(U-375) 3

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REPORT TYPE		
Service report	REPORT NO. IFE/KR/F-84/021	DATE 1984-01-31
	REPORT TITLE AN ORGANIC GEOCHEMICAL EVALUATION OF SAGA'S 6407/2-2 WELL OFFSHORE NORWAY	DATE OF LAST REV.
		REV. NO.
	CLIENT Saga Petroleum a/s	NUMBER OF PAGES
	CLIENT REF.	NUMBER OF ISSUES 20

SUMMARY

The 6407/2-2 well penetrated two stratigraphical units with significant source rock potential. The Kimmeridge Clay Formation has a rich potential for oil generation, whereas the Coal Unit has a rich potential for gas and condensate.

The maturity increases continously with depth reaching the transitional zone (Ro = 0.35) around 2150 m and the early mature zone (Ro = 0.55) around 3350 m. The peak zone (Ro = 0.70) is not reached in the well. It will be reached at approximately 4000 m.

The presence of reservoired hydrocarbons in the well proves that migration has occurred, however, migrated hydrocarbons occur over a wider well section than the main reservoir intervals.

84-1375 -BA

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KEYWORDS SOURCE ROCKS, MATURITY, MIGRATION, LOWER TERTIARY-TRIASSIC

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T A B L E O F C O N T E N T S

1. EXPLORATION SUMMARY

Well 6407/2-2 was drilled into Triassic grey beds with Middle and Lower Jurassic sandstones as the main targets. The well penetrated as expected the two sandstone intervals, and both proved to be gas condensate bearing. A drillstem test was carried out in the upper sandstone interval (DST 1, 2476-84 m).

This report contains an organic geochemical evaluation primarily of the Jurassic section with a brief note on the Lower Tertiary and Cretaceous sections. Items to be discussed include source rock identification, maturity evaluation, and detection of migrated hydrocarbons. An organic geochemical evaluation of the gas condensate has been reported previously (Throndsen et al. 1983).

1.1 Source rocks (Figure I)

The well encountered two stratigraphic units with significant source rock potential : the Kimmeridge Clay Formation and the Coal Unit.

The Drake Formation and claystone interbeds in the Lower Jurassic Sandstone unit have a marginal capacity for generation of gas with some liquids.

The remaining units being studied, the Rogaland Group, Shetland Group and the Heather Formation, have practically no potential for generation of hydrocarbons.

The Kimmeridge Clay Formation (11.5 m) consists of dark grey claystone. The content of organic carbon is very high, averaging at 9.04 weight percent. The pyrolysate yield (S2-peak) on the rock-eval pyrolysis is also very high averaging at 24.08 mg/g rock with a corresponding hydrogen index value of 259. Pyrolysis-GC, visual kerogen, maceral analysis and solvent extraction data support the enhanced quality of this unit. The kerogen is type II. The Kimmeridge Clay Formation is a good although immature source rock for oil.

The Coal Unit (383 m) consists of alternating coal, shale and sandstone lithologies. Altogether the Coal Unit contains 39.35 m of coaly lithologies. The major portion of these are carbonaceous shales and carbominerites. Very little is true coal. The organic carbon values range up to 57-60 weight percent, the pyrolysate yield (S2-peak) up to 169.51 mg/g rock and the corresponding hydrogen index up to 320. Maceral analysis and solvent extraction data indicate that the organic matter is of humic nature. The composition is dominated by vitrinite with a potential principally for dry gas at high maturity levels (Ro > 1.0). Exinitic components with potential for heavier hydrocarbons are also abundant.
The Coal Unit has a considerable thickness, contain abundant organic matter and represent a rich potential for wet gas and condensate at relatively high maturity levels, Ro > 0.9.

1.2 Maturity (Figure I and II)

The maturity appears to increase continously with depth reaching the transitional zone (Ro = 0.35) around 2150 m, and the early mature zone (Ro = 0.55) at 3350 m. The peak mature zone (Ro = 0.70) is not reached in the well section. It will be reached at approximately 4000 m.

1.3 Migrated hydrocarbons (Figure III)

The presence of reservoired hydrocarbons in the well section proves that migration has occurred. In addition solvent extraction and head-space gas data suggest that migrated hydrocarbons occur over a much wider well section than the main reservoir interval. Migrated wet hydrocarbon gases are evident as high as 2000 m in the well section (Rogaland Group), and methane as high as 1750 m (Hordaland Group). The overlying well section contains only biogenic methane. The Coal Unit below the main reservoir interval is totally dominated by indigenous hydrocarbons, indicating that migrated hydrocarbons are dominating over the interval from the Lower Jurassic Sandstone to the Rogaland Group with diffusion slightly into the Hordaland Group.

2. DISCUSSION AND RESULTS

2.1 Introduction

Well 6407/2-2 was drilled into Triassic grey beds with Middle and Lower Jurassic sandstones as the main targets. The well penetrated as expected the two sandstone intervals, and both proved to be gas condensate bearing. A drillstem test was carried out in the upper sandstone interval (DST 1, 2476-84 m).

This report contains an organic geochemical evaluation primarily of the Jurassic section with a brief note on the Lower Tertiary and Cretaceous sections. The Triassic grey beds below the Coal Unit is left out of discussion as the samples obtained were mainly sandstone heavily contaminated by cavings from the Coal Unit. Items to be discussed include source rock identifaction, maturity evaluation, and detection of migrated hydrocarbons. An organic geochemical evaluation of the gas condensate has been reported previously (Throndsen et al. 1983).

The methods being used represent well established routine analytical techniques and hence are not described here.

The organic carbon measurements, rock-eval pyrolysis, visual kerogen, maceral analysis and vitrinite reflectance have been carried out in the geological laboratory at Saga Petroleum A/S, whereas the pyrolysis gas chromatography, extraction, fractionation and GC of alkanes have been carried out by IKU. The headspace gas component and isotopic composition have been measured by IFE.

2.2 Source rocks

2.2.1 Hordaland Group (Enclosure 1)

The Hordaland Group has been penetrated with a total thickness of 571 m. Only the lowermost part of the unit (1920-55) is discussed here.

The lithology consists predominantly of greenish claystone interbedded with brownish grey and brick red claystones. The log responses are moderately homogenous with Gamma Ray values mostly between 40 and 50 API units. The interval considered is dated as being of Early Eocene age.

Four cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements and rock-eval pyrolysis.

Organic carbon. The organic carbon data are shown in Table I. The values range from 0.35 to 0.45 weight percent averaging at 0.39 weight percent which is poor.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) are poor ranging from 0.11 to 0.17 mg/g rock with corresponding hydrogen index values ranging from 32 to 38. This gives average values of 0.14 mg/g rock and 36 which are poor and suggest type III kerogen.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated on Figure I. The lowermost part of the Hordaland Group has no potential for generation of hydrocarbons.

2.2.2 Rogaland Group (Enclosure 1)

The Rogaland Group has been penetrated with a total thickness of 133 m, and consists of the Balder and Lista/Sele Formations.

The lithology is variable ranging from tuffaceous variegated claystone in the Balder Formation to less tuffaceous grey claystone and siltstone in the Lista/Sele Formations. The log responses are moderately homogenous with gamma ray values slightly depressed compared to the unit above. The interval is dated as being of Late Paleocene to Early Eocene age.

Numerous sidewall core and cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements and rock-eval pyrolysis.

Organic carbon. The organic carbon data are shown in Table I. The values ranges from 0.11 to 1.67 weight percent averaging at 0.71 weight percent which is fair.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) are poor ranging from 0.04 to 0.87 mg/g rock with corresponding hydrogen index values ranging from 13 to 98. This gives average values of 0.34 mg/g rock and 43 which are poor and suggest type III kerogen.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated on Figure I. The Rogaland Group has no potential for generation of hydrocarbons.

2.2.3 Shetland Group (Enclosure 1)

The Shetland Group has been penetrated with a total thickness of 240 m.

The lithology is homogenous consisting predominantly of medium grey claystone. The log responses are homogenous with somewhat elevated Gamma Ray values around 60 API units compared to the unit above. The Densilog-Neutron trace shows consistant "mud-separation". The interval is dated as being of Middle Santonian to Santonian-Campanian age.

Numerous sidewall core and cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements and rock-eval pyrolysis.

Organic carbon. The organic carbon data are shown in Table I. The content of organic carbon ranges from 0.56 to 1.26 weight percent averaging at 0.92 weight percent which is fair.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) are poor ranging from 0.10 to 0.56 mg/g rock with corresponding hydrogen index values ranging from 10 to 54. This gives average values of 0.24 mg/g rock and 26 which are poor and suggest type III kerogen.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated on Figure I. The Shetland Group has no potential for generation of hydrocarbons.

2.2.4 Cromer Knoll Group (Enclosure 1)

The Cromer Knoll Group has been penetrated with a thickness of only 81.5 m.

The lithology consists of grey claystone in the upper part and brick red calcareous claystone near the base of the formation. The log responses are homogenous with Gamma Ray values slightly increased compared to the Shetland Group above. The Densilog-Neutron trace shows clear "mud-separation". The unit is dated as being of Valanginian-Hauterivian to Albian age.

Several cuttings and sidewall core samples have been subjected to geochemical analysis by means of organic carbon measurements and rock-eval pyrolysis.

Organic carbon. The organic carbon data are shown in Table I. The values are ranging from 0.74 to 1.20 weight percent giving an average value of 0.92 weight percent which is fair.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) are poor ranging from 0.02 to 0.54 mg/g rock with corresponding hydrogen index values ranging from 2 to 50. This give average values of 0.18 mg/g rock and 18 which are poor and suggest type III kerogen.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated on Figure I. A non-source capacity can be inferred.

2.2.5 Kimmeridge Clay Formation (Enclosure 1)

The Kimmeridge Clay Formation (2409.5-21 m) is readily recognized from the "hot shale" response on the Gamma Ray trace reflecting high Uranium concentrations as inferred from the Spectralog. The Densilog-Neutron trace shows distinct "mud-separation". The lithology consists of dark grey laminated claystone. The formation is dated as being of Portlandian to Late Ryazanian age.

Three sidewall cores, one cuttings and one picked cuttings sample have been subjected to geochemical analysis. The programme includes organic carbon measurements, rock-eval pyrolysis, pyrolysis gas chromatography, solvent extraction, fractionation, gas chromatography of alkanes, visual kerogen estimates and maceral analysis.

Organic carbon. The organic carbon data are shown in Table I. The values range from 6.80 (1.64) to 10.90 weight percent averaging at 9.04 (7.56) weight percent which is very rich. The numbers in brackets include the 2414-25 m cuttings sample which is significantly contaminated by caved material and not representative for the unit.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) range from 14.97 (0.75) to 38.63 mg/g rock with corresponding hydrogen index values ranging from 203 (46) to 354. This give average values of 24.08 (18.25) mg/g rock and 259 (206) which is very rich. The numbers in brackets again include the 2414-23 m sample.

Pyrolysis-GC.- The three sidewall core samples and the picked cuttings sample (2405-23 m) have been analysed in more detail using pyrolysis gas chromatography. The pyrograms are shown in Figure IV a-d. The uppermost sidewall core sample (2410 m) shows a very depressed but still a long range n-C_7 to n-C_{27} aliphatic homology (Figure IV b). The remaining samples show distinct n-alkene/n-alkane homologies ranging beyond n-C_{25}, and the proportion of aromatic compounds are low relative to the aliphatics. Generally these pyrograms show kerogen type II fingerprints.

Visual kerogen and maceral analysis. The three sidewall core samples being analysed for pyrolysis-GC have also been studied microscopically in transmitted and reflected light combined with fluorescence. The data are given in Table VI and VII.

Examination of ordinary strew mounts in transmitted light combined with incident light fluorescence (visual kerogen analysis) shows that the kerogen in all the three samples are highly dominated by amorphous organic material associated with minor amounts of herbaceous, woody and coaly material. The amorphous components show predominantly weak brownish fluorescence and abundant herbaceous inclusions.

Analysis of polished rock specimens in reflected light (maceral analysis) shows that the maceral composition in all three samples are dominated by exinite over vitrinite and inertinite. The 2416 m sample differs from the 2410 m and 2418 m samples in that the major proportion of the exinite macerals have a more intense and brighter yellowish fluorescence typical of algal derived material, whereas the others are dominated by more deep orange yellow fluorescent exinite macerals typical for terrestrially derived material. This effect is also seen in the rock-eval pyrolysis data. The pyrolsate yield (S2-peak) and hydrogen index in the 2416 m sample is roughly twice as high as in the 2410 m and 2418 m samples. All three samples have a weak brownish fluorescent groundmass (rock matrix) and abundant pyrite.

Solvent extraction. The picked cuttings sample (2405-23 m) has been subjected to solvent extraction, fractionation and gas chromatography of alkanes. The extraction data are given in Table V a-d, and the gas chromatogram is shown in Figure V a. The abundance of extractable bitumen is 2120 ppm of rock which is high. The ratio of extractable bitumen normalised to organic carbon is moderate, 22.8 mg/g organic carbon. Extractrable bitumen crossplotted versus organic carbon falls in the field of good oil source rocks. There is reason to believe that the extracted bitumen is indigenous to the formation ; aromatics are more abundant than saturates, non-hydrocarbons are more abundant than hydrocarbons and the gas chromatogram of the alkanes shows distinct immature features. The gas chromatogram shows a bimodal n-alkane distribution peaking at $n-C_{17}$ and $n-C_{29}$. The $n-C_{17}$ centered hump is the more prominent indicating a predominantly algal marine character of the parent organic matter. An odd over even predominance is prominent beyond $n-C_{21}$ (CPI = 1.5). The pristane to phytane ratio of 1.3 is modest and indicative of sapropelic conditions.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated in Figure I. The Kimmeridge Clay Formation is a good although immature source rock for oil, and it could possibly be even more prolific in off-structure areas supposed the dominance of algal derived material as reveiled by reflected/fluorescent light microscopy in one of the samples (2416 m, swc) is prevalent.

2.2.6 Heather Formation (Enclosure 1)

The Heather Formation has been penetrated with a total thickness of 39.5 m.

The lithology is homogenous consisting predominantly of medium grey silty claystone. The log responses are homogenous with relatively high Gamma Ray values around 90 to 100 API units. The Densilog-Neutron trace shows consistant "mud-separation". The interval is dated as being of Bathonian to Callovian-Early Oxfordian age.

A number of sidewall core and cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements, rock-eval pyrolysis, pyrolysis gas chromatography, solvent extraction, fractionation, gas chromatography of alkanes and visual kerogen.

Organic carbon. The organic carbon data are shown in Table I. The values range from 0.98 to 2.26 weight percent averaging at 1.65 weight percent which is moderate.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) range from 0.56 to 1.80 mg/g rock with corresponding hydrogen index values ranging from 34 to 92. This give average values of 1.00 mg/g rock and 51 which are poor and suggest type III kerogen.

Pyrolysis-GC. Two picked cutting samples (2441-50 m and 2450-59) have been analysed in more detail using pyrolysis gas chromatography. The pyrograms are shown in Figure IV e-f. Both samples show distinct toluene and xylene peaks and a depressed short range n-C_7 to n-C_{20} aliphatic homology. Generally the pyrograms show rather inert kerogen type III fingerprints. The depressed aliphatic homology could reflect trace of caved material from the overlying Kimmeridge Clay Formation.

Visual kerogen. The two picked cuttings samples being analysed for pyrolysis-GC have also been studied microscopically. The data are given in Table VI. Examination of ordinary strew mounts in transmitted light combined with incident light fluorescence (visual kerogen analysis) shows that the kerogen in the upper sample (2441-50 m) is dominated by amorphous material over woody, coaly and herbaceous components, whereas the lower sample is dominated by herbaceous over amorphous, woody and coaly components. The amorphous material is non-fluorescent.

Solvent extraction. The picked cuttings sample 2450-59 m has been subjected to solvent extraction, fractionation and gas chromatography of alkanes. The extraction data are given in Table V a-d, and the gas chromatogram is shown in Figure V b. The abundance of extractable bitumen is only 173 ppm of rock which is very low. The ratio of extractable bitumen normalised to organic carbon is 17.7 mg/g organic carbon. Extractable bitumen crossplotted versus organic carbon falls in the field of poor sources. The gas chromatogram shows a bimodal n-alkane distribution peaking at n-C_{17} and n-C_{25}. The n-C_{17} centered hump is the more prominent. The odd over even predominance is prominent only beyond n-C_{25} (CPI = 1.5). The pristane to phytane ratio of 1.6 is relatively high. There is reason to believe from the ratios of saturates to aromatics, hydrocarbons to non-hydrocarbons and the n-alkane distribution patterns that the extracted bitumen is to some degree contaminated by non-indigeneous hydrocarbons presumably by gas-condensate migrated from the main reservoir immediately below the analysed sample.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated in Figure I. The Heather Formation has virtually no potential for generation of hydrocarbons.

2.2.7 Drake Formation (Enclosure 2)

The Drake Formation has been penetrated with a total thickness of 107 m.

The lithology is relatively homogenous consisting predominantly of medium grey silty claystone. The log responses are homogenous with

Gamma Ray values mostly between 70 and 90 API units. The Densilog -Neutron trace shows consistant "mud-separation". The formation is dated as being of Toarcian age.

A number of sidewall core and cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements, rock-eveal pyrolysis, pyrolysis gas chromatography, solvent extraction, fractionation, gas chromatography of alkanes and visual kerogen.

Organic carbon. The organic carbon data are shown in Table I. The values range from 0.58 to 1.95 weight percent averaging at 1.19 weight percent which is moderate.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) range from 0.23 to 2.80 mg/g rock with corresponding hydrogen index values ranging from 21 to 167. This give average values of 0.98 mg/g rock and 83 which are poor and suggest type III kerogen.

Pyrolysis-GC. Two picked cuttings samples (2627-36 m and 2663-72 m) have been analysed in more detail using pyrolysis gas chromatography. Both samples show distinct toluene and xylene peaks followed by a medium range aliphatic homology extending to $n\text{-}C_{25}$. The pyrograms can be interpreted as kerogen type II fingerprints.

Visual kerogen. The two picked cuttings samples analysed for pyrolysis-GC have also been studied microscopically. The data are given in Table VI. Examination of ordinary strew mounts in transmitted light combined with incident light fluorescence (visual kerogen analysis) shows that the kerogen in both samples is dominated by amorphous and herbaceous material. The amorphous material is non-fluorescent.

Solvent extraction.

The two picked cuttings samples have also been subjected to solvent extractions, fractionation and gas chromatography of alkanes. The extraction data are given in Table V a-d, and the gas chromatograms are shown in Figure V c-d. The abundance of extractable bitumen is 382 and 673 ppm of rock in the 2727-36 m and 2663-72 m sample respectively. These are fair values. The ratio of extractable bitumen normalised to organic carbon is 41.5 and 51.0 mg/g organic carbon respectively. Extractable bitumen crossplotted versus organic carbon falls in the field of poor to fair oil sources. The two gas chromatograms are nearly identical. They show a strong unimodal n-alkane distribution peaking at n-C_{16}. An odd over even predominance is distinct only beyond n-C_{25} (CPI = 1.2 and 1.4 respectively). The pristane to phytane ratio of 1.5 and 1.8 respectively for the two samples is relatively high. The presence of non-indigenous hydrocarbon is suspected based on the high extractable bitumen to organic carbon ratio and the dominance and mature appearance of the n-C_{20} alkanes. This effect, however, cannot be verified from other sensitive parameters like the saturates to aromatics and the hydrocarbon to non-hydrocarbon ratios.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated in Figure I. The rock-eval pyrolysis indicates a poor source rock capacity for the Drake Formation, and pyrolysis-GC and extraction data indicate some potential for generation of heavier C_{15+} hydrocarbons. These features can be interpreted as a mixed kerogen type with an overall poor capacity predominantly for gas with some oil. The potential is coming mainly from the herbaceous kerogen constituents.

2.2.8 Lower Jurassic sandstone (Enclosure 2)

The Lower Jurassic sandstone unit has been penetrated with a total thickness of 183 m. The lithology is heterogeneous consisting predominantly of sandstone interbedded with grey claystone and siltstone. The log responses are equally heterogenous. The Gamma Ray values for the interbedded finegrained lithologies are mostly between 70 and 90 API units. The unit is dated as being of Pliensbachian-Sinemurian to Toarcian age.

One sidewall core and two picked cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements, rock-eval pyrolysis, pyrolysis gas chromatography, solvent extraction, fractionation, gas chromatography of alkanes, and visual kerogen.

Organic carbon. The organic carbon data are shown in Table I. The values range from 1.14 to 1.96 weight percent averaging at 1.54 weight percent which is moderate.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) range from 1.78 to 1.96 mg/g rock with corresponding hydrogen index values ranging from 100 to 169. This gives average values of 1.89 mg/g rock and 123 which are poor to fair and suggest type III kerogen.

Pyrolysis-GC. The two picked cuttings samples have been analysed in more detail using pyrolysis gas chromatography. The pyrograms are shown in Figure IV i-j. Both samples show distinct toluene and xylene peaks followed by a medium range aliphatic homology extending to $n\text{-}C_{25}$. The pyrograms can be interpreted as kerogen type II fingerprints.

Visual kerogen. The two picked cuttings samples analysed for pyrolysis-GC have also been studied microscopically. The data are given in Table VI. Examination of ordinary strew mounts in transmitted light combined with incident light fluorescence (visual kerogen analysis) shows that the kerogen in both samples is dominated by herbaceous and woody material over amorphous (non to weak fluorescent) and coaly material.

Solvent extraction. The two picked cuttings samples have also been subjected to solvent extraction, fractionation and gas chromatography of alkanes. The extraction data are given in Table V a-d, and the gas chromatograms are shown in Figure V e-f. The abundance of extractable bitumen is 486 and 515 ppm of rock in the 2717-26 m and 2735-44 m sample respectively. The ratio of extractable bitumen normalised to organic carbon is 31.8 and 45.2 mg/g organic carbon respectively. Extractable bitumen crossplotted versus organic carbon falls in the field of poor to fair oil sources. The two gas chromatograms show a unimodal n-alkane distribution peaking at n-C_{17}, however, with a distinch hump around n-C_{29}. An odd over even predominance is significant beyond n-C_{21} (CPI = 1.8 and 1.7 respectively). The pristane to phytane ratio of 2.0 and 1.7 for the two samples is high. The presence of non-indigenous hydrocarbons is suspected especially in the lower sample (2735-44 m) based on the high extractable bitumen to organic carbon, saturates to aromatics, hydrocarbon to non-hydrocarbon ratios and the dominance and mature appearance of the n-C_{20} alkanes.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated in Figure I. The rock-eval pyrolysis indicates a poor to fair source rock capacity for the finegrained lithologies. The pyrolysis-GC data indicate some potential for heavier C_{15+} hydrocarbons. These features can be interpreted in terms of a mixed kerogen type with an overall poor capacity predominantly for gas with some oil. The potential is mainly due to the herbaceous kerogen constituents.

2.2.9 Coal Unit (Enclosure 2)

The Coal Unit has been penetrated with a total thickness of 383 m.

The sequence consists of alternating coal, shale and sandstone lithologies, and is dated as being of Late-Middle Rhaetian to Pliensbachian-Sinemurian age.

Amount of coal and carbonaceous shale. The amount of coal and carbonaceous shale in the Coal Unit can be estimated from the Densilog trace. The principle behind this approach is the density contrast between organic and mineral matter. Organic matter in coal-bearing series has densities in the range of 1.0 to 1.5 g/cm^3, whereas mineral matter has densities ranging from 2.65 to 2.87 g/cm^3 for clay minerals, quartz and the most common carbonates. Associations of organic and mineral matter thereby result in intermediate densities. A density of 1.5 g/cm^3 corresponds to approximately 55 weight percent organic carbon, 1.7 g/cm^3 to 45 weight percent, and 2.0 g/cm^3 to 30 weight percent.

The cumulative thickness of coal and carbonaceous are given in Table X. Altogether the Coal Unit contains 39.35 m of low density (< 2.0 g/cm^3) coaly lithologies. Complementary to these carbon enriched lithologies the Coal Unit bears considerable amounts of shaly lithologies with variable and in parts high organic matter contents.

A number of picked cuttings samples have been subjected to geochemical analysis by means of organic carbon measurements, rock-eval pyrolysis, pyrolysis gas chromatography, solvent extraction, fractionation, gas chromatography of alkanes, and maceral analysis. The samples being analysed are not representative for the Coal Unit as a whole, but give an idea of the size and variability in organic richness in the carbonaceous lithologies.

Organic carbon. The organic carbon data are shown in Table I. The values range from 4.30 to 57.60 weight percent averaging at 33.59 weight percent which is very high.

Rock-eval pyrolysis. The rock-eval pyrolysis results are given in Table II. The pyrolysate yields (S2-peak) range from 9.31 to 169.51 mg/g rock with corresponding hydrogen index values ranging from 186 to 320. This gives average values of 89.57 mg/g rock and 260 which are very high and moderate values respectively and suggests type III to II kerogens.

Pyrolysis-GC. Several picked cuttings samples have been analysed in more detail using pyrolysis gas chromatography. The pyrograms are shown i Figure IV k-n. The samples show distinct low molecular weight aromatics followed by a long range aliphatic homology extending beyond n-C_{25} indicating a significant input of lipid material (spores, cuticles, resins). The pyrograms can be interpreted as kerogen type II fingerprints.

Maceral analysis. Polished rock specimens of the picked cuttings samples analysed for pyrolysis-GC have been studied microscopically in reflected light combined with incident light fluorescence (maceral analysis). All the samples are dominated by mineral matter making up 55.5 to 71.7% of the total sample. This is in accordance with the organic carbon data. Pyrite is not a major component among the minerals (0.5-2.3%). The maceral composition is dominated by vitrinite (43.3-68.8%) over inertinite (21.6-39.0%) and exinite (7.1-21.6%), a typical succession in humic coal series. The exinite concentration is, however, relatively high and in good agreement with the rather aliphatic pyrolysis-GC fingerprints. The exinite macerals have a yellow to orange-yellow fluorescence typical for terrestrially derived exinite (sporinite, cutinite, resinite). Alginite is not a significant component.

Solvent extraction. The picked cuttings samples have also been subjected to solvent extraction, fractionation and gas chromatography of alkanes. The extraction data are given in Table V a-d, and the gas chromatograms are shown in Figure V g-j. The abundance of extractable bitumen is ranging from 6568 to 7722 ppm weight of rock averaging at 6984 ppm of rock which is very high. The ratio of extractable bitumen normalised to organic carbon is, however, moderate ranging from 17.4 to 29.9 mg/g organic carbon with an average at 21.8 mg/g. Extractable bitumen crossplotted versus organic carbon falls in the field of good oil source rocks. The extracted bitumen is indigenous to the formation ; aromatics are more abundant than saturates, non-hydrocarbons are more abundant than hydrocarbons and the gas chromatograms of the alkanes show distinct immature features. The gas chromatograms are characterised by a marked pristane peak and a dominance of C_{23+} n-alkanes indicating a terrestrially derived nature of the parent organic matter. An odd over even predominance is prominent beyond n-C_{19} (CPI = 1.8-2.0). The pristane to phytane ratio ranging from 4.9 to 7.7 is very high and supports the humic nature of the organic matter.

Hydrocarbon potential. The interpreted hydrocarbon potential is illustrated in Figure I. The Coal Unit has a considerable thickness, contain abundant organic matter, and represent a rich potential for hydrocarbon generation. The major portion of the organic matter is contained in carbonaceous shales, carbominerites, and only to a limited extent in pure coal. The organic matter is of humic nature. The composition is dominated by vitrinite with a potential principally for dry gas at high maturity levels (Ro>1.0). Exinitic components with potential for heavier hydrocarbons are also abundant.

The above consideration can be summarised with respect to hydrocarbon potential as follows : The Coal Unit has a considerable thickness, contain abundant organic matter and represent a rich potential for wet gas and condensate at relatively high maturity levels, Ro > 0.9.

2.3 Maturity

Vitrinite reflectance. Although the material quality in this well for the main part is unfavourable, it has been possible to establish a reliable vitrinite reflectance versus depth profile (Figure II) owing to the excellent material obtained from the Coal Unit. The vitrinite reflectance profile represents the base to which the maturity level will be referred. More secondary maturity indicators including spore colour, rock-eval pyrolysis and solvent extraction data are used primarily to confirm the vitrinite reflectance data.

The vitrinite reflectance data are given in Table VIII and IX.

The vitrinite reflectance appears to increase continously with depth reaching Ro = 0.35 at approximately 2150 m and Ro = 0.55 at 3350 m. A vitrinite reflectance value of Ro =0.70 is not reached in this well. It will be reached at approximately 4000 m based on extrapolation of the above trend.

Spore colour. Spore colour estimates have been run over the Lower Jurassic Sandstone to Kimmeridge Clay Formation interval. The results are contained in Table VI. A TAI value of 2.0 is inferred for all the samples, which is in accordance with the vitrinite reflectance data.

Rock-eval pyrolysis. The rock-eval pyrolysis data are given in Table II. The pyrolysis T-max values measured are variable mostly due to very low pyrolysate yield (S2-peak) and thereby difficult T-max pick. Reliable values, however, appears to increase from around $412^{0}C$ in the Kimmeridge Clay Formation to around $423^{0}C$ in the Coal Unit. This is in agreement with the vitrinite reflectance data.

Solvent extraction. Several cuttings samples over the interval from the Coal Unit to the Kimmeridge Clay Formation have been subjected to solvent extractions, fractionation and gas chromatography of alkanes. The results are shown in Table V a-d and Figure V.

All the GC-chromatograms show at least some immature features (odd over even predominance) although contamination from non-indigenous hydrocarbons is suspected in some of the samples. Prominent immature features are evident in the Kimmeridge Clay Formation and Coal Unit samples.

The Kimmeridge Clay Formation sample (2405-23 m) shows clearly immature features with a typical bimodal distribution with a maximum for pristane and around $n-C_{29}$. The proportion of high carbon number biomarker compounds is relatively high. This proportion will diminish considerably with increasing maturity. In addition there is a notable odd over even predomonance (CPI = 1.5), pristane and phytane are more abundant than their associated n-alkanes, C_{22+} n-alkanes are relatively abundant and the ratio of saturates to aromatics is less than unity altogether supporting the immature setting of this sample.

The Coal Unit samples also show clearly immature characters with a marked odd over even predominance (CPI = 1.8 to 2.0), marked predominance of pristane over the associated n-alkane $n-C_{17}$ (pristane/$n-C_{17}$ = 2.2 - 6.8), C_{22+} n-alkanes are abundant and the ratio of saturates to aromatics is mostly below 0.5 altogether supporting the immature setting of these samples.

Maturity levels. Based on the discussion above, it is reasonable to interpret the established vitrinite reflectance profile as reliable. The vertical maturity trend can be summarized as shown in Figure II. The maturity increases continously with depth reaching the transitional zone (Ro = 0.35) around 2150 m, and the early mature zone (Ro = 0.55) at 3350 m. The peak mature zone (Ro = 0.70) is not reached in the well section. It will be reached at approximately 4000 m.

2.4 Migrated hydrocarbons

The presence of reservoired hydrocarbons in the well section proves that migration has occurred. This effect is reflected in various parameters which are sensitive to thermogenic non-indigenous hydrocarbons.

Solvent extraction. Altogether 10 cuttings samples covering the interval from the Coal Unit to the Kimmeridge Clay Formation have been subjected to solvent extraction, fractionation and gas chromatography of alkanes. The results are shown in Table V a-d and Figure V. Solvent extraction data are sensitive to migration of thermogenic C_{15+} hydrocarbons into immature sections.

The uppermost sample, from the Kimmeridge Clay Formation (2405-23 m) shows no clear evidence of migrated hydrocarbons. All the parameters from this sample point toward an indigenous origin for the extracted bitumen.

The following five samples, however, covering the interval from the Lower Jurassic Sandstone to the Heather Formation are suspected to contain some non-indigenous hydrocarbons. The ratios of extractable organic matter to organic carbon, saturates to aromatics and hydrocarbons to non-hydrocarbons are not very high, but high enough to suspect some degree of contamination. In addition the gas chromatograms are relatively similar with respect to overall pattern, pristane to phytane and pristane to n-C_{17}, and furthermore they bear striking similarities in the n-C_{21} range alkane distribution with the reservoired condensate (see Throndsen et al. 1983)

The underlying Coal Unit samples show no evidence of migrated hydrocarbons. All the parameters indicate an indigenous origin for the extracted bitumens.

Headspace gas. The headspace gas in numerous canned cuttings samples covering the interval from 400 m (Nordland Group) to 3347 m (Triassic Grey Beds, T.D.) has been analysed by means of component and carbon isotope composition. The results are given in Table III and IV and illustrated in Figure III.

Throughout the Nordland and Hordaland Groups the abundance of gaseous hydrocarbons is high. The wetness (C_2-C_4/C_1-C_4) of the gas is low, for the main part below 0.01, whereas the isobutane to n-butane ratio (i-C_4/n-C_4) is high, normally above 1.5. These data indicate a low maturity and indigenous origin for these gases. The isotopic composition of the methane clearly indicates biogenic gas down to 1750 m with $\delta^{13}C$ values mainly below -55 ^{0}/oo. At this depth there is an incipient change-over to more positive values, probably reflecting diffusion of thermogenic methane from below.

In the Rogaland Group the picture is different. The abundance of gaseous hydrocarbons is till high. On the contrary the wetness (C_2-C_4/C_1-C_4) is turning to higher values, around 0.05, and the isobutane to n-butane ratio is turning to much lower values, around 0.50. The turning point occurs at 2000 m. The various data suggest that this zone below 2000 m contains some mature migrated hydrocarbon gases. The isotopic composition of the methane clearly indicates a thermogenic origin. The turning point of 2000 m is considerable deeper than the turning point indicated by the carbon isotopic composition of the methane at 1750 m. This discrepancy probably reflects the different ability for diffusion between methane and the wet hydrocarbon gases. Methane diffuses more easily than the wet hydrocarbon gases.

Through the underlying interval from the Shetland Group to the Lower Jurassic Sandstone the headspace gas is relatively homogenous with respect to abundance, wetness, isobutane to n-butane ratio and carbon isotopic composition. The abundance is high to very high, the wetness (C_2-C_4/C_1-C_4) is moderate ranging from around 0.20 to 0.70, the isobutane to n-butane ratio is low, around 0.60, and the $\delta^{13}C$ values for methane are around -40^0/oo. All the data are very similar to the reservoired gas condensate and clearly indicate a thermogenic and migrated origin for these hydrocarbon gases.

In the underlying Coal Unit the picture is again different. The abundance of gaseous hydrocarbons is very high, the wetness (C_2-C_4/C_1-C_4) is relatively low, around 0.10, and the isobutane to n-butane ratio is high, for the main part above 2.0. This is in strong contrast to the reservoir section above, and suggest an indigenous origin for the Coal Unit gases. The carbon isotopic composition with $\delta^{13}C$ values for methane around $-40\ ^0$/oo indicate significant generation of thermogenic gases in the Coal Unit. These gases are, however, not released from the coal structure at the present maturity level. Significant release of gaseous hydrocarbons from coal-bearings series occurs at relatively high maturity levels, above Ro = 1.0.

<u>Migrated hydrocarbons</u>. The presence of the reservoired hydrocarbons in the well section proves that migration has occurred, however, the discussion above confirms that migrated hydrocarbons occur over a wider well section than the main reservoir intervals. Migrated wet hydrocarbon gases are evident as high as 2000 m in the well section, and methane as high as 1750 m. The overlying well section contains only bacterially formed biogenic methane. The Coal Unit below the reservoir is totally dominated by indigenous hydrocarbons.

3. REFERENCES

THRONDSEN, T.O., ANDRESEN, B., BREVIK, E.M. AND RAHEIM, A. (1983)
An organic geochemical evaluation of a gas-condensate (DST 1) in Saga's 6407/2-2 well offshore Norway.
Institute for energy technology report No. IFE/KR/F-83/081, 18 pp.

4. TABLES AND FIGURES

LIST OF TABLES

TABLE : I a

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
HORDALAND GP 1384-1955 m			
1920-30	ctgs	60% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	0.45
		30% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous	
		10% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
1930-40	ctgs	60% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	0.40
		20% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous	
		20% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
1940-50	ctgs	75% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	0.34
		20% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
		5% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous	
		Tr Pyrite, limestone, sand	

TABLE : I b

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
1950-60	ctgs	70% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	0.35
		20% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
		10% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous	
		Tr Pyrite, sand, limestone	
ROGALAND GROUP 1955-2088 m			
1960-70	ctgs	50% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	0.57
		20% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
		20% Tuffaceous claystone, light grey with black specs, soft, non-calcareous	
		10% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous	
		Tr Limestone, sand, glauconite, pyrite	

TABLE : I c

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
1970-80	ctgs	50% Tuffaceous claystone, light grey with black specs, soft, non-calcareous	0.46
		20% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	
		20% Claystone, brick red, blocky, soft to firm, non to slightly calcareous.	
		10% Claystone/siltstone, brownish grey, firm to soft, non to slightly calcareous.	
		Tr Sand, pyrite, limestone	
1975.0	swc	Claystone, medium to dark grey, firm, blocky, silty, non to slightly calcareous	0.38
1980-90	ctgs	60% Tuffaceous claystone, light to medium grey with black specs, firm, blocky to subfissile, non to slightly calcareous.	0.41
		30% Claystone, light grey to greenish grey, blocky to subfissile, firm to soft, predominantly non-calcareous, occasionally glauconitic	
		10% Claystone, brick red, blocky, soft to firm, non to slightly calcareous	
		Tr Sand, pyrite, limestone	
1989.0	swc	Claystone, medium to dark grey, firm, blocky, slightly calcareous	1.16
1990-00	ctgs	60% Tuffaceous claystone, medium to dark grey with black specs, firm, blocky to subfissile, non to slightly calcarous	0.82
		40% Cement	
		Tr Claystone, light grey to greenish grey	

TABLE : I d

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2000.0	swc	Claystone, medium to dark grey, firm blocky, slightly calcareous	1.67
2000-10	ctgs	85% Tuffaceous claystone, medium to dark grey with black specs, occ brownish, blocky to subfissile, non to slightly calcareous	1.06
		10% Cement	
		5% Limestone, crystalline, clear	
2010-20	ctgs	100% Tuffaceous claystone, medium to dark grey with black specs, occ brownish, blocky to subfissile, non to slightly calcareous	1.20
		Tr Light greenish grey claystone, pyrite, cement, limestone	
2012.0	swc	Claystone, medium to dark grey, firm, blocky to subfissile, non-calcareous	1.24
2019.0	swc	Sample a/a	0.70
2020-30	ctgs	95% Tuffaceous claystone, medium to dark grey with black specs, occ brownish, blocky to subfissile, non to slightly calcareous	1.08
		5% Claystone, light to greenish grey, firm to soft, blocky, in parts glauconitic, non-calcareous	
		Tr Limestone	
2030-40	ctgs	50% Tuffaceous claystone, medium to dark grey with black specs, occ brownish, blocky to subfissile, non to slightly calcareous	0.35
		40% Claystone, light to greenish grey, firm to soft, blocky, in parts glauconitic, non to slightly calcareous	
		10% Claystone, redbrown occasionally with tuffaceous specs, firm, blocky, non to slightly calcareous	

TABLE : I e

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
		Tr Limestone, cement	
2038.0	swc	Claystone, light green interlaminated with redbrown claystone, firm, blocky, non-calcareous	0.11
2040-50	ctgs	50% Claystone, light to greenish grey, firm to soft, blocky, in parts glauconitic, non to slightly calcareous	0.35
		25% Tuffaceous claystone, medium to dark grey with black specs, occ brownish, blocky to subfissile, non to slightly calcareous	
		25% Claystone, redbrown occasionally with tuffaceous specs, firm, blocky, non-calcareous	
		Tr Limestone, cement, pyrite	
2050-60	ctgs	Sample a/a	0.35
2056.0	swc	Claystone, light to medium greenish grey, firm to hard, non-calcareous	0.28
2060-70	ctgs	50% Claystone, medium grey, firm, blocky to subfissile, non-calcareous, occasionally tuffaceous	0.40
		40% Claystone, light to medium greenish grey, firm to hard, non-calcareous, in parts glauconitic	
		10% Claystone, redbrown occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, glauconite, pyrite	
2070.0	swc	Claystone, medium grey, firm, blocky to subfissile, non-calcareous	0.60

TABLE : I f

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2070-80	ctgs	70% Claystone, medium grey, firm, blocky to subfissile, non-calcareous, occasionally tuffaceous	
		25% Claystone, light to medium greenish grey, firm to hard, non-calcareous, in parts glauconitic	
		5% Claystone, redbrown occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, pyrite	
2080-90	ctgs	Sample a/a	0.90
SHETLAND GP 2088-2328			
2090-00	ctgs	Sample a/a	0.76
2100-10	ctgs	60% Claystone, medium grey, firm, blocky to subfissile, non-calcareous	0.98
		35% Claystone, light grey to greenish grey, firm, blocky, non-calcareous, in parts glauconitic	
		5% Claystone, redbrown occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, pyrite, glauconite	
2110-20	ctgs	Sample a/a	0.61
2120-30	ctgs	Sample a/a	1.26
2130-40	ctgs	80% Claystone, medium grey, firm, blocky to subfissile, non-calcareous	0.80
		15% Claystone, light grey to greenish grey, firm, blocky, non-calcareous, in parts glauconitic	
		5% Claystone, redbrown, occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, pyrite, glauconite	

TABLE : I g

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2140-50	ctgs	Sample a/a	0.78
2150-60	ctgs	Sample a/a	0.80
2160-70	ctgs	Sample a/a	0.92
2170-80	ctgs	Sample a/a	0.87
2175.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly to non-calcareous	1.02
2180-90	ctgs	80% Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	1.04
		15% Claystone, light grey to greenish grey, firm, blocky, non-calcareous, in parts glauconitic	
		5% Claystone, redbrown, occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, pyrite, glauconite	
2190-00	ctgs	Sample a/a	0.80
2200-10	ctgs	Sample a/a	1.00
2210-20	ctgs	Sample a/a	0.79
2220-30	ctgs	Sample a/a	1.20
2227.5	swc	Claystone, medium grey, firm, blocky to subfissile, slightly calcareous	0.56
2230-40	ctgs	80% Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	0.71
		15% Claystone, light grey to greenish grey, firm, blocky, non-calcareous, in parts glauconitic	
		5% Claystone, redbrown, occasionally light brown, firm, blocky, non-calcareous	
		Tr Limestone, pyrite, glauconite	

TABLE : I h

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2240-50	ctgs	Sample a/a	0.87
2250-60	ctgs	95% Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	0.95
		5% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone	
2258.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	0.99
2260-70	ctgs	90% Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	1.11
		10% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone, glauconite	
2270-80	ctgs	Sample a/a	0.98
2280-90	ctgs	Sample a/a	1.01
2290-00	ctgs	Sample a/a	0.93
2293.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, calcareous	1.16
2310-20	ctgs	90% Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	1.00
		10% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone, glauconite	
2320-30	ctgs	Sample a/a	0.81
2326.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous.	0.80

TABLE : I i

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
CROMER KNOLL GP 2328-2409.5 m			
2330-40	ctgs	90% Claystone, medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	1.04
		10% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone, glauconite	
2340-50	ctgs	Sample a/a	0.92
2347.0	swc	Claystone with interbeds of limestone, medium grey, firm, blocky to subfissile, silty	0.72
2350-60	ctgs	90% Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	0.92
		10% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone, glauconite	
2360-70	ctgs	Sample a/a	0.87
2364.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	0.74
2370-78	ctgs	90% Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	0.89
		10% Claystone, light grey to greenish grey firm, blocky, non-calcareous	
		Tr Redbrown claystone, limestone, glauconite	
2375.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	1.11
2378-87	ctgs	85% Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	0.85

TABLE : I j

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
		10% Claystone, light grey to greenish grey, firm, blocky, non-calcareous	
		5% Claystone, redbrown, firm, blocky, non to slightly calcareous	
		Tr Limestone, glauconite, pyrite	
2387-96	ctgs	70% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	0.85
		30% Claystone, redbrown, firm, blocky, slightly to very calcareous, grading to marl.	
		Tr Limestone	
2388.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	1.20
2396-05	ctgs	60% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	0.75
		40% Claystone, redbrown, firm, blocky, slightly to very calcareous, grading to marl.	
		Tr Limestone	
2405-14	ctgs	40% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	1.09
		40% Claystone, redbrown, firm, blocky, slightly to very calcareous, grading to marl.	
		10% Claystone, dark grey, firm, fissile, carbonaceous, non-calcareous	
		10% Limestone, white, hard	
		Tr Pyrite	

TABLE : I k

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
KIMMERIDGE CLAY FM 2409.5 - 2421 m			
2405-23	ctgs	Picked : Claystone, dark grey, firm, fissile, carbonaceous, non-calcareous	9.28
2410.0	swc	Sample a/a	6.80
2414-23	ctgs	40% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous.	1.64
		40% Claystone, redbrown, firm, blocky, slightly to very calcareous, grading to marl.	
		20% Claystone, dark grey, firm, fissile, carbonaceous, non-calcareous	
		Tr Limestone, pyrite	
2416.0	swc	Claystone, dark grey, firm, fissile, carbonaceous, non-calcareous	10.90
2418.0	swc	Sample a/a	9.17
HEATHER FM 2421-2460.5 m			
2423.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, non-calcareous	1.13
2423-32	ctgs	60% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	1.85
		30% Claystone, redbrown, firm, blocky, slightly to very calcareous	
		10% Claystone, dark grey, firm fissile, carbonaceous, non-calcareous	
		Tr Limestone, pyrite, sand	
2426.0	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	2.26

TABLE : I 1

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2429.0	swc	Sample a/a	1.79
2432-41	ctgs	70% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	1.63
		25% Claystone, redbrown, firm, blocky, slightly to very calcareous	
		5% Claystone, dark grey, firm, fissile, carbonaceous, non calcareous	
		Tr Limestone, pyrite, sand	
2434.5	swc	Claystone, medium grey, firm, blocky to subfissile, silty, slightly calcareous	1.69
2438.5	swc	Sample a/a	2.25
2441-50	ctgs	70% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous	1.60
		25% Claystone, redbrown, firm, blocky, slightly to very calcareous	
		5% Claystone, dark grey, firm, fissile, carbonaceous, non-calcareous	
		Tr Limestone, pyrite, sand	
2441-50	ctgs	Picked: Claystone, light to medium grey, blocky to subfissile, silty, non to slightly calcareous.	
2450.0	swc	Claystone interbedded with finegrained sandstone, medium grey, firm, blocky to subfissile, calcareous, micromicaceous.	1.36
2450-59	ctgs	70% Claystone, light to medium grey, firm, blocky to subfissile, silty, non to slightly calcareous.	1.60
		25% Claystone, redbrown, firm, blocky, slightly to very calcareous.	
		5% Claystone, dark grey firm, fissile, carbonaceous, non-calcareous	

TABLE : I m

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2450-59	ctgs	Picked : Claystone, light to medium grey firm, blocky to subfissile, silty, non to slightly calcareous	0.98
2455.5	swc	Claystone, medium grey, firm, blocky to subfissile, silty, non to slightly calcareous.	1.67
DRAKE FM 2602-2709 m			
2600-09	ctgs	85% Claystone/siltstone, medium to light grey, firm, blocky to subfissile, in parts micromicaceous, non to slightly calcareous	1.95
		10% Sand/sandstone	
		5% Claystone, redbrown, firm, blocky, slightly calcareous	
		Tr Pyrite, limestone, dark grey claystone	
2600-09	ctgs	Picked : Claystone/siltstone, medium to light grey, firm, blocky to subfissile, non to slightly calcareous.	0.97
2609-18	ctgs	Picked : Claystone/siltstone, medium grey, occasionally light and dark grey, firm, blocky to subfissile, occasionally laminated claystone and siltstone, in parts micaceous, non to slightly calcareous	0.90
2612.0	swc	Siltstone/claystone, grey, firm, blocky to subfissile, non to slightly calcareous, micaceous	0.58
2618-27	ctgs	90% Claystone/siltstone, medium to light grey, firm, blocky to subfissile, in parts micromicaceous, non to slightly calcareous	1.16
		5% Sand/sandstone	

TABLE : I n

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
		5% Claystone, redbrown, firm, blocky slightly calcareous	
		Tr Pyrite, limestone, dark grey claystone	
2618-27	ctgs	Picked : Claystone/siltstone, medium to light grey, firm, blocky to subfissile, in parts micromicaceous, non to slightly calcareous.	1.11
2627-36	ctgs	Picked: Sample a/a	0.92
2636-45	ctgs	100% Claystone/siltstone, medium to light grey, firm blocky to subfissile, non to slightly calcareous, in parts micromicaceous	1.33
		Tr Redbrown claystone, sand, pyrite, limestone	
2645-54	ctgs	Picked : Claystone/siltstone, medium to light grey, firm, blocky to subfissile, non to slightly calcareous, in parts micromicaceous	1.78
2663-72	ctgs	Picked : Sample a/a	1.32
2672-81	ctgs	100% Claystone/siltstone, medium to light grey, firm, blocky to subfissile, non to slightly calcareous, in parts micromicaceous.	1.51
		Tr Redbrown claystone, sand, pyrite, limestone	
2681-90	ctgs	Picked : Claystone/siltstone, medium to light grey, firm, blocky to subfissile, non to slightly calcareous, in parts micromicaceous	1.30
2690-99	ctgs	100% Claystone/siltstone, medium to light grey, firm, blocky to subfissile, non to slightly calcareous, in parts micromicaceous	1.23
		Tr Redbrown claystone, sand, pyrite, limestone	

TABLE : I o

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
2699-08	ctgs	Picked : Claystone/siltstone, medium to light grey, firm, blocky to sub-fissile, non to slightly calcareous, in parts micromicaceous.	0.60
LOWER JURASSIC SANDSTONE 2709-2892 m			
2717-26	ctgs	Picked : Sample a/a	1.53
2735-44	ctgs	Picked : Sample a/a	1.14
2797.0	swc	Claystone, brownish grey, firm, laminated, silty, calcareous	1.96
COAL UNIT 2892-3275 m			
2906-15	ctgs	Picked : Coal/carbominerite, black, firm to brittle occasionally vitrinittic, non-calcareous	57.60
2924-33	ctgs	Picked : Sample a/a	44.31
2942-51	ctgs	Picked : Coal/carbominerite/carbonaceous shale, black to dark brown, firm to brittle occasionally vitrinittic, fissile, non-calcareous	24.10
2960-69	ctgs	Picked : Coal/carbominerite, black, firm to brittle occasionally vitrinittic, non-calcareous	32.90
2978-87	ctgs	Picked : Sample a/a	25.80
		Picked : Claystone/carbonaceous shale, light grey to black, firm, blocky to fissile, plant fragments, in parts micromicaceous, non calcareous	16.60
2996-05	ctgs	Picked : Coal/carbominerite, black, firm to brittle occasionally vitrinittic, non-calcareous	42.38
3014-23	ctgs	Picked : Sample a/a	56.08

TABLE : I p

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
3032-41	ctgs	Picked : Sample a/a	37,82
3050-59	ctgs	Picked : 50% Coal/carbominerite, black firm to brittle, occasionally vitrinittic, non-calcareous 50% Claystone/carbonaceous shale light grey to black, firm, blocky to fissile, plant fragments, in parts micaceous, non-calcareous	27.69
		Picked : Claystone/carbonaceous shale, light grey to black, firm, blocky to fissile, plant fragments, in parts micaceous, non-calcareous	4.30
3068-77	ctgs	Picked : 50% Coal/carbominerite, black, firm to brittle, occasionally vitrinittic, non-calcareous 50% Claystone/carbonaceous shale, light grey to black, firm, blocky to fissile, plant fragments, in parts micaceous, non-calcareous	22.80
3086-95	ctgs	Picked : Coal/carbominerite/carbonaceous shale, black to dark brown, firm to brittle, occasionally vitrinittic, fissile, non-calcareous	55.09
3104-13	ctgs	Picked : Sample a/a	26.44
3122-31	ctgs	Picked : Coal/carbominerite/carbonaceous shale, black to dark brown, firm to brittle, occasionally vitrinittic, fissile, non-calcareous Tr Light to dark grey claystone	47.65

TABLE : I q

LITHOLOGY AND ORGANIC CARBON

Sample depth m	Sample type	Analysed lithology	Organic carbon % wt
3140-49	ctgs	Picked : 50% Coal/carbominerite, black, firm to brittle, occasionally vitrinittic, non-calcareous	31.55
		50% Claystone/carbonaceous shale, light grey to black, firm, blocky to fissile, plant fragments, in parts micaceous, non-calcareous	
3158-67	ctgs	Picked : Coal/carbominerite/carbonaceous shale, black to dark brown, firm to brittle, occasionally vitrinittic, fissile, non-calcareous	49.80
		Tr Light to dark grey claystone	
3176-85	ctgs	Picked : Sample a/a	33.55
3194-03	ctgs	Picked : 50% Coal/carbominerite, black, firm to brittle, occasionally vitrinittic, non-calcareous	31.49
		50% Claystone/carbonaceous shale, light grey to black, firm, blocky to fissile, plant fragments, in parts micaceous, non-calcareous.	
3212-21	ctgs	Picked : Sample a/a	30.14
3230-39	ctgs	Picked : Sample a/a	22.00
3248-57	ctgs	Picked : Sample a/a	32.16
3266-75	ctgs	Picked : Sample a/a	20.32

TABLE : IIa

ROCK-EVAL PYROLYSIS

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/(S1+S2)	S2/S3	HI	OI	T_{max} °C
HORDALAND GP 1384-1955 m										
1920-30	ctgs	0.45	0.02	0.17	1.00	0.11	0.17	38	222	427
1930-40	ctgs	0.40	0.02	0.15	1.17	0.12	0.12	37	292	427
1940-50	ctgs	0.34	0.02	0.11	1.01	0.17	0.10	32	297	427
1950-60	ctgs	0.35	0.02	0.13	0.92	0.14	0.14	37	262	427
ROGALAND GP 1955-2088 m										
1960-70	ctgs	0.57	1.22	0.32	2.20	0.79	0.20	56	385	391
1970-80	ctgs	0.46	0.01	0.14	0.97	0.07	0.14	30	210	428
1975.0	swc	0.38	0.13	0.20	5.64	0.41	0.03	52	1484	472
1980-90	ctgs	0.41	0.04	0.07	0.87	0.40	0.08	17	212	425
1989.0	swc	1.16	0.06	0.43	0.30	0.12	1.43	37	25	433
1990-00	ctgs	0.82	0.09	0.29	2.91	0.24	0.09	35	354	424
2000.0	swc	1.67	0.13	0.67	0.58	0.16	1.15	40	34	411
2000-10	ctgs	1.06	0.05	0.54	3.46	0.09	0.15	50	326	428
2010-20	ctgs	1.20	0.04	0.84	0.88	0.05	0.95	70	73	427
2012.0	swc	1.24	0.18	0.87	0.33	0.17	2.63	70	26	415
2019.0	swc	0.70	0.09	0.69	0.27	0.12	2.55	98	38	442
2020-30	ctgs	1.08	0.07	0.69	0.77	0.09	0.89	63	71	427
2030-40	ctgs	0.35	0.02	0.11	0.60	0.17	0.18	31	171	391
2038.0	swc	0.11	0.09	0.09	0.42	0.50	0.21	81	231	362
2040-50	ctgs	0.35	0.04	0.18	0.72	0.18	0.25	51	205	422
2050-60	ctgs	0.35	0.03	0.04	0.77	0.50	0.05	11	220	439
2056.0	swc	0.28	0.30	0.16	0.65	0.65	0.24	57	232	468
2060-70	ctgs	0.40	0.00	0.05	0.68	0.00	0.07	13	170	427
2070.0	swc	0.60	0.02	0.15	0.25	0.12	0.57	25	43	441
2080-90	ctgs	0.90	0.06	0.12	0.77	0.33	0.15	13	85	422
SHETLAND GP 2088-2328 m										
2090-00	ctgs	0.76	0.02	0.10	0.74	9.17	0.13	13	85	425
2100-10	ctgs	0.98	0.03	0.10	0.63	0.25	0.15	10	64	423
2110-20	ctgs	0.61	0.10	0.11	1.60	0.50	0.06	18	262	367
2120-30	ctgs	1.26	0.06	0.18	0.73	0.25	0.24	14	57	424
2130-40	ctgs	0.80	0.05	0.20	0.67	0.21	0.29	25	83	426
2140-50	ctgs	0.78	0.04	0.22	0.57	0.15	0.38	28	73	426
2150-60	ctgs	0.80	0.05	0.20	1.32	0.21	0.15	25	165	426
2160-70	ctgs	0.92	0.03	0.19	0.76	0.14	0.25	20	82	425
2170-80	ctgs	0.87	0.06	0.15	0.77	0.30	0.19	17	88	425
2175.0	swc	1.02	0.10	0.56	0.15	0.15	3.72	54	14	423
2180-90	ctgs	1.04	0.05	0.20	1.13	0.21	0.17	19	108	430
2190-00	ctgs	0.80	0.04	0.21	0.65	0.17	0.32	26	81	430
2200-10	ctgs	1.00	0.03	0.26	0.79	0.11	0.32	26	79	428
2210-20	ctgs	0.79	0.05	0.27	0.71	0.16	0.38	34	89	426

TABLE : II b

ROCK-EVAL PYROLYSIS

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/(S1+S2)	S2/S3	HI	OI	T max °C
2220-30	ctgs	1.20	0.05	0.22	0.66	0.19	0.33	18	55	429
2227.5	swc	0.56	0.01	0.12	0.23	0.08	0.52	21	41	410
2230-40	ctgs	0.71	0.08	0.20	0.71	0.29	0.28	28	100	416
2240-50	ctgs	0.87	0.02	0.19	0.41	0.10	0.46	22	67	428
2258.0	swc	0.99	0.03	0.30	0.46	0.09	0.65	30	46	431
2260-70	ctgs	1.11	0.03	0.22	0.61	0.12	0.36	20	55	433
2270-80	ctgs	0.98	0.02	0.25	0.58	0.08	0.43	26	59	431
2280-90	ctgs	1.01	0.03	0.28	0.93	0.10	0.30	28	92	430
2290-00	ctgs	0.93	0.03	0.19	0.72	0.14	0.26	20	77	432
2293.0	swc	1.16	0.03	0.50	0.19	0.06	2.63	43	16	427
2310-20	ctgs	1.00	0.08	0.33	0.96	0.20	0.34	33	96	430
2320-30	ctgs	0.81	0.05	0.34	1.48	0.13	0.22	42	183	428
2326.0	swc	0.80	0.02	0.21	0.02	0.09	10.50	26	2	455

CROMER KNOLL GP 2328-2409.5 m

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/(S1+S2)	S2/S3	HI	OI	T max °C
2330-40	ctgs	1.04	0.03	0.42	0.40	0.07	1.05	40	38	425
2340-50	ctgs	0.92								
2347.0	swc	0.72	0.12	0.21	0.32	0.37	0.65	29	44	343
2350-60	ctgs	0.92	0.01	0.13	0.38	0.07	0.34	14	41	430
2360-70	ctgs	0.87	0.01	0.12	0.59	0.08	0.20	14	68	432
2364.0	swc	0.74	0.01	0.02	0.56	0.50	0.03	2	75	369
2370-78	ctgs	0.89	0.02	0.15	0.68	0.12	0.22	17	75	431
2375.0	swc	1.11	0.03	0.08	0.47	0.30	0.17	7	42	356
2378-87	ctgs	0.85	0.02	0.10	0.52	0.17	0.19	12	61	429
2387-96	ctgs	0.85	0.01	0.10	0.44	0.10	0.22	12	52	429
2388.0	swc	1.20	0.02	0.19	0.11	0.10	1.72	15	9	415
2396-05	ctgs	0.75	0.01	0.07	0.50	0.12	0.19	9	67	382
2405-14	ctgs	1.09	0.13	0.54	1.56	0.20	0.34	50	143	413

KIMMERIDGE CLAY FM 2409.5-2421 m

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/(S1+S2)	S2/S3	HI	OI	T max °C
2405-23	ctgs P	9.28								
2410.0	swc	6.80	0.99	14.97	1.53	0.06	9.78	220	22	411
2414-23	ctgs	1.64	0.07	0.75	0.43	0.09	1.74	46	26	424
2416.0	swc	10.90	1.59	38.63	2.44	0.04	15.83	354	22	412
2418.0	swc	9.17	10.17	18.63	2.14	0.35	8.70	203	23	413

HEATHER FM 2421-2460.5 m

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/(S1+S2)	S2/S3	HI	OI	T max °C
2423.0	swc	1.13	0.09	0.96	0.27	0.09	3.55	84	23	422
2423-32	ctgs	1.85	0.13	1.70	0.56	0.07	3.03	92	30	425
2426.0	swc	2.26	0.13	1.80	0.40	0.07	4.50	79	17	423
2429.0	swc	1.79	0.11	0.93	0.28	0.11	3.32	51	15	426
2432-41	ctgs	1.63	0.05	1.03	0.40	0.05	2.57	63	25	422
2434.5	swc	1.69	0.42	0.73	0.76	0.37	0.96	43	44	423
2438.5	swc	2.25	0.19	0.78	0.81	0.20	0.96	34	36	427
2441-50	ctgs	1.60	0.05	0.54	0.54	0.09	1.00	34	34	427

TABLE : IIc

ROCK-EVAL PYROLYSIS

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1/S1+S2	S2/S3	HI	OI	T max °C
2450.0	swc	1.36	0.29	0.56	1.25	0.35	0.44	41	91	430
2450-59	ctgs	1.60	0.09	0.82	0.52	0.10	1.57	51	33	428
2450-59	ctgs P	0.98								
2455.5	swc	1.67	0.33	1.13	0.27	0.23	4.18	67	16	426
DRAKE FM 2602-2709 m										
2600-09	ctgs	1.95	1.97	2.80	1.44	0.41	1.94	143	74	419
2600-09	ctgs P	0.97	0.26	0.31	1.22	0.46	0.25	32	126	415
2609-18	ctgs P	0.90	0.19	0.52	2.00	0.27	0.26	58	222	521
2612.0	swc	0.58	0.21	0.57	0.42	0.27	1.35	98	72	435
2618-27	ctgs	1.16	0.13	0.46	0.67	0.22	0.68	40	58	426
2618-27	ctgs P	1.11	0.09	0.23	1.15	0.28	0.20	21	104	421
2627-36	ctgs P	0.92	0.16	0.45	1.86	0.27	0.24	49	202	425
2636-45	ctgs	1.33	0.31	0.70	1.19	0.31	0.59	53	89	426
2645-54	ctgs P	1.78	0.23	1.00	2.25	0.19	0.44	56	126	427
2663-72	ctgs P	1.32	0.34	1.61	1.88	0.18	0.85	122	142	428
2672-81	ctgs	1.51	0.21	1.19	1.07	0.15	1.11	97	87	430
2681-90	ctgs P	1.30	0.12	1.43	0.98	0.08	1.45	110	75	429
2690-99	ctgs	1.23	0.21	1.50	1.27	0.17	1.18	121	103	426
2699-08	ctgs P	0.60	0.17	1.00	2.97	0.15	0.33	167	495	427
LOWER JURASSIC SANDSTONE 2709-2892 m										
2717-26	ctgs P	1.53	0.33	1.78	1.38	0.15	1.28	116	90	424
2735-44	ctgs P	1.14	0.58	1.93	6.22	0.23	0.31	169	545	428
2797.0	swc	1.96	0.12	1.96	8.92	0.06	0.21	100	455	434
COAL UNIT 2892-3275 m										
2906-15	ctgs P	57.60	6.94	121.03	6.19	0.05	19.55	210	11	421
2924-33	ctgs P	44.31	5.74	109.46	5.86	0.05	18.67	247	13	423
2942-51	ctgs P	24.10	2.33	44.53	3.33	0.05	13.37	184	14	423
2960-69	ctgs P	32.90	2.53	76.42	1.78	0.03	42.93	217	5	422
2978-87	ctgs P	25.80	2.26	67.08	1.39	0.03	48.25	260	5	420
2978-87	ctgs P	16.60	1.36	30.99	1.06	0.04	29.23	186	6	421
2996-05	ctgs P	42.38	2.37	95.76	2.19	0.02	43.72	226	5	425
3014-23	ctgs P	56.08	5.01	153.28	2.76	0.03	55.53	273	5	424
3032-41	ctgs P	37.82	2.66	104.13	1.64	0.02	63.49	275	4	425
3050-59	ctgs P	27.69	2.18	65.06	2.48	0.03	26.23	234	9	425
3050-59	ctgs P	4.30	0.25	9.31	0.57	0.03	16.33	217	13	428
3068-77	ctgs P	22.80	2.30	61.18	1.20	0.04	50.98	268	5	423
3086-95	ctgs P	55.09	4.86	169.51	4.48	0.03	37.83	307	8	425
3104-13	ctgs P	26.44	1.63	62.78	1.81	0.03	34.68	237	7	427
3122-31	ctgs P	47.65	5.02	152.59	2.77	0.03	55.08	320	6	426

TABLE : II d

ROCK-EVAL PYROLYSIS

Sample depth m	Sample type	Organic carbon % wt	S1	S2	S3	S1 / S1+S2	S2 / S3	HI	OI	T_{max} °C
3140-49	ctgs P	31.55	4.00	96.23	1.64	0.04	58.74	305	5	422
3158-67	ctgs P	49.80	4.26	147.10	2.70	0.03	54.58	295	5	426
3176-85	ctgs P	33.55	3.01	99.32	1.87	0.03	53.11	296	6	426
3194-03	ctgs P	31.49	2.59	90.51	1.66	0.03	54.52	287	5	427
3212-21	ctgs P	30.14	2.89	84.14	1.92	0.03	43.82	279	6	426
3230-39	ctgs P	22.00	2.12	62.25	1.44	0.03	43.22	282	7	424
3248-57	ctgs P	32.16	2.82	101.28	1.69	0.03	59.92	315	5	429
3266-75	ctgs P	20.32	1.64	56.12	0.91	0.03	61.67	276	5	427

TABLE : III a

HEADSPACE GAS

Sample depth m	C_1-C_4 ppm	C_2-C_4 ppm	C_1	C_2	C_3	iC_4	nC_4	$\frac{C_2-C_4}{C_1-C_4}$	$\frac{iC_4}{nC_4}$
			% of C_1-C_4						
400-20	46675	675	98.5	0.4	0.3	0.2	0.6	0.015	0.30
420-40	100315	315	99.7	0.2	-	-	-	0.003	2.10
440-60	66762	462	99.1	0.4	0.2	0.1	0.2	0.009	0.58
460-80	54596	96	99.7	0.2	-	-	-	0.003	2.50
480-00	105651	451	99.5	0.2	0.1	-	0.2	0.005	0.18
500-20	45072	72	99.8	0.1	-	-	-	0.002	2.30
520-40	39227	227	99.7	0.2	-	-	-	0.003	0.06
540-60	21029	29	99.8	0.1	-	-	-	0.002	2.00
560-80	57969	269	99.4	0.2	-	-	0.3	0.005	0.05
580-00	36450	50	99.8	0.1	-	-	-	0.002	1.50
600-20	39000	-	100.0	-	-	-	-	0.000	-
620-40	51849	49	99.8	0.1	-	-	-	0.002	-
640-60	62649	249	99.6	0.1	0.1	0.1	0.1	0.004	1.20
660-80	58197	97	99.8	0.1	-	-	-	0.002	1.00
680-00	89053	153	99.8	0.1	-	-	-	0.002	1.10
700-20	60989	89	99.8	0.1	-	-	-	0.002	2.50
720-40	73409	109	99.8	0.1	-	-	-	0.002	1.40
740-60	66657	147	99.7	0.2	-	-	-	0.003	3.30
760-80	129161	261	99.8	0.1	-	-	-	0.002	1.80
800-20	99132	132	99.9	0.1	-	-	-	0.001	2.10
820-40	98361	361	99.6	0.3	0.1	-	-	0.004	2.20
840-60	112442	142	99.9	0.1	-	-	-	0.001	2.10
860-80	15477	77	99.4	0.1	0.1	0.2	0.1	0.006	1.90
920-40	124122	122	99.9	-	0.1	-	-	0.001	-
940-60	162462	464	99.7	0.2	-	-	-	0.003	1.40
960-80	165093	93	99.9	-	0.1	-	-	0.001	-
980-00	112314	314	99.7	0.2	-	-	-	0.003	1.20
1000-20	62494	694	98.8	0.2	0.2	0.2	0.6	0.012	0.39
1020-40	40655	55	99.9	0.1	-	-	-	0.001	1.00
1040-60	50273	273	99.5	0.1	0.1	0.1	0.2	0.005	0.39
1080-00	95850	450	99.5	0.1	0.1	-	0.3	0.005	0.11
1120-40	27615	315	98.9	-	-	-	1.0	0.011	0.02
1160-80	61402	502	99.2	0.1	-	-	0.7	0.008	0.03
1200-20	125405	405	99.7	0.1	0.1	-	0.1	0.003	0.24
1280-00	24509	209	99.2	-	0.1	-	0.7	0.008	0.05
1300-20	69270	270	99.6	0.3	0.1	-	-	0.004	-
1320-40	52133	133	99.7	0.2	0.1	-	-	0.003	-
1360-80	80121	1121	98.6	0.3	0.2	0.2	0.7	0.014	0.27
1400-20	27655	1955	92.9	0.2	0.1	0.1	6.6	0.071	0.02
1440-60	17224	824	95.2	0.2	0.2	0.1	4.3	0.048	0.02
1480-00	916	6	99.3	0.2	0.4	-	-	0.007	-
1510-20	5953	53	99.1	0.2	0.4	0.1	0.2	0.001	0.80

TABLE : III b

HEADSPACE GAS

Sample depth m	C_1-C_4	C_2-C_4	C_1	C_2	C_3	iC_4	nC_4	$\frac{C_2-C_4}{C_1-C_4}$	$\frac{iC_4}{nC_4}$
	ppm		% of C_1-C_4						
1530-40	137712	1412	99.0	0.3	0.4	0.2	0.2	0.010	1.03
1540-50	128558	1258	99.0	0.4	0.3	0.2	0.1	0.010	2.10
1560-70	160934	2334	98.5	0.4	0.6	0.4	0.1	0.015	4.70
1570-80	106403	1403	98.7	0.3	0.5	0.4	0.1	0.013	4.20
1580-90	121493	1493	98.8	0.3	0.5	0.4	0.1	0.012	5.10
1590-00	173814	2314	98.7	0.4	0.5	0.3	0.1	0.013	5.00
1610-20	170888	1888	98.0	0.5	0.4	0.2	0.1	0.012	2.70
1620-30	181940	1940	98.9	0.4	0.4	0.2	0.1	0.011	2.90
1640-50	184925	1925	98.9	0.4	0.4	0.2	0.1	0.011	2.70
1670-80	186791	1641	99.1	0.4	0.3	0.2	0.1	0.009	2.50
1720-30	121441	941	99.2	0.4	0.2	-	0.2	0.008	0.07
1750-60	109806	3556	96.7	1.2	0.7	0.7	0.7	0.033	0.99
1780-90	62915	1315	97.9	0.3	0.4	0.6	0.9	0.021	0.67
1810-20	60360	360	99.4	0.4	0.1	0.1	0.1	0.006	0.56
1830-40	84632	632	99.2	0.5	0.1	0.1	0.1	0.008	1.20
1840-50	144126	1226	99.1	0.5	0.1	0.1	0.1	0.009	1.70
1860-70	26878	78	99.7	0.2	0.1	-	-	0.003	-
1870-80	55274	274	99.5	0.4	0.1	-	-	0.004	1.10
1900-10	93608	608	99.3	0.5	0.1	0.1	-	0.007	1.80
1910-20	81807	1807	97.8	1.7	0.3	0.1	0.1	0.022	2.80
1940-50	75911	911	98.8	1.0	0.1	0.1	0.1	0.012	1.50
1960-70	85870	1870	97.8	1.9	0.2	0.1	-	0.022	1.80
1980-90	97340	2240	97.7	2.0	0.3	0.1	-	0.023	2.10
1990-00	57415	2415	95.8	3.4	0.7	-	-	0.042	1.20
2000-10	103610	8610	91.6	6.6	1.5	0.1	0.1	0.084	0.95
2030-40	94215	6215	93.4	4.1	1.8	0.2	0.4	0.066	0.62
2060-70	86463	4363	94.9	2.9	1.4	0.3	0.5	0.051	0.46
	[illegible]328 m								
2090-00	89412	9312	89.6	4.3	3.5	0.6	2.0	0.104	0.31
2120-30	174970	32270	83.9	6.0	2.7	2.4	5.1	0.184	0.46
2150-60	193960	49480	74.5	7.1	8.8	2.7	6.9	0.255	0.39
2160-70	288770	82070	71.5	7.0	9.3	4.0	8.1	0.284	0.49
2180-90	219900	59890	72.8	6.7	9.2	3.8	7.4	0.272	0.51
2200-10	255200	84200	67.0	7.8	11.0	4.9	9.3	0.330	0.54
2220-30	332900	111800	63.4	7.1	11.4	5.7	9.4	0.336	0.60
2230-40	542200	160000	70.5	8.2	9.6	4.7	7.1	0.295	0.67
2260-70	389000	122300	68.6	8.1	10.3	5.2	7.8	0.314	0.67
2290-00	213700	62600	70.7	7.7	10.0	4.3	7.3	0.293	0.59
2310-20	361600	90600	74.9	8.2	8.5	3.2	5.1	0.251	0.64

TABLE : III c

HEADSPACE GAS

Sample depth m	C_1-C_4 ppm	C_2-C_4 ppm	C_1	C_2	C_3	iC_4	nC_4	$\frac{C_2-C_4}{C_1-C_4}$	$\frac{iC_4}{nC_4}$
			% of C_1-C_4						
2340-50	192400	45400	76.4	6.6	8.4	3.0	5.6	0.236	0.54
2360-70	187500	49700	73.5	7.0	9.1	3.6	6.8	0.265	0.53
2370-78	87220	28515	70.4	8.0	10.0	3.6	7.9	0.327	0.47
2378-87	73260	19260	73.7	8.6	9.2	2.7	5.8	0.263	0.47
2387-96	77765	23465	69.8	7.5	10.2	4.0	8.5	0.302	0.47
2396-05	81500	27500	66.3	7.5	11.2	5.3	9.7	0.337	0.54
2423-32	237700	103400	56.5	14.6	13.0	6.5	9.4	0.435	0.69
2450-59	163570	64570	60.5	13.1	12.9	5.1	8.3	0.395	0.61
				12 m					
2477-86	197650	86250	56.4	12.6	13.4	6.9	10.8	0.436	0.64
2495-04	130400	63700	51.5	12.5	14.7	7.8	13.4	0.485	0.58
2504-13	107500	45400	47.4	14.4	15.6	8.7	13.8	0.526	0.63
2513-22	150850	76550	49.3	13.7	15.3	8.4	13.4	0.507	0.62
2531-40	71840	44700	37.8	14.0	18.9	10.2	19.1	0.622	0.53
2549-58	74650	38950	47.8	14.7	16.6	7.1	13.7	0.528	0.52
2573-82	80850	47250	41.6	16.5	18.1	8.8	15.2	0.584	0.58
2582-91	154980	72480	63.2	17.0	14.7	6.0	9.1	0.568	0.65
2591-00	147300	65900	55.3	13.7	13.7	6.6	10.9	0.447	0.61
2618-27	119340	52200	56.3	11.7	13.8	6.9	11.3	0.437	0.61
2627-36	81150	35400	56.4	12.6	14.5	5.7	10.8	0.436	0.52
2636-45	90900	46600	48.7	14.2	16.0	7.3	13.8	0.513	0.53
2654-63	167150	83650	50.0	15.5	16.4	7.2	10.3	0.500	0.66
2672-81	109350	57250	47.7	15.4	18.2	7.1	11.7	0.523	0.61
2681-90	113250	43250	61.8	11.6	14.0	4.5	8.4	0.382	0.54
2699-08	108950	41050	62.3	11.4	13.8	4.3	8.3	0.377	0.52
2708-17	108000	62500	42.1	15.9	20.7	8.5	12.7	0.579	0.67
2726-35	84500	53000	37.3	21.5	21.2	7.9	12.1	0.627	0.66
2744-53	18830	13230	29.7	23.4	28.7	6.1	12.1	0.703	0.50
2762-71	38200	24500	35.9	24.1	24.4	5.5	10.2	0.641	0.54
2780-89	39000	21500	44.9	18.0	20.4	6.2	10.5	0.551	0.59
2807-16	15910	10660	33.0	20.5	27.7	6.5	12.3	0.670	0.53
2816-25	18720	13470	28.0	15.4	29.5	9.4	17.6	0.720	0.53
2843-52	6063	4163	31.3	15.3	30.2	8.5	14.7	0.687	0.58
2861-70	4460	1360	69.5	16.4	10.4	1.1	2.6	0.305	0.43
2886-95	324080	40080	87.6	7.8	3.7	0.3	0.5	0.124	0.62

TABLE : III d

HEADSPACE GAS

Sample depth m	C_1-C_4 ppm	C_2-C_4 ppm	C_1 % of C_1-C_4	C_2	C_3	iC_4	nC_4	$\frac{C_2-C_4}{C_1-C_4}$	$\frac{iC_4}{nC_4}$
2906-15	67333	12133	82.0	14.2	3.4	0.2	0.3	0.180	0.52
2915-24	254850	54850	78.5	13.7	6.5	0.5	0.8	0.215	0.67
2942-51	266340	51340	80.7	12.0	5.9	0.7	0.4	0.193	0.82
2978-87	208448	40448	80.6	13.1	5.5	0.4	0.4	0.194	0.91
2996-05	524480	65480	87.5	9.2	2.9	0.2	0.1	0.125	1.60
3005-14	688100	66100	90.4	7.3	2.1	0.1	-	0.096	2.11
3023-32	480960	53960	88.8	8.6	2.3	0.2	0.1	0.112	2.12
3041-50	327408	58608	82.1	14.6	2.9	0.3	0.1	0.179	3.33
3059-68	377195	44195	88.3	8.9	2.4	0.3	0.1	0.117	2.32
3077-86	631370	45370	92.8	5.7	1.3	0.3	-	0.072	3.08
3095-04	598390	45390	92.4	5.9	1.4	0.2	0.1	0.076	2.06
3113-22	331060	27060	91.8	6.6	1.3	0.2	0.1	0.082	1.80
3131-40	648770	48770	92.5	5.8	1.5	0.2	0.1	0.075	2.12
3149-58	409840	40840	90.0	7.5	2.0	0.3	0.1	0.096	2.21
3167-76	641350	45350	92.9	5.4	1.4	0.2	0.1	0.071	2.46
3185-94	436990	45990	89.5	7.9	2.3	0.2	0.1	0.106	2.31
3203-12	565450	55450	90.2	7.1	2.3	0.3	0.1	0.098	2.13
3221-30	355850	48550	86.4	9.7	3.3	0.4	0.2	0.136	1.67
3239-48	524710	51210	90.2	7.1	2.2	0.3	0.2	0.098	1.57
3257-66	427210	47210	89.0	7.9	2.8	0.3	0.2	0.111	1.45
3275-84	404253	49053	87.9	8.9	2.6	0.3	0.2	0.121	1.41
3284-93	123039	15039	87.8	9.3	2.3	0.4	0.3	0.122	1.04
3320-29	156411	18411	88.2	9.6	1.9	0.2	0.1	0.118	1.38
3338-47	132848	15248	88.5	9.4	1.8	0.2	0.1	0.115	1.49

GAS CONDENSATE DST 1

Sample depth m	C_1-C_4 ppm	C_2-C_4 ppm	C_1	C_2	C_3	iC_4	nC_4	$\frac{C_2-C_4}{C_1-C_4}$	$\frac{iC_4}{nC_4}$
2476-84			83.8	8.9	4.9	0.9	1.5	0.162	0.60

TABLE : IV a

ISOTOPIC COMPOSITION OF HEADSPACE GAS $\partial^{13}C$ ($^{o}/oo$)

Sample depth m	C_1	C_2	C_3	iC_4	nC_4
480-00	- 61.1				
620-40	- 61.2				
680-00	- 58.8				
840-60	- 59.6				
920-40	- 53.3				
1040-60	- 60.1				
1200-20	- 64.1				
1320-40	- 57.2				
1360-80	- 51.0				
1530-40	- 60.4				
1660-70	- 61.7				
1750-60	- 55.3				
1840-50	- 49.1				
1960-70	- 49.4				
2090-00	- 40.0				
2160-70	- 41.6				
2230-40	- 46.3				
2310-20	- 49.3	- 27.8	- 26.5	- 25.3	
2370-78	- 44.5		- 26.3	- 26.5	
2423-32	- 42.0	- 28.6		- 25.1	
2591-00 x)	- 31.8				
2654-63 x)	- 30.0	- 24.7	- 25.3	- 27.6	
2708-17	- 44.4		- 27.4	- 26.1	
2780-89 x)	- 23.4	- 15.6	- 18.3	- 19.1	
2834-43	- 34.5				
2915-24	- 36.6	- 27.5	- 26.3	- 23.5	
3005-14	- 39.3	- 28.1	- 27.3		
3095-04	- 41.3	- 30.4	- 28.4		
3167-76	- 40.7	- 28.8	- 27.4		
3257-66	- 39.9	- 29.2	- 26.7		
GAS CONDENSATE DST 1					
2476-84	- 41.9	- 25.4	- 25.2	- 24.3	- 26.5

x) Bacterial degradation in the can

TABLE : V a

SOLVENT EXTRACTION

Sample depth m	Sample type	Organic carbon % wt	Abundance (ppm wt of rock) EOM	Sat	Aro	HC	non-HC
KIMMERIDGE CLAY FM 2409.5-2421 m							
2405-23	ctgs P	9.28	2120	267	301	568	1533
HEATHER FM 2421-2460.5 m							
2450-59	ctgs P	0.98	173	40	52	92	81
DRAKE FM 2602-2709 m							
2627-36	ctgs P	0.92	382	50	114	164	218
2663-72	ctgs P	1.32	673	103	112	216	457
LOWER JURASSIC SANDSTONE 2709-2892 m							
2717-26	ctgs P	1.53	486	34	78	112	374
2735-44	ctgs P	1.14	515	140	136	276	240
COAL UNIT 2892-3275 m							
2924-33	ctgs P	44.31	7722	1646	1990	3636	4086
3032-41	ctgs P	37.82	6669	787	1710	2497	4172
3140-49	ctgs P	31.55	6976	509	1451	1961	5016
3230-39	ctgs P	22.00	6568	578	1007	1585	4983

TABLE : V b

SOLVENT EXTRACTION

Sample depth m	Sample type	Organic carbon % wt	Abundance (mg/g organic carbon) EOM	Sat	Aro	HC	non-HC
KIMMERIDGE CLAY FM 2409.5-2421 m							
2405-23	ctgs P	9.28	22.8	2.9	3.2	6.1	16.7
HEATHER FM 2421-2460.5 m							
2450-59	ctgs P	0.98	17.7	4.1	5.3	9.4	8.2
DRAKE FM 2602-2709 m							
2627-36	ctgs P	0.92	41.5	5.4	12.4	17.8	23.7
2663-72	ctgs P	1.32	51.0	7.8	8.5	16.3	34.6
LOWER JURASSIC SANDSTONE 2709-2892 m							
2717-26	ctgs P	1.53	31.8	2.2	5.1	7.3	24.5
2735-44	ctgs P	1.14	45.2	12.3	11.9	24.2	21.0
COAL UNIT 2892-3275 m							
2924-33	ctgs P	44.31	17.4	3.7	4.5	8.2	9.2
3032-41	ctgs P	37.82	17.6	2.1	4.5	6.6	11.0
3140-49	ctgs P	31.55	22.1	1.6	4.6	6.2	15.9
3230-39	ctgs P	22.00	29.9	2.6	4.6	7.2	22.7

TABLE : V c

SOLVENT EXTRACTION

Sample depth m	Sample type	Sat / EOM	Aro / EOM	HC / EOM	Sat / Aro	non-HC / EOM	HC / non-HC
KIMMERIDGE CLAY FM 2409.5-2421 m							
2405-23	ctgs P	0.13	0.14	0.27	0.89	0.73	0.73
HEATHER FM 2421-2460.5 m							
2450-59	ctgs P	0.23	0.30	0.59	0.79	0.47	1.14
DRAKE FM 2602-2709 m							
2627-36	ctgs P	0.13	0-30	0.43	0.44	0.57	0.75
2663-72	ctgs P	0.15	0.17	0.32	0.92	0.68	0.47
LOWER JURASSIC SANDSTONE 2709-2892 m							
2717-26	ctgs P	0.07	0.16	0.23	0.44	0.77	0.30
2735-44	ctgs P	0.27	0.26	0.54	1.03	0.47	1.15
COAL UNIT 2892-3275 m							
2924-33	ctgs P	0.21	0.26	0.47	0.83	0.53	0.89
3032-41	ctgs P	0.12	0.26	0.37	0.46	0.63	0.60
3140-49	ctgs P	0.07	0.21	0.28	0.35	0.72	0.39
3230-39	ctgs P	0.09	0.15	0.24	0.57	0.76	0.32

TABLE : V d

SOLVENT EXTRACTION

Sample depth m	Sample type	pristane / n-C17	pristane / phytane	CPI
KIMMERIDGE CLAY FM 2409.5-2421 m				
2405-23	ctgs P	1.4	1.3	1.5
HEATHER FM 2421-2460.5 m				
2450-59	ctgs P	0.8	1.6	1.5
DRAKE FM 2602-2709 m				
2627-36	ctgs P	0.6	1.5	1.2
2663-72	ctgs P	0.7	1.8	1.4
LOWER JURASSIC SANDSTONE 2709-2892 m				
2717-26	ctgs P	0.8	2.0	1.8
2735-44	ctgs P	0.6	1.7	1.7
COAL UNIT 2892-3275 m				
2924-33	ctgs P	2.2	6.5	2.0
3032-41	ctgs P	6.8	7.7	1.9
3140-49	ctgs P	3.1	7.6	1.8
3230-39	ctgs P	2.9	4.9	1.9

TABLE : VI a

VISUAL KEROGEN AND SPORE COLOUR

Sample depth m	Sample type	Visual kerogen	Spore colour TAI
2410.0	swc	95% Amorphous, degraded and clotty masses occasionally subcolloidal, non to weakly brownish fluorescence, abundant herbaceous inclusions.	2.0
		5% Herbaceous, woody and coaly	
2416.0	swc	Sample a/a	2.0
2418.0	swc	85% Amorphous, degraded and clotty masses occasionally subcolloidal, non to weak brownish fluorescence, abundant herbaceous inclusions.	2.0
		5% Herbaceous	
		5% Woody	
		5% Coaly	
2441-50	ctgs P	70% Amorphous, subcolloidal to clotty, non fluorescent	2.0
		10% Woody	
		10% Coaly	
		10% Herbaceous	
2450-59	ctgs P	40% Herbaceous	2.0
		30% Amorphous, clotty and degraded masses occasionally subcolloidal, non fluorescent	
		15% Woody	
		15% Coaly	
2627-36	ctgs P	30% Amorphous, degraded, non occasionally weak yellowish fluorescence	2.0
		20% Herbaceous	
		20% Woody	
		20% Coaly	

TABLE : VI b

VISUAL KEROGEN AND SPORE COLOUR

Sample depth m	Sample type	Visual kerogen	Spore colour TAI
2663-72	ctgs P	40% Amorphous, degraded occasionally clotty masses, weak brownish to weak yellowish fluorescence, occasionally non fluorescent	2.0
		30% Herbaceous	
		15% Woody	
		15% Coaly	
2717-26	ctgs P	50% Herbaceous	2.0
		30% Woody	
		10% Amorphous, subcolloidal to degraded, non to weak yellowish fluorescence	
		10% Coaly	
2735-44	ctgs P	40% Herbaceous	2.0
		40% Woody	
		10% Amorphous, clotty to degraded, non to weak yellowish fluorescence	
		10% Coaly	

TABLE : VII a

MACERAL COMPOSITION

Sample depth m	Sample type	Min	Py	In	Vi	Ex	Fluorescent groundmass
		Minerals and macerals %					
KIMMERIDGE CLAY FM 2409.5-2421 m							
2410.0	swc	85.0	10.2	0.3	1.1	3.4	(+)
2416.0	swc	75.6	8.9	0.8	3.0	11.7	(+)
2418.0	swc	83.0	8.7	0.4	0.1	7.8	(+)
COAL UNIT 2892-3275 m							
2924-33	ctgs P	55.0	0.5	17.4	19.3	7.9	
3032-41	ctgs P	57.5	2.3	12.5	19.0	8.7	
3140-49	ctgs P	61.5	0.9	8.1	21.8	7.7	
3230-39	ctgs P	70.6	1.1	6.8	19.4	2.0	

Min : minerals

Py : pyrite

In : inertinite

Vi : vitrinite

Ex : exinite

TABLE : VII b

MACERAL COMPOSITION

Sample depth m	Sample type	Macerals % In	Vi	Ex	Fluorescent groundmmass
KIMMERIDGE CLAY FM 2409.5-2421 m					
2410.0	swc	6.3	22.9	70.8	(+)
2416.0	swc	5.2	19.4	75.5	(+)
2418.0	swc	4.8	1.2	94.0	(+)
COAL UNIT 2892-3275 m					
2924-33	ctgs P	39.0	43.3	17.7	
3032-41	ctgs P	31.1	47.3	21.6	
3140-49	ctgs P	21.6	57.9	20.5	
3230-39	ctgs P	24.1	68.8	7.1	

In : inertinite

Vi : vitrinite

Ex : exinite

TABLE : VIII

VITRINITE REFLECTANCE, Ro

Sample depth m	Sample type	Ro	Sample depth m	Sample type	Ro
2070.0	swc	-	2669.0	swc	0.44
2087.0	swc	-	2678.0	swc	0.40
2091.5	swc	0.61	2705.5	swc	0.54
2100.0	swc	1.10	2717-26	ctgs	0.32
2175.0	swc	0.40	2718.5	swc	0.36
2220.0	swc	0.42	2924-33	ctgs	0.47*
2310.0	swc	0.46	2931.0	swc	0.52*
2326.0	swc	0.41	3000.0	swc	0.48*
2333.0	swc	-	3032-41	ctgs	0.53*
2347.0	swc	0.42	3098.0	swc	0.52*
2358.0	swc	-	3140-49	ctgs	0.48*
2364.0	swc	-	3167.0	swc	0.48*
2410.0	swc	0.50	3174.5	swc	0.49*
2410.0	swc	0.38*	3230-39	ctgs	0.50*
2416.0	swc	0.44	3251.0	swc	0.51*
2418.0	swc	0.46			
2423.0	swc	0.45			
2450.0	swc	0.46			
2455.5	swc	0.48			
2461.3	core	0.48			
2515.5	swc	0.54			
2526.5	core	0.45*			
2558.8	core	0.43*			
2582.0	core	0.45*			
2604.5	swc	0.49			

* good quality samples

TABLE : IX a

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2070.0 n
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5- barren of vitrinite
.56
0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX b

VITRINITE REFLECTANCE RAW DATA

Sample depth	:	2087.0 m
Sample type	:	swc
Preparation	:	HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.40 barren of vitrinite
0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX c

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2091.5 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
    .35
0.4-
    .48                        difficult interpretation
0.5-
    .55                        mean Ro = 0.61
0.6-
    .63-.61
0.7-
    .70
0.8-

0.9-
   .98
1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX d

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2100.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-

0.6-

0.7-

0.8-
.83
.87
0.9-

1.0- difficult interpretation
1.03
1.1-
1.12 mean Ro = 1.10
1.19
1.2-
1.21
1.3-

1.4-
1.45
1.5-

1.6-

1.7-

TABLE : IX e

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2175.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
     .30-.33              <
     .37                  <  true population
0.4-                      <  mean Ro = 0.40
     .44                  <
     .49-.46
0.5-

0.6-
     .66
0.7-

0.8-
     .80
0.9-
     .94
     .97
1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX f

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2220.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-
.23
0.3-
<u>.35</u> <possibly true population
0.4-
<u>.48</u> < mean Ro = 0.42
0.5-
.54
.55-.55
0.6-

0.7-
.72
.75-.76
0.8-

0.9-

1.0-
1.06
1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX g

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2310.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
      .39                          <
0.4-                                 true population
                                     mean Ro = 0.46
0.5-                               <
      .52
0.6-
      .61
0.7-
      .74-.74
      .76
0.8-
      .85
0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX h

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2326.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.31 <
.38-.39 < true population
0.4- mean Ro = 0.41
.49-.47 <
0.5-
.58-.59-.57
0.6-

0.7-
.78-.76
0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX i

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2333.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-

0.6-

0.7-

barren

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX j

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2347.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-
.27
0.3-

0.4-
.42 < possibly true value, Ro = 0.42
0.5-

0.6-

0.7-

0.8-
.83
0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX k

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2358.0m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-

0.6- barren

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX 1

VITRINITE REFLECTANCE RAW DATA

Sample depth	: 2364.0 m
Sample type	: swc
Preparation	: HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-

barren

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX m

VITRINITE REFLECTANCE RAW DATA

Sample depth	:	2410.0 m
Sample type	:	swc
Preparation	:	HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-
     .24
     .29
0.3-
     .33
0.4-
     .47                      < possibly true population
0.5- .53                      < mean Ro = 0.50

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX n

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2410.0 m
Sample type : swc
Preparation : bulk rock

Vitrinite reflectance (Ro) values :

```
0.2-
     .29-.28-.29-.28
0.3-
     .34-.30-.31-.31-.31-.33-.30-.33-.32-.31-.30-.33-.32  < true
     .35-.36-.39-.38-.38-.37-.36-.35-.37-37               < population
0.4-                                                      < mean
     .41-.41-.40-.43-.41-.41-.43                          < Ro = 0.38

0.5-
     .53
     .59-.58-.57
0.6-
     .63-.61
     .65
0.7-
     .74-.70
0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX o

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2416.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
      .31
0.4-
      .42-.41               < true population
      .49                   < mean Ro = 0.44
0.5-

0.6-

0.7-

0.8-

0.9-
      .97
1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX p

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2418.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-
     .28
0.3-
     .30
     .36          <true population
0.4-              <
     .43-.40      <mean Ro = 0.46
     .49-.49      <
0.5-
     .51-.52
     .56
0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-
     1.21
1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX q

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2423.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.40 < possibly true population
0.5-
.50 < mean Ro = 0.45
0.6-
.67
0.7-

0.8-

0.9-

1.0-
1.05
1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX r

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2450.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
      .39       <
0.4-            < true population
      .43       <
      .49       < mean Ro = 0.46
0.5-            <
      .52       <
0.6-

0.7-

0.8-

0.9-

1.0-
      1.01
1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX s

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2455.5 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.48-.49-.46 < true population, mean Ro = 0.48
0.5-
.55-
0.6-
.61-
0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX t

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2461.3 m
Sample type : core
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.33-.31
0.4-
.40-.44 <
.49-.45 < true population
0.5- <
.52-.53 < mean Ro = 0.48
.56
0.6-

0.7-
.70-.73
.75
0.8-

0.9-
.97-.95
1.0-

1.1-
1.11
1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX u

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2515.5 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values -

0.2-

0.3-

0.4-

0.5-
    .50   < possibly true population
    .58   < mean Ro = .54
0.6-
    .66-.66
0.7-
    .77
0.8-
    .84
    .89
0.9-
    .97-.96-.98-.96
1.0-
    1.01
    1.09-.1.09
1.1-
    1.19
1.2-
    1.29
1.3-

1.4-
    1.43
1.5-
    1.59
1.6-

1.7-

TABLE : IX v

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2526.5 m
Sample type : core
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-
.28
0.3-
.33
.37-.39 < true population
0.4- < mean Ro = 0.45
.44-.42-.41-.43
.48-.46-.49-.48-.48-.49
0.5-

0.6-
.64
.67
0.7-
.70-.72
0.8-
.84-.83-.83
.88-
0.9-

1.0-
1.07
1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX w

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2558.8 m
Sample type : core
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
        .31-.34-.30
        .36-.39-.39                    <
0.4-                                   < true population
        .43-.40-.42-.43                < mean Ro = 0.43
        .48                            <
0.5-
        .54-.50-.51
0.6-
        .60-.60
0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX x

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2582.0 m
Sample type : core
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

```
0.2-

0.3-
        .30
        .39                                       < true population
0.4-                                              < mean Ro = 0.45
        .43-                                      <
        .45-.49-.49
0.5-
        .59-.58-.59-.58
0.6-
        .64-.64-.63-.60
        .67-.65
0.7-
        .72-.72-.70-.71
        .75
0.8-
        .82
        .85-.86
0.9-
        .95
1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-
```

TABLE : IX y

VITRINITE REFLECTANCE RAW DATA

Sample depth	:	2604.5 m
Sample type	:	swc
Preparation	:	HF-residue

Vitrinite reflectance (Ro) values :

0.2-		
0.3-		
0.4-		
	.44	< possibly true
0.5-		< population
	.54	< mean Ro = 0.49
0.6-		
	.60-.64	
	.69	
0.7-		
	.71	
0.8-		
0.9-		
1.0-		
1.1-		
1.2-		
1.3-		
1.4-		
1.5-		
1.6-		
1.7-		

TABLE : IX z

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2669.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.33-.32
0.4-
.44- < possibly true population,
0.4 < mean Ro = 0.44
0.5-

0.6-

0.7-

0.8-
.80-
0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX aa

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2678.0 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.30-.30
.39- < true population
0.4-
.42-.40 < mean Ro = 0.40
0.5-

0.6-
.63-.62-
0.7-
.72
.79
0.8-

0.9-

1.0-
1.00
1.1-
1.11
1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ab

VITRINITE REFLECTANCE RAW DATA

Sample depth	:	2705.5 m
Sample type	:	swc
Preparation	:	HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-

.54 < true population, mean Ro = 0.54

0.6-

0.7-

0.8-

.87

0.9-

1.0-

1.04

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ac

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2717-26 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-
.28-.26-.28-.29-.27-.29-.29-.28-.29-.29-.29-.29
0.3-
.33-.31-.33-.33-.34-.34-.30-.30-.33-.32-.33-.34-.32-.34-32-.31
.35-.37-.37-.37-.35-.35-.37-.39-.36-.37-.35-.35

0.4- True population, mean Ro 0.32

0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ac

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2717-26 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.33-.30-.30-.30-.32-.34-.32-.30-.30-.32

0.4-

0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ad

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2718.5 m
Sample type : swc
Preparation : HF-residue

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.33-.34 < true population
.38-.35-.38-.37-.35 < mean Ro = 0.36
0.4-

0.5-
.55-
0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ae

VITRINITE REFLECTANCE RAW DATA

Sample depth	:	2924-33 m
Sample type	:	ctgs
Preparation	:	bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.34-
.38-.37-
0.4-
.43-.41-.40-.42-.42-.40-.43-.44-.42-.42-.42-.42-.42-.42-.42
.45-.47-.47-.47-.46-.48-.48-.45-.49-.47-.47-.49-.49-.49-.45-.46
0.5-
.53-.54-.53-.51-.52-.52-.52-.50-.52
.58-.56-.55-.55
0.6-

0.7-

true population
0.8- mean Ro = 0.47

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ae cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2924-33 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.49-.46-.46
0.5-

0.6-

0.7- true population

0.8- mean Ro = 0.47

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX af

VITRINITE REFLECTANCE RAW DATA

Sample depth : 2931.0 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.39
0.4-
.40
.49-.45-.45-.49-.48-.49-.47-.46-.49-.48-.49-.48-.46
0.5-
.50-.53-.53-.52-.50-.50-.53-.50-.52-.51-.52-.51-.53-.50-.50
.58-.57-.58-.58-.58-.56-.59-.56
0.6-
.62-.60-.64-.60-.60-.63
0.7-

0.8-

true population
mean Ro = 0.52

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX af cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-
.52-.51-.53-.51-.54-.53
0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ag

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3000.0 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.44-.42-.43-.44-.43-.40-.41-.44
.48-.47-.48-.47-.49-.45-.45-.48-.47-.47-.46-.48-.49-.46-.48
0.5-
.51-.50-.50-.52-.52-.54-.54-.51-.51-.51-.52-.51-.50-.50-.50
0.6-

0.7-

true population
0.8- mean Ro = 0.48

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ag cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.46-.49-.47-.48-.49-.45-.48-.49-.46-.49-.46-.49

0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ah

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3032-41 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-
.43-.44-.44
.46-.45-.45-.48-.46-.49-.45-.47-.46-.48
0.5-
.50-.52-.52-.51-.53-.54-.50-.51-.50-.51-.52-.54-.50-.53-.51
.55-.59-.58-.56-.58-.58-.55-.55-.59-.56-.56-.58
0.6-
.60-.61-.61-.64
.69
0.7-

0.8-
true population
0.9- mean Ro = 0.53

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ah cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-
.51-.51-.50-.53-.53

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ai

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3098.0 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.36
0.4-
.44-.44
.48-.49-.49-.48-.47-.48-.49-.47-.46-.47-.48-.48-.45
0.5-
.54-.54-.54-.53-.50-.52-.53-.51-.50-.51-.53-.53-.53-.50-.51
.59-.57-.58-.57-.55-.56-.55-.55-.59-.59-.56
0.6-
.63-.60-.63
0.7-

0.8-

true population
0.9- mean Ro = 0.52

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ai cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

0.5-
.50-.54-.51-.53-.54

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX aj

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3140-49 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.39-.36
0.4-
.42-.44-.42-.40-.43-.44-.41-.43-.42-.44
.48-.48-.46-.46-.47-.49-.47-.47-.45-.46-.47-.49-.48-.48-.46
0.5-
.54-.54-.52-.53-.50-.51-.52-.51-.51-.54-.54
.56-.59-.55-.56-.55-.58
0.6-

0.7- true population
mean Ro = 0.48
0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX aj cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :-

0.2-

0.3-

0.4-

.47-.49-.46-.47-.45-.48
0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ak

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3167.0 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.38
0.4-
.42-.44-.43-.43-.42-.41-.44-.44-.43
.45-.48-.45-.47-.47-.49-.49-.45-.49-.49-.47-.46-.47-.48-.45
0.5-
.54-.53-.54-.50-.54-.50-.52-.50-.53-.52-.51-.51
.57
0.6-

0.7-

true population
0.8- mean Ro = 0.48

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX ak cont'd

VITRINITE REFLECTANCE RAW DATA

Sample depth :
Sample type :
Preparation :

Vitrinite reflectance (Ro) values :

0.2-

0.3-

0.4-

.48-.48-.49-.48-.49-.49-.49-.47-.49-.47-.47
0.5-

0.6-

0.7-

0.8-

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX a1

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3174.5 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.37-
0.4-
.44-.44-.44-.44-.44-.44-.41-.44-.44-.42-.44
.47-.49-.45-.46-.49-.47-.49-.45-.46-.49-.49-.48-.46-.48-.48-.48
0.5-
.51-.54-.52-.52-.51-.53-.51-.53-.53-.52-.54-.54-.52-.50-.51-.51- .50
.58-.57-.55-.55-.56
0.6-

0.7-

0.8- true population
mean Ro = 0.49

0.9-

1.0-

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX am

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3230-39 m
Sample type : ctgs
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.38
0.4-
.44-.43-.40-.41-.44-.42-.43
.46-.49-.45-.48-.49-.46-.49-.46-.47-.49-.45-.47-.47-.49-.49-.46-.46
0.5
.52-.51-.50-.52-.51-.52-.51-.52-.52-.52-.52-.54
.58-.55-.56-.56-.55-.56-.55-.56-.55-.55
0.6-
.64-.60
0.7-
.70
0.8-

0.9- true population

1.0- mean Ro = 0.50

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : IX an

VITRINITE REFLECTANCE RAW DATA

Sample depth : 3251.0 m
Sample type : swc
Preparation : bulk rock (coal)

Vitrinite reflectance (Ro) values :

0.2-

0.3-
.39-.39
0.4-
.44-.40-.41-.44
.45-.45-.48-.46-.46-.49-.45-.47-.45-.48-.46-.48-.49-.49-.48-.48-.45
0.5-
.54-.54-.50-.51-.51-.53-.52-.52-.51-.53-.54-.53-.51-.53-.52
.55-.58-.55-.57-.56-.56-.56-.59
0.6-
62-.60-.63-.60
0.7-

0.8-

0.9- true population

1.0- mean Ro = 0.51

1.1-

1.2-

1.3-

1.4-

1.5-

1.6-

1.7-

TABLE : X

COAL UNIT . CUMULATIVE THICKNESS OF COAL AND CARBONACEOUS SHALE

Density	Lithology	Cumulative thickness, m
< 1.5	Coal	0
1.5 - 1.7	Carbonaceous shale	5.50
1.7 - 2.0	Carbonaceous shale	33.75
	total	39.25

LIST OF FIGURES

ABBREVIATIONS USED IN FIGURES

Figure IV : Numbered peaks - n-alkene/n-alkane doublets of the corresponding carbon number

T	=	Toluene
X	=	Xylenes (m+p)
C_3B	=	C_3-alkylbenzenes
P	=	Phenol
