC (w%)	S-1 peak	S-2 peak	S-3 peak	Hydr. index	Oxyg. index	Tmax deg C	Prod. index
3380.00	C		1.4	29.74	7.53	0.50	538	36	425	0.80
3380.00	C		1.4	0.81	4.81	0.51	344	36	428	0.14
3610.00	C		1.6	31.82	10.56	0.77	660	48	431	0.75
3610.00	C		1.6	0.73	7.57	0.71	473	44	431	0.09
3860.00	C		2.2	32.39	8.79	0.67	400	30	422	0.79
3860.00	C		2.2	0.75	5.19	0.64	236	29	426	0.13
3960.00	C		2.1	26.22	8.54	0.84	407	40	427	0.75
3960.00	C		2.1	0.66	5.76	0.81	274	39	433	0.10
4245.00	C		1.7	26.09	7.49	0.89	441	52	424	0.78
4245.00	C		1.7	0.66	4.24	0.99	249	58	432	0.13
4355.00	C		2.1	31.67	10.60	1.04	505	50	428	0.75
4355.00	C		2.1	1.01	6.81	1.01	324	48	431	0.13
4425.00	C		2.0	30.03	7.96	0.72	398	36	425	0.79
4425.00	C		2.0	0.97	5.15	0.83	258	42	433	0.16
4520.00	C		2.5	31.14	10.25	0.97	410	39	427	0.75
4520.00	C		2.5	1.06	7.33	0.94	293	38	434	0.13
4600.00	C		2.0	19.90	5.69	0.64	285	32	419	0.78
4600.00	C		2.0	0.48	3.42	0.60	171	30	425	0.12

ROCK EVAL DATA AND CLASSIFICATION OF KEROGEN TYPES

Well/Outcrop : 214/29_1

UK



MACERAL DESCRIPTION OF WELL/OUTCROP

United Kingdom, 214/29-01

Date : 30-NOV-94

Sample(s)

3610.00 m/C
3960.00 m/C
4355.00 m/C
4520.00 m/C

ORGANIC MATTER																									MINERAL MATTER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																						
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L E G E N D	
*	ABUNDANT
+	COMMON
/	FEW
-	RARE

Listing of Comment lines

Country : United Kingdom (208)
Well/Outcrop : 214/29-01 (208/0749)
Order seq.nr. : ALL orders

Depth (m)	Sample Type	Comment
3610.00 (S 165715)	C	SOM partly micrinised Sample slightly oxidised Rare glauconite (Dark)yellow fluorescence -> probably mature
3960.00 (S 165721)	C	SOM micrinised Sample slightly oxidised Desmocollinite grades into (semi-)fusinite Fossil remains Contaminated Rare foraminifera Rare cement particles
4355.00 (S 165726)	C	SOM micrinised Sample slightly oxidised Contaminated Few bit-metamorphism or mud invasion ?
4520.00 (S 165730)	C	SOM micrinised Contaminated Rare cement particles Few bit-metamorphism or mud invasion ?

Sample(s)

3610.00	m/c
3960.00	m/c
4355.00	m/c
4520.00	m/c

ORGANIC MATTER														MINERAL MATTER			
SOM		LOAD BEARING				VITRINITE		LIPTINITE				INERTINITE		MINERAL MATTER			
		DENSE															
		LAYERS															
		LENSES															
		DIFFUSE / INTERGRANULAR				NON-L. B.											
		LAYERS / LENSES TELOCOLLINITE				VT.-1											
		DETRITAL TELOCOLLINITE															
		LAYERS / LENSES TELINITE															
		DETRITAL TELINITE				VT.-2											
		LAYERS / LENSES DESMOCOLLINITE															
		DETRITAL DESMOCOLLINITE															
		SPORINITE (MICRO-)															
		SPORINITE (MEGA-)															
		CUTINITE															
		SUBERINITE															
		RESINITE (+ FLUORINITE)															
		LIPTODETRINITE				ALGAE											
		BOTRYOCOCCUS															
		TASMANITES															
		OTHER ALGAE															
		MICROPLANKTON															
		EXSUDATINITE (FLUORESCING)															
		EXSUDATINITE (NON-FLUORESING) S.HYDR.															
		SCLEROTINITE															
		(SEMI-) FUSINITE (+, INERTODETRINITE)															
		MICRINITE (+ OXY-MICRINITE)															
		UNDEFINED MINERALS															
		FRAMBOIDAL PYRITE															
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