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HYDROCARBON EVALUATION OF CORE SAMPLES FROM WELL 31/6-2

CLIENT/ OPPDRAGSGIVER

Statoil

RESPONSIBLE SCIENTIST/ PROSJEKTANSVARLIG

Ger van Graas

AUTHORS/ FORFATTERE

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SUMMARY/ SAMMENDRAG

Hydrocarbon evaluation was performed on three core samples from well 31/6-2. A limited analytical program was carried out. The samples contain small amounts of migrated material. Gas chromatography of the saturated and aromatic hydrocarbon fractions show that sample B-2845 (1571m) is richest in migrated material.

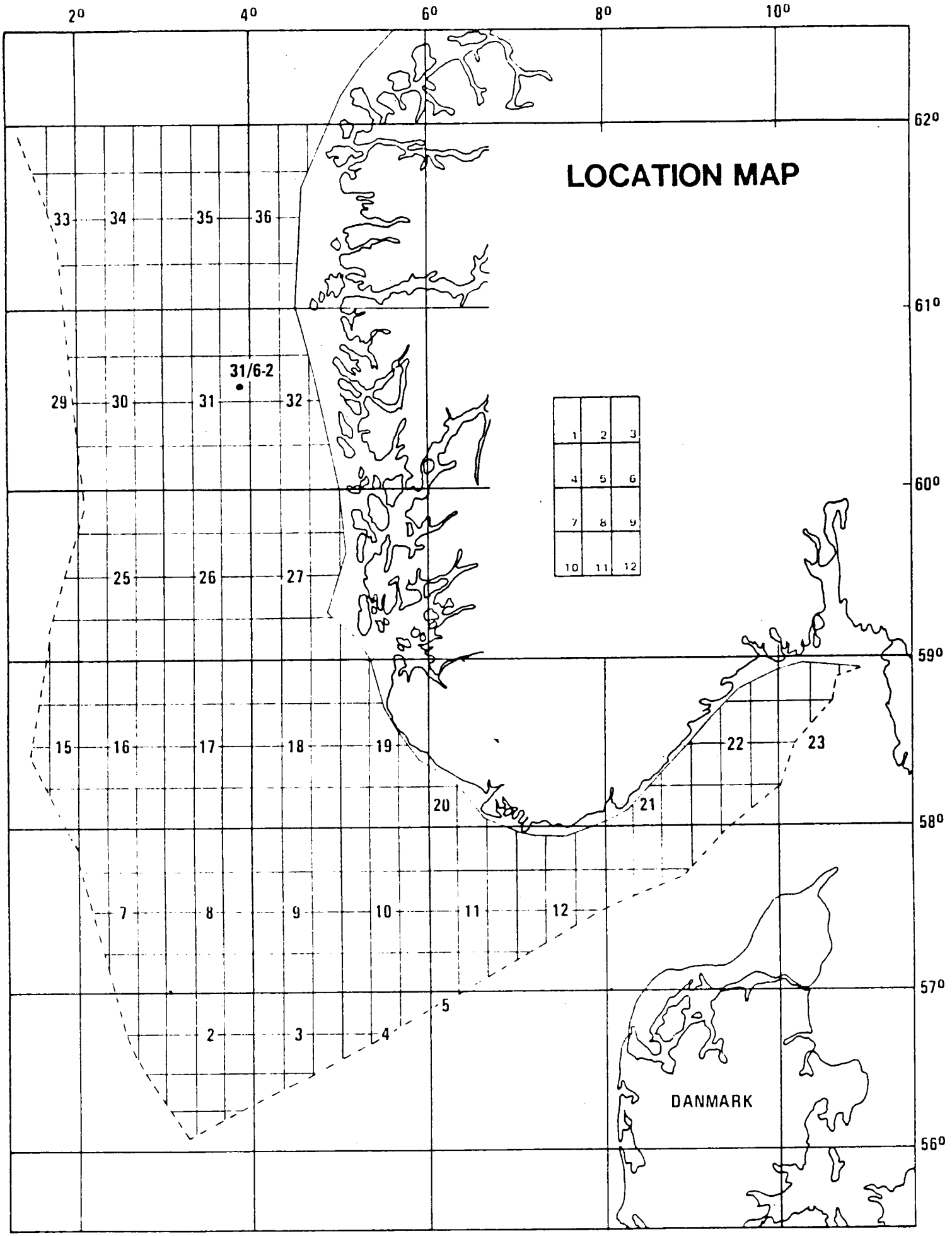
KEY WORDS/ STIKKORD
Troll 31/6-2
Hydrocarbon evaluation

