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GEOCHEMICAL INVESTIGATION OF SIX CORE SAMPLE
EXTRACTS AND A CRUDE OIL SAMPLE FROM WELL 31/2-8,
NORWAY

by

J.M.A. Buiskool Toxopeus and J. Posthuma



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KONINKLIJKE / SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM

RIJSWIJK, THE NETHERLANDS

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Investigation 95.34.92

With co-operation from Ms. A. Faber

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GEOCHEMICAL INVESTIGATION OF SIX CORE SAMPLE EXTRACTS
AND A CRUDE OIL SAMPLE FROM WELL 31/2-8, NORWAY

1. RESULTS AND DISCUSSION

A geochemical investigation has been carried out on a crude oil sample (rft sample 1849 m) and on six core samples (1843.4-1852.9 m) with oil shows. The results are shown in Tables 1-3 and in Figures 1-13. The results indicate the following:

- 1.1 The 1 liter mud fluid sample from 1849 m contained 25 ml crude oil after centrifuging. The six core samples (1843.4-1852.9 m) are all impregnations (extract/carbon ratios of 10.8-114.0).
- 1.2 Crude oil sample 1849 m has been bacterially degraded (C_7 -alkane distribution, Fig. 8; gas chromatogram, Fig. 5; API gravity).
- 1.3 The shape of the gas chromatogram (Fig. 5) and the DOM of oil of 65 indicate that the crude was derived from a mature source rock. This is confirmed by the gross composition and the mature sterane/triterpane distribution (Fig. 12). It should be noted that the DOM of oil is susceptible to bacterial degradation which lowers the figure. Although the oil has been bacterially degraded the GC indicates that the degradation was not severe enough to largely affect the DOM of oil.
- 1.4 The crude oil was derived from a source rock which contained predominantly structureless organic matter - SOM - (gas chromatogram, Fig. 5; parameter M_2 , Fig. 10). As the crude has been bacterially degraded no definite conclusions from the parameter M_1 could be drawn. The sterane/triterpane fragmentograms indicate that the variety of SOM was bacterially reworked phytoplankton (Fig. 12).
- 1.5 The impregnations from core samples 1843.4 and 1844.9 m are not - or probably lightly - bacterially degraded (gas chromatograms, Figs. 1-2; DOM of oil values of 68; gross composition - see also results of the sample 1849 m). The impregnation in sample 1847.2 m is bacterially degraded (gas chromatogram, Fig. 3; lower DOM of oil value of 61; gross composition; triterpane fragmentogram, Fig. 11). The impregnations from samples 1848.8, 1850.3 and 1852.9 m are heavily bacterially degraded (gas chromatograms, Figs. 4, 6-7; DOM of oil values of 62-59; gross compositions; triterpane fragmentogram, Fig. 13).

- 1.6 All impregnations were derived from mature source rocks (gas chromatograms, Figs. 1-2; DOM of oil values of 68 of the not or lightly bacterially degraded samples; gross compositions; sterane/triterpane fragmentograms, Figs. 10-11, 13).
- 1.7 The impregnations of all samples were derived from source rocks which contained predominantly structureless organic matter (gas chromatograms, Figs. 1-2; parameter M_2 , Fig. 10). The sterane/triterpane fragmentograms indicate that the SOM was of bacterially reworked phytoplanktonic origin (Figs. 10-11, 13).
- 1.8 Apart from the varying bacterial degradation of the samples, the sterane and the parameter M_2 distributions indicate that the crude oil sample and the impregnations are very similar. All samples were derived from a similar or identical source rock.

2. CONCLUSIONS

One liter fluid mud sample (1849 m), containing 25 ml crude oil, and six core impregnations (1843.4-1852.9 m) from well 31/2-8, Norway, have been geochemically investigated. The crude oil sample 1849 m has been bacterially degraded. The impregnations show a variable degree of bacterial degradation: not or lightly bacterially degraded (1843.4 and 1844.9 m), bacterially degraded (1847.2 m) and heavily bacterially degraded (1848.8, 1850.3, 1852.9 m). All samples were derived from mature source rocks, containing predominantly structureless organic matter of bacterially reworked phytoplanktonic origin. Apart from the varying bacterial degradation the samples are geochemically very similar. They were derived from a similar or identical source rock.

TABLE 1 - GEOCHEMICAL DATA OF CRUDE OILS

Sample Norway 31/2-8
1849 m*

API	21.5
specific gravity	0.9249
%w. boil. <120°C	1.8
% sulphur	0.2
ppm V as metals	< 1
ppm Ni as metals	< 1
pristane/phytane	1.7
pristane/nC17	0.6
phytane/nC18	0.4

C₇-distribution

C ₇ -alkane	
nC7	16
monobranched	67
polybranched	17

C₇-alk/naphthene

nC7	3
naphthenes	80
branched alkanes	17

C₇-alk/naphth/arom

nC7	13
naphthenes	50
aromatics	37

Parameter M₁

A	42
B	41
C	17

Parameter M₂

P	27
Q	46
R	27

DOM of oil	65
------------	----

% saturates**	60
---------------	----

% aromatics	35
-------------	----

% heterocompounds	5
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δ ¹³ C/∞	-31.2***
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* 25 ml crude centrifuged from 1 l mud.

** determined by thin layer chromatography.

*** This value is unreliable since the crude is probably (slightly) contaminated with mud.

TABLE 2 - GEOCHEMICAL DATA OF ROCK EXTRACTS

Sample	31/2-8 1843.4 m	31/2-8 1844.9 m	31/2-8 1847.2 m
% ethyl acetate extract	1.64	1.40	1.38
% organic carbon after ethyl acetate extraction	0.06	0.13	0.04
% sulphur	0.8	0.7	0.5
ppm V as metals	1	<1	1
ppm Ni as metals	<1	<1	<1
pristane/phytane	1.8	1.8	1.9
pristane/nC17	0.6	0.6	0.7
phytane/nC18	0.4	0.4	0.5
Parameter M ₁			
A	45	48	41
B	38	35	40
C	17	17	19
Parameter M ₂			
P	27	27	27
Q	45	45	46
R	28	28	27
DOM of oil	68	68	61
% saturates*	64	66	53
% aromatics	31	29	39
% heterocompounds	5	5	8
$\delta^{13}\text{C}^{\circ}/\text{oo}$	-28.0	-28.0	-28.5
extract/carbon	27.3	10.8	34.5

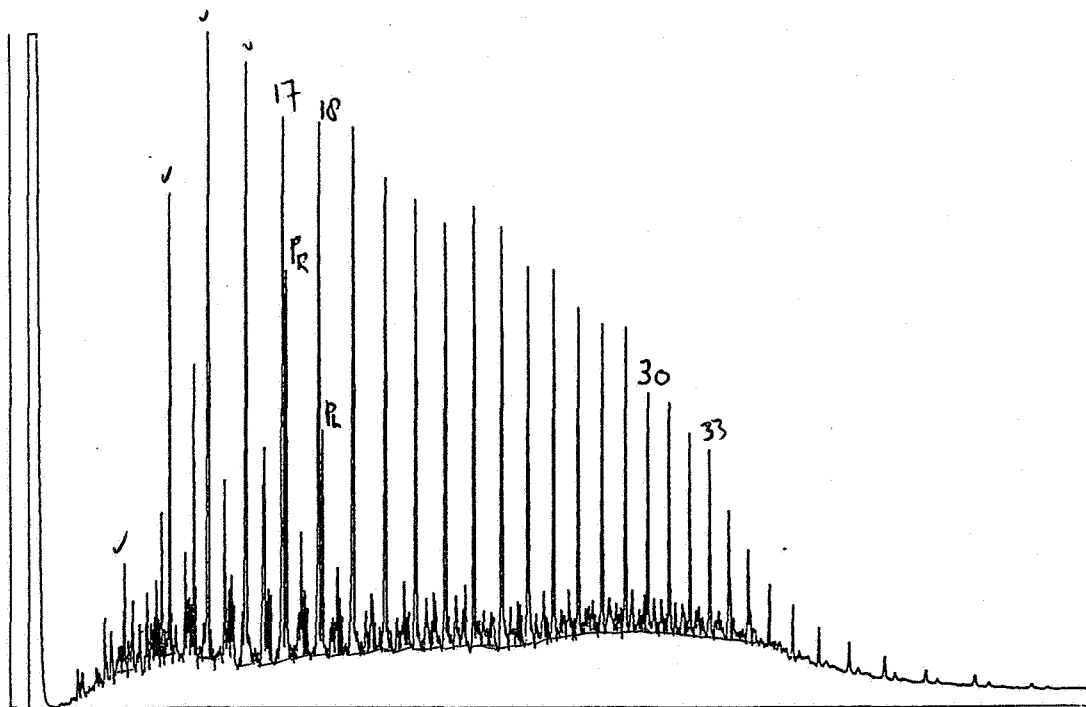
* determined with thin layer chromatography

TABLE 3 - GEOCHEMICAL DATA OF EXTRACTS

Sample	31/2-8 1848.8 m	31/2-8 1850.3 m	31/2-8 1852.9 m
% ethyl acetate extract	2.28	1.89	2.14
% organic carbon after ethyl acetate extraction	0.02	0.04	0.00
% sulphur	0.4	0.5	0.3
ppm V as metals	1	<1	2
ppm Ni as metals	<1	<1	<1
pristane/phytane	ND	ND	ND
pristane/nC17			
phytane/nC18			
Parameter M ₁			
A	34	34	33
B	46	46	46
C	20	20	21
Parameter M ₂			
P	25	27	24
Q	46	45	46
R	29	28	30
DOM of oil	60	62	59
% saturates*	50	46	48
% aromatics	40	43	40
% heterocompounds	10	11	12
$\delta^{13}\text{C}^{\circ}/\text{oo}$	-28.4	-28.4	-28.4
extract/carbon	114.0	47.3	-

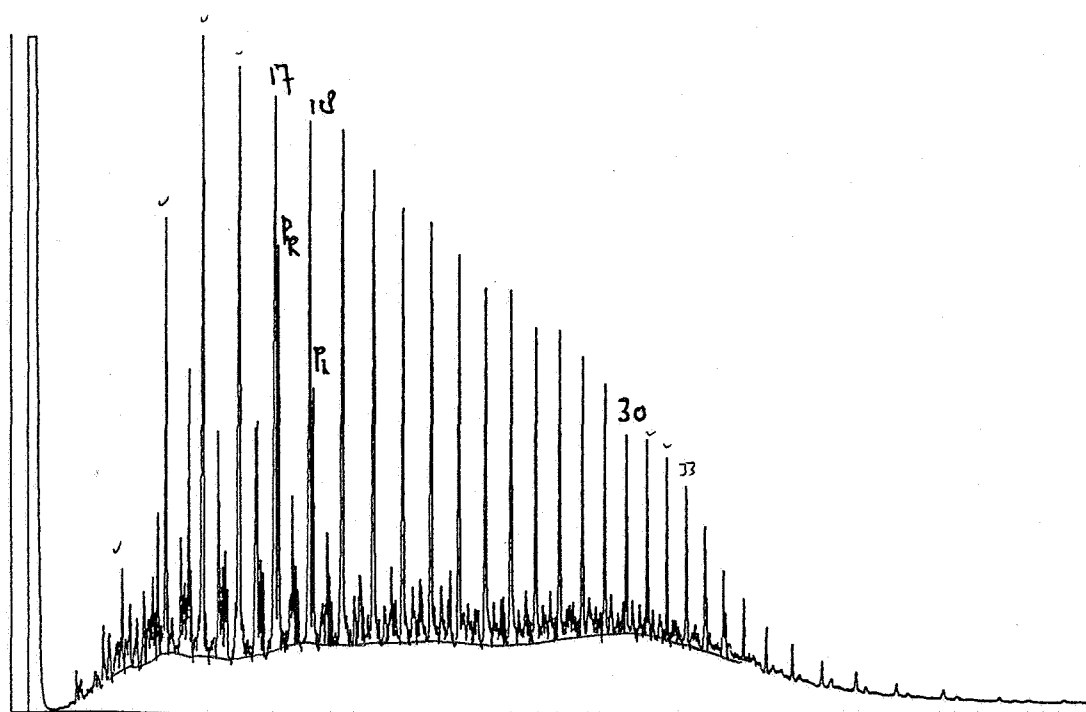
ND = not detectable

* determined with thin layer chromatography



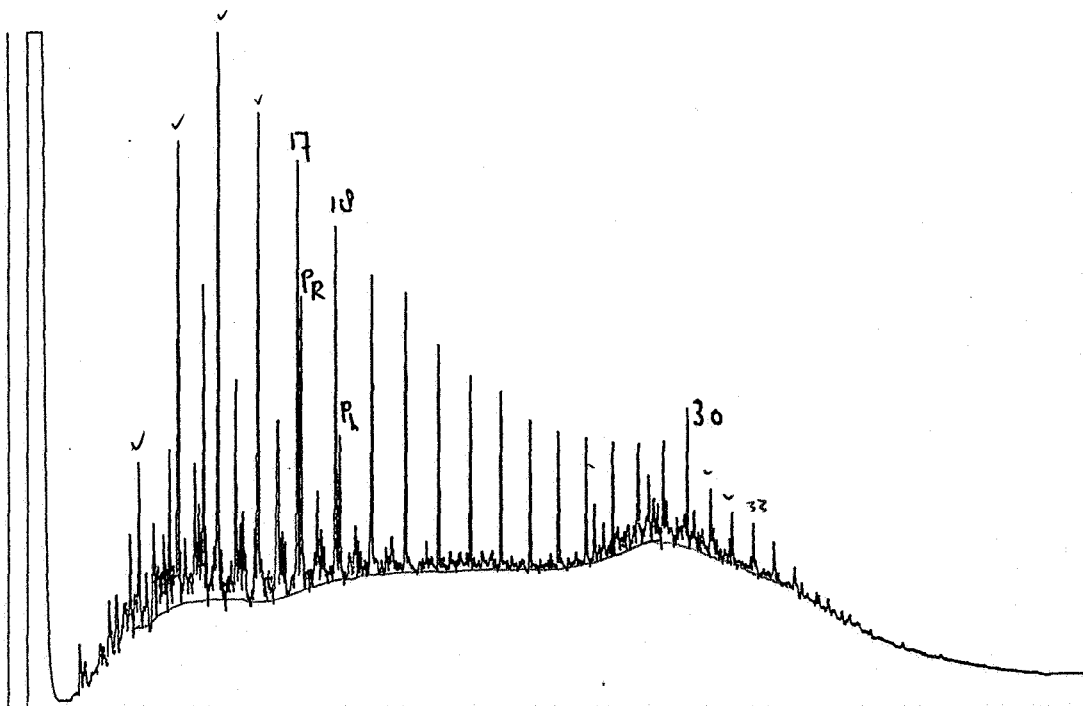
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 1. NORWAY: 31/2-8 1843.3 M **impregnation**



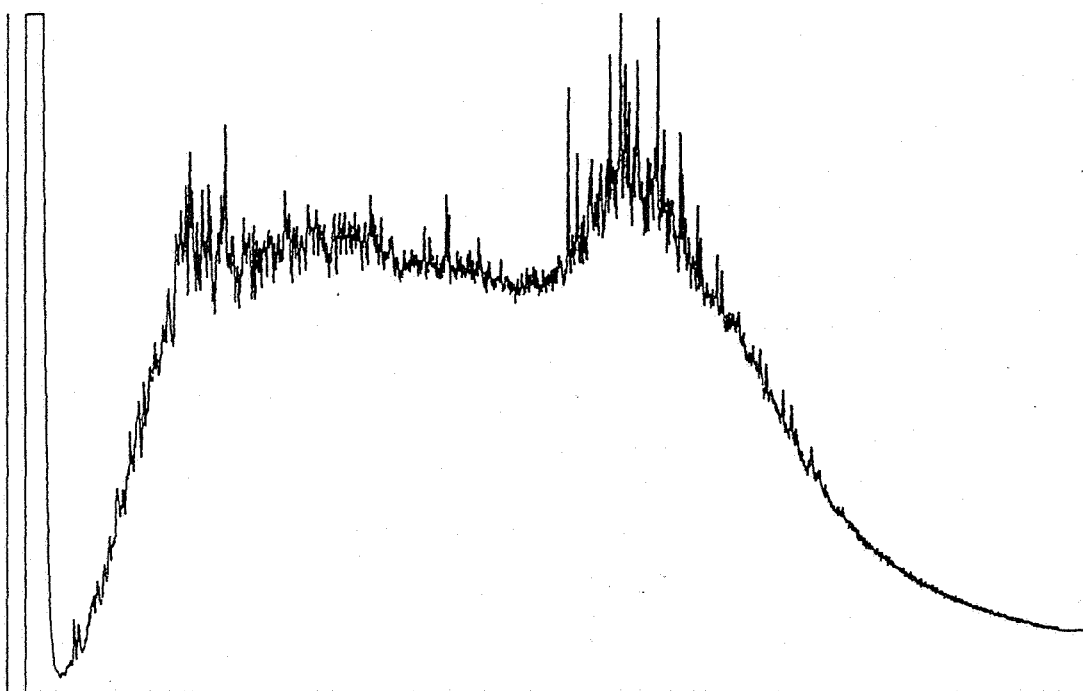
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 2. NORWAY: 31/2-8 1844.9 M **impregnation**



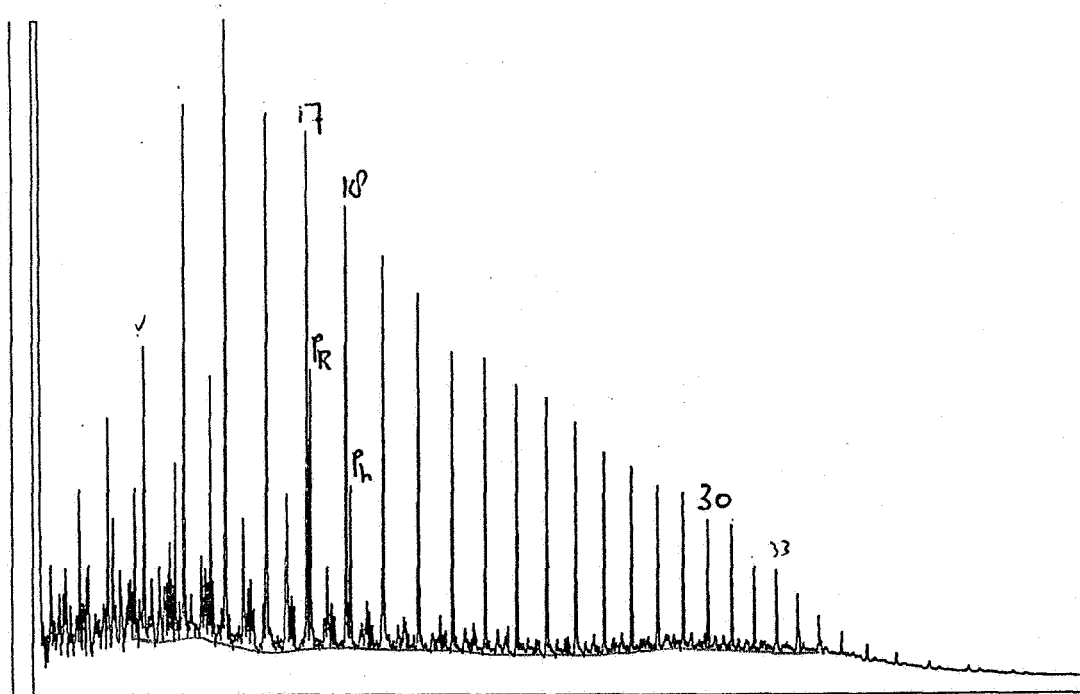
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 3. NORWAY: 31/2-8 1847.2 M **impregnation**



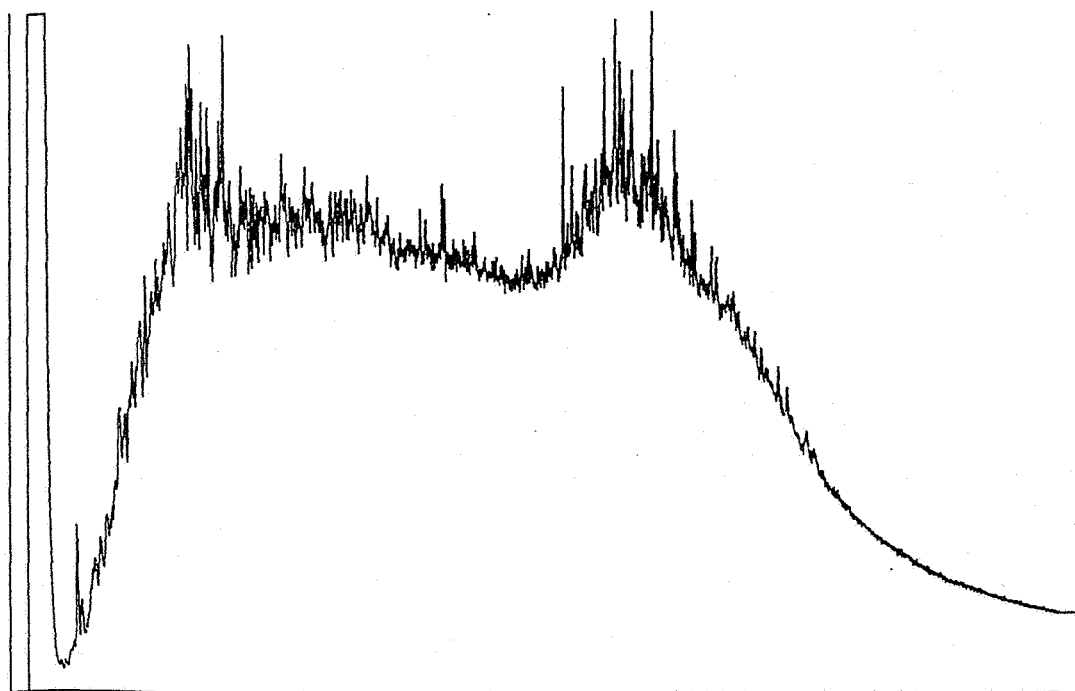
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 4. NORWAY: 31/2-8 1848.8 M **impregnation**



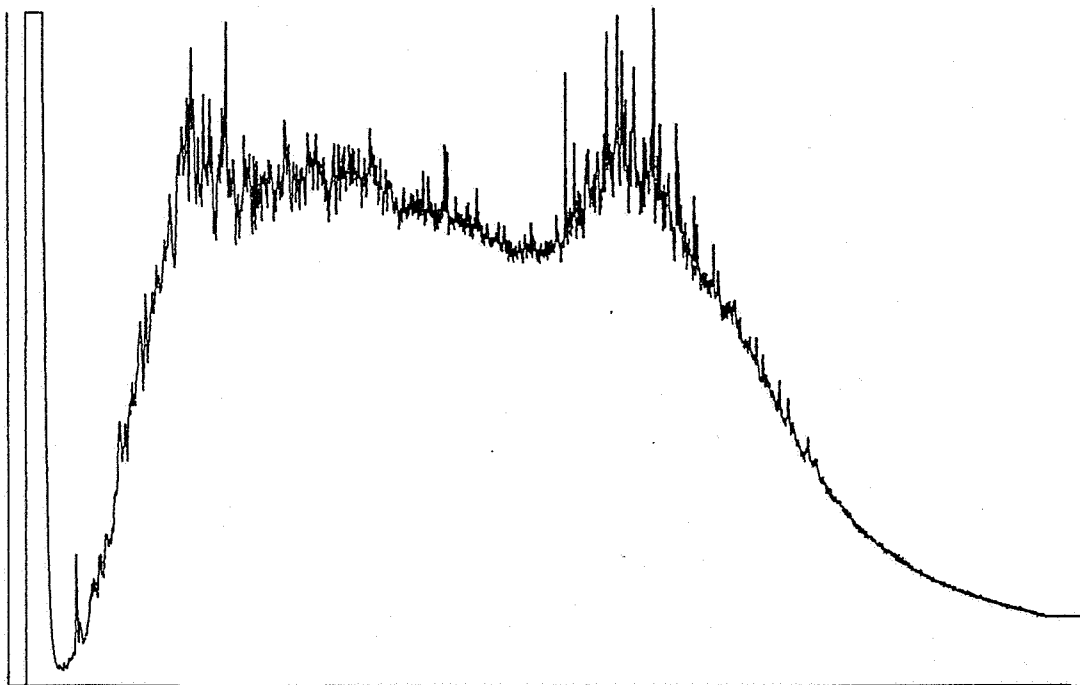
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 5. NORWAY: 31/2-8 1849 M crude oil



GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 6. NORWAY: 31/2-8 1850.3 M impregnation

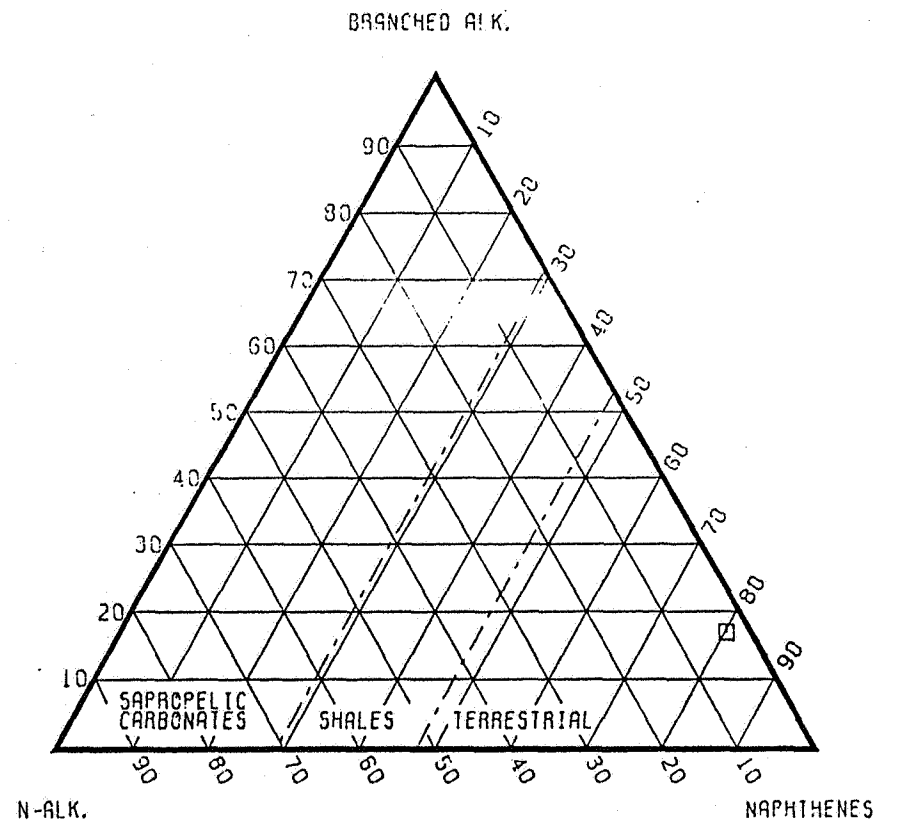
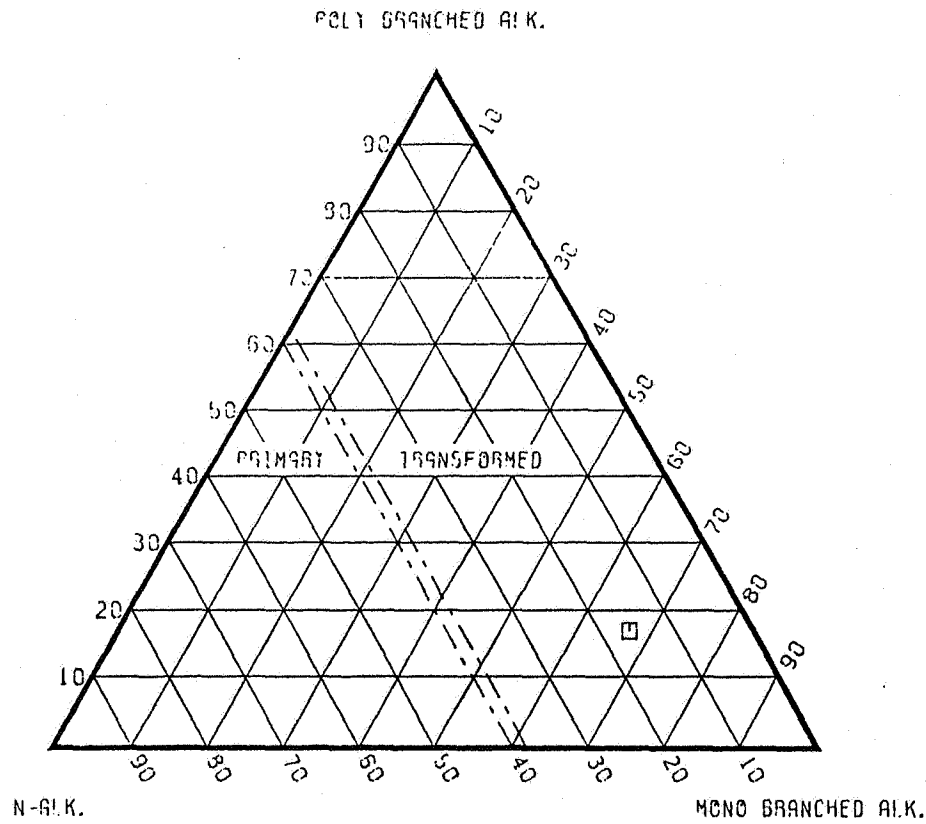


GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 7. NORWAY. 31/2-8 1852.9 M **impregnation**

C7-ALKANE DISTRIBUTION

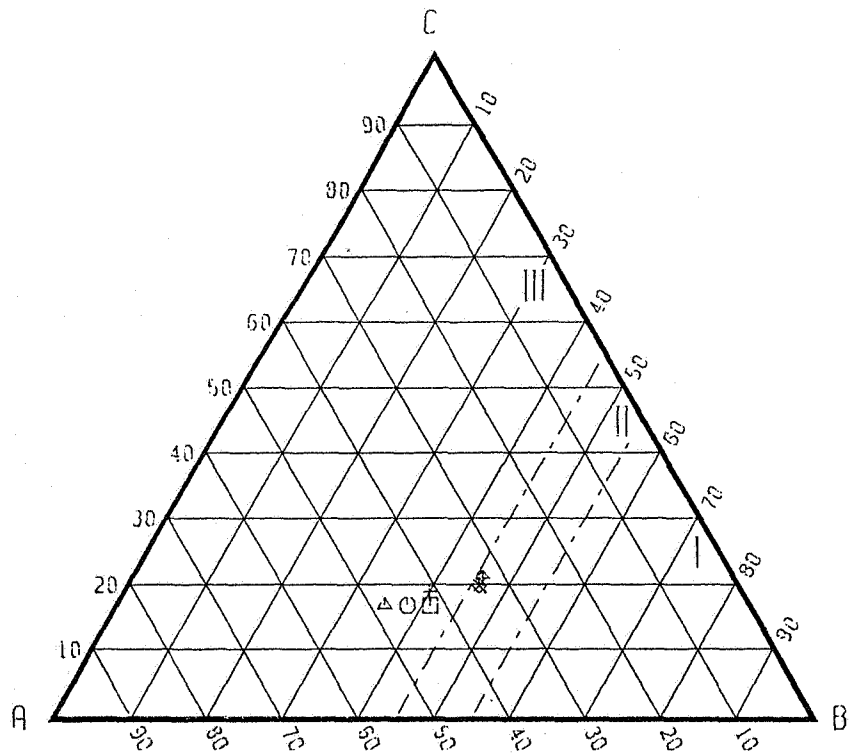
C7-ALKANE/NAPHTHENE DISTRIBUTION



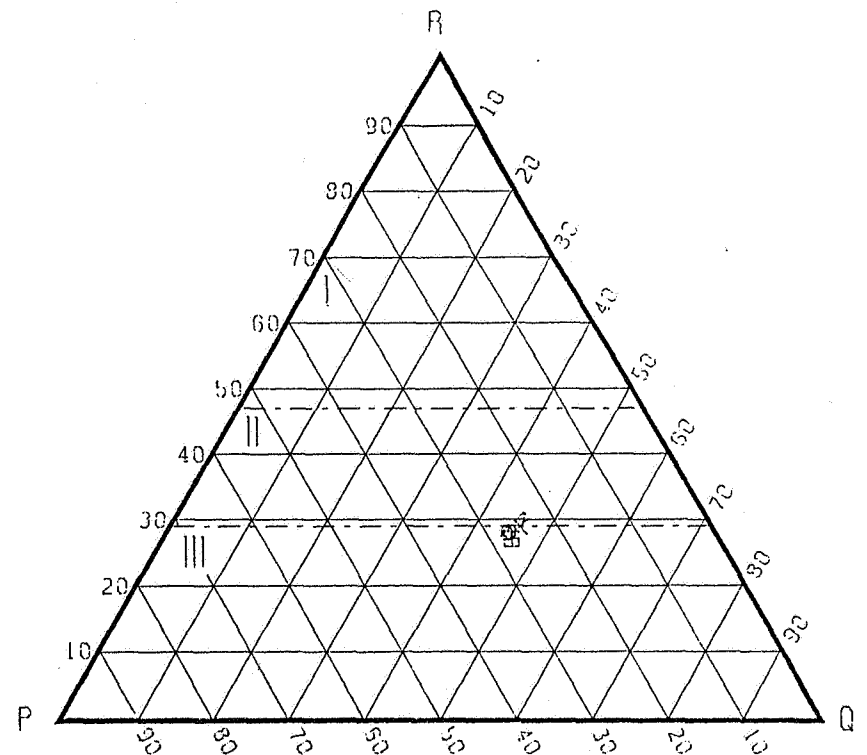
LEGEND	
□ - 31/2-8. 1949 M	crude oil

FIG. 8

PARAMETER M1



PARAMETER M2



- I LANDPLANT-DERIVED CRUDES WITH SUBSTANTIAL RESIN CONTRIBUTION TO SOURCE MATTER
- II CRUDES OF MIXED ORIGIN
- III CRUDES DERIVED FROM SOM AND/OR ALGAL MATTER

LEGEND	
□	- 31/2-8. 1849 M
○	- 31/2-8. 1843. 4 M
△	- 31/2-8. 1844. 9 M
+	- 31/2-8. 1847. 2 M
×	- 31/2-8. 1848. 8 M
◇	- 31/2-8. 1850. 3 M
†	- 31/2-8. 1852. 9 M

FIG. 9

FIG. 10. GC-MS analysis well 31/2-8, 1843.4 m.

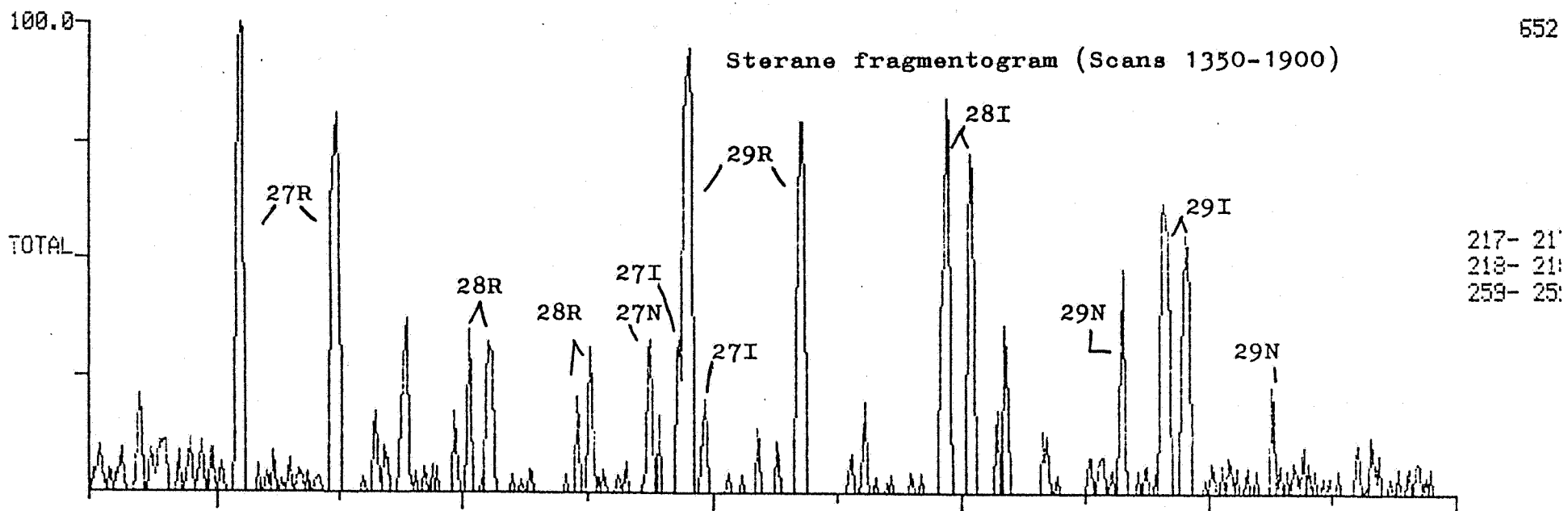
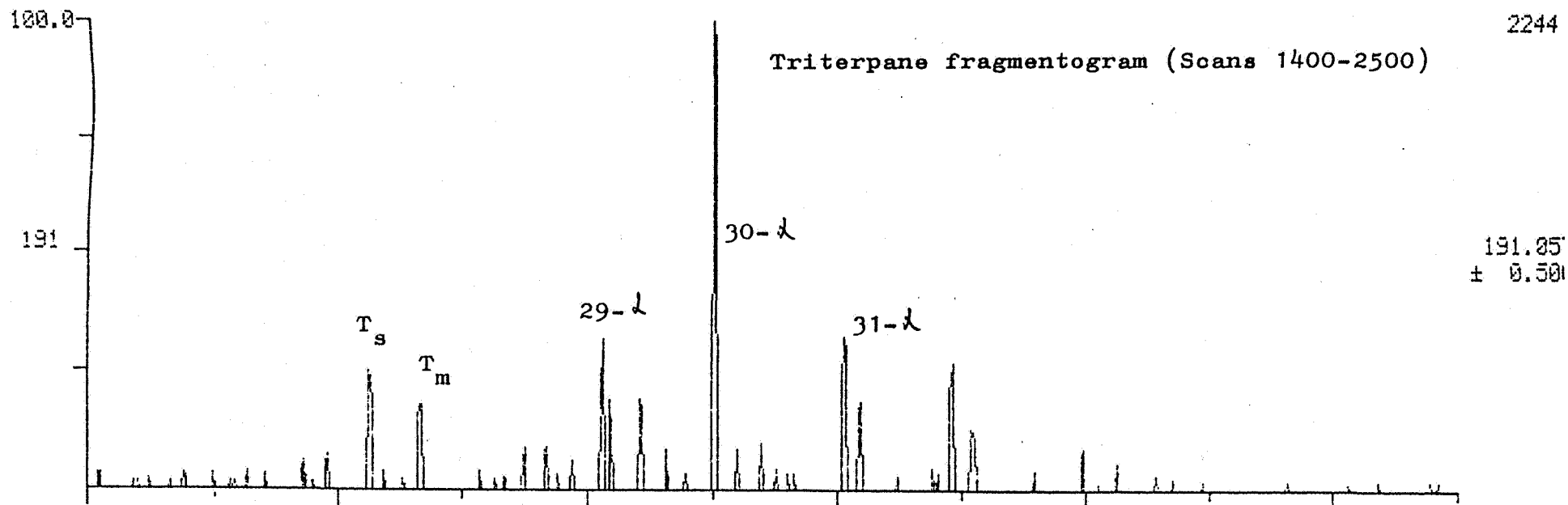


FIG. 11. GC-MS analysis well 31/2-8, 1847.2m.

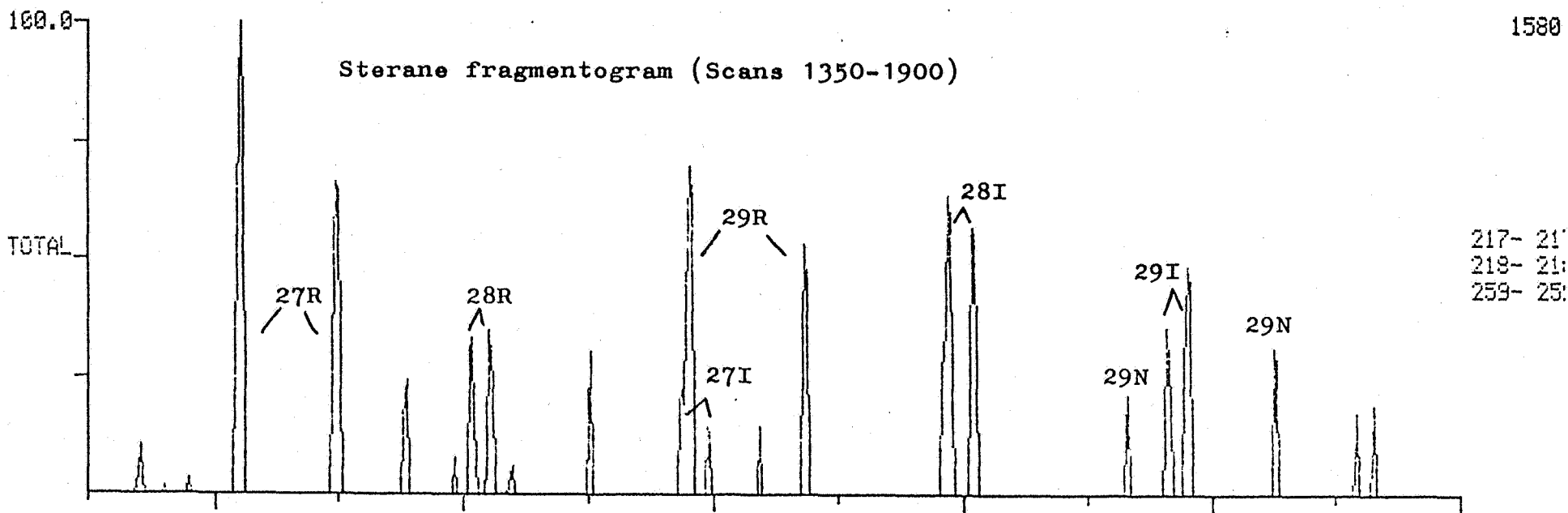
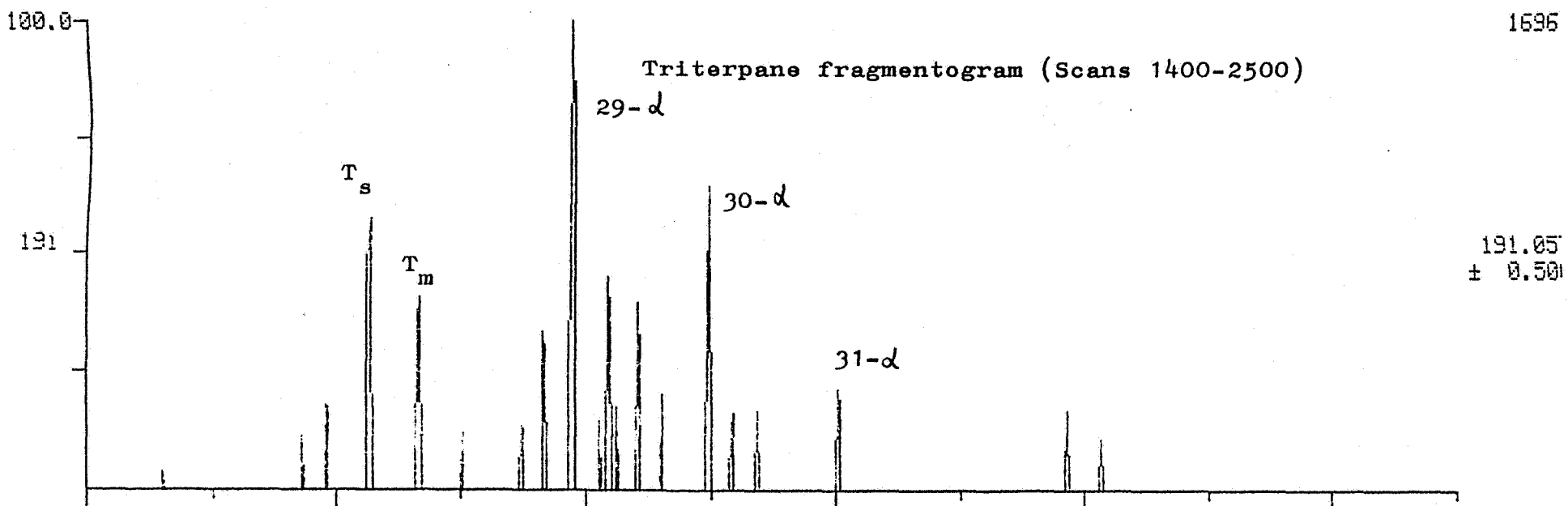


FIG. 12. GC-MS analysis well 31/2-8, 1849 m. crude oil.

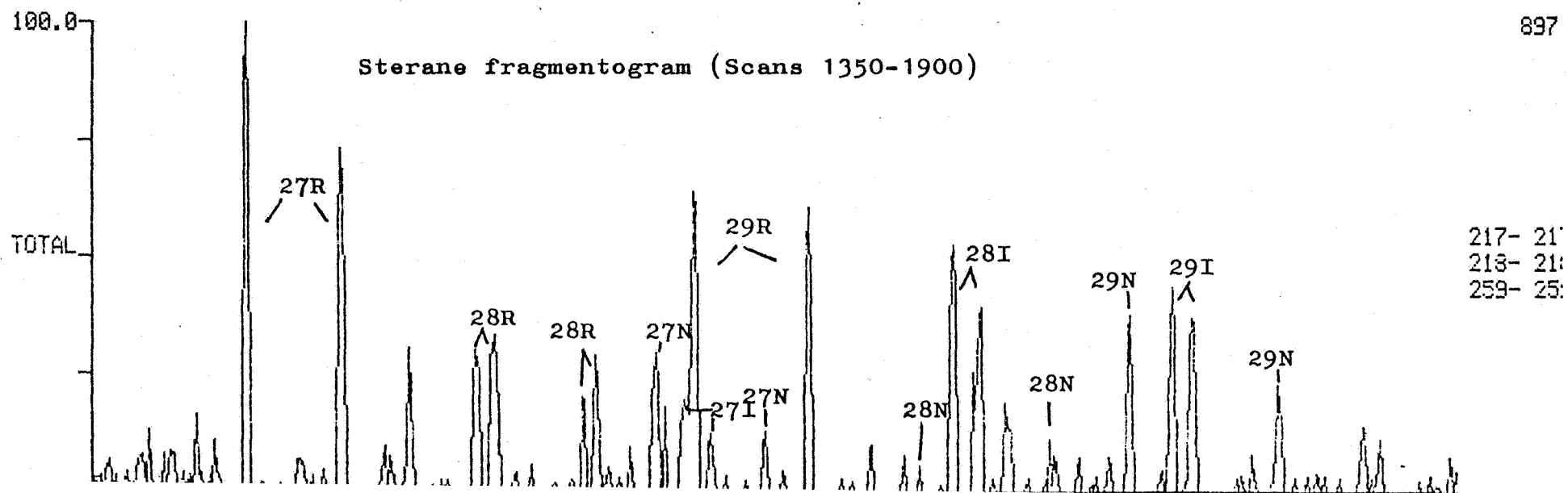
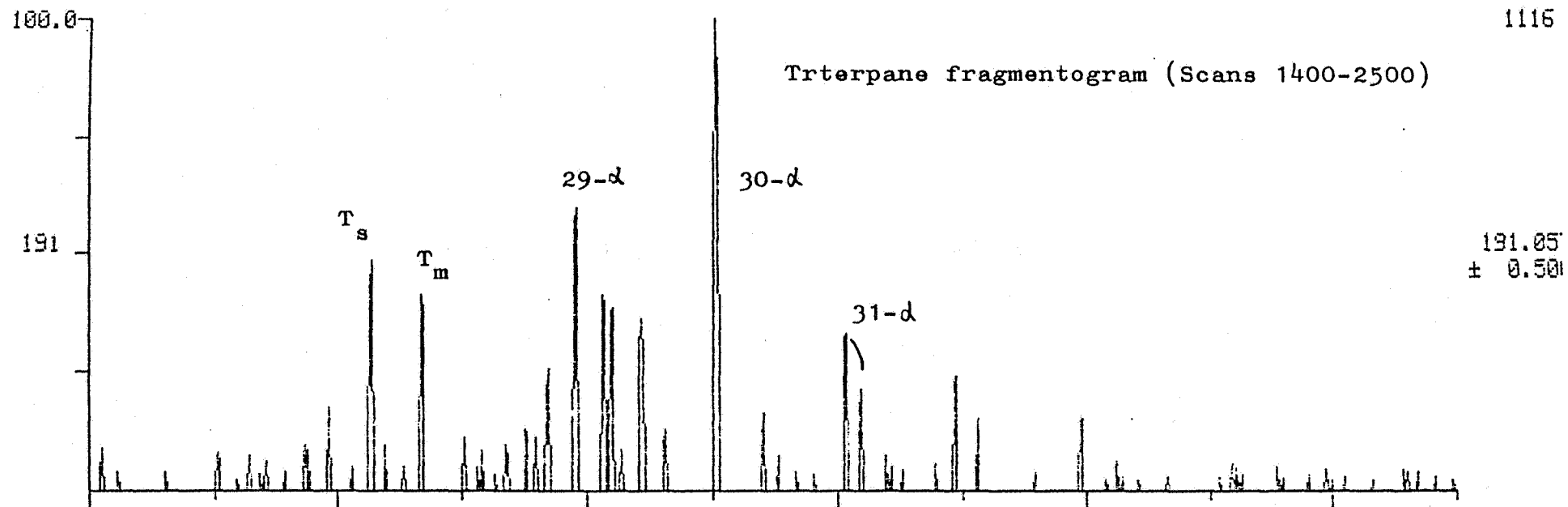
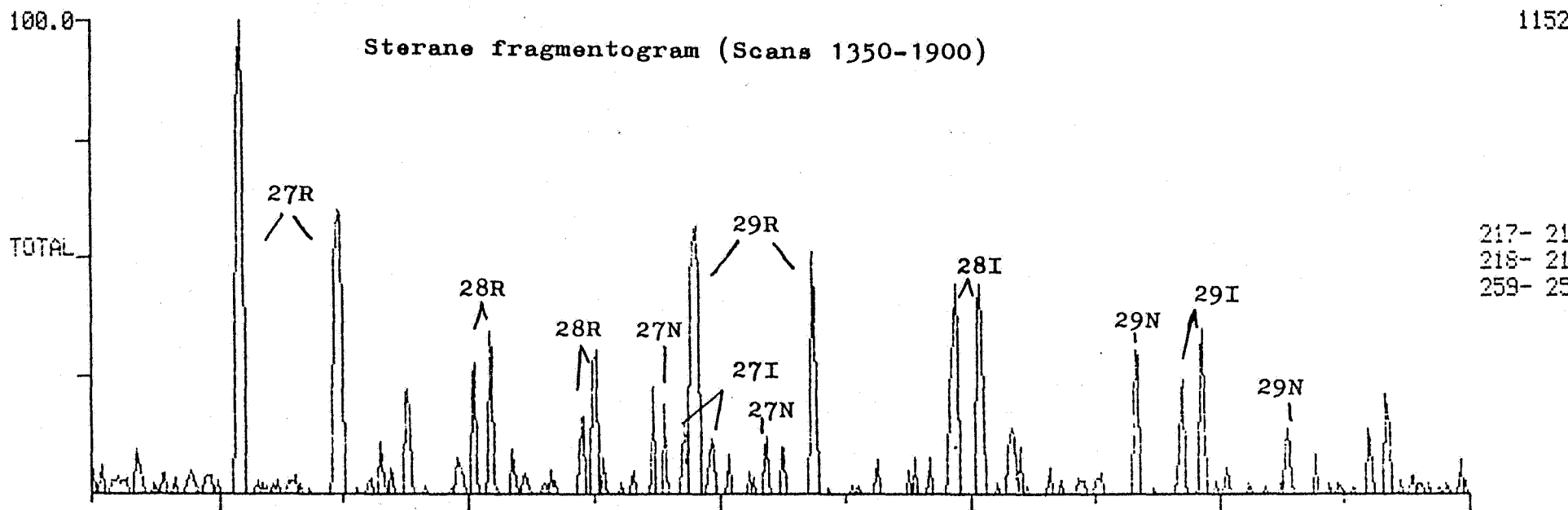
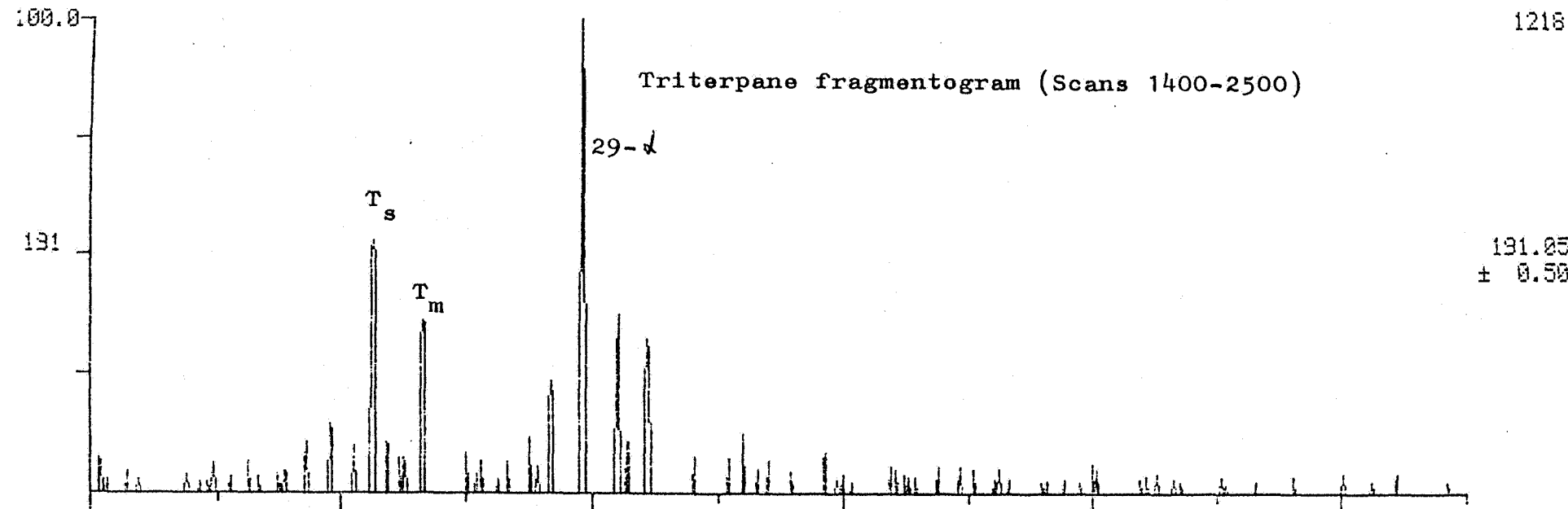


FIG. 13. GC-MS analysis well 31/2-8, 1850.3 m



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