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GEOCHEMICAL SERVICE REPORT

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NORSK HYDRO A.S.

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GEOCHEMICAL EVALUATION OF NORSK HYDRO's 6609/11-1 WELL
NORWEGIAN NORTH SEA

October 1983

CHESTER STREET · CHESTER CH4 8RD · ENGLAND

COMPANY PROPRIETARY

(6-374)

kull ned 2740 : Vitrinit domineret
mye Cerebinitt, mindre mangel
ekstritt
 $R_o = 0.52$
kull 2620 Vitrinit, mindre inertinit og ekstritt $R_o = 0.42$

GEOCHEMICAL EVALUATION OF NORSK HYDRO'S 6609/11-1 WELL
NORWEGIAN NORTH SEA

SUMMARY

The section between 915 metres and 3068 metres (TD) has been analysed in 6609/11-1.

The Tertiary and Cretaceous intervals consist of poor and immature source rocks which generally have a primary potential for gas.

In contrast the Kimmeridgian, although immature, is a potentially rich source unit for oil and gas. Reservoirs in communication with the mature equivalents of these mudstones should be very prospective.

Similarly rich mudstones are also present within the samples from the Heather Formation equivalent but are (at least largely) caved. Otherwise, although minor hydrocarbon generation has occurred below 2350± metres, the sediments from the top of the Heather Formation to total depth commonly have good contents of organic matter but are poor source rocks for gas or gas and condensate. Scattered richer source intervals are present in the Middle and Lower Jurassic but the chief exceptions to this generalisation are:-

- a) the Lower Jurassic shales from 2710-2785± metres which are potentially good source rocks for gas or sometimes, for gas and oil.
- b) the coaly and carbonaceous shales of the Lower Jurassic and Triassic which are potentially rich source rocks. The sample analysed from the Triassic will yield gas and oil.

It is believed that oil-prone source rocks would be mature a short distance below total depth.

Shaly coal at 2785: $R_o = 0.45$

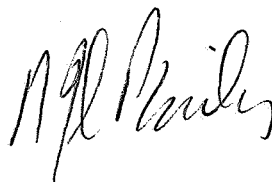
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REGISTRERT

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No strong shows were detected but there appear to be weak shows of marginally wet gas within the Kimmeridgian with traces up to $1900\pm$ metres, down to $2600\pm$ metres and below $2900\pm$ metres. There is a show of a young waxy crude at $1915-1930\pm$ metres.



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INTRODUCTION

This report presents a geochemical evaluation of the section between 915 metres and 3068 metres (TD) in Norsk Hydro's 6609/11-1 well, Norwegian North Sea.

The analytical format employed in this study was specified by Norsk Hydro and was designed to:

- investigate the hydrocarbon source potential of the section.
- detect and characterise shows of migrated, out of place hydrocarbons.

This project was authorised by S.I. Leivestad, Norsk Hydro A.S., Oslo.

A. ANALYTICAL

One hundred and forty four (144) canned samples, each composited over fifteen (15) metres, were received from 915-3068 metres in 6609/11-1. These samples were assigned the Geochem job number 772.

No significant contamination was observed during the sample preparation steps.

The samples were screened with the light hydrocarbon (C_1 - C_7) and organic carbon analyses and a limited number of specified samples were also analysed by the vitrinite reflectance and mini-pyrolysis analyses. These data were reported to the client and Ms. A.S. Lycke then selected samples for further analysis. At this point Rockeval pyrolysis was added to the original scheme. A total of one hundred and forty four light hydrocarbon analyses, two hundred and eight five organic carbon analyses, thirty eight Rockeval pyrolysis analyses, thirty eight mini pyrolysis analyses, thirty six kerogen analyses, forty one vitrinite reflectance determinations, twenty eight pyrolysis-GC analyses, twenty six C_{15+} extractions with chromatography and twenty six high resolution paraffin-naphthene analyses were performed in this study.

The data are presented in tables 1 through 9 and graphically in figures 1 through 8. A brief description of the analytical techniques employed in this study is included in the back of the report.

B. GENERAL INFORMATION

Ten (10) copies of this report have been forwarded to S.I. Leivestad in Oslo together with the kerogen slides prepared for this study. A copy of the data has been retained by Geochem for future consultation with authorised Norsk Hydro personnel.