CONTENTS

1. INTRODUCTION

Three sandstone cores from the Upper Jurassic Sognefjord Formation of well 31/6-2 (figure 1) were received for hydrocarbon characterisation. As no oil shows have been recorded a limited analytical program was carried out. The following analyses were performed: extraction, asphaltene precipitation, MPLC separation, gas chromatography of saturated and aromatic hydrocarbons.

Figure 1. Location of well 31/6-2.



2. EXPERIMENTAL

2.1 Extractable Organic Matter

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

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

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

2.2 Chromatographic Separation

Asphaltenes were precipitated by dilution of the EOM with a 40 times excess amount n-pentane.

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

2.3 Gas Chromatographic Analysis

The saturated hydrocarbon fractions were diluted with n-hexane and analysed on a HP 5730A or a HP 5790 GC. Both GC's are equipped with 15m DB-1 fused silica columns and hydrogen (ca. 2.5 ml/min.) is used as carrier gas. Injections are performed in split mode (split ratio 1:10). The temperature program applied is 80^{o}C (2 min.) to 280^{o}C at 4^{o}C/min.

The total aromatic fractions were, after dilution with n-hexane, analysed on a Carlo Erba Fractovap Series 2150 GC or a HP 5730 A GC. Both GC's are equipped with 30m DB-5 fused silica columns, and hydrogen (2.5 ml/min.) is used as carrier gas. The temperature program applied is 80^{o}C (2 min.) to 280^{o}C at 4^{o}C/min. on both systems. Injections are

performed splitless on the Carlo Erba GC, while split injections (split ratio 1:10) are used on the HP 5730 A GC.

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

3. RESULTS AND DISCUSSION

3.1 Extraction and MPLC separation

Based on the expected low extract amounts 200 gr of the samples were extracted. The results of extraction and MPLC separation are presented in tables 1-4.

Two of the cores, B-3181 and B-2845, showed clayey layers, this is reflected by the higher TOC values of these samples.

Extract amounts, expressed as ppm/rock wgt (table 2), classify the samples as poor (B-3181 and B-2846) to fair (B-2845). Normalized on TOC content (table 3) the extract amounts range from poor (B-3181) to fair (B-2845 and B-2846) but this classification is used mainly for source rock classification and has only limited value for reservoir rocks.

The hydrocarbon fractions in all samples are small, between 23 and 38% of EOM (table 4). Migrated material is normally characterized by significantly larger hydrocarbon fractions (>50%) due to the loss of polar compounds during migration.

3.2 Gas chromatography of saturated hydrocarbons

All samples show a major contribution in the C_{12}-C_{20} hydrocarbon range (fig. 2). These compounds represent material of a fairly high maturity based on the n-alkane distribution and on several compound ratios (table 5). These parameters indicate a higher maturity than was encountered at this depth level during the source rock evaluation (IKU report 05.0198.04/1/84).

The C_{23}-C_{35} hydrocarbon range of the chromatograms represents a contribution from indigenous material.

The relative amounts of the C_{12}-C_{20} and the C_{23}-C_{35} fractions indicate that B-2845 has the largest contribution from migrated hydrocarbons followed by B-2846.

3.3 Gas chromatography of aromatic hydrocarbons

All chromatograms show a set of compounds at the higher end of the chromatograms where the aromatic steranes elute, indicating indigenous material (fig. 3). The lower part of the chromatogram containing the compounds that migrate most easily, is best developed in B-2845.

The lower part of the chromatogram indicates the presence of migrated material from a more mature source than the sediments at this depth. This is e.g. shown by the predominance of 2-methylnaphthalene over 1-methylnaphthalene suggesting a maturity of well over 1% vitrinite reflectance (Radke et al., Geochim. Cosmochim. Acta 46, 1831-1848). This predominance is again strongest in B-2845. The distribution pattern of the methylphenanthrenes is suggesting a low maturity but a detailed inspection of the chromatograms shows that unknown compounds are coeluting with the 1- and 9-methyl isomers, thus making them unsuitable for maturity estimation.