C_4B	=	C_4-alkylbenzenes
C_1p	=	Methylphenols (cresols)
C_2P	=	Di-methylphenols
N	=	Naphthalene
C_1N	=	2- and 1-methylnaphthalenes
Pr	=	Pristenes

Figure V Numbered peaks - n-alkanes of the corresponding carbon number

pr - pristane

ph - phytane

FIGURE :I

SOURCE ROCK AND MATURITY EVALUATION

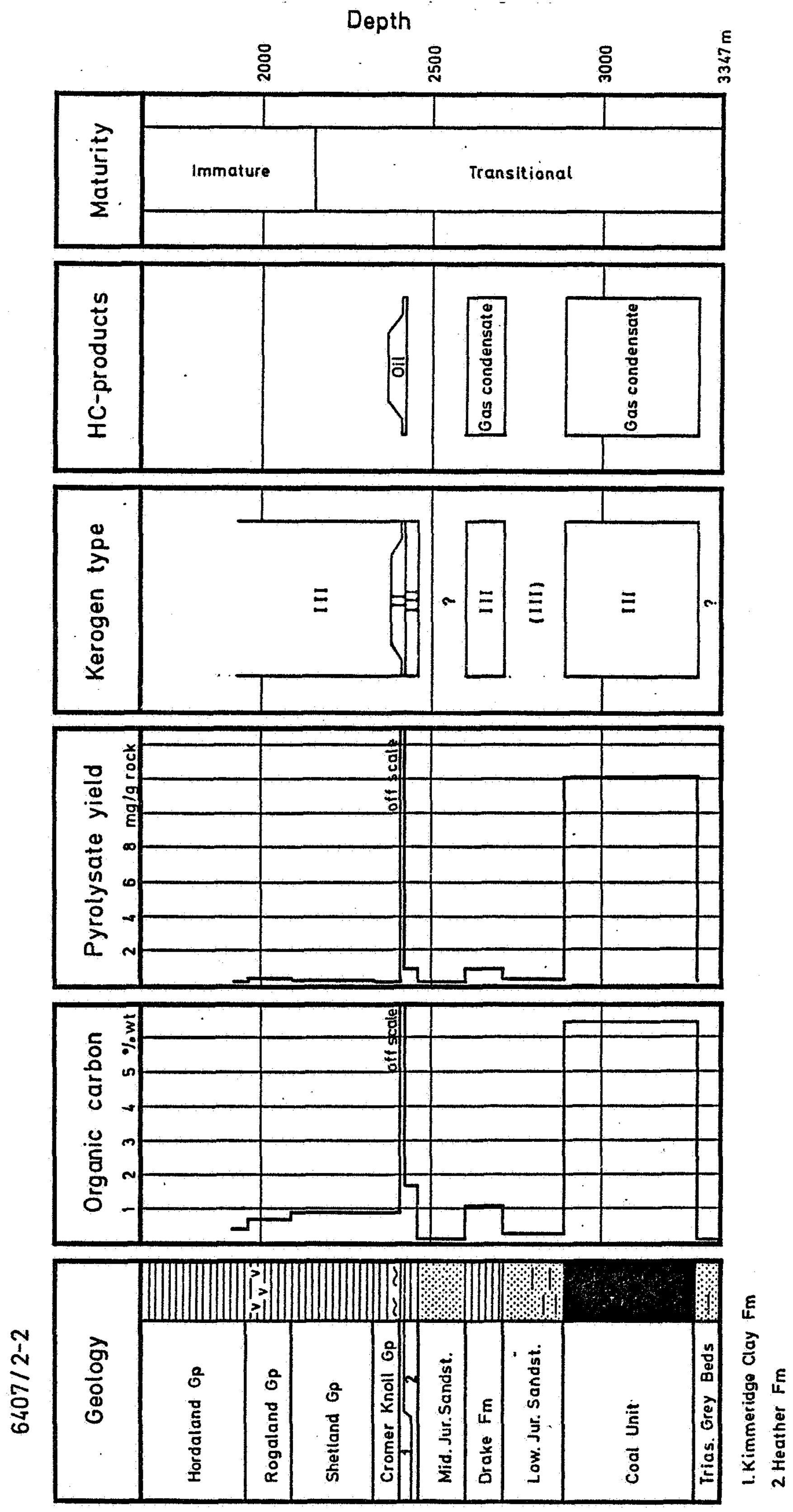
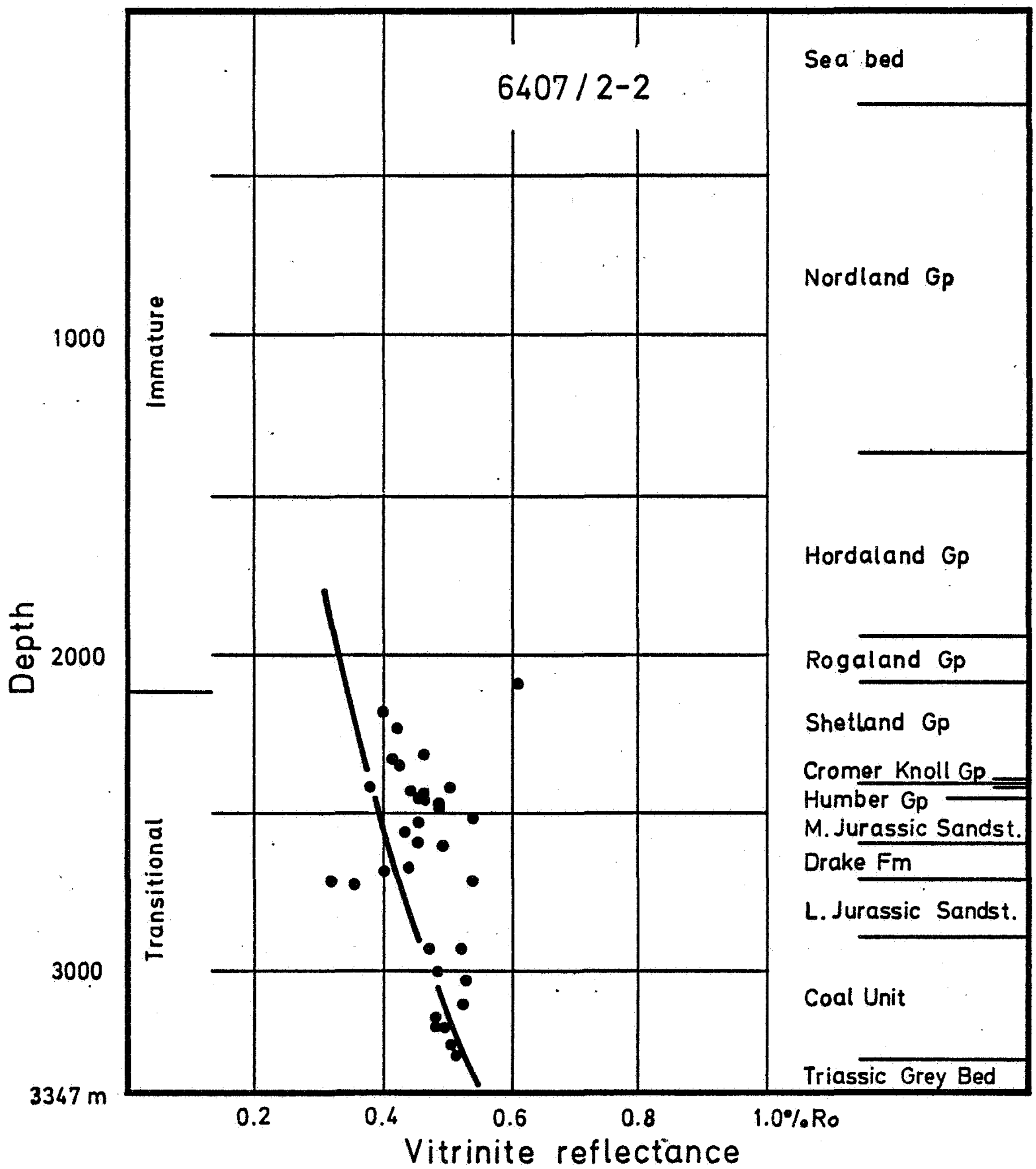
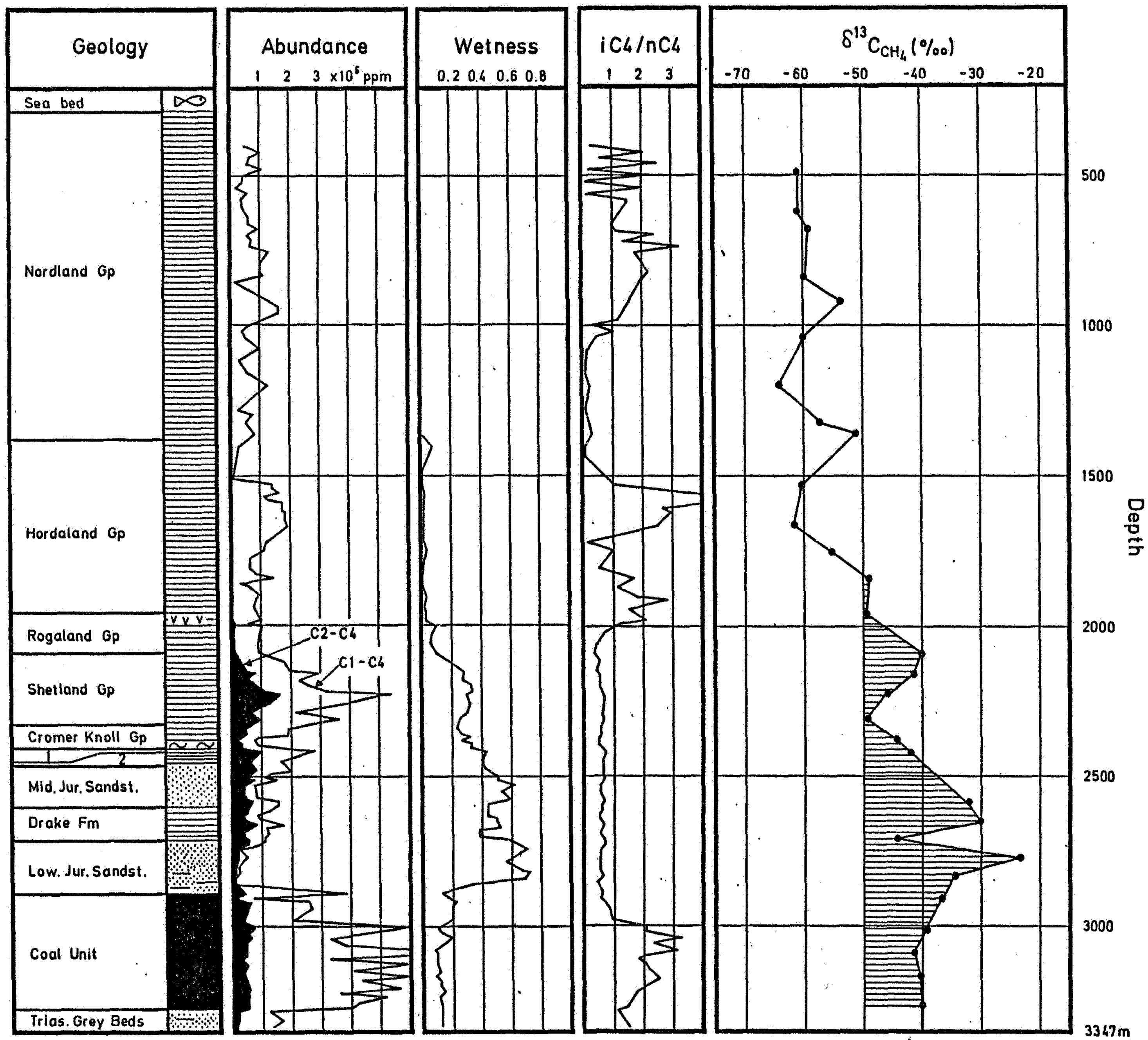


FIGURE :II

VITRINITE REFLECTANCE PROFILE



6407 / 2-2



1. Kimm. Clay Fm

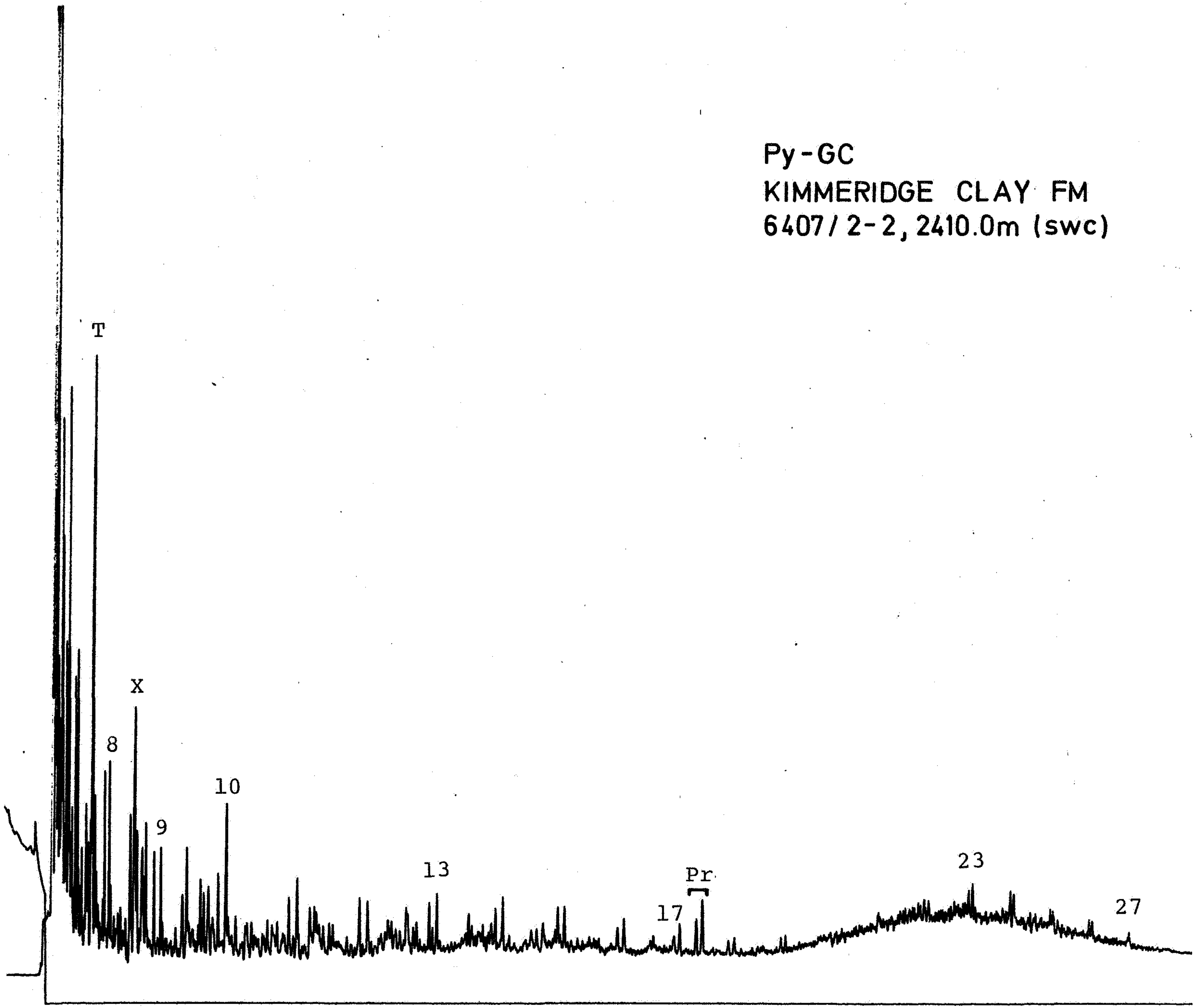
2. Heather Fm

FIGURE : III

HEADSPACE GAS COMPOSITION

FIGURE : IV a

PYROGRAM (Pyrolysis gas chromatography)



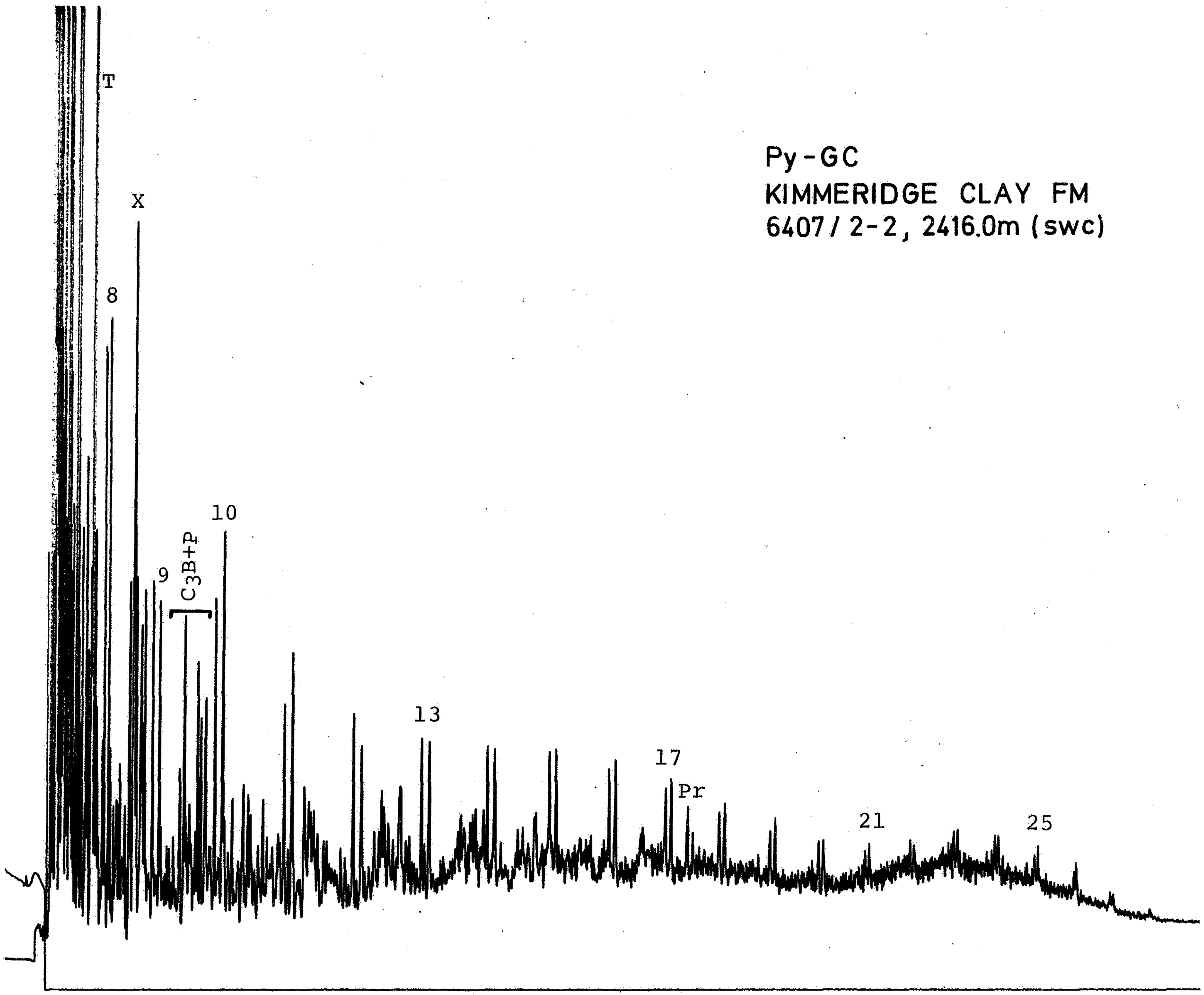


FIGURE : IV b

PYROGRAM (Pyrolysis gas chromatography)

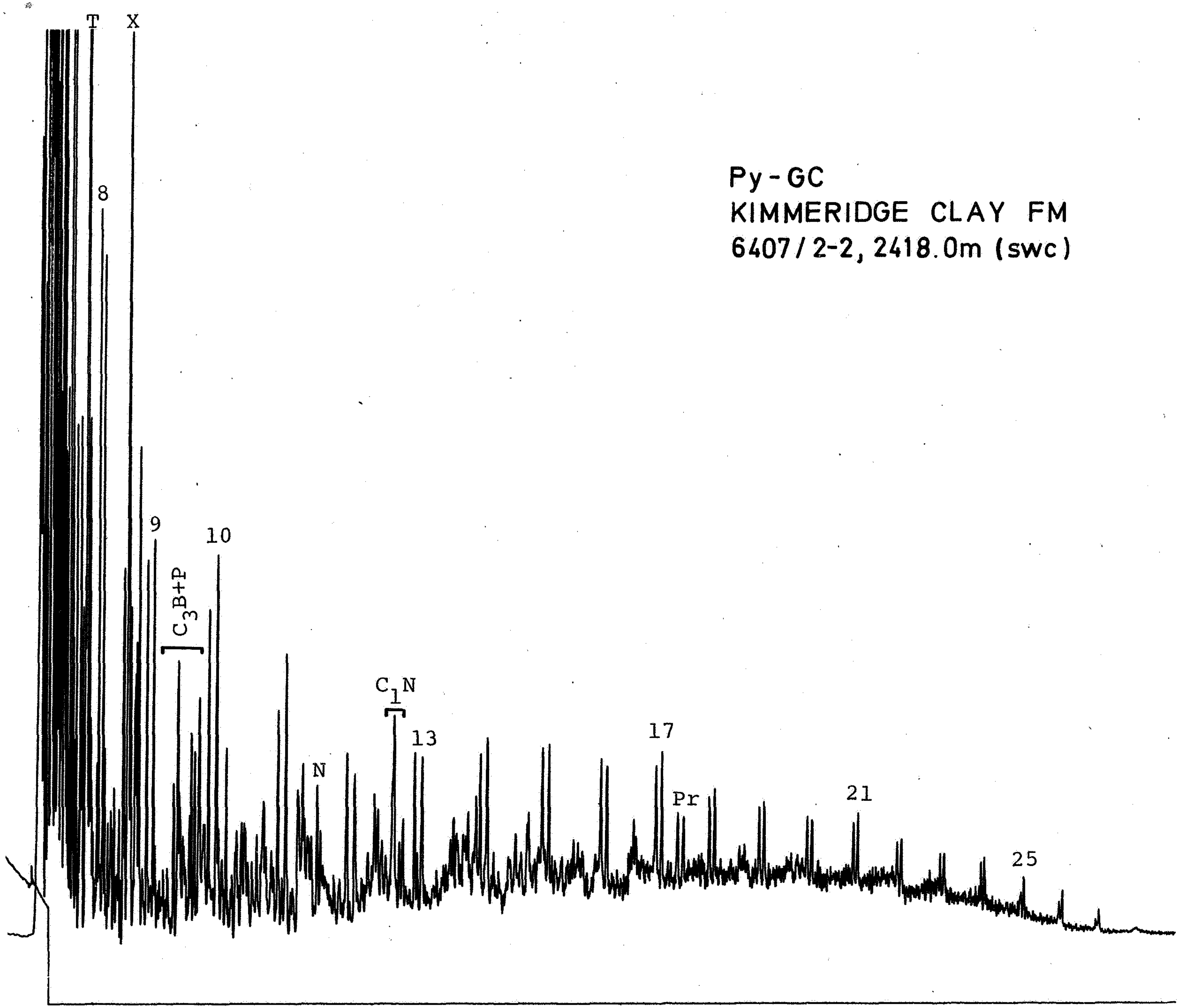


FIGURE : IVc

PYROGRAM (Pyrolysis gas chromatography)

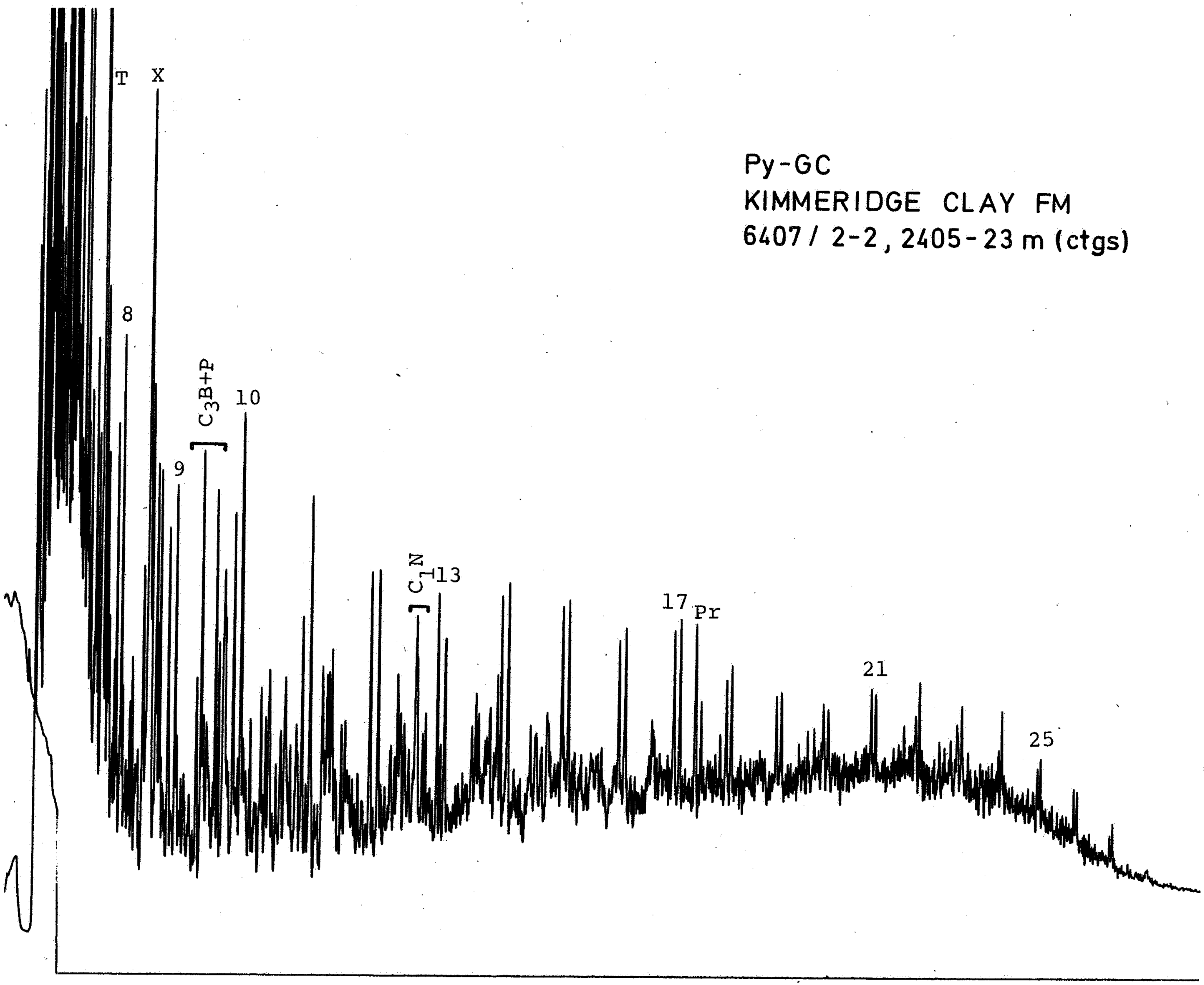


FIGURE : IVd

PYROGRAM (Pyrolysis gas chromatography)

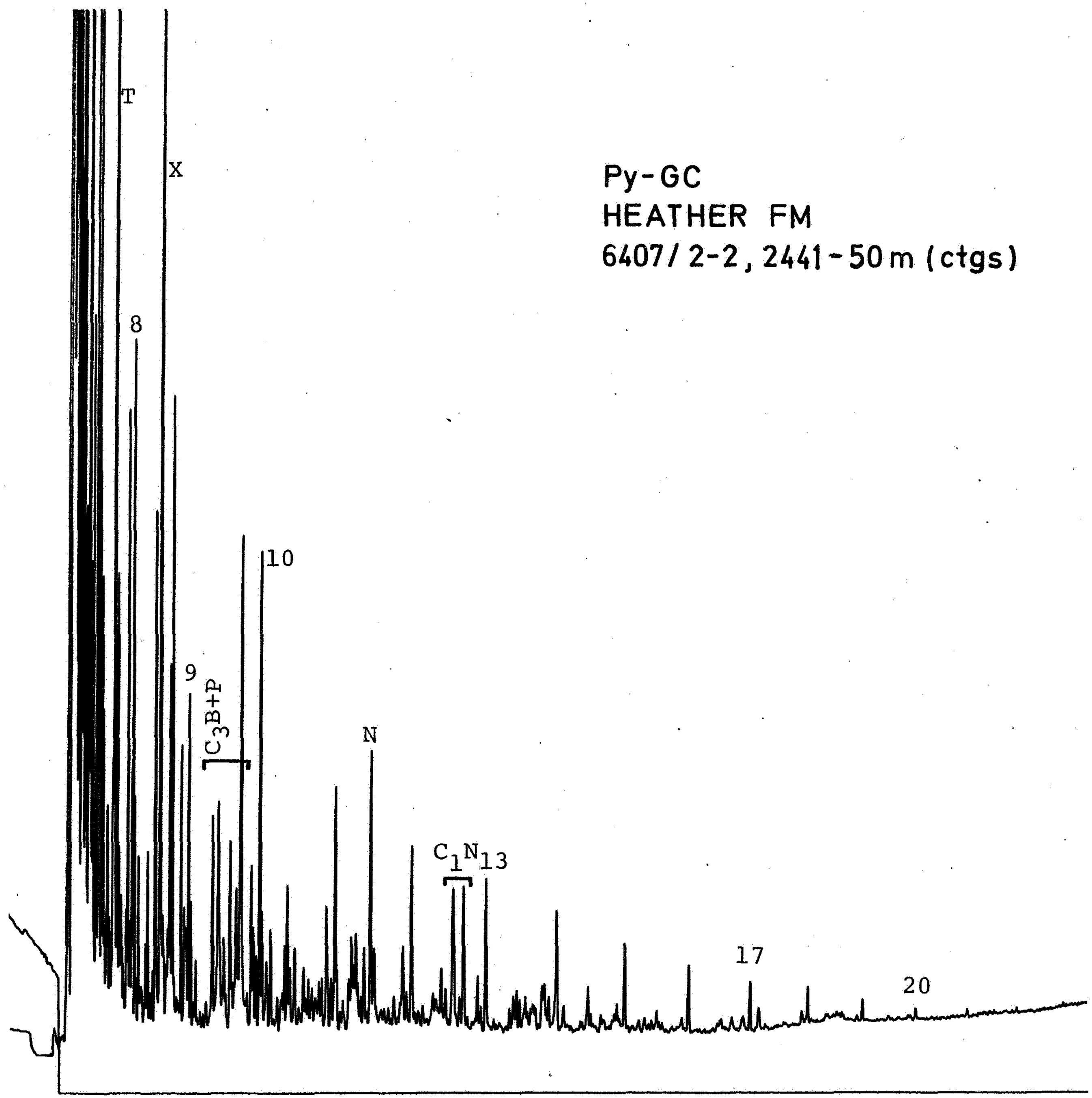


FIGURE : IVe

PYROGRAM (Pyrolysis gas chromatography)

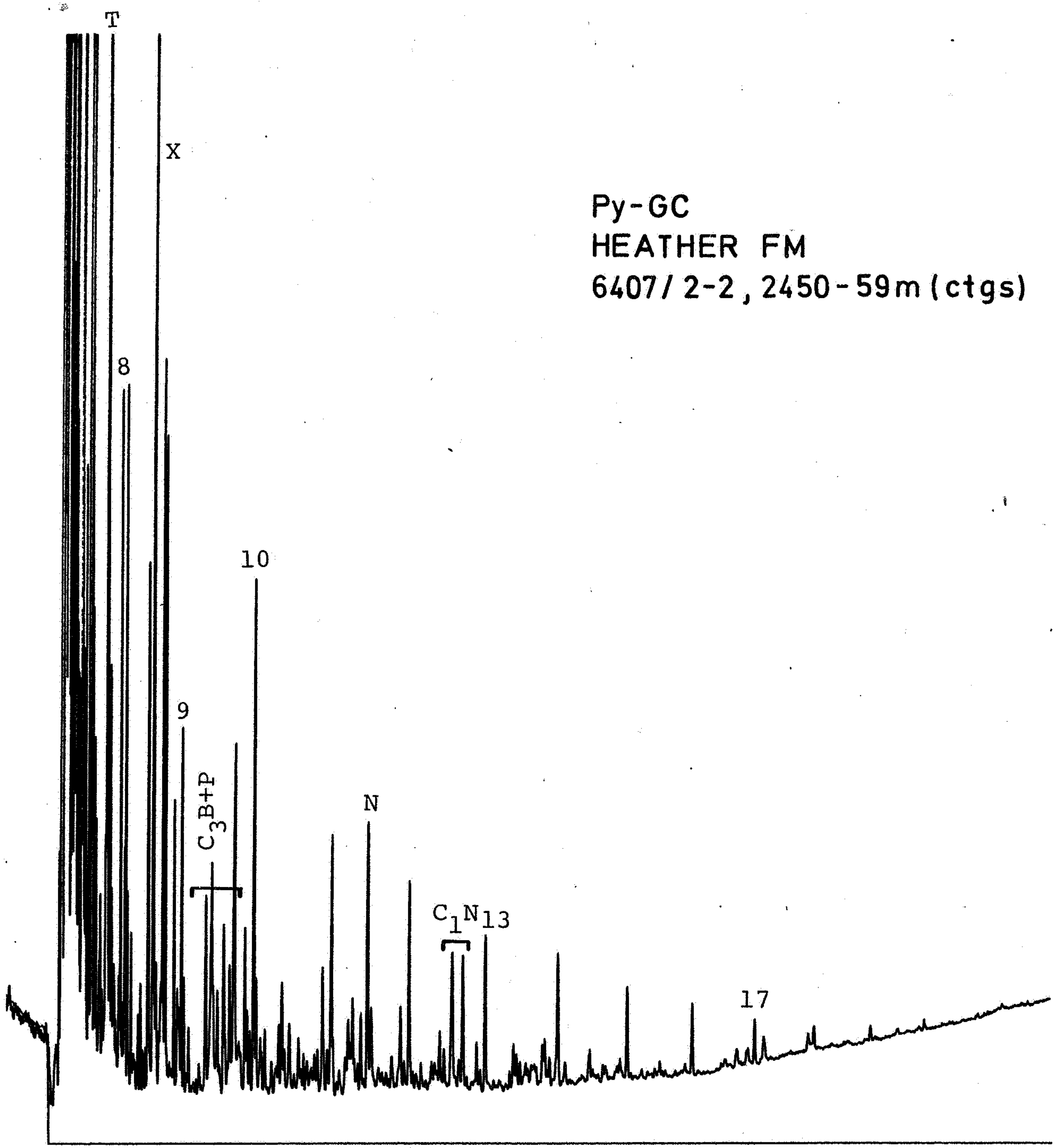


FIGURE : IV f

PYROGRAM (Pyrolysis gas chromatography)

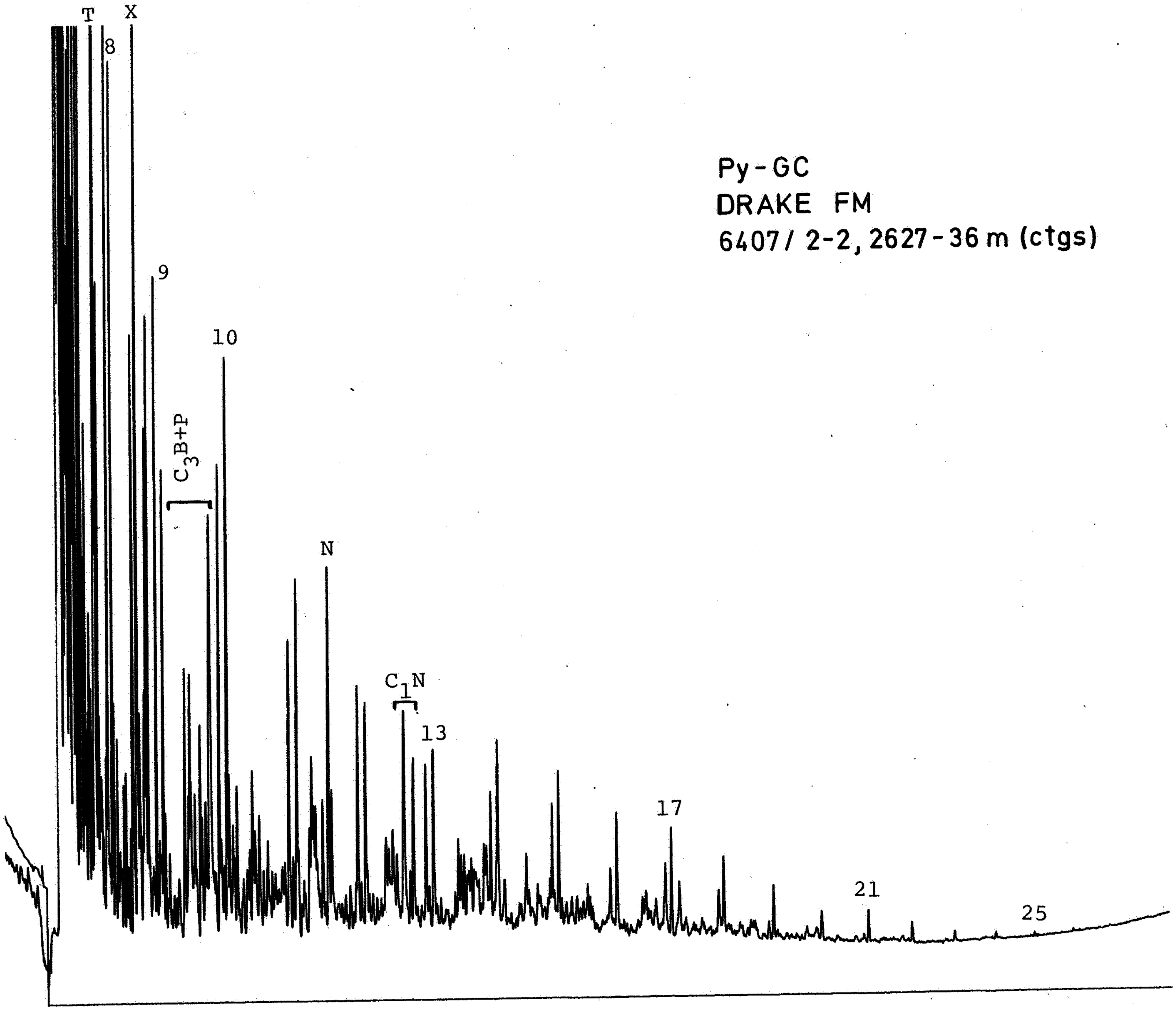
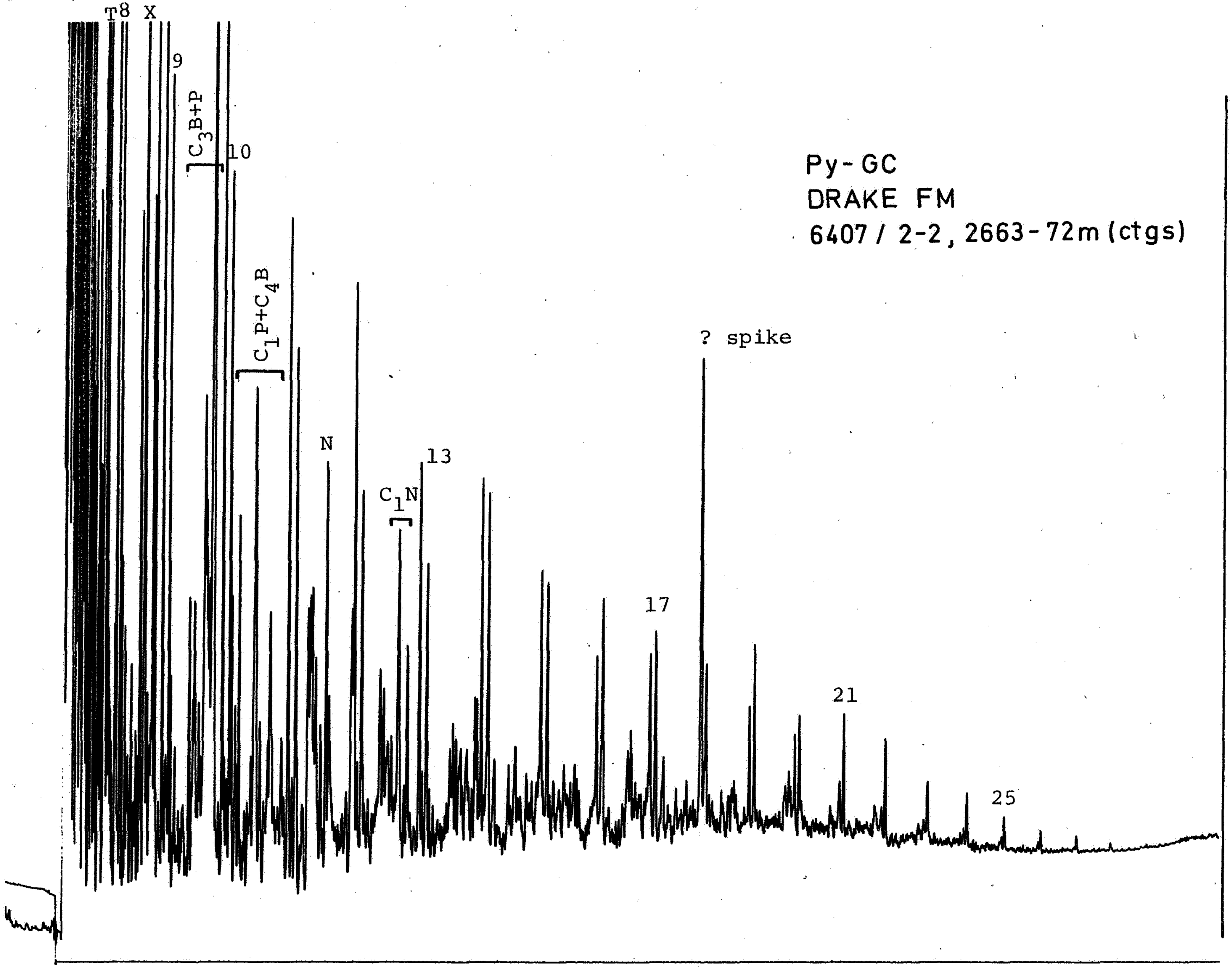


FIGURE : IVg

PYROGRAM (Pyrolysis gas chromatography)

FIGURE : IVh

PYROGRAM (Pyrolysis gas chromatography)



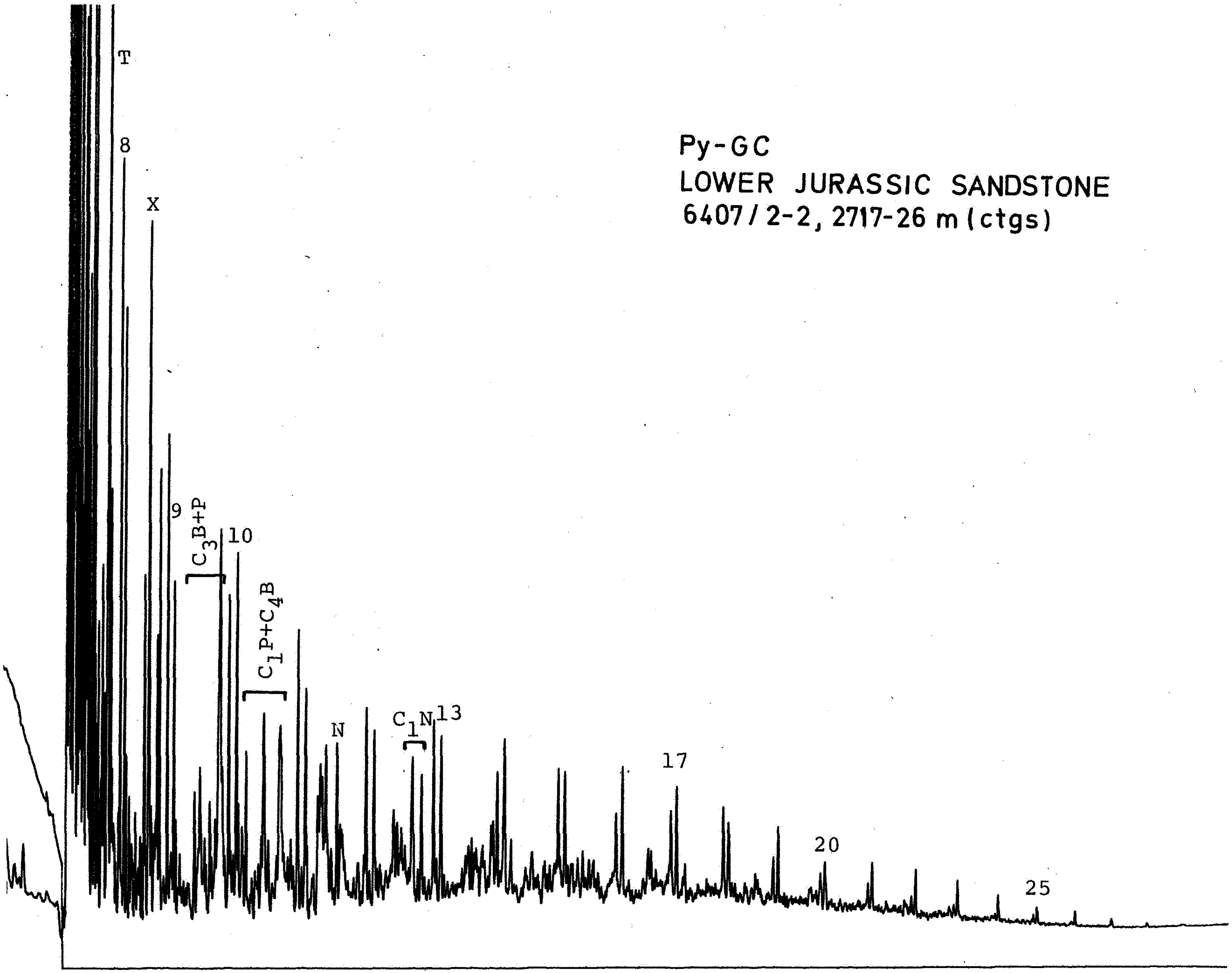


FIGURE : IV i

PYROGRAM (Pyrolysis gas chromatography)

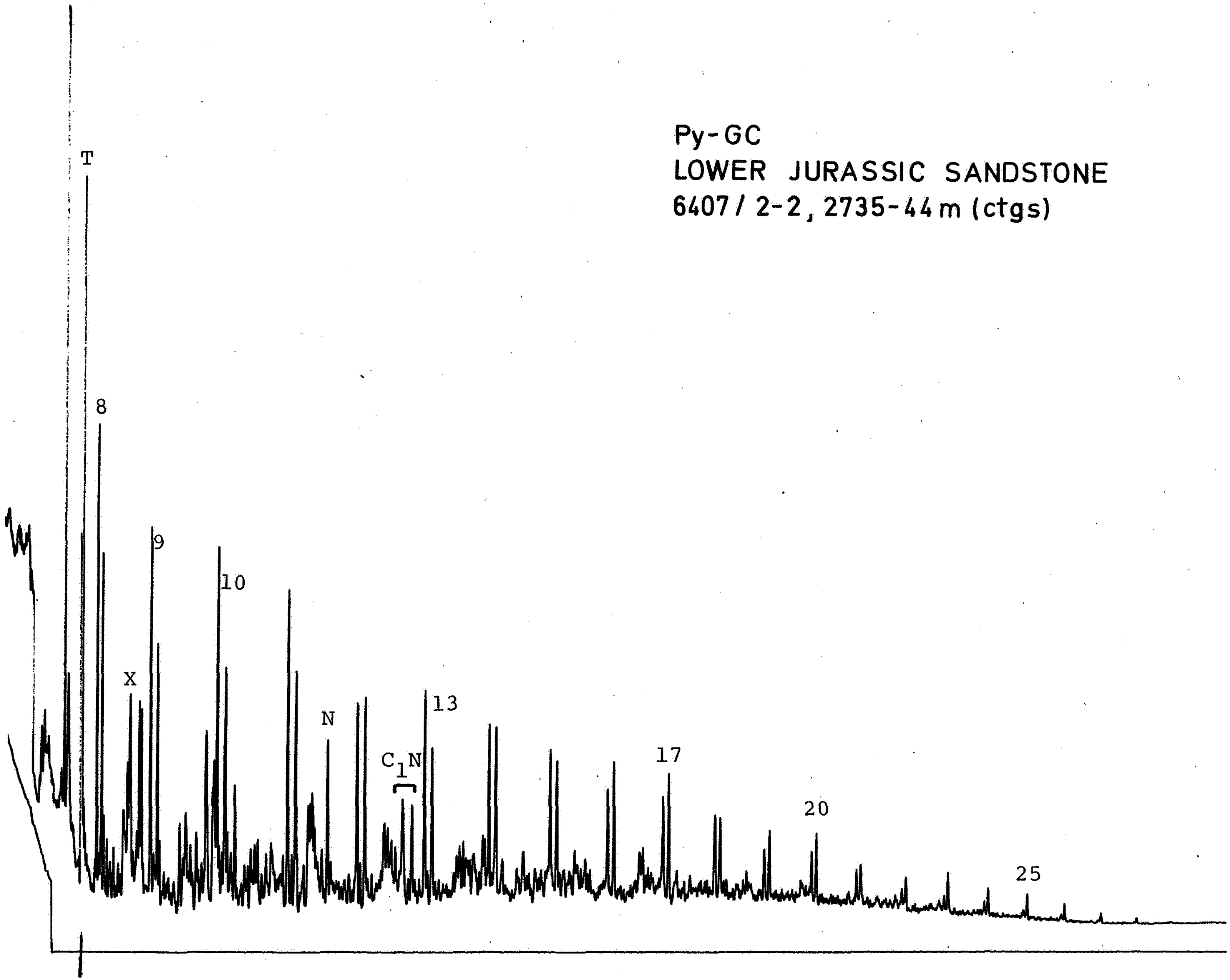


FIGURE : IVj

PYROGRAM (Pyrolysis gas chromatography)

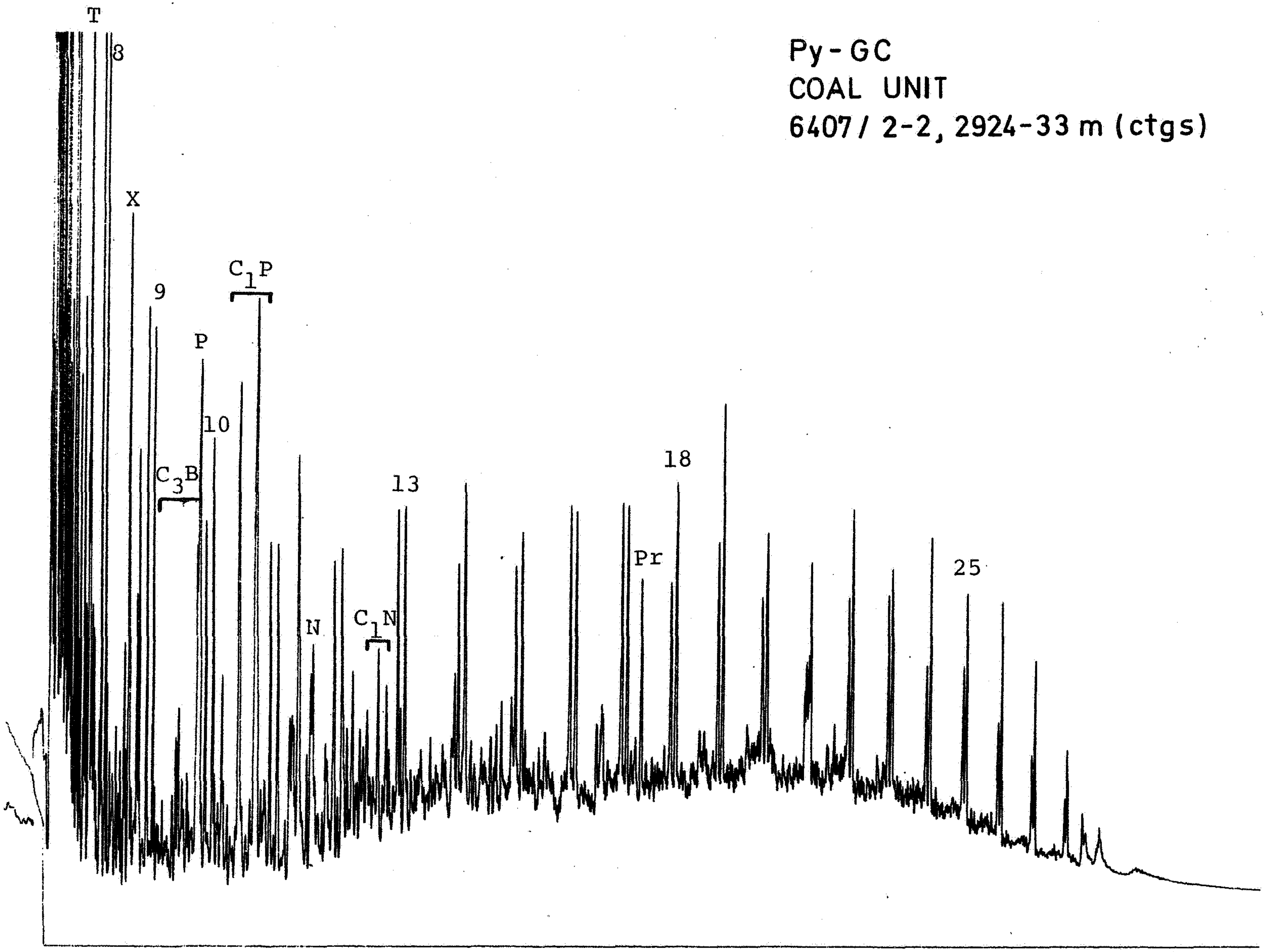


FIGURE : IV k

PYROGRAM (Pyrolysis gas chromatography)

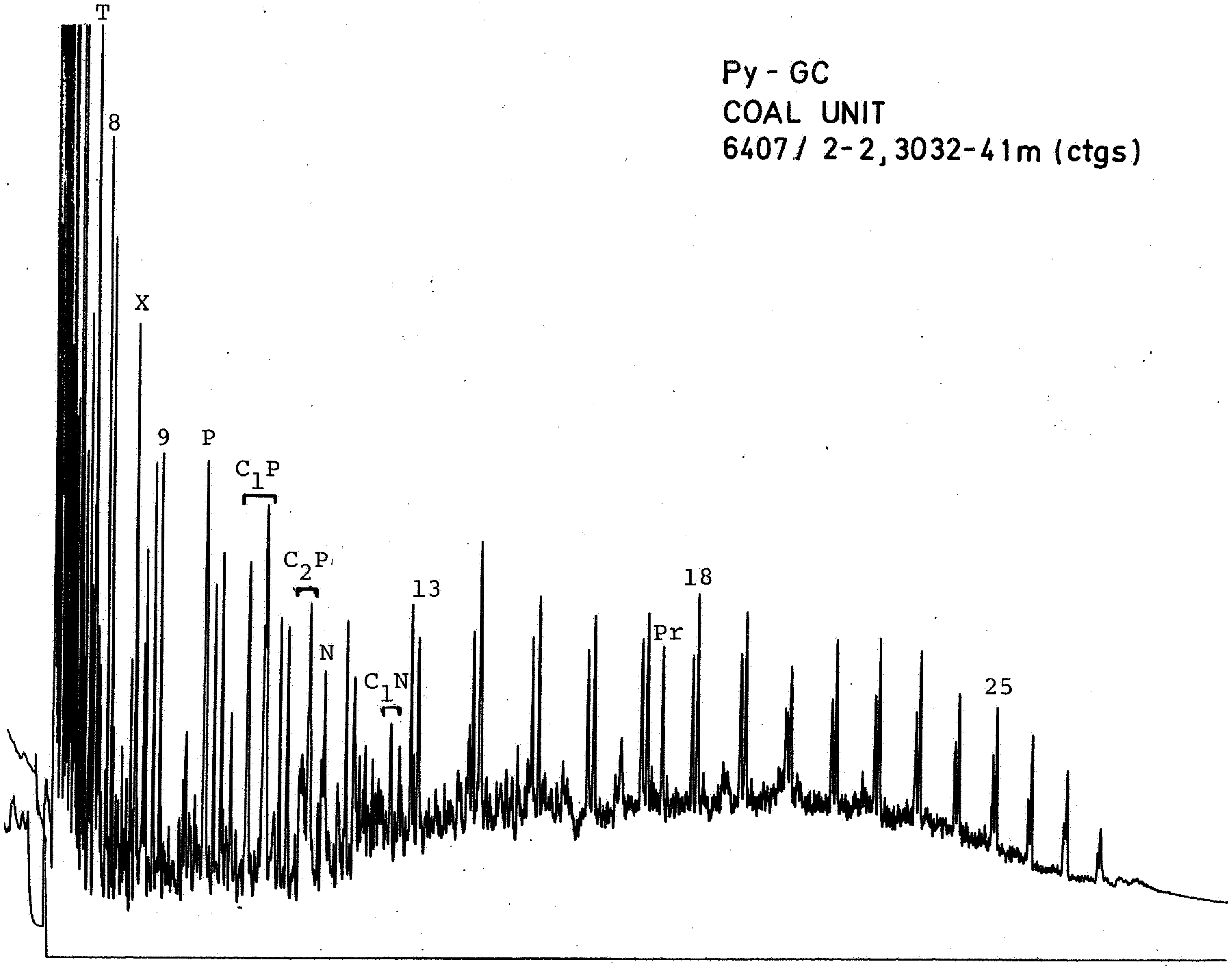


FIGURE : IV 1

PYROGRAM (Pyrolysis gas chromatography)

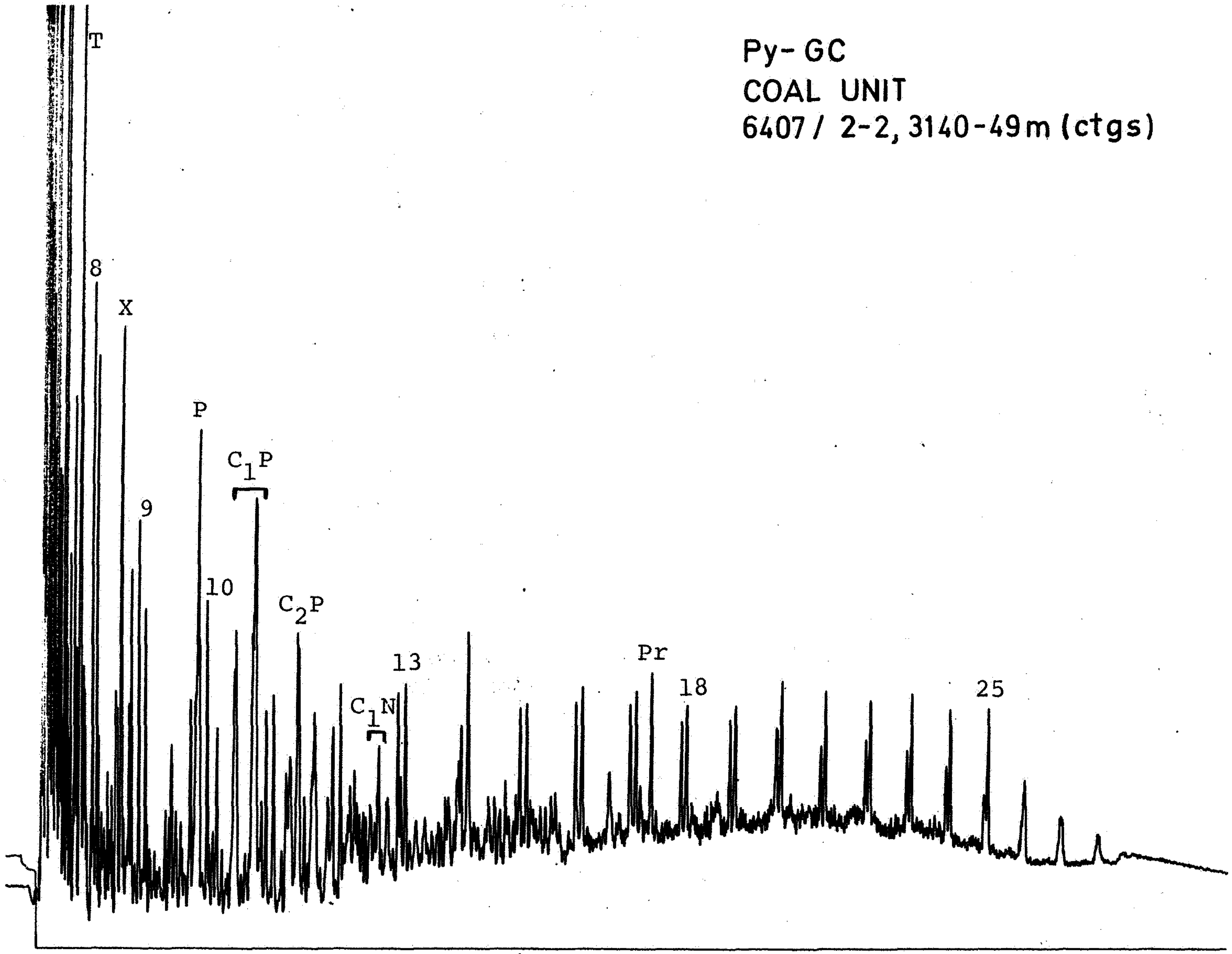


FIGURE : IV m

PYROGRAM (Pyrolysis gas chromatography)

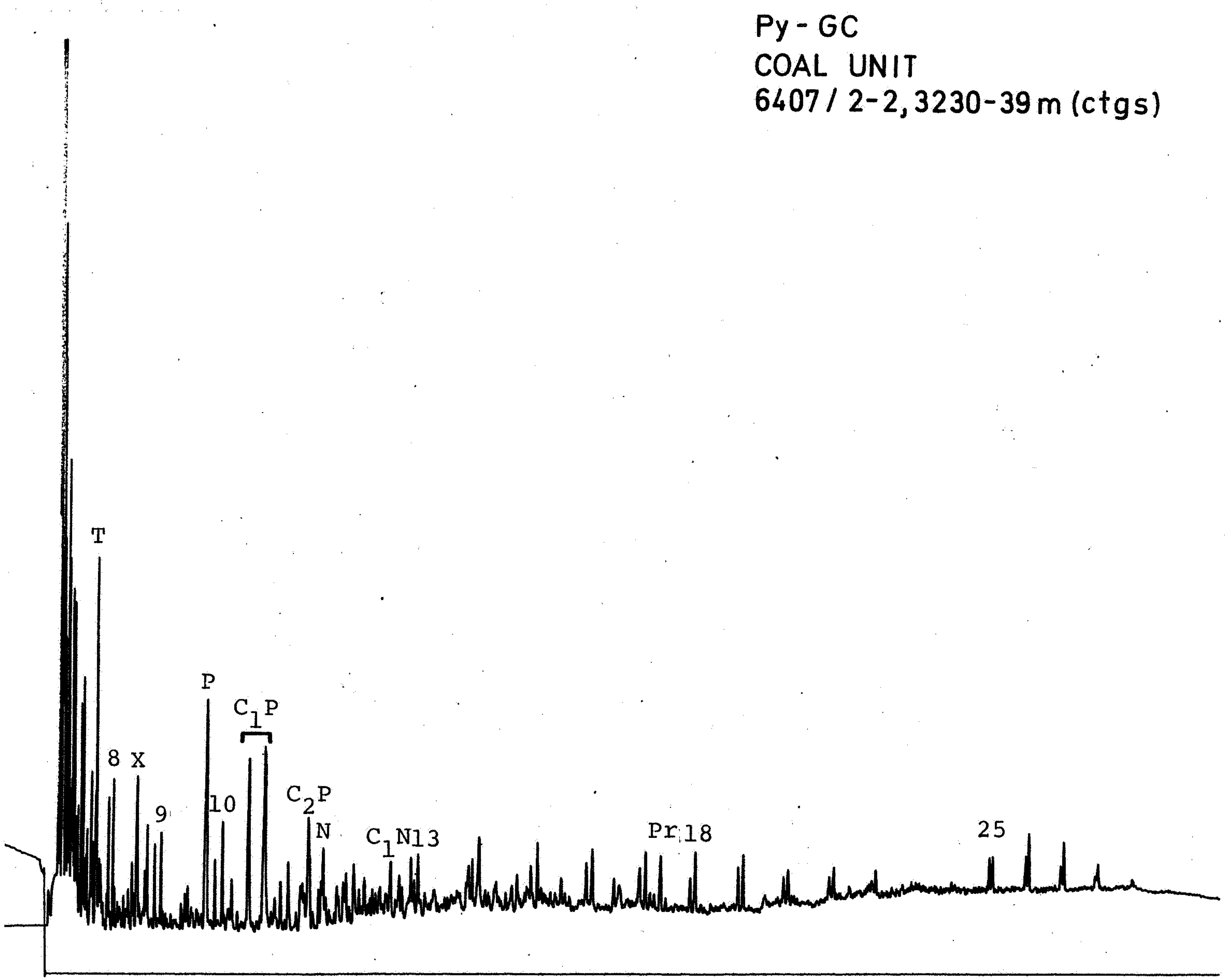
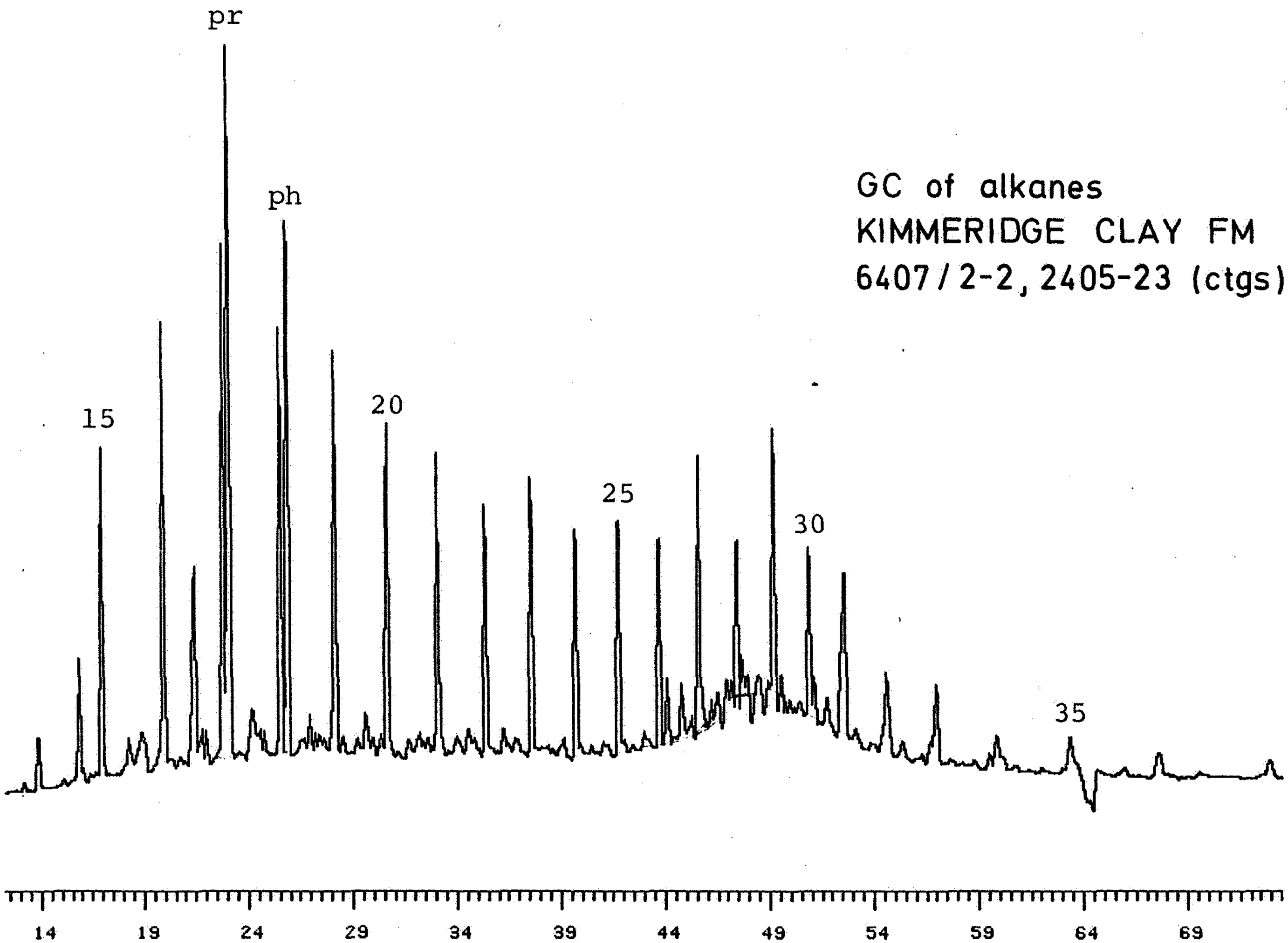


FIGURE : IV n

PYROGRAM (Pyrolysis gas chromatography)

FIGURE : V a

GAS CHROMATOGRAM OF ALKANES



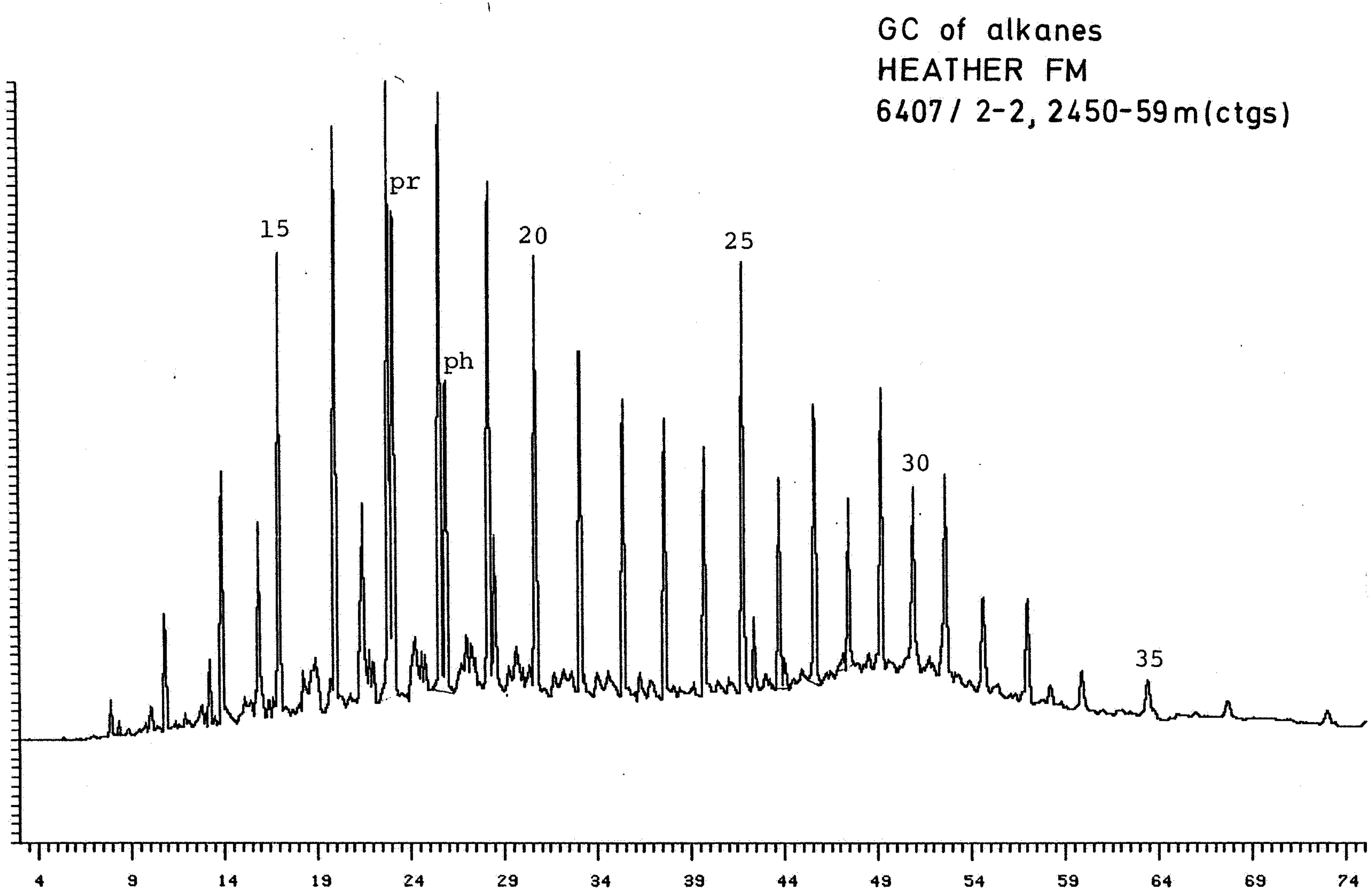


FIGURE : Vb

GAS CHROMATOGRAM OF ALKANES

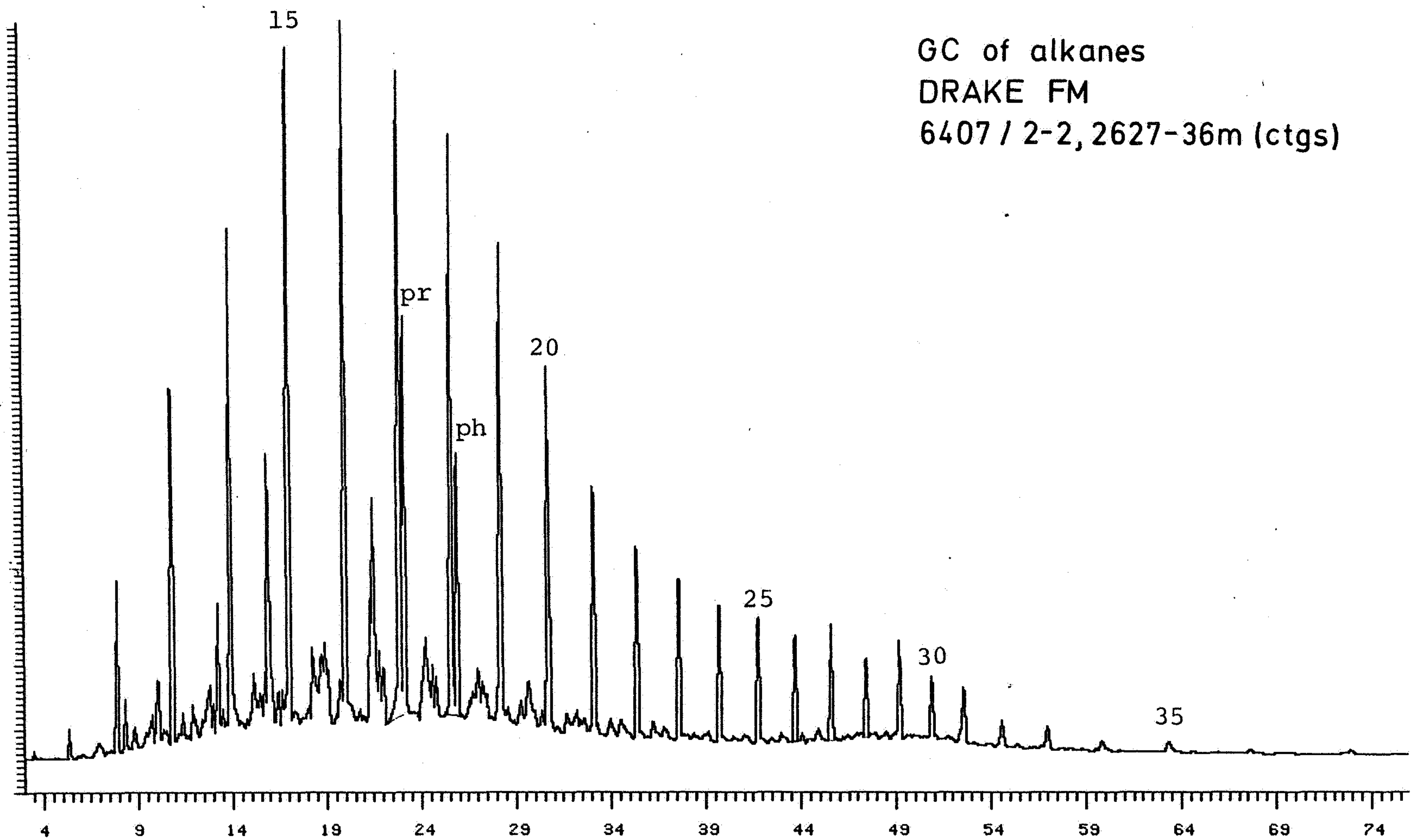


FIGURE : Vc

GAS CHROMATOGRAM OF ALKANES

FIGURE : Vd

GAS CHROMATOGRAM OF ALKANES

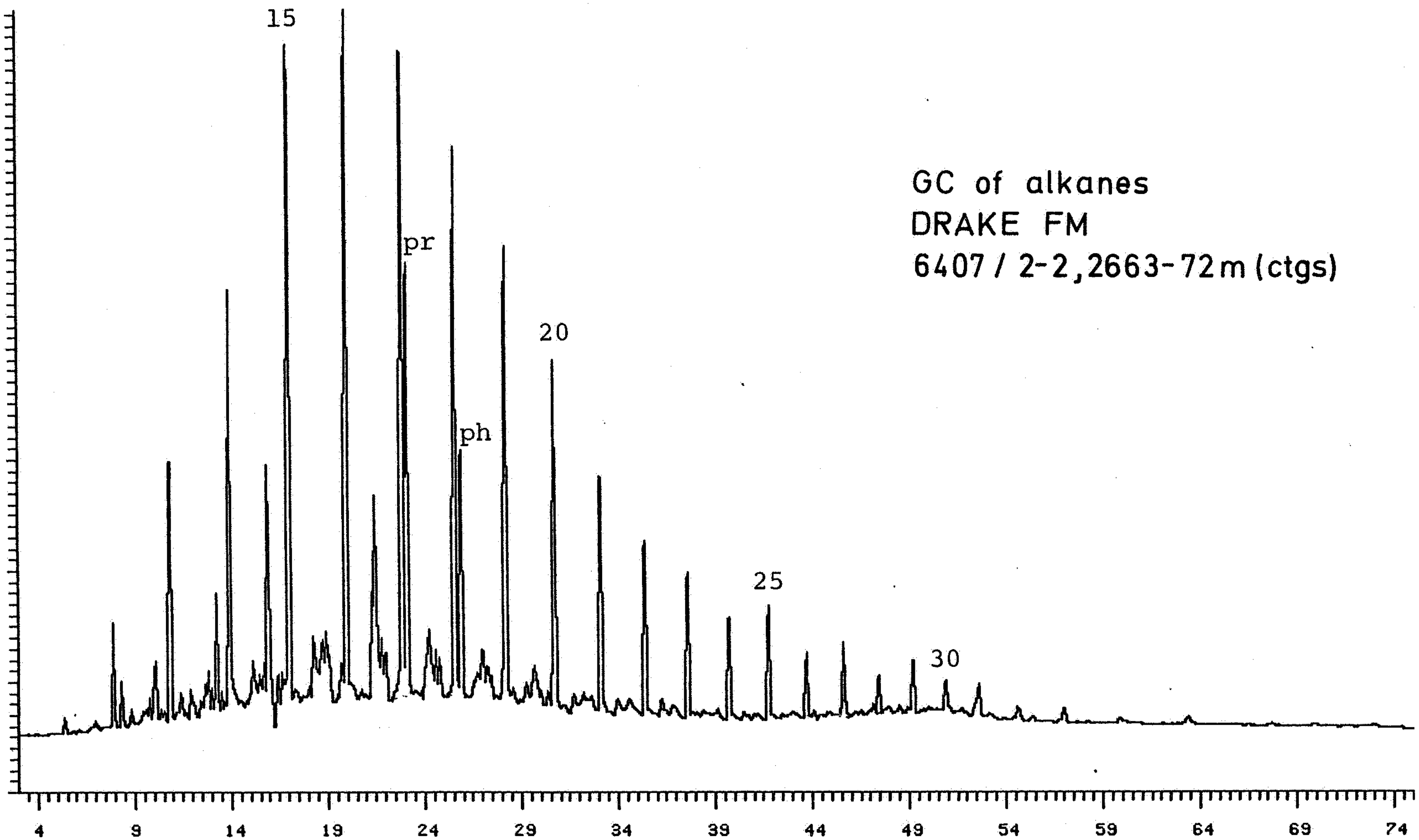
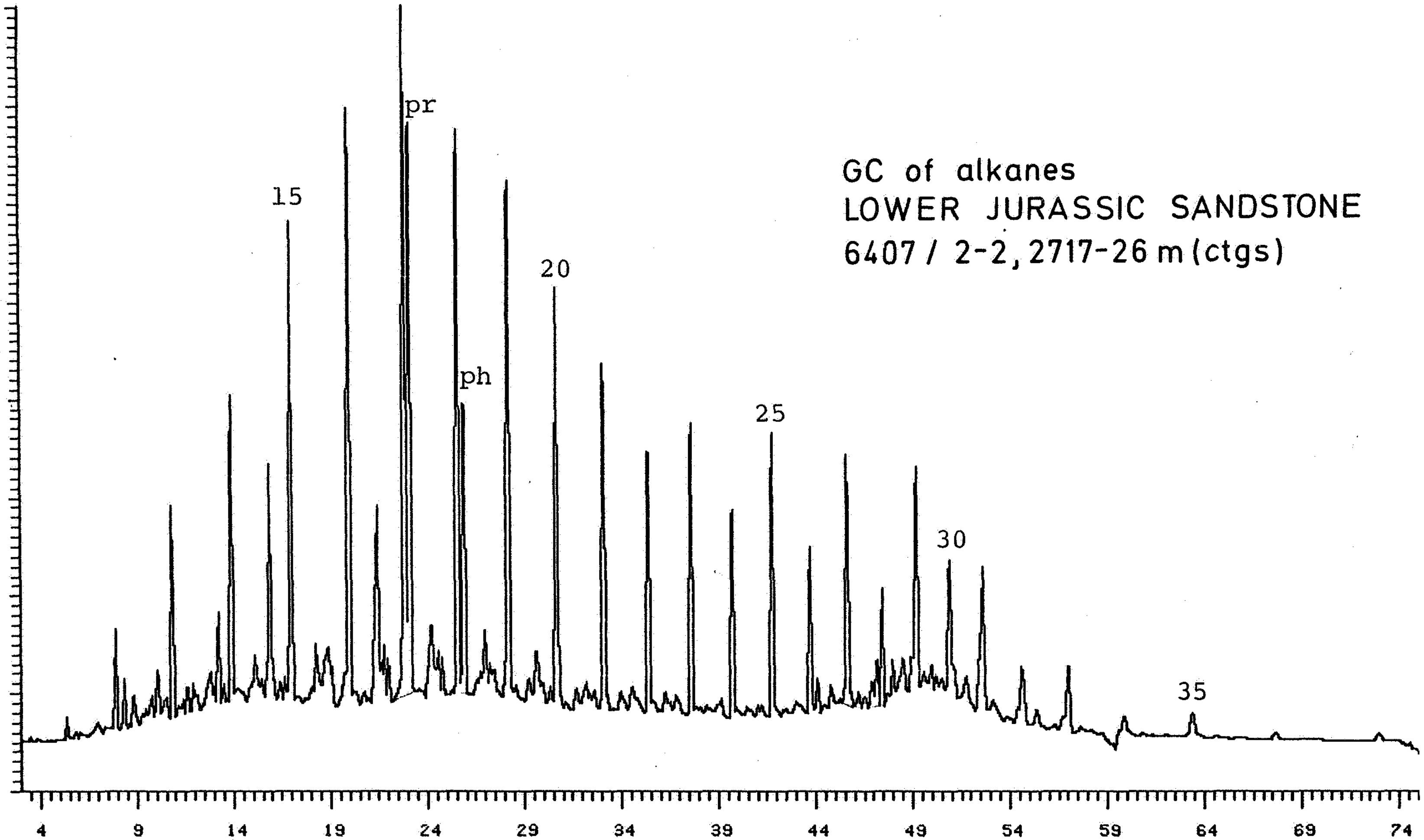


FIGURE : Ve

GAS CHROMATOGRAM OF ALKANES



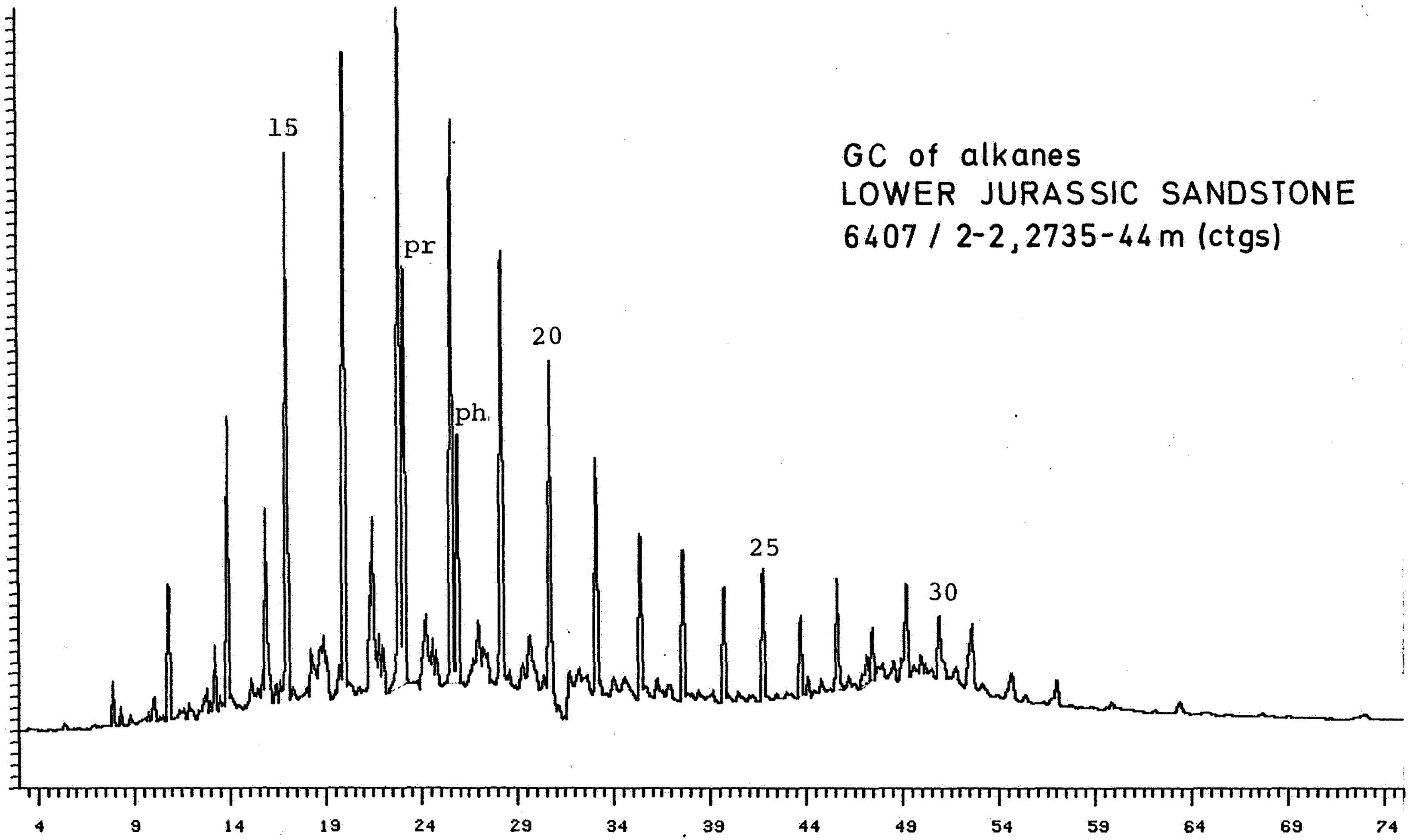


FIGURE : Vf

GAS CHROMATOGRAM OF ALKANES

FIGURE : Vg

GAS CHROMATOGRAM OF ALKANES

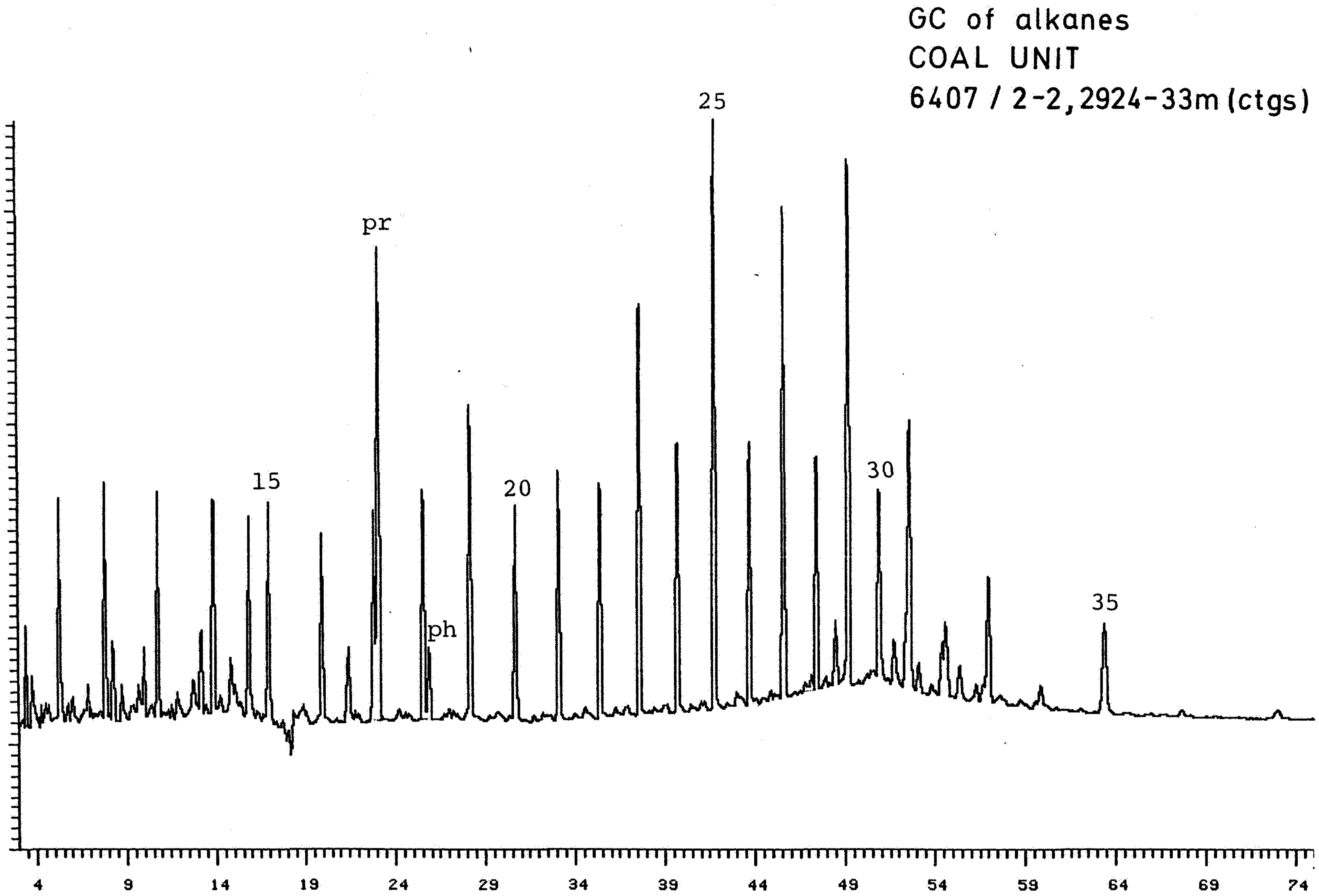
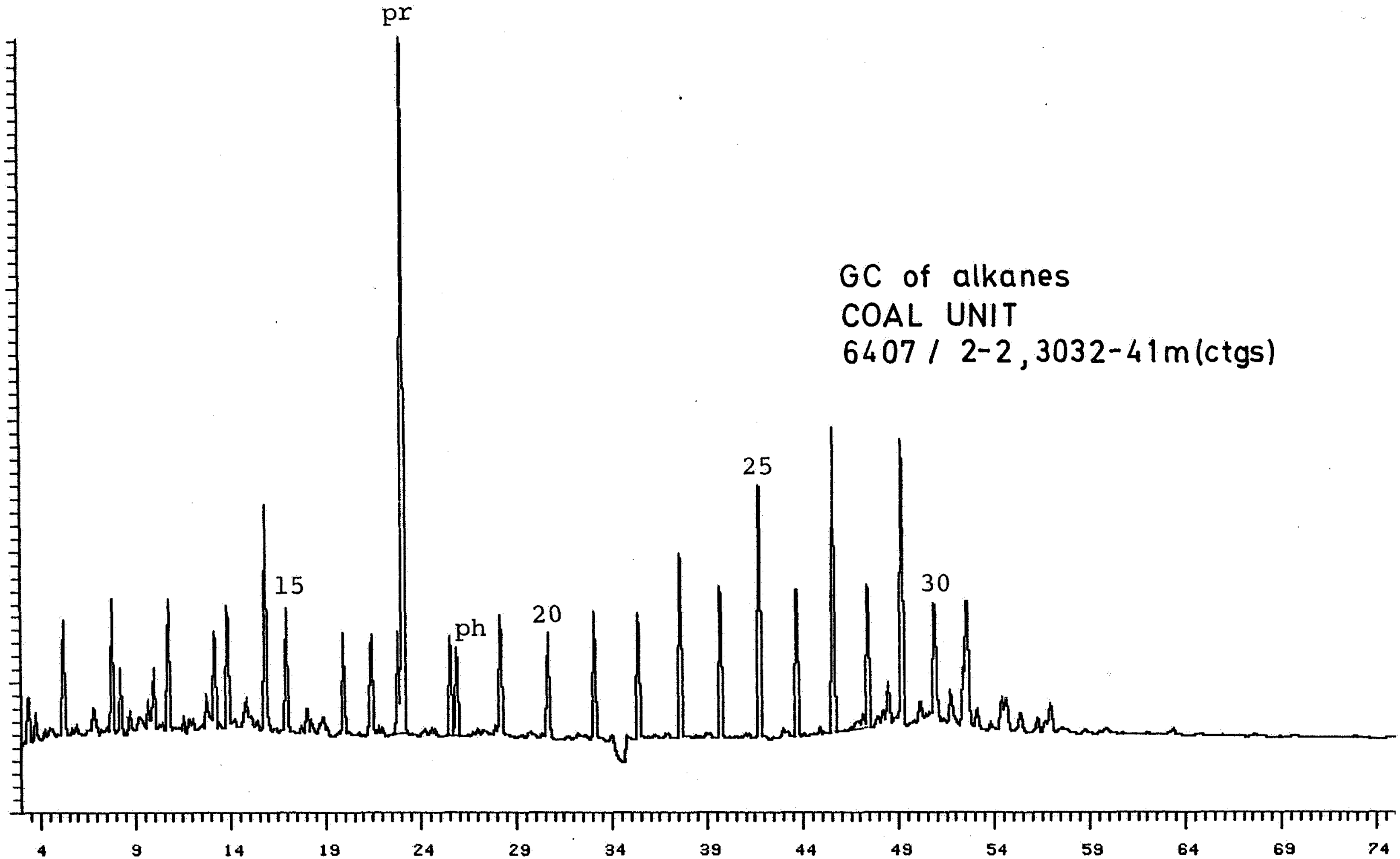


FIGURE : Vh

GAS CHROMATOGRAM OF ALKANES



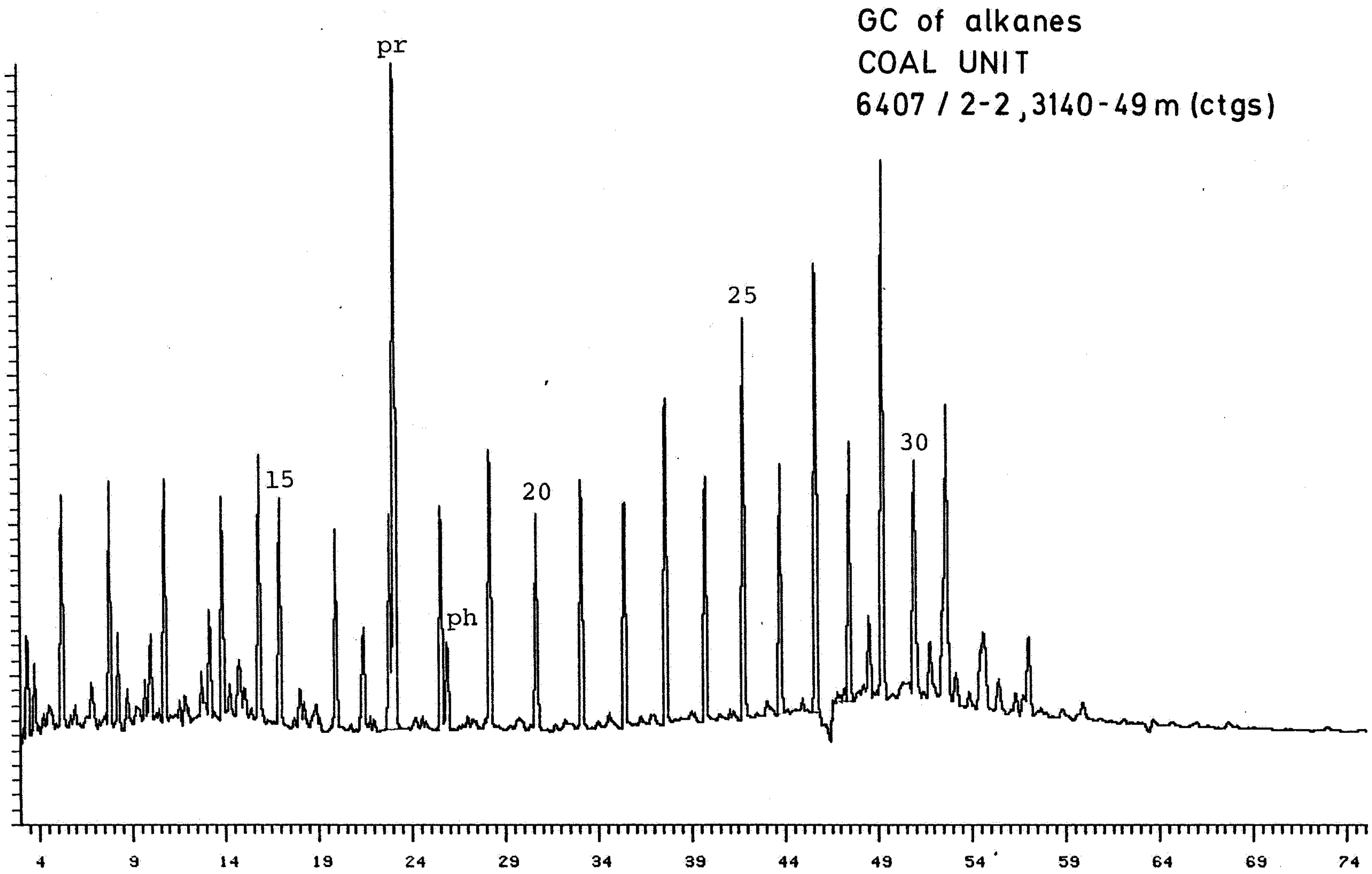


FIGURE : Vi

GAS CHROMATOGRAM OF ALKANES

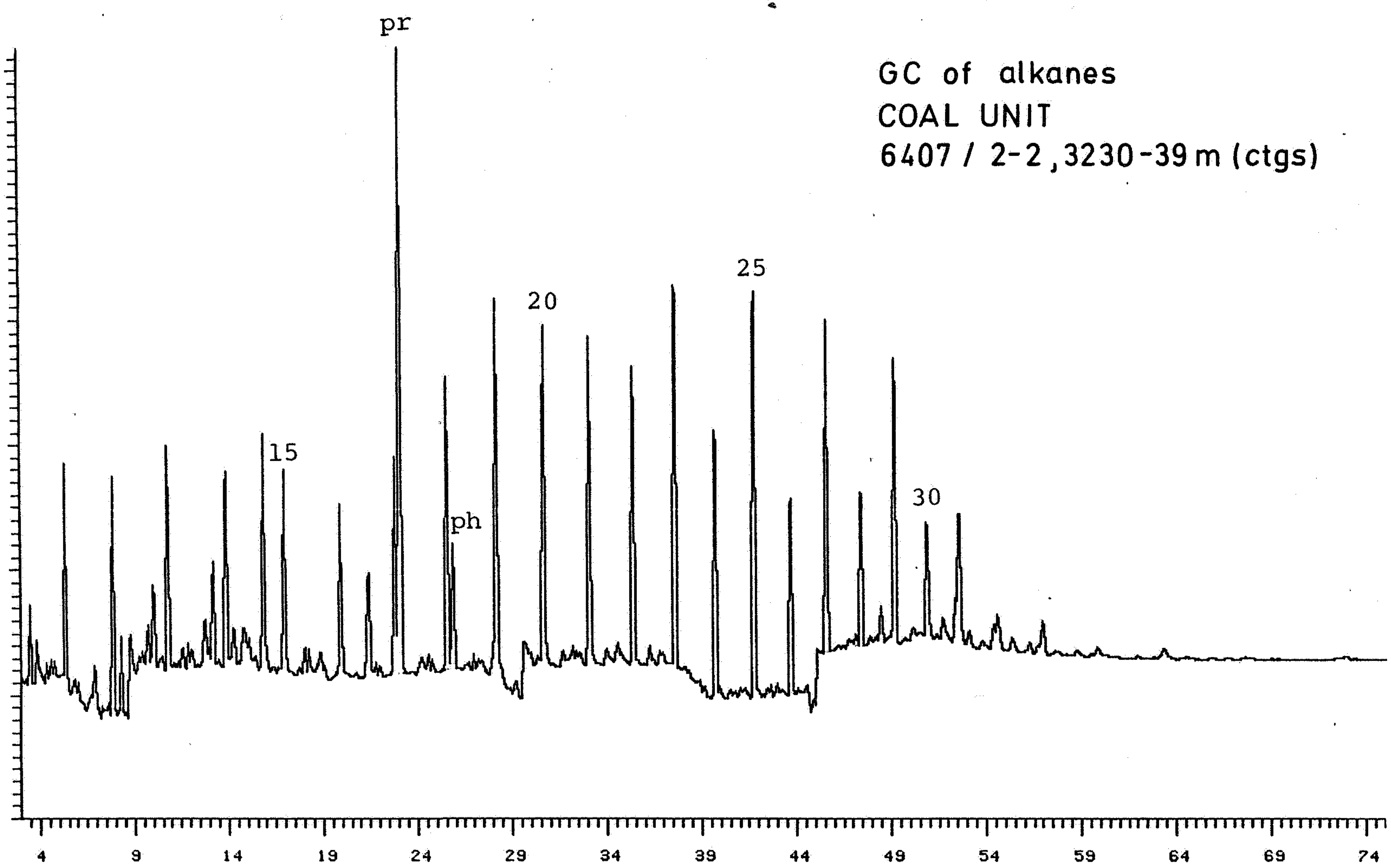


FIGURE : V j

GAS CHROMATOGRAM OF ALKANES

LIST OF ENCLOSURES