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GEOCHEMICAL ANALYSIS OF TWO KIMMERIDGE CLAY ROCK SAMPLES AND OF TWO CRUDE OILS FROM WELL 2/5-7, NORWAY

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Investigation 9.5.5091

with co-operation from R.F. Stuifzand

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GEOCHEMICAL ANALYSIS OF TWO KIMMERIDGE CLAY ROCK SAMPLES AND OF TWO CRUDE OILS FROM WELL 2/5-7, NORWAY.

1. INTRODUCTION

Geochemical analysis have been carried out on the following two rock samples and two crude oil sample from well 2/5-7 (request telex for 240229 of 24.02.84 and 070502 of 7.05.84):

- Crude oil sample. OMC 3250, 3300-3335 m, PT-1.
- Crude oil sample, OMC 3295, 3263-3287 m, PT-2.
- Sidewall sample, Kimmeridge clay formation, 4112.5 m
- Sidewall sample, Kimmeridge clay formation, 4113.5 m

Since the sidewall samples were only of limited size not all typing parameters could be determined.

2. RESULTS AND DISCUSSION

The results, which are given in Tables 1-3 and Figs. 1-10 indicate the following:

Crude oil samples

The gas chromatograms of the saturated hydrocarbons (Fig.1-2) and the C7 alkane distributions (Fig.5) indicate that both crude oil samples have not been bacterially degraded.

The relatively low intensity of the non-n-alkanes in the C30 region of the gas chromatograms (Fig.1-2) and the C29 DOM values of 70 (VR/E =1.0) point to expulsion from (a) mature source rock(s). It should be kept in mind that the C29 DOM has only been calibrated between 56-66 (VR/E= 0.5-0.85) and that values above and below this range has been obtained by extrapolation.

The shape of the gas chromatogram (Fig.1-2) and the C15- and C30 ringdistribution (Fig.6) indicate that both oils were generated from a source rock containing structureless organic matter (S.O.M.). The sterane and triterpane fragmentograms (Figs. 7-8) indicate that the S.O.M. is probably of bacterially reworked phytoplanktonic origin.

The C7 alkane/naphthene distribution (Fig.5) points to a shaly environment of deposition of the source matter of these crude oils.

All data indicate that both crude oils have been expelled from the same or a similar type of source rock.

Extracts of Kimmeridge clay formation

All data indicate that the extracts of both samples (4112.5 and 4113.5 m) are very similar.

The relatively low intensity of the non-n-alkanes in the C30 region of the gas chromatogram (Figs. 3-4) and the C29 DOM values of 68 (VR/E= 0.9) indicate that these extracts are mature. This is in agreement with the estimated DOM values of 65-68 (VR/E= 0.8-0.9) obtained by a fluorescence measurement of liptinites. (Table 3).

The shape of the gas chromatograms (Figs. 3-4), the C15- and C30 ringdistributions (Fig.6) and the sterane and triterpane fragmentograms (Figs. 9-10) indicate that these samples contain structureless organic matter of probably bacterially reworked phytoplanktonic origin.

Correlation

All data indicate that both crude oils and the two extracts are rather similar.

3. CONCLUSIONS

Both crude oil samples (Well 2/5-7, 3300-3335 m and 3263-3287m) have been expelled from the same or similar type of source rock. They have not been bacterially degraded and were expelled from a mature (shaly) source rock containing structureless organic matter of bacterially reworked phytoplanktonic origin.

Both rock samples (4112.5 and 4113.5 m), are rather similar and can be regarded as mature source rocks.
They contain structureless organic matter probably of bacterially reworked phytoplanktonic origin.

The Kimmeridge Clay Formation as represented by the two samples investigated may well be the source of the crudes found in this well.

Table-1 GEOCHEMICAL DATA OF CRUDE OILS, WELL 2/5-7

	3300-3335 M PT-1, OMC 3250	3263-3287 M PT-2, OMC 3295
API	41.8	40.7
specific gravity	0.8162	0.8219
%w. boil. 120°C	15.5	12.6
% sulphur	0.1	0.1
ppm V as metals	0	0.2
ppm Ni as metals	0	0.7
Pristane/phytane	1.4	1.4
Pristane/nC17	0.5	0.6
Phytane/nC18	0.5	0.5
C7-distribution		
C7-alkane		
nC7	53	54
monobranched	37	36
polybranched	10	10
C7-alk/naphthene		
nC7	28	29
naphthenes	46	46
branched alkanes	26	25
C7-alk/naphth/arom		
nC7	48	48
naphthenes	41	41
aromatics	11	11
C15-distribution		
1-ring	56	61
2-ring	32	24
3-ring	12	15
C30-distribution		
3-ring	33	29
4-ring	42	46
5-ring	25	25
C29 DOM	70	70
% asphaltenes	0	-
% saturates	45**	67*
% aromatics	9	28
% heterocompounds	3	5
% rest	43	
$\delta^{13}C$ o/oo	-28.1	-28.2

** Determined by column chromatography
* Determined by TLCFID

Table-2 GEOCHEMICAL DATA OF EXTRACTS

	Kimmeridge Clay Fm Well 2/5 - 7 Sidewall samples 4112.5 m	4113.5 m
% ethyl acetate extract	2.0	2.6
% organic carbon after extraction	7.0	6.6
% sulphur	ND	ND
ppm V as metals	ND	ND
ppm Ni as metals	ND	ND
Pristane/phytane	1.5	1.5
Pristane/nc17	0.6	0.6
Phytane/nC18	0.5	0.5
C15 distribution		
1-ring	54	55
2-ring	32	30
3-ring	14	15
C30 distribution		
3-ring	24	32
4-ring	51	40
5-ring	25	28
C29 DOM	68	68
% saturates	39	43
% aromatics	46	40
% heterocompounds	15	17
$\delta\ ^{13}C$ o/oo (extract)	ND	-29.8
$\delta\ ^{13}C$ o/oo (kerogen)	-28.7	-29.3
extract/carbon	0.28	0.39

ND = Not detectable due to the small amount of material

MACERAL DESCRIPTION OF 1 SAMPLE FROM WELL 2/5-7

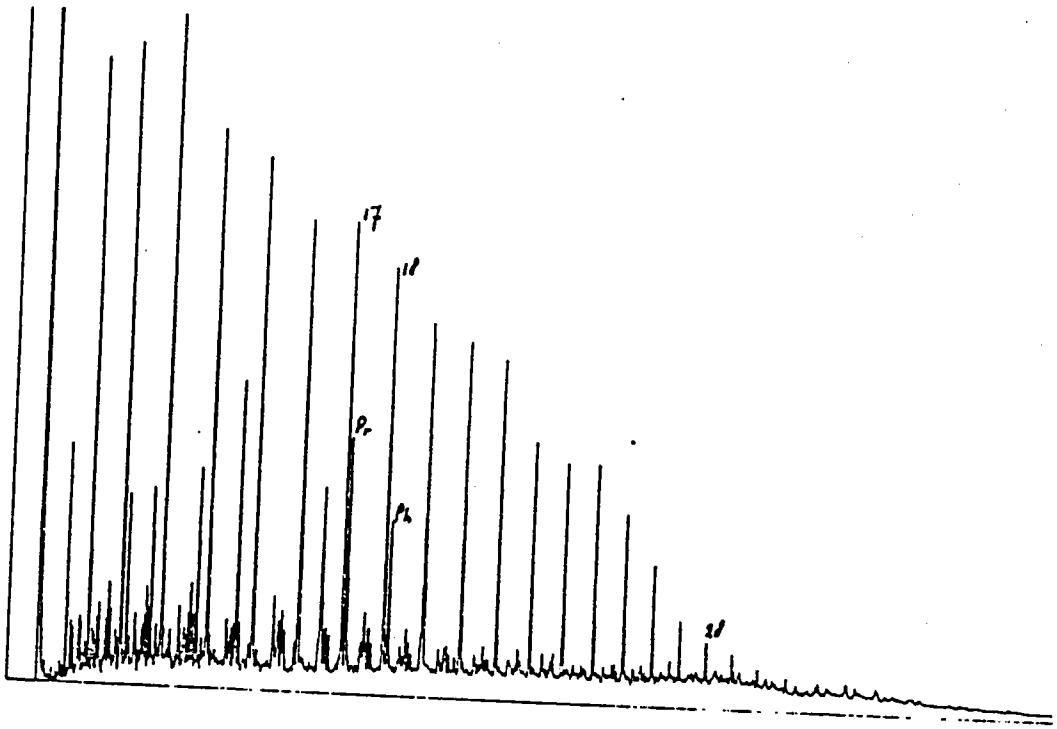
DEPTH IN M	SAMPLE TYPE
4112.5	S.W.S.

ORGANIC																	INORG.		
	VITR.	LIPTINITE									INERT.								
								ALGAE											
SAPROPELIC ORG. MATTER	TELOCOLLINITE	TELINITE	DESMOCOLLINITE	SPORINITE	CUTINITE	RESINITE	LIPTODETRINITE	BOTRYOCOCCUS	TASMANITES	OTHER ALGAE	MICROPLANKTON	EXSUDATINITE	SCLEROTINITE	FUSINITE	MACRINITE	MICRINITE	UNDIFFERENTIATED MINERALS	FRAMBOIDAL PYRITE	AGGREGATES OF PYRITE	CRYSTALS OF PYRITE
+							+	/			-		/		+	*	+	/	-

L E G E N D	
*	: ABUNDANT
+	: COMMON
/	: FEW
-	: RARE

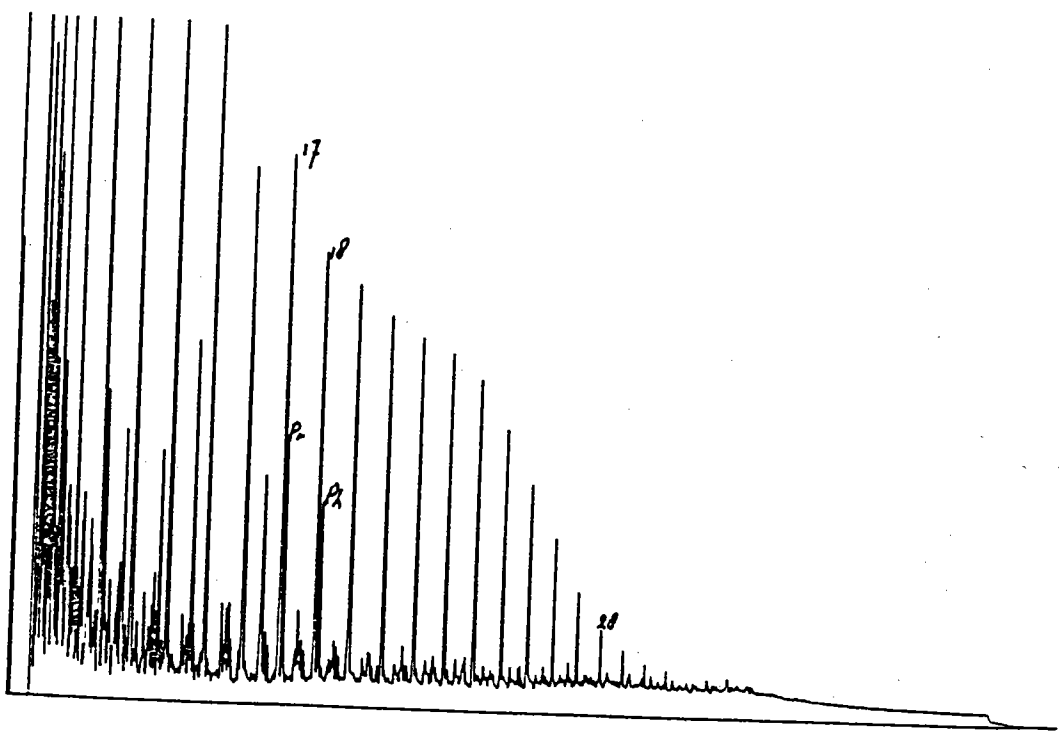
4112.5 M : S.O.M. PARTLY MICRINISED
FOSSIL REMAINS
DARK FLUORESCENT LIPTINITES (MATURE)
DOM ABOUT 65-68 ?

TABLE : 3



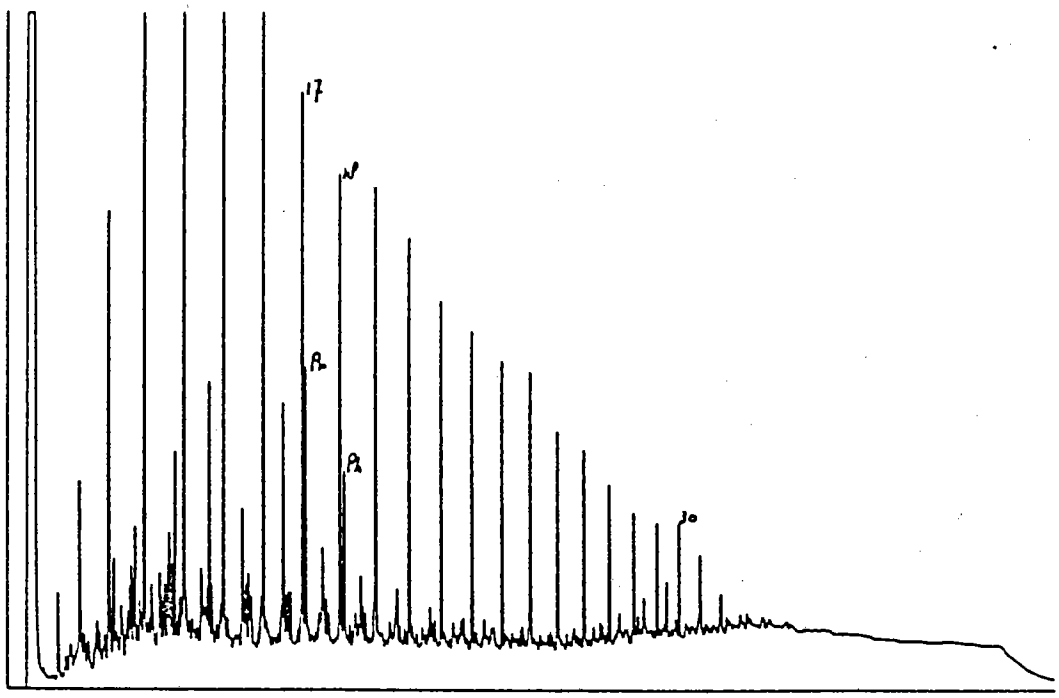
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 1. NORWAY. 2/5-7. 3300-3335M. OMC 3250. PT-1



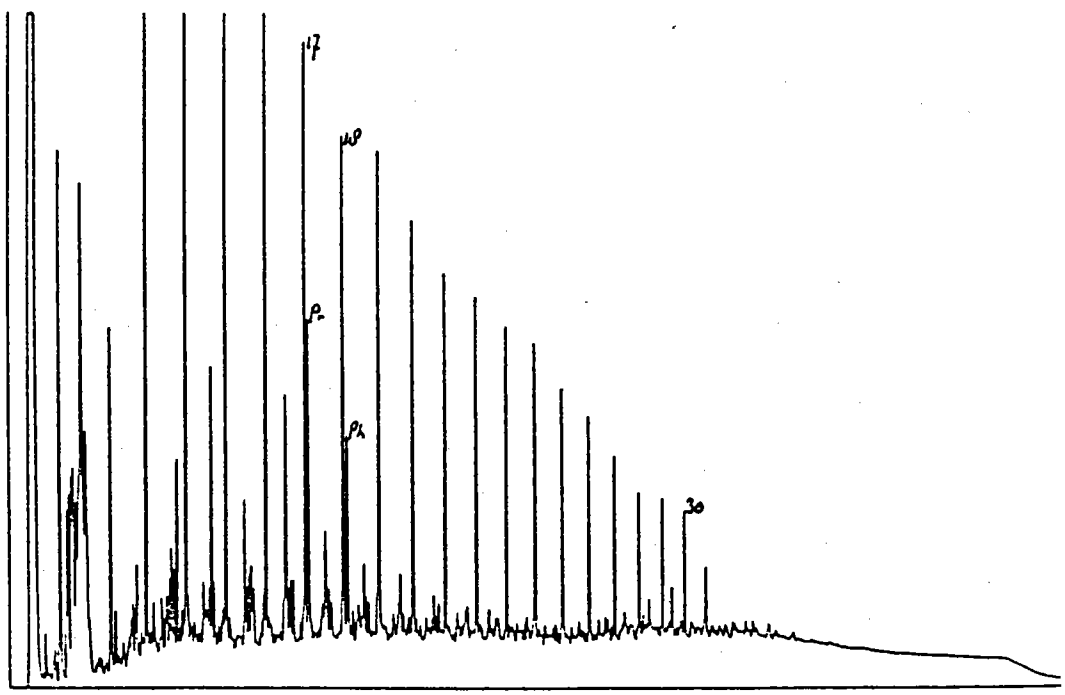
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 2. NORWAY 2/5-7 3263-3287 FT OMC 3295



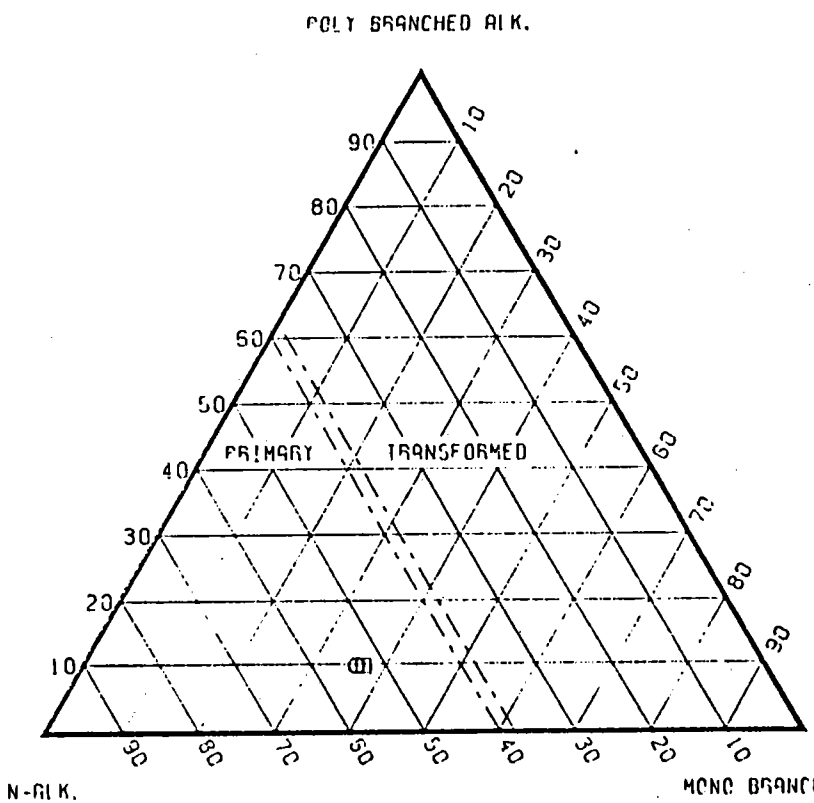
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

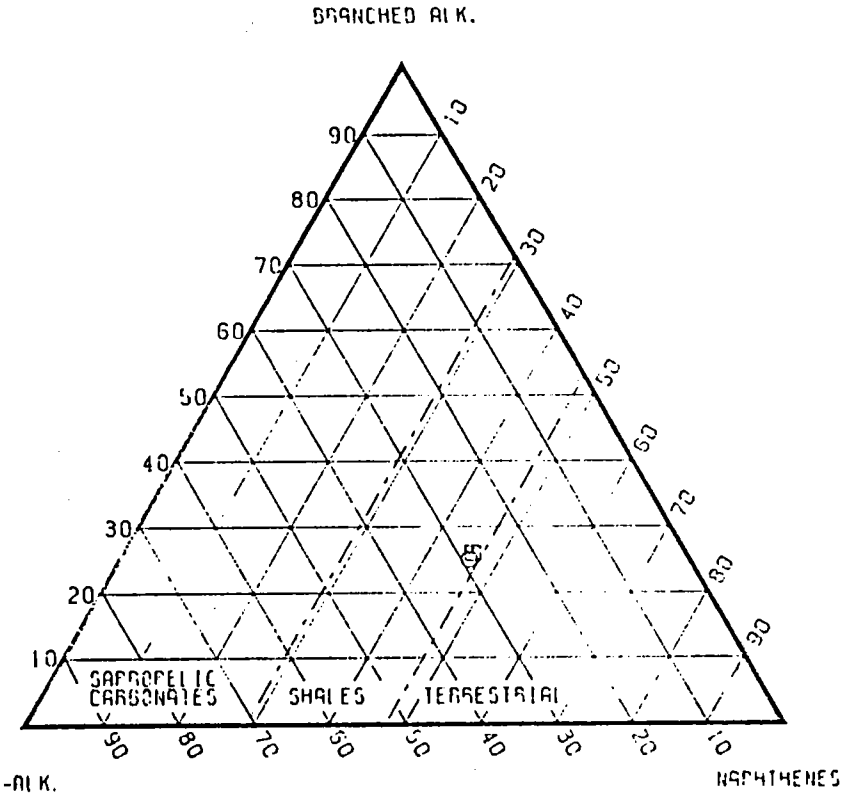
FIG. 3 NORWAY 2/5-7 4112.5M KIMM. CLAY. SWS



GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 4 NORWAY 2/5-7 4113.5M KIMM. CLAY. SWS

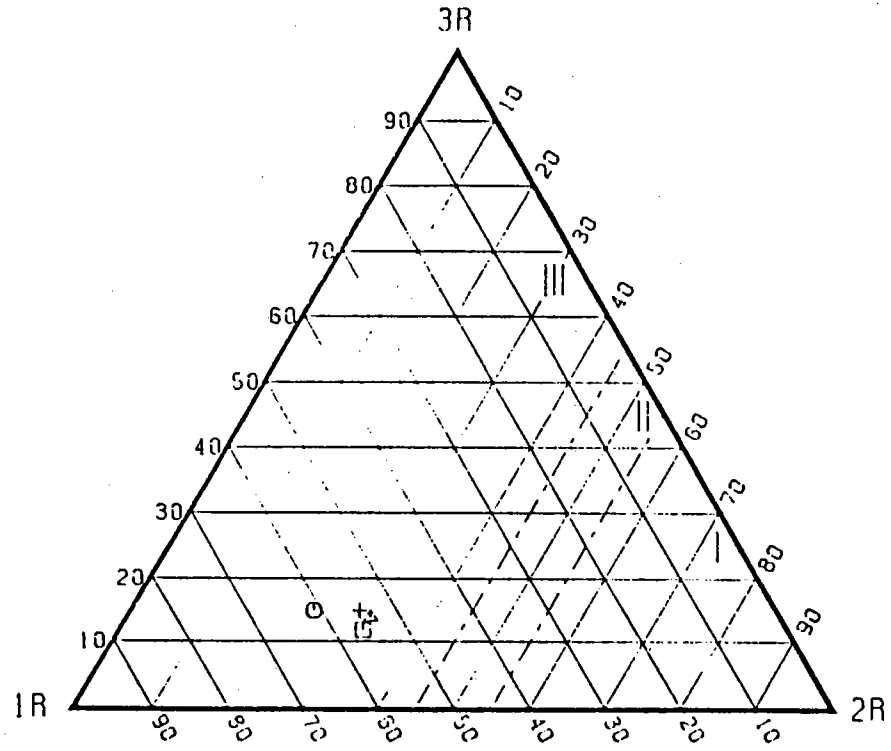




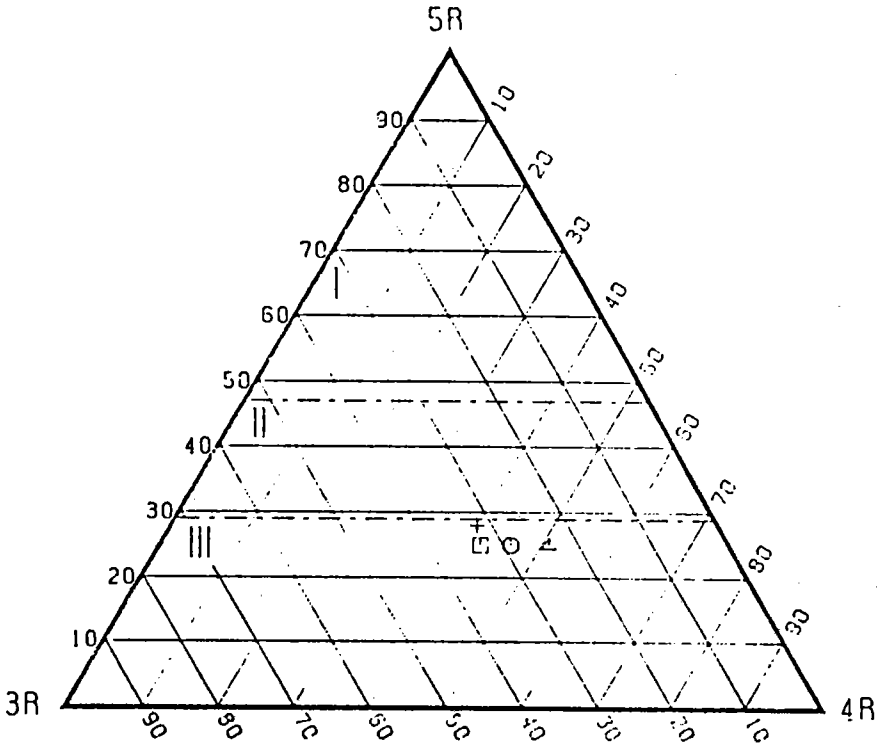
LEGEND
⊡ - 2/5-7, 3300-3335M, PI-1, DMC 3250, NORWAY
⊙ - 2/5-7, 3263-3287M, PI-2, DMC 3295, NORWAY

FIG. 5

C_{15}-RINGDISTRIBUTION



C_{30}-RINGDISTRIBUTION



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
□ - 2/5-7, 3300-3335M, OMC 3250, NORWAY
⊙ - 2/5-7, 3263-3287M, C1-2, OMC 3295, NORWAY
△ - 2/5-7, 4112.5M, SNS, KIMMERIDGE CLAY, NORWAY
+ - 2/5-7, 4113.5M, SNS, KIMMERIDGE CLAY, NORWAY

FIG. 3

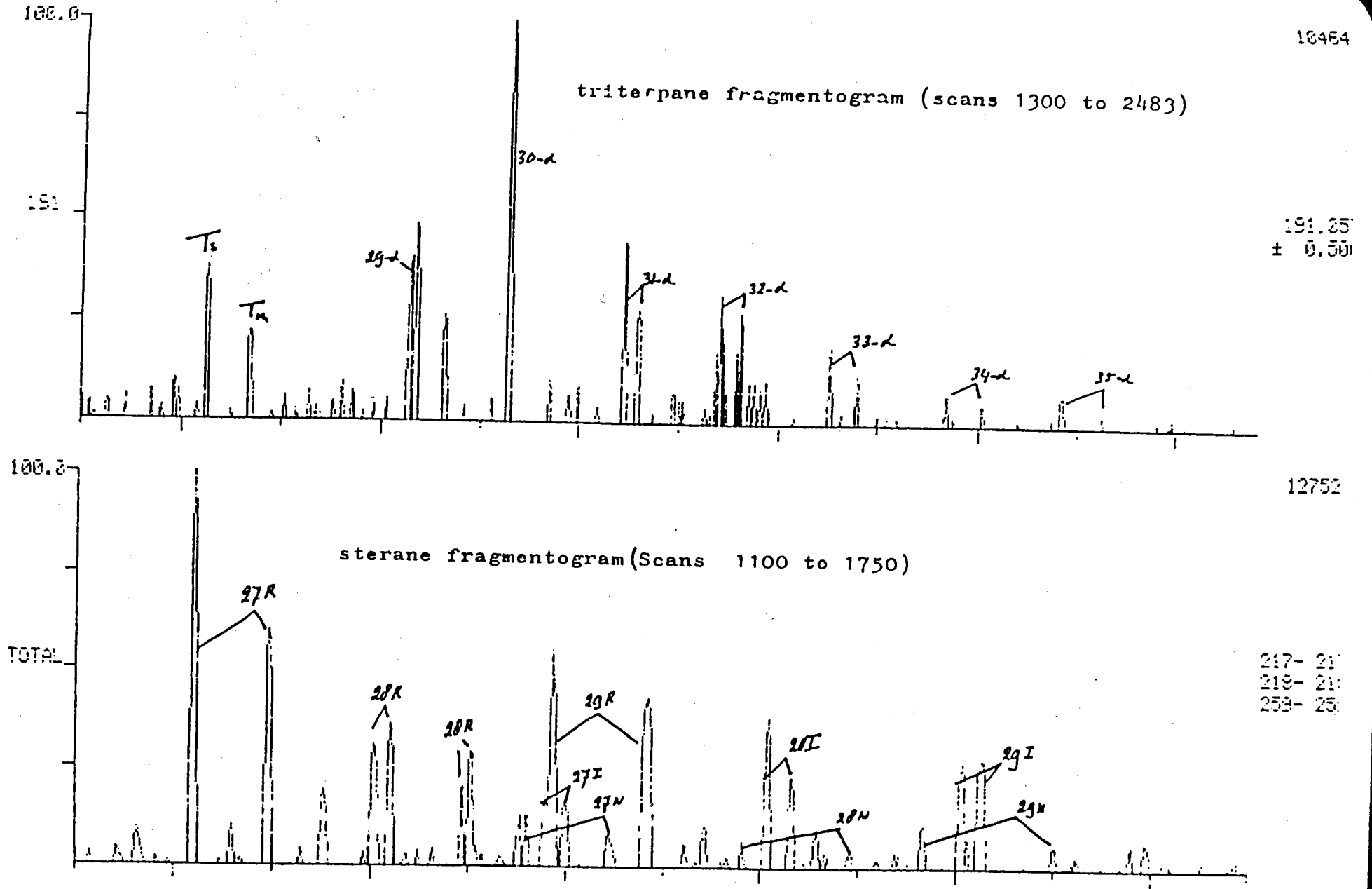


FIG. 7 GC-MS ANALYSIS WELL 2/5-7, 3300-3350M, PT-1
CRUDE OIL SAMPLE, OMC 3250

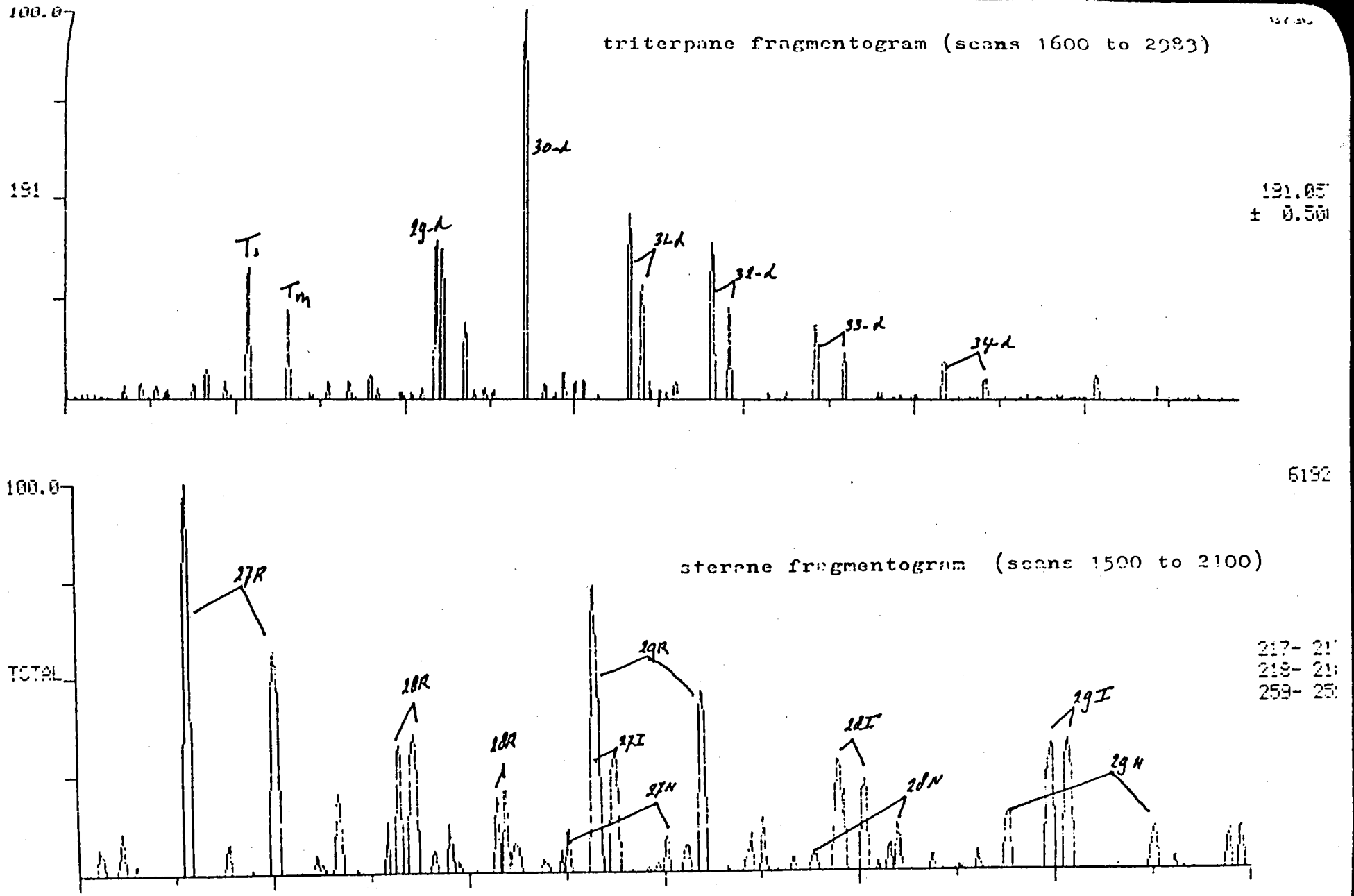


FIG. 8 GC-MS ANALYSIS [illegible] CRUDE OIL SAMPLE (OWS 3295)

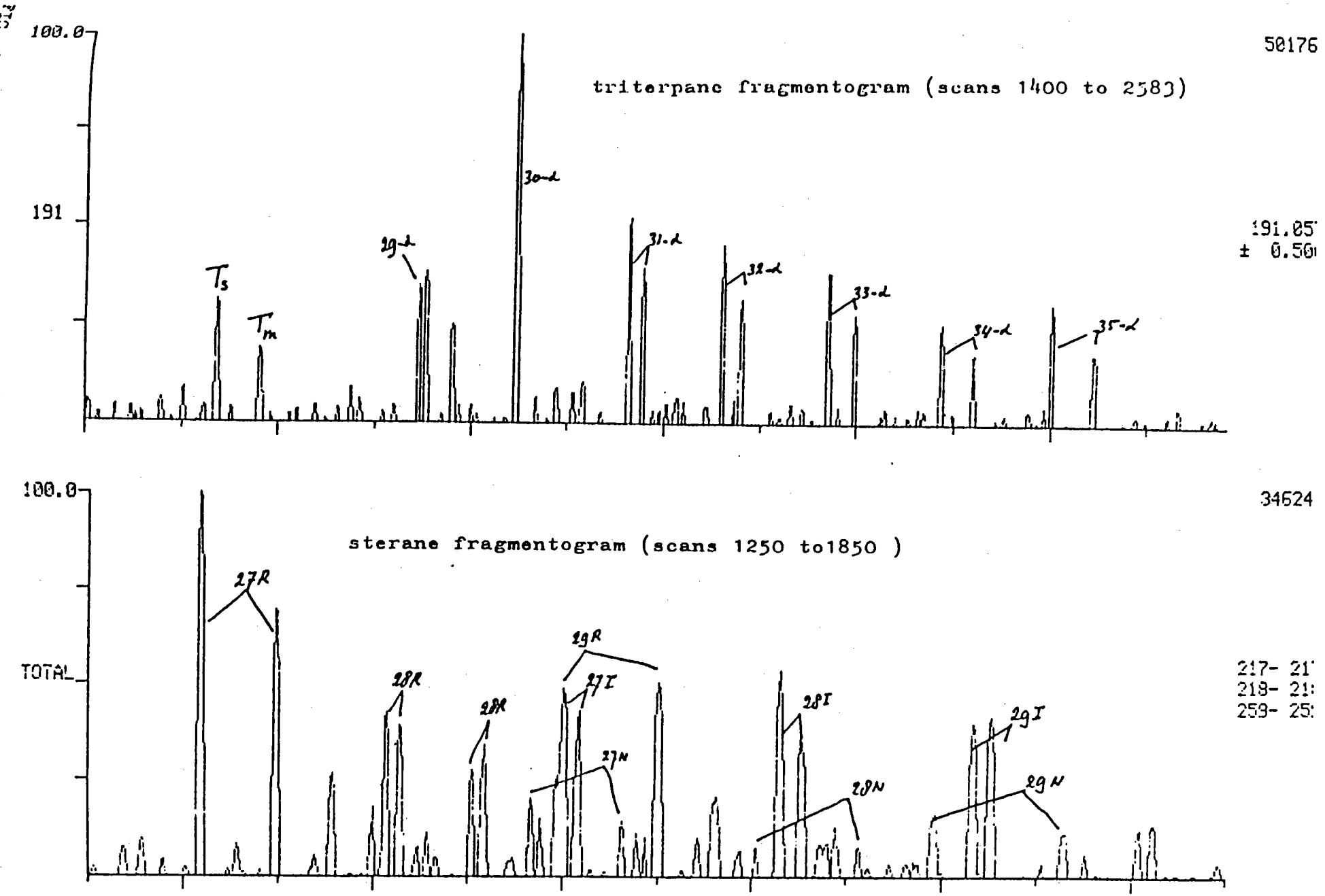
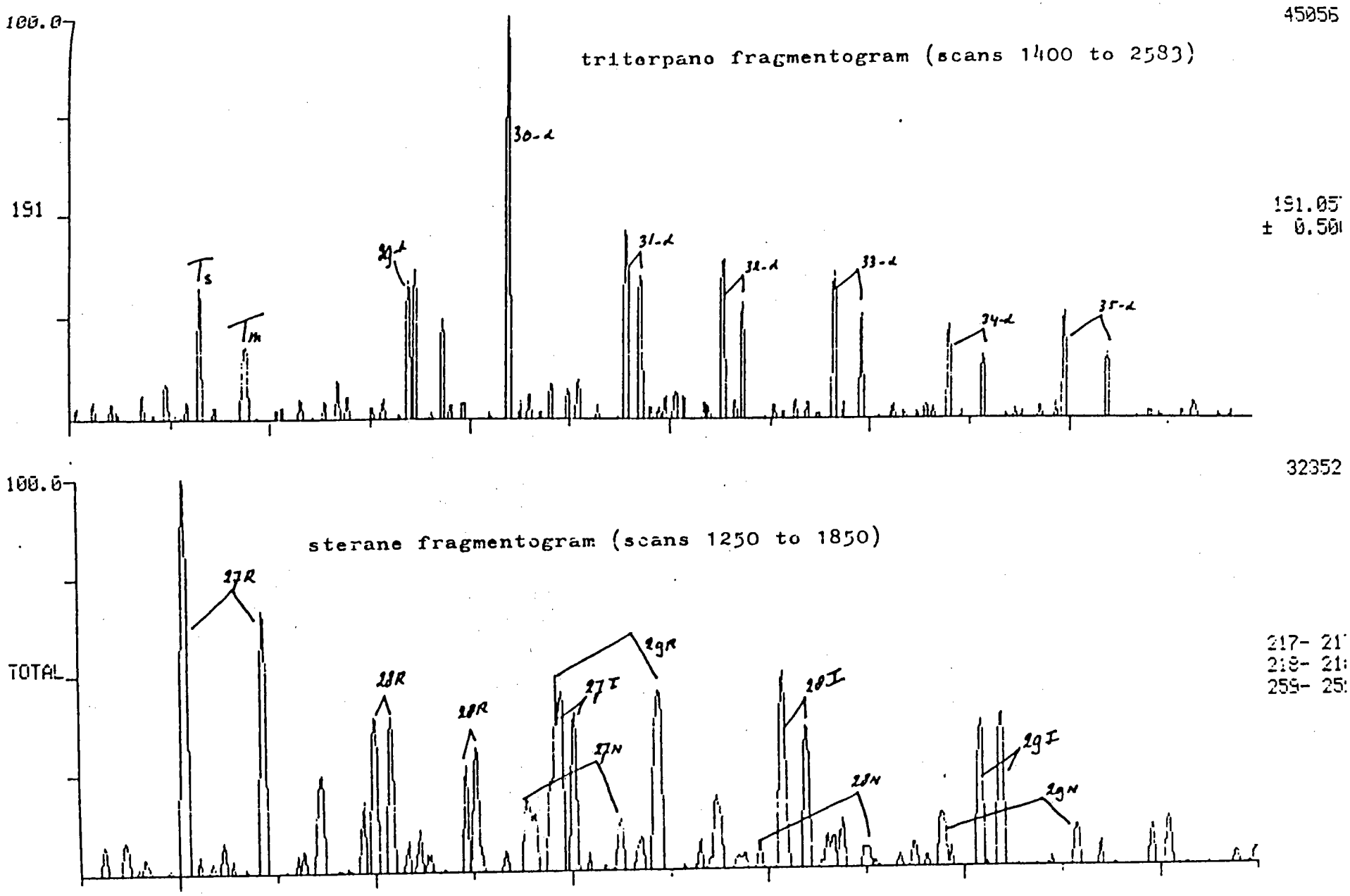


FIG. 9 GC-MS ANALYSIS WELL 2/5-7, 4112.5M, KIMMERIDGE CLAY SIDEWALL SAMPLE

GC-MS ANALYSIS WELL 2/5-7, 4113.5M, KIMMERIDGE CLAY
SIDEWALL SAMPLE



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