4. CONCLUSION

Based on the limited analytical program only a few conclusions on the presence of migrated hydrocarbons can be drawn.

The amount of hydrocarbons (indigenous and/or migrated) is relatively low in all samples. Both the low extract amounts and the extract compositions are suggesting that only minor amounts of migrated material are present.

The gas chromatograms of the saturated and aromatic hydrocarbons suggest contributions from both indigenous and migrated material. The amount of migrated material is highest in B-2845 (1571m).

T A B L E : 1.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

IKU-No	DEPTH (m)	Rock Extr. (g)	EOM (mg)	Sat. (mg)	Aro. (mg)	HC (mg)	Non HC (mg)	TOC (%)
B 3181	1569.95	200.0	20.3	2.9	1.7	4.6	15.7	0.82
B 2845	1571.30	205.0	64.6	10.3	14.3	24.6	40.0	0.95
B 2846	1588.10	184.5	11.5	1.4	2.2	3.6	7.9	0.19

DATE : 23 - 5 - 84.

T A B L E : 2.

WEIGHT OF EOM AND CHROMATOGRAPHIC FRACTIONS

(Weight ppm OF rock)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
B 3181	1569.95	101	15	9	23	79
B 2845	1571.30	315	50	70	120	195
B 2846	1588.10	62	8	12	20	43

DATE : 23 - 5 - 84.

T A B L E : 3.

CONCENTRATION OF EOM AND CHROMATOGRAPHIC FRACTIONS

(mg/g TOC)

IKU-No	DEPTH (m)	EOM	Sat.	Aro.	HC	Non HC
B 3181	1569.95	12.4	1.8	1.0	2.8	9.6
B 2845	1571.30	33.2	5.3	7.3	12.6	20.5
B 2846	1588.10	32.8	4.0	6.3	10.3	22.5

DATE : 23 - 5 - 84.

T A B L E : 4.

COMPOSITION IN % OF MATERIAL EXTRACTED FROM THE ROCK

IKU-No	DEPTH (m)	Sat / EOM	Aro / EOM	HC / EOM	SAT / Aro	Non HC / EOM	HC / Non HC
B 3181	1569.95	14.3	8.4	22.7	170.6	77.3	29.3
B 2845	1571.30	15.9	22.1	38.1	72.0	61.9	61.5
B 2846	1588.10	12.2	19.1	31.3	63.6	68.7	45.6

DATE : 23 - 5 - 84.

T A B L E 5.

TABULATION OF DATA FROM THE GASCHROMATOGRAMS

IKU No.	DEPTH (m)	PRISTANE / n-C17	PRISTANE / PHYTANE	CPI
B 3181	1569.95	0.6	1.8	1.0
B 2845	1571.30	0.7	2.2	0.7
B 2846	1588.10	0.5	2.1	1.0

DATE : 1 - 6 - 84.

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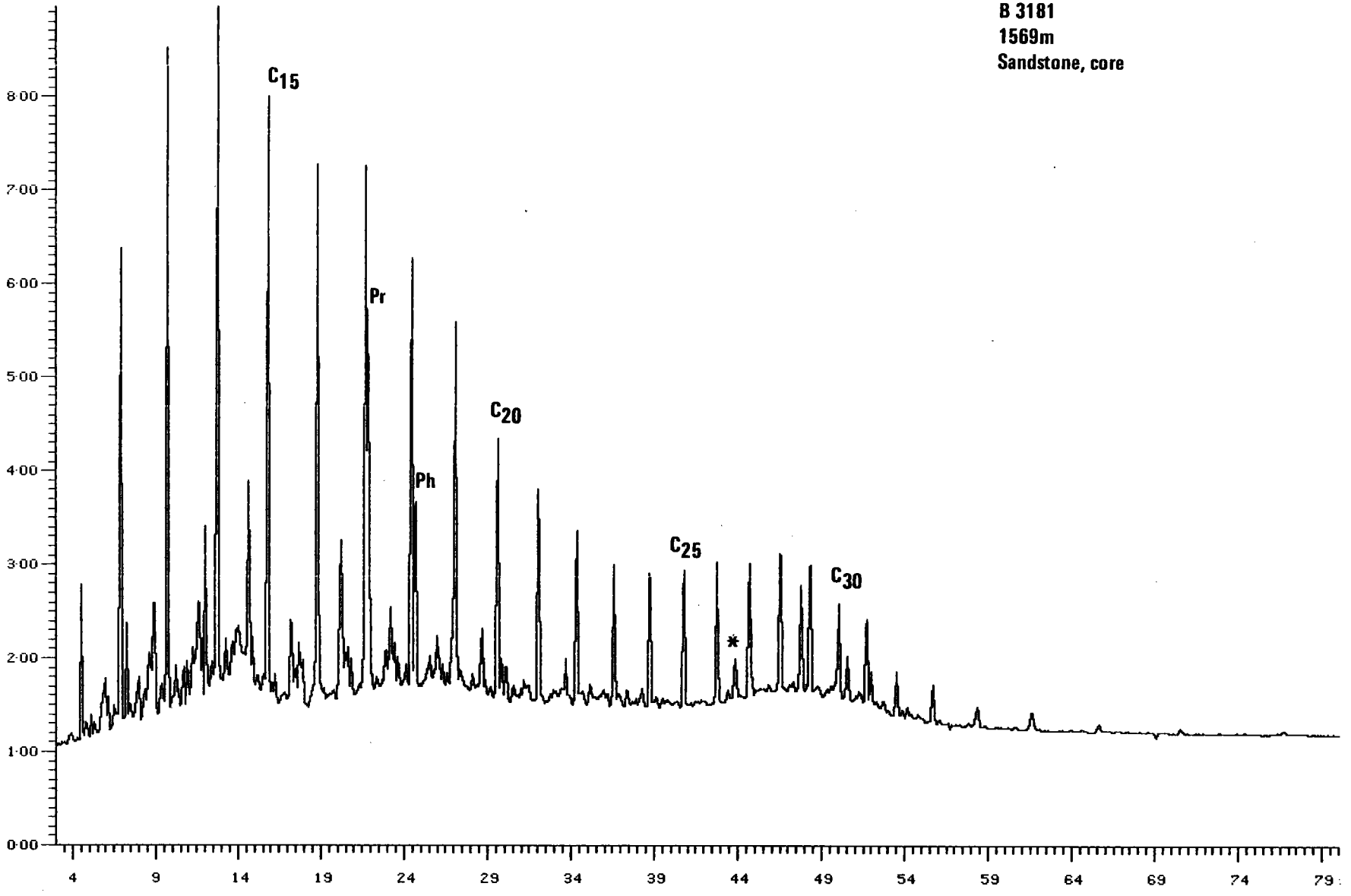
Figure 2

Gas chromatograms of C_{15}^{+}
saturated hydrocarbons

Pr - pristane
Ph - phytane
* - contaminant

Created at 12:22 on 11/May/84
RAW DATA PLOT-CHANNEL 2
Data Scale Plot Box 1 of 1
Analysis :198B3181S Sample £: 1 Injection £: 1
Sample Name :B-3181,SAT,KA Maximum signal (%) :8.961



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RAW DATA PLOT-CHANNEL 2
Data Scale Plot Box 1 of 1
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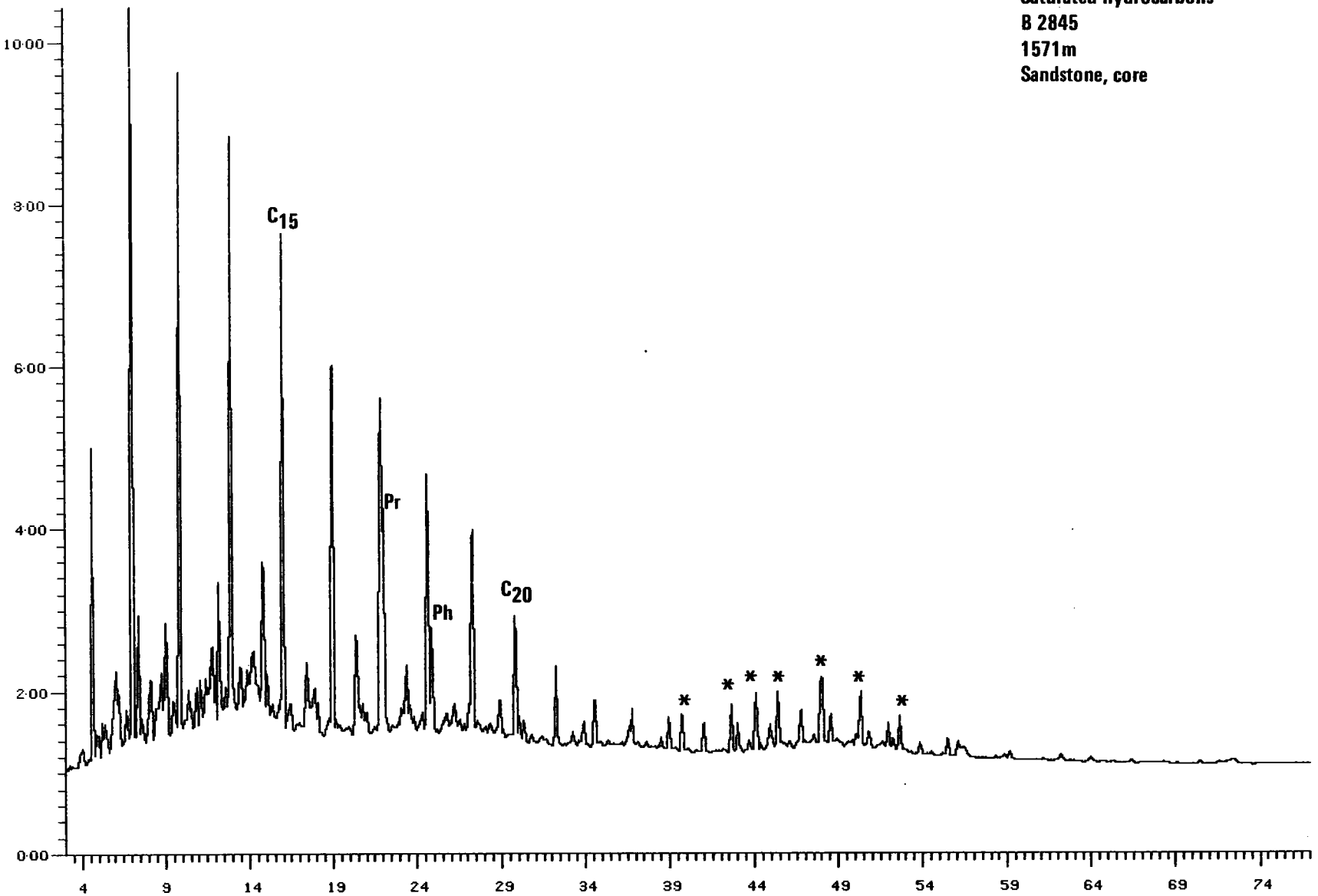
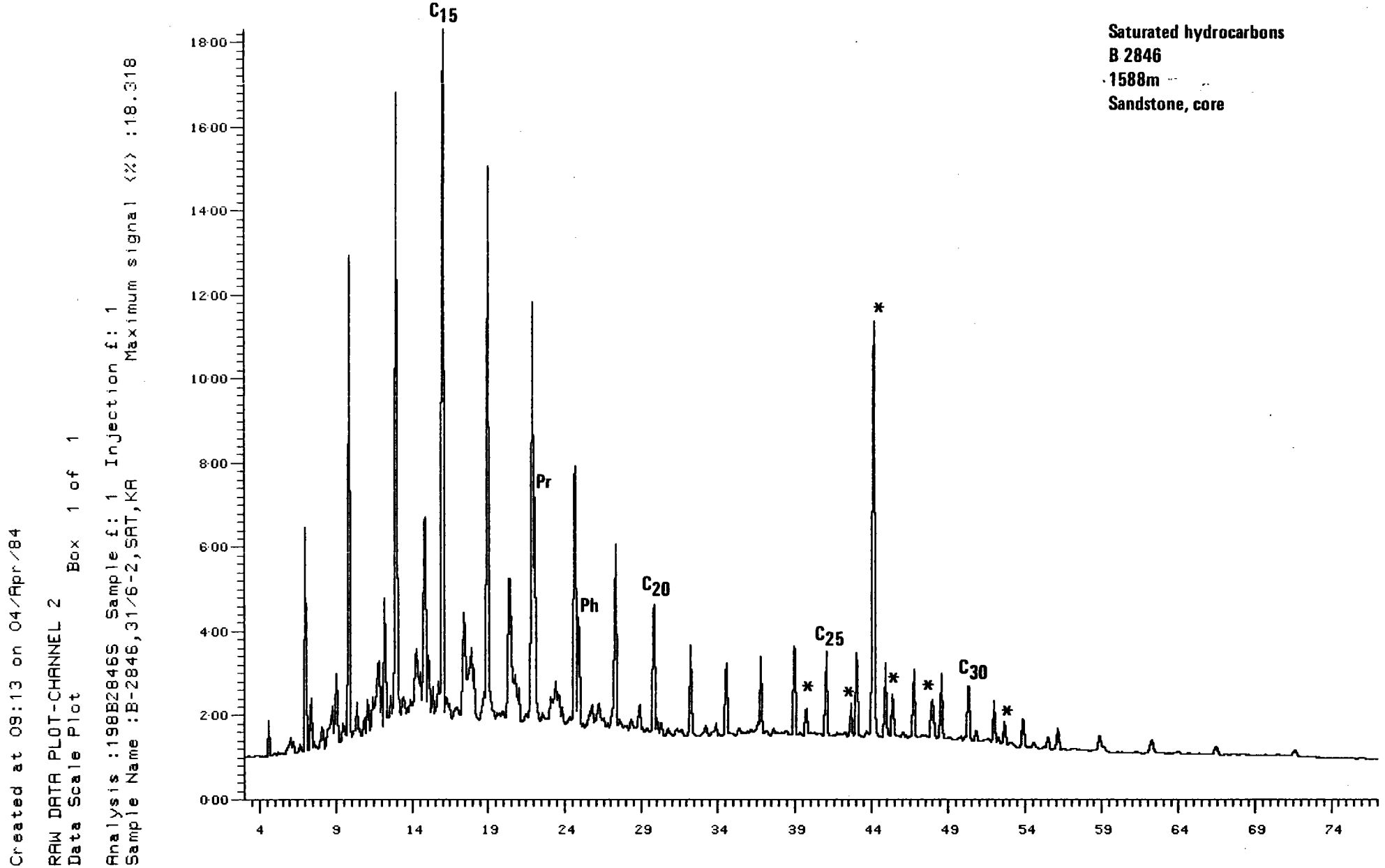
Sample Name :B-2845,31/6-2,SAT,KA Maximum signal (%) :10.433



Saturated hydrocarbons
B 2845
1571m
Sandstone, core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RAW DATA PLOT-CHANNEL 2
Data Scale Plot
Box 1 of 1
Analysis :198B2846S Sample f: 1 Injection f: 1
Sample Name :B-2846,31/6-2,SAT,KA
Maximum signal (%) :18.318
Saturated hydrocarbons
B 2846
1588m
Sandstone, core
C15
Pr
Ph
C20
C25
C30
*
18·00
16·00
14·00
12·00
10·00
8·00
6·00
4·00
2·00
0·00
4
9
14
19
24
29
34
39
44
49
54
59
64
69
74

Figure 3

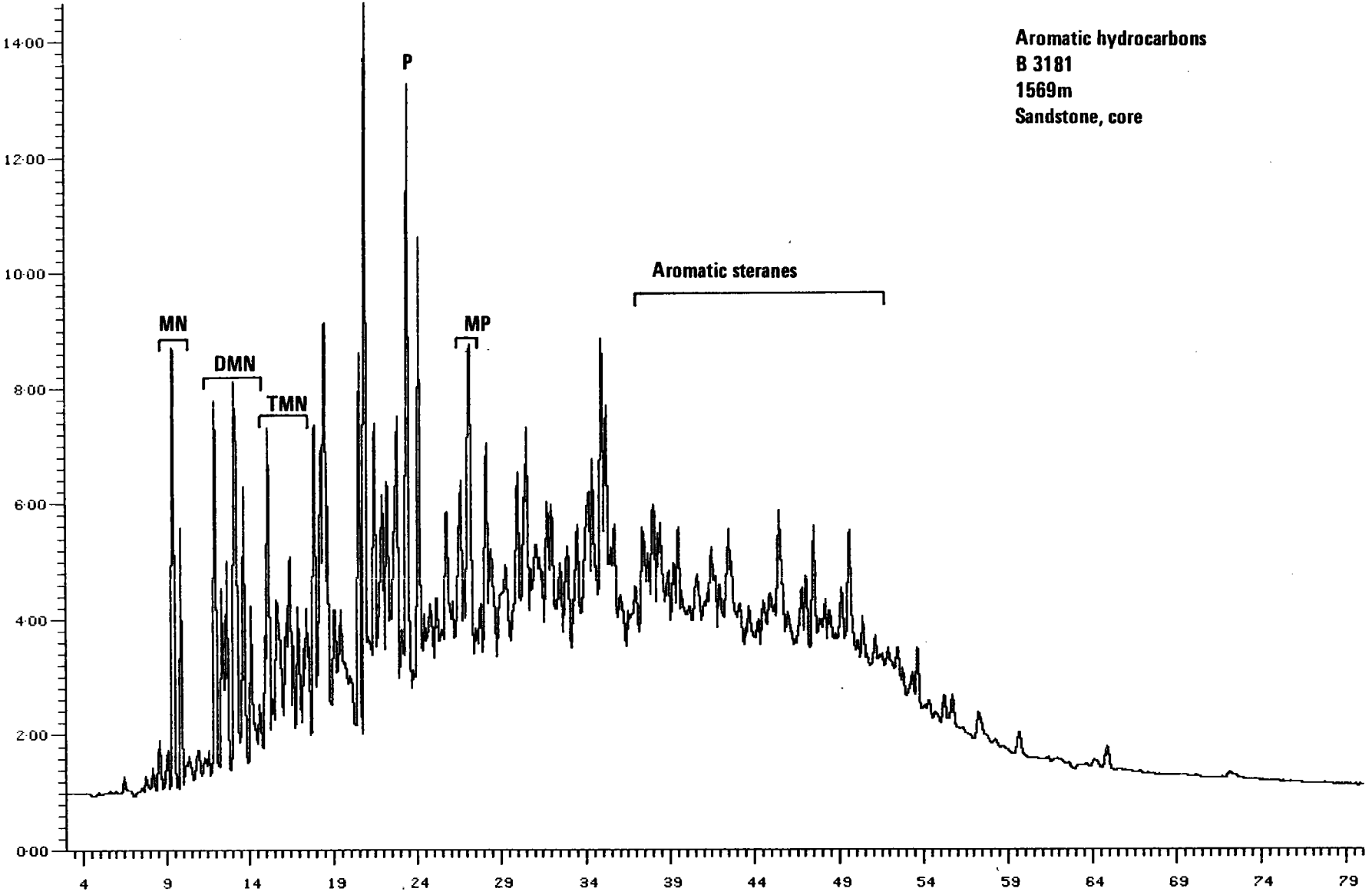
Gas chromatograms of C_{15}^+ aromatic hydrocarbons

N - naphthalene
MN - C_1-naphthalenes
DMN - C_2-naphthalenes
TMN - C_3-naphthalenes
P - phenanthrene
MP - C_1-phenanthrenes
DMP - C_2-phenanthrenes

Created at 13:59 on 11/May/84

RAW DATA PLOT-CHANNEL 2
Data Scale Plot Box 1 of 1

Analysis :198B3181A Sample £: 1 Injection £: 1
Sample Name :B-3181,ARO,KA Maximum signal (%) :14.674



Aromatic hydrocarbons
B 3181
1569m
Sandstone, core

Created at 09:16 on 04/Apr/84
RAW DATA PLOT-CHANNEL 2
Data Scale Plot Box 1 of 1
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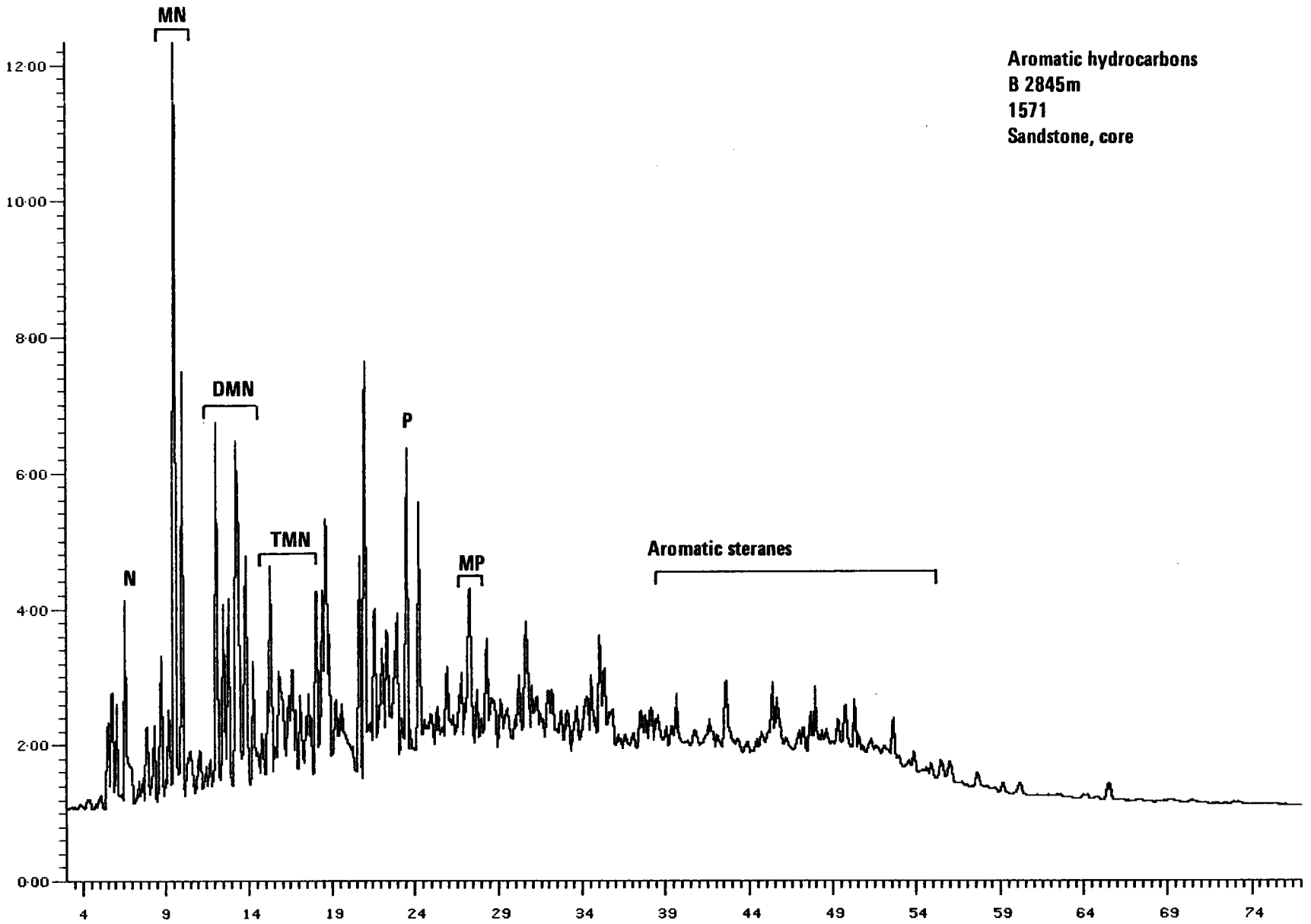
Sample Name :B-2845,31/6-2,ARO,KA Maximum signal (%) :12.345



Aromatic hydrocarbons
B 2845m
1571
Sandstone, core

Created at 08:25 on 05/Apr/84

RAW DATA PLOT-CHANNEL 2
Data Scale Plot Box 1 of 1

Analysis :198B2846A Sample £: 1 Injection £: 1
Sample Name :B-2846,31/6-2,ARO,KA Maximum signal (%) :7.583