The remaining sample material will be returned to Norsk Hydro.

All of the results related to this study are proprietary to Norsk Hydro A.S.

RESULTS AND INTERPRETATION

Each of the parameters relevant to the geochemical evaluation of the section between 915 metres and 3068 metres (TD) in 6609/11-1 will be considered in turn and then combined to form the "Conclusions".

A Preliminary Geological Well Summary was provided for this study.

A. ZONATION

This zonation represents a synthesis of the formation tops with the light hydrocarbon (C_1 - C_7) and organic carbon data. Ten (10) zones are recognised.

The Tertiary is subdivided into Zones A¹ through A³.

Zone A¹ 915 metres to 1260± metres, consists of olive grey silty mudstones with minor sands below 1095± metres. Minor proportions of basaltic material are present at 1020-1200± metres whilst above 1020± metres a more granitic igneous rock is present and, above 945± metres, constitutes a major proportion of the total sample.

The C_1 - C_4 gaseous hydrocarbons range in abundance from 1008 ppm up to 4263 ppm, generally exceeding 2200 ppm above 1125± metres and commonly approximating 1200 ppm below this depth, although they exceed 2800 ppm below 2300± metres. These gases are extremely dry and the C_5 - C_7 fraction was not detected.

Zone A² 1260± metres down to 1380± metres is also dominated by olive grey silty mudstones with minor interbeds of dark olive grey silty mudstone at 1290-1320± metres.

Gas abundances are somewhat higher at (1717)3247-8255 ppm and the gases are wetter (but still very dry) at 2-6% of the C_{2+} fraction. Minimal C_5 - C_7 abundances were recorded.

Zone A³ 1380± metres down to the base of the Tertiary at 1640± metres, is an interval of assorted mudstones and shaly mudstones.

The gaseous C_1 - C_4 hydrocarbons lie within the limits of (474)821-

1826(2592) ppm and are very dry, particularly below 1500± metres. The heavier C₅-C₇ hydrocarbons are very sparse above 1500± metres and were not detected below that depth.

Zone B lies between 1640± metres and 1849± metres, thus corresponding to the Upper Cretaceous. It comprises medium grey shaly mudstones with minor sands below 1665± metres.

Gas abundances range from 298 ppm up to 1428 ppm but seldom exceed 1000 ppm and these gases are extremely dry, with only one sample exceeding 1.5% C₂₊.

Zone C 1849± metres to 2069± metres is Lower Cretaceous in age. It consists of medium grey shaly mudstones (with occasional minor interbeds of very pale brown silty mudstone) above 1975± metres, of medium light grey silty mudstones at 1975-2020± metres and then of calcareous siltstones which grade into limestones.

No fluorescence was detected.

Gases are sparse above 1900± metres but then improve to the general range of 694-1563 ppm. Also above 1900± metres the gases are very dry (3% C₂₊) and the C₅-C₇ hydrocarbons are sparse (0-8 ppm) whilst below 1915± metres the gases, although still dry, are 12-19% wet and the C₅-C₇ fraction lies within the higher limits of 90-168 ppm. Isobutane to normal butane ratios generally exceed 1.0.

Zone D¹ 2069± metres to 2228.5± metres correlates with the Kimmeridge Clay Formation equivalent and is composed of dark grey and olive black (above and below 2110± metres) silty mudstones.

Zone D is much richer than the overlying sediments. The C₁-C₄ gases jump up to (4156)10385 ppm at the top of the zone and then increase erratically to 20,000 ppm at 2200± metres, reaching 29351-35580 ppm below this depth. Similarly, the gases are marginally wet (with (23)27-42% C₂₊) above 2200± metres and then marginally wet to wet (45-52% C₂₊), whilst their butane ratios decrease with depth to approximate 0.7 below 2185± metres. The

C₅-C₇ fraction is improved relative to Zone C at 374-986(1261) ppm and then jumps, at 2200± metres, to 2156-4307 ppm. As with the gases, they also exhibit an irregular improvement with depth above 2200± metres.

Thus Zone D¹ is much richer and wetter than Zones A¹ through C. Furthermore, it becomes better with depth, peaking below 2200± metres.

Zone D² 2228.5± metres to 2476± metres corresponds to the Heather Formation equivalent. Above 2380± metres it comprises a sequence of medium grey shales interbedded with calcareