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# GEOCHEMICAL INVESTIGATION OF TWO HYDROCARBON IMPREGNATED SANDS FROM OSMINGTON MILLS AND LULWORTH COVE, UNITED KINGDOM

by

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Sponsor: Code:

Investigation 9.7.12.26

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**KONINKLIJKE/SHELL EXPLORATIE EN PRODUKTIE LABORATORIUM**

RIJSWIJK, THE NETHERLANDS

(Shell Research B.V.)

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CONTENTS

# GEOCHEMICAL INVESTIGATION OF TWO HYDROCARBON IMPREGNATED SANDS FROM OSMINGTON MILLS AND LULWORTH COVE, UNITED KINGDOM

## 1. RESULTS AND DISCUSSION

Two hydrocarbon impregnated sands have been geochemically investigated from Osmington Mills (Bencliff grit, Upper Jurassic) and Lulworth Cove (Wealden, Lower Cretaceous). The results are shown in Tables 1-3 and in Figures 1-8. A description of the geochemical parameters can be found in RKTR.82.028. The results indicate the following:

1.1 The organic carbon percentages and the extract/carbon ratios indicate that both samples are impregnations and not source rocks (see Tables 1 and 2).

1.2 The gas chromatograms of both samples (Figs. 1,3) show similarities and indicate bacterially degraded and/or immature extracts.

Both samples were heated for 6 days at 330°, to investigate whether the extracts can be matured. Heating produces less extractable material and lower amounts of saturates in the extracts. Moreover, the gas chromatograms after heating (Figs. 2,4) are not mature. This suggests that the heterocompounds present are not immature and possibly highly mature.

The $C_{15}$-ring distributions before heating (Fig. 5), moreover, imply that the samples are bacterially degraded.

Another indication for bacterial degradation are the low $C_{29}$ DOM values (55-62). The $C_{29}$ DOM is susceptible to bacterial degradation which lowers the figure.

The sample from Lulworth Cove is probably more bacterially degraded than the sample from Osmington Mills (sulphur content, gross composition, $C_{29}$ DOM, $C_{15}$-ring distributions).

1.3 As the extracts are bacterially degraded, no definite conclusions can be drawn from the $C_{15}$-ring distributions concerning the type of organic matter. The $C_{30}$-ring distributions indicate that the extracts were derived from source rocks containing predominantly structureless organic matter (SOM). The sterane/triterpane fragmentograms indicate that the SOM was of bacterially reworked phytoplanktonic origin.

1.4 With the exception of the greater degree of bacterial degradation of the Lulworth Cove sample, both samples appear to be geochemically similar (V and Ni content, $C_{30}$-ring distribution, carbon isotope values, sterane/triterpane fragmentograms). Both impregnations were most probably generated from the same or similar source rocks. The geochemical typing parameters not affected by bacterial degradation (carbon isotope values, $C_{30}$-ring distributions, steranes/triterpanes) resemble closely those of an average North Sea crude and those of the Wytch Farm crude (see RKTR.82.138).

## 2. CONCLUSIONS

Two impregnations from Osmington Mills and Lulworth Cove are bacterially degraded. The sample from Lulworth Cove is more heavily bacterially degraded than the sample from Osmington Mills. Both impregnations were generated from mature source rocks which contained structureless organic matter of bacterially reworked phytoplanktonic origin. Geochemically both impregnations are similar and were most probably generated from similar source rocks. The geochemical typing parameters not affected by bacterial degradation such as carbon isotope values, $C_{30}$-ring distributions and steranes/triterpanes resemble closely those of an average North Sea crude and those of the Wytch Farm crude.

TABLE 1 - GEOCHEMICAL DATA OF EXTRACTS

| Sample | Osmington Mills Bencliff grit original | Osmington Mills Bencliff grit heated, 6 days at 330°C |
|---|---|---|
| % ethyl acetate extract | 8.0 | 6.7 |
| % organic carbon after extraction | 0.1 | 0.2 |
| % sulphur | 0.8 | 0.4 |
| ppm V as metals | 1 | - |
| ppm Ni as metals | 3 | 2 |
| pristane/phytane | N.D. | 1.3 |
| pristane/nC17 | | 0.7 |
| phytane/nC18 | | 0.7 |
| $C_{15}$ distribution | | |
| 1-ring | 10 | 24 |
| 2-ring | 53 | 45 |
| 3-ring | 37 | 31 |
| $C_{30}$ distribution | | |
| 3-ring | 31 | 34 |
| 4-ring | 45 | 40 |
| 5-ring | 24 | 26 |
| $C_{29}$ DOM | 62** | - |
| % saturates* | 52 | 41 |
| % aromatics | 37 | 50 |
| % heterocompounds | 11 | 9 |
| $\delta^{13}C^{o}/oo$ | -29.3 | -30.0 |
| extract/carbon | 80.0 | 42.0 |

* Determined by thin layer chromatography.

** Unreliable, since the $C_{29}$ DOM is susceptible to bacterial degradation.

N.D. = not detectable.

TABLE 2 - GEOCHEMICAL DATA OF EXTRACTS

| Sample | Lulworth Cove Wealden original | Lulworth Cove Wealden heated, 6 days 330°C |
|---|---|---|
| % ethyl acetate extract | 2.0 | 1.2 |
| % organic carbon after extraction | 0.1 | 0.2 |
| % sulphur | 1.4 | 0.7 |
| ppm V as metals | 1 | 1 |
| ppm Ni as metals | 4 | 3 |
| pristane/phytane | N.D. | 1.0 |
| pristane/nC17 | | 0.5 |
| phytane/nC18 | | 0.7 |
| $C_{15}$ distribution | | |
| 1-ring | 6 | 37 |
| 2-ring | 41 | 36 |
| 3-ring | 53 | 27 |
| $C_{30}$ distribution | | |
| 3-ring | 23 | 30 |
| 4-ring | 52 | 43 |
| 5-ring | 25 | 27 |
| $C_{29}$ DOM | 55** | - |
| % saturates* | 34 | 26 |
| % aromatics | 30 | 55 |
| % heterocompounds | 36 | 19 |
| $\delta^{13}C^{o}/oo$ | -29.3 | -28.7 |
| extract/carbon | 20.0 | 5.0 |

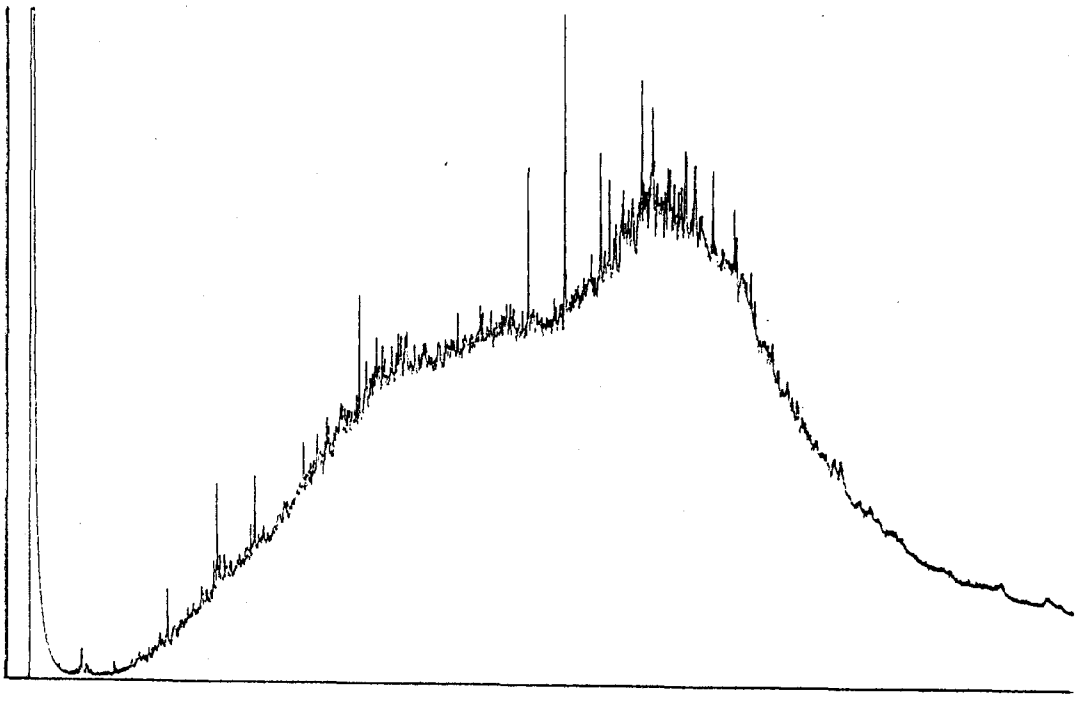
* Determined by thin layer chromatography.

** Unreliable since the $C_{29}$ DOM is susceptible to bacterial degradation.

N.D. = not detectable.

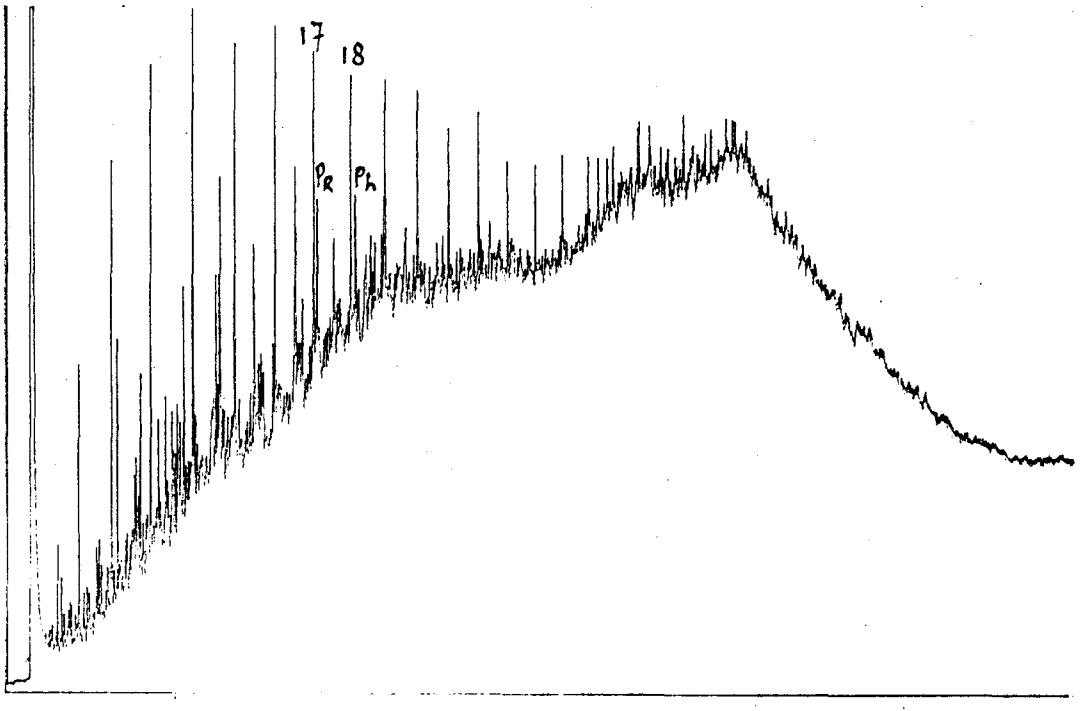
TABLE 3 - GC-MS DATA

| | Osmington Mills Bencliff grit | Lulworth Cove Wealden |
|---|---|---|
| Sterane/triterpane diagram | | |
| % iso-steranes | 23 | 26 |
| % rearranged-steranes | 66 | 62 |
| % triterpanes | 11 | 12 |
| Sterane diagram | | |
| % iso-steranes | 32 | 33 |
| % rearranged-steranes | 61 | 54 |
| % normal-steranes | 7 | 13 |
| Sterane carbon number distribution | | |
| % C-27 | 34 | 28 |
| % C-28 | 23 | 26 |
| % C-29 | 43 | 46 |



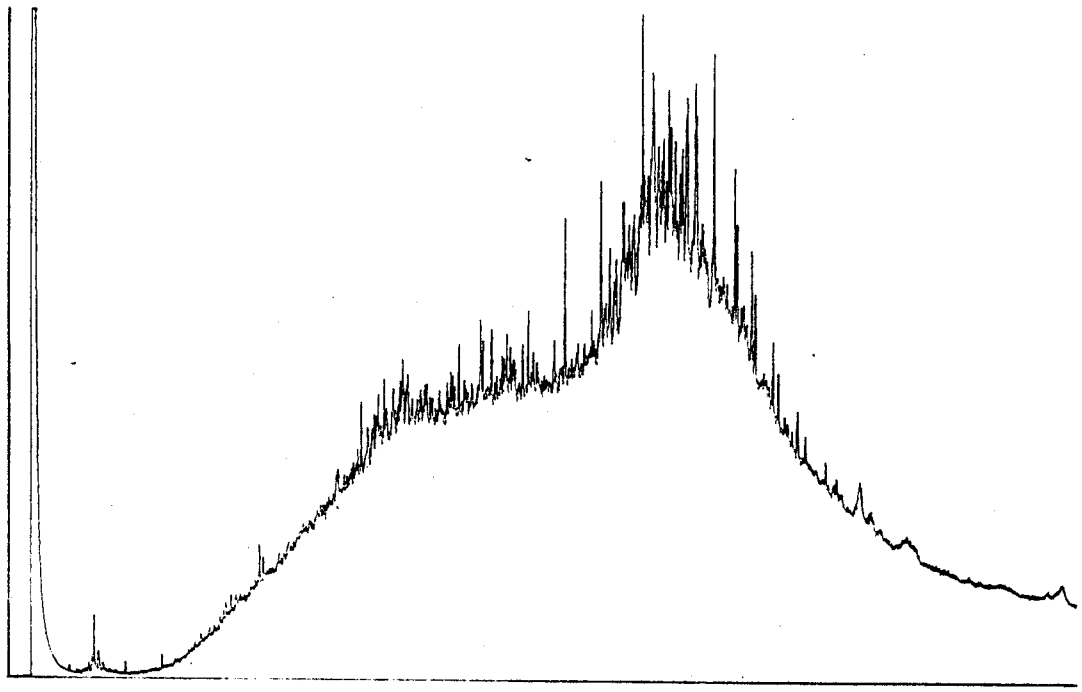
GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 1. UK OSMINGTON MILLS



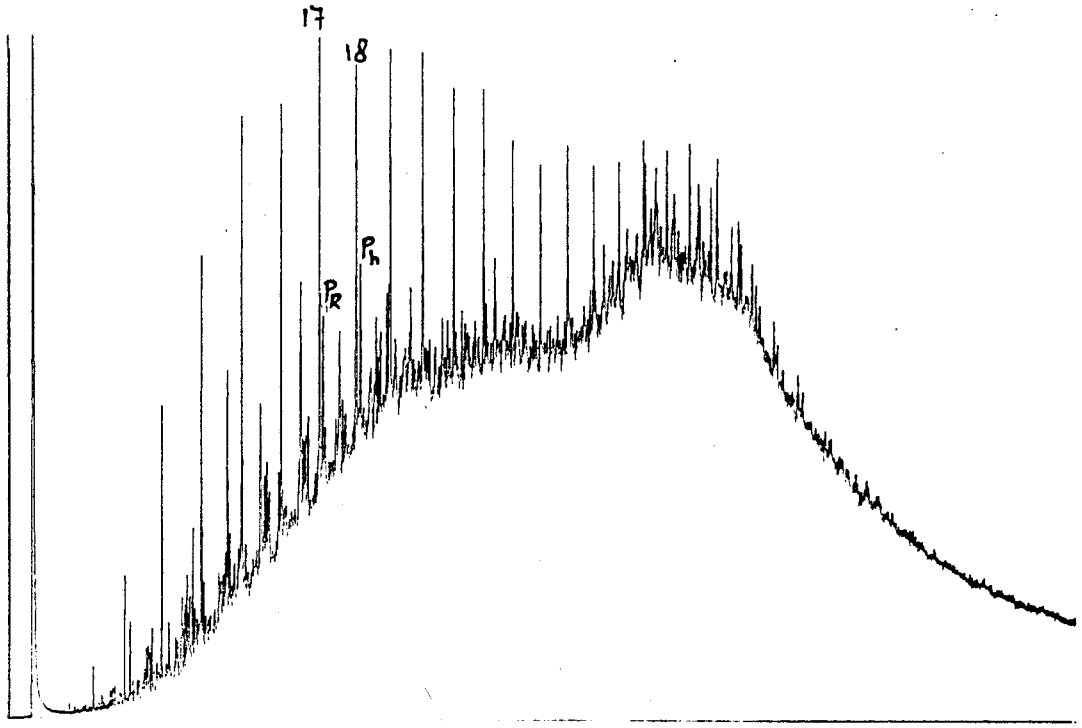

GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 2. UK OSMINGTON MILLS HEATED 60DAYS 330C



GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

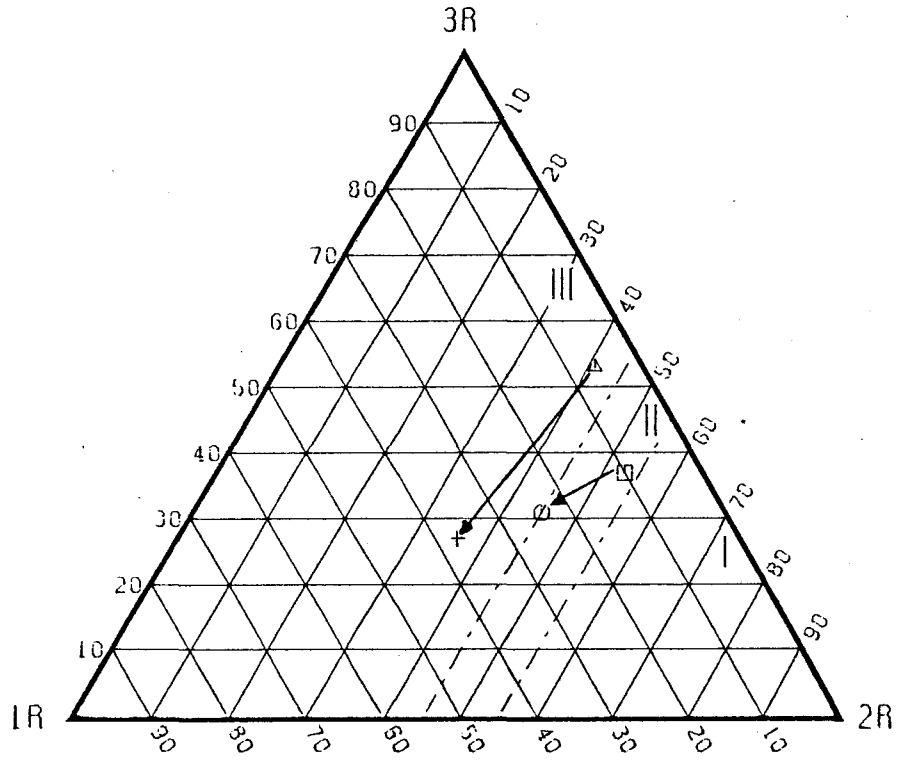
FIG. 3. UK LULWORTH COVE



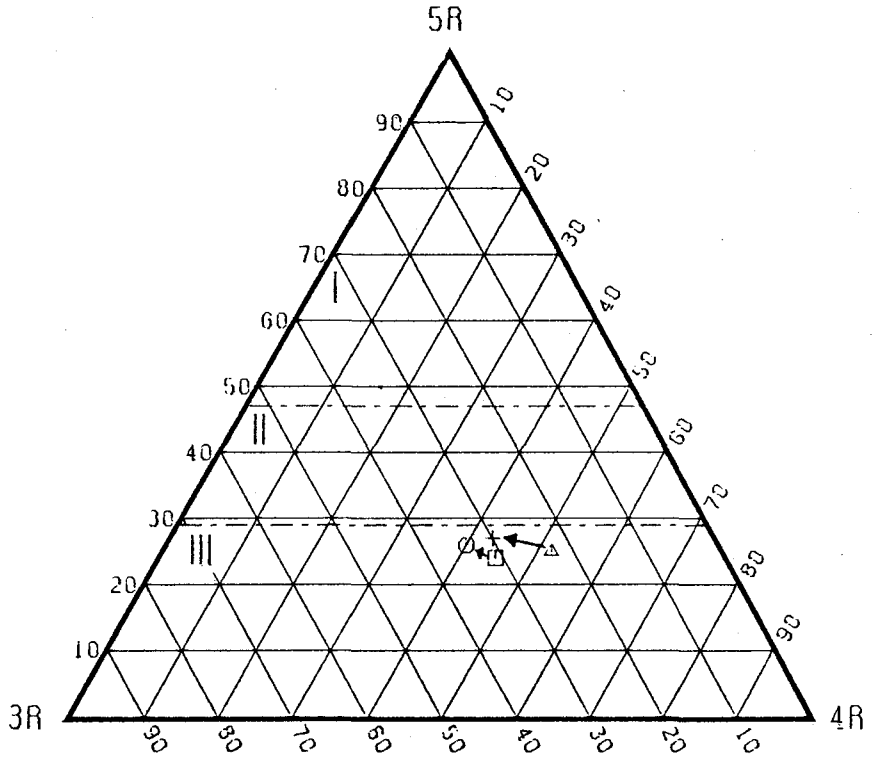

GAS CHROMATOGRAM OF SATURATED HYDROCARBONS

FIG. 4. UK LULWORTH COVE HEATED 6DAYS 330C

## $C_{15}$-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 |
|---|
| ⊡ - OSMINGTON MILLS |
| ⊙ - OSMINGTON MILLS HEATED 60A'S 330C |
| △ - LULWORTH COVE |
| + - LULWORTH COVE HEATED 60A'S 330C |

FIG. 5

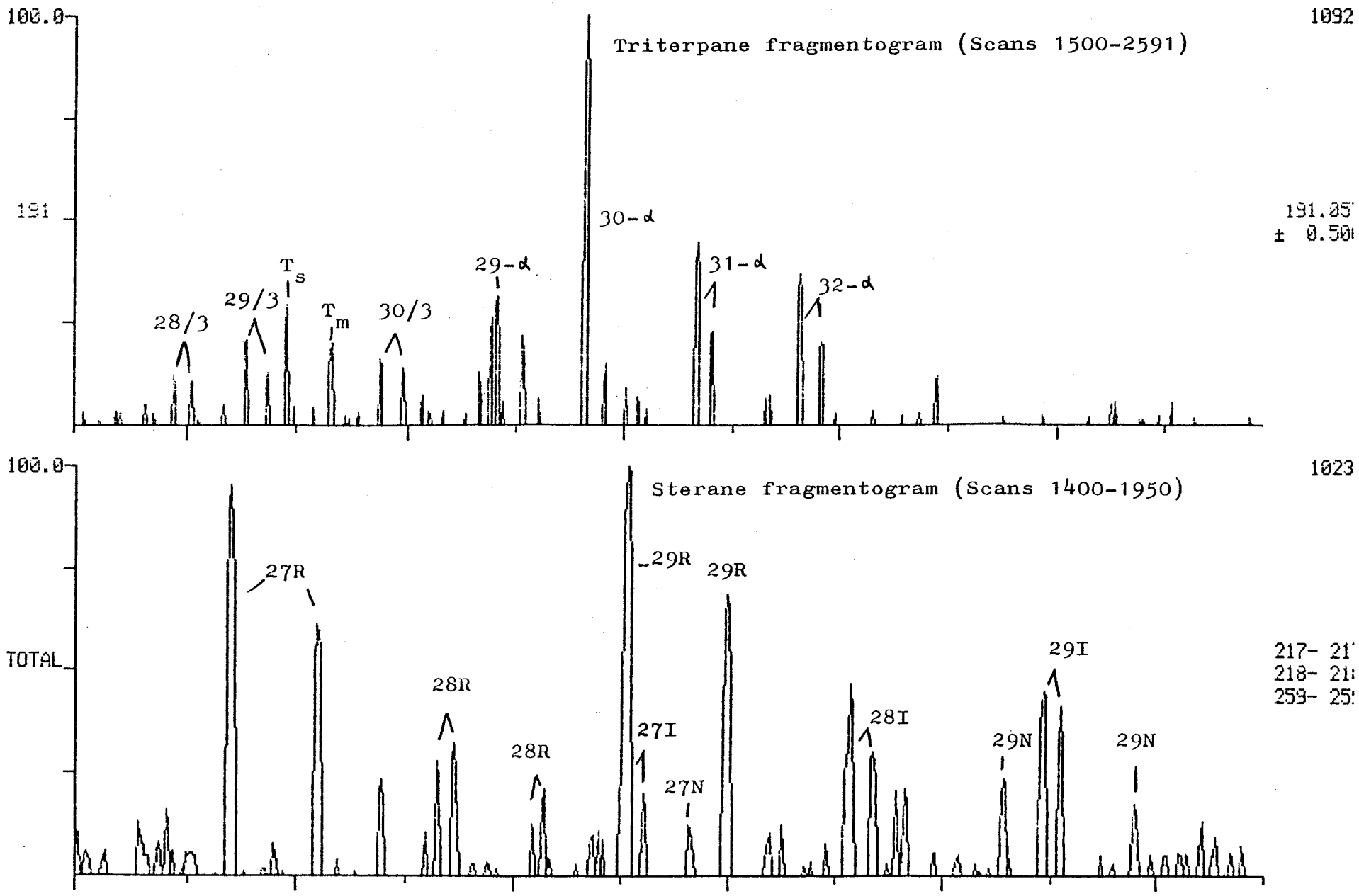



FIG. 6. GC-MS analysis Osmington Mills, Bencliff grit.

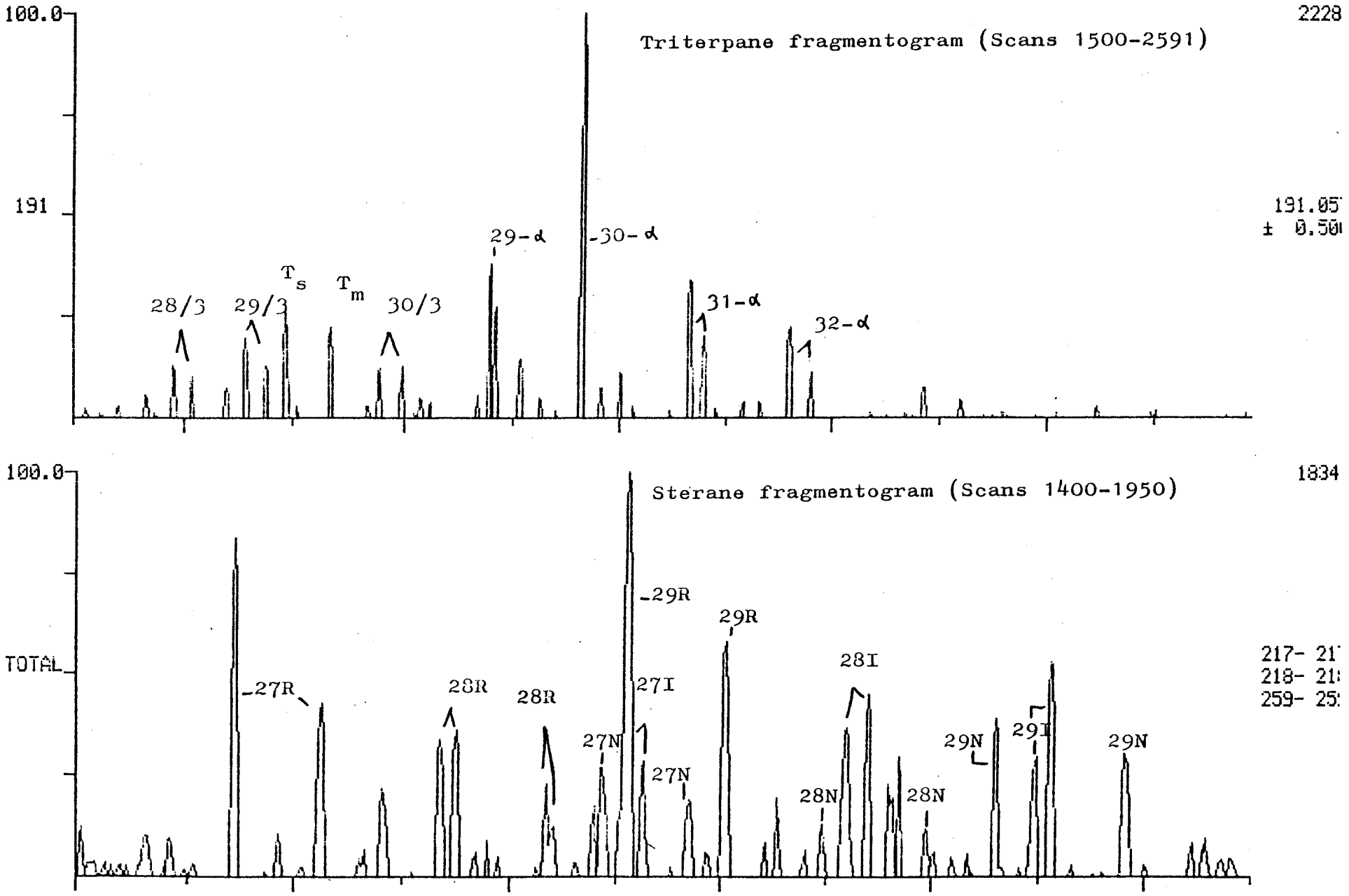
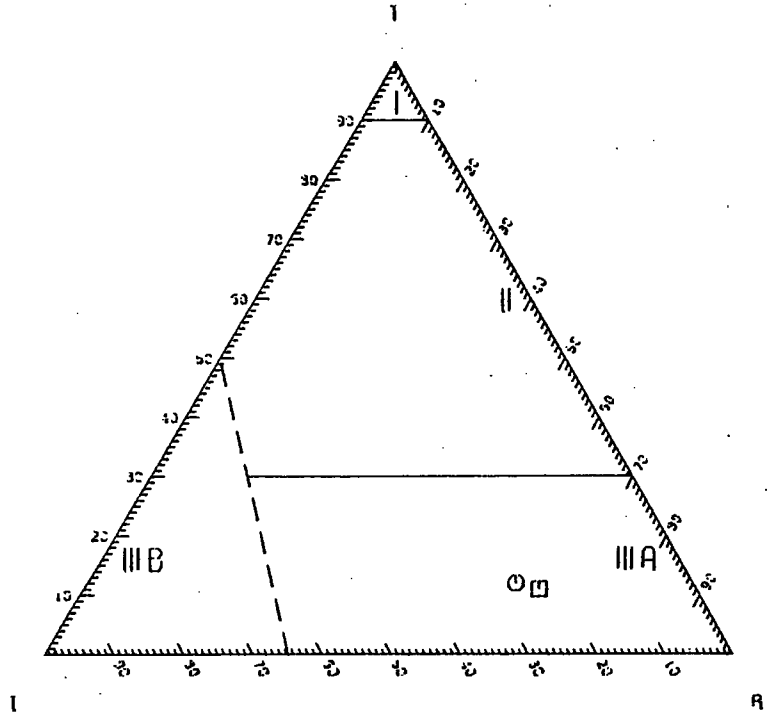
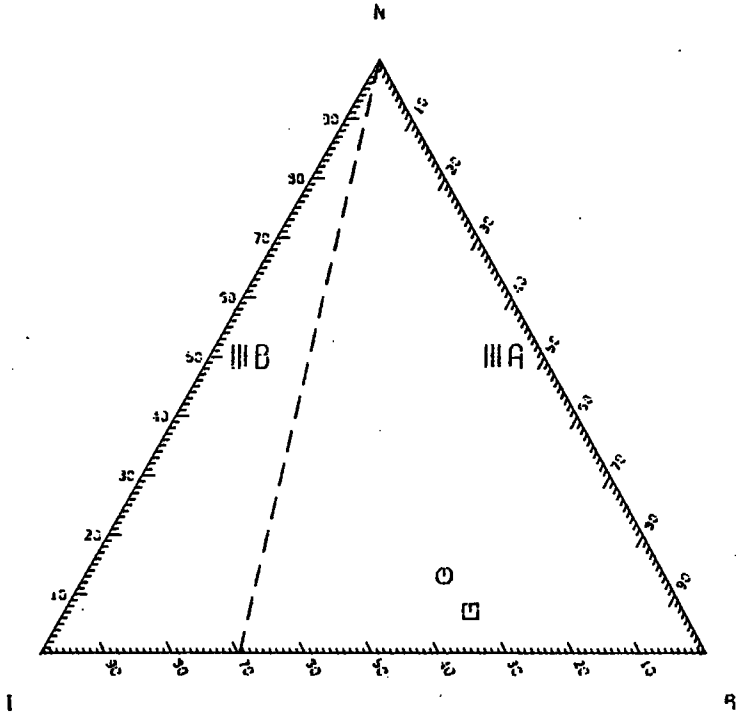



FIG. 7. GC-MS analysis Lulworth Cove, Wealden.

## STERANE/TRITERPANE DIAGRAM




## STERANE DIAGRAM




I LANDPLANT DERIVED CRUDES WITH SUBSTANTIAL RESIN CONTRIBUTION TO SOURCE MATTER

II CRUDES OF MIXED LANDPLANT/S.O.M. ORIGIN OR ALGAL ORIGIN

IIIA CRUDES OF BACTERIALLY REWORKED PHYTOPLANKTONIC ORIGIN

IIIB CRUDES OF ALGAL PLUS BACTERIAL ORIGIN

| LEGEND |
| --- |
| ⊡ - OSMINGTON MILLS<br>⊙ - FULWORTH COVE |

FIG. 8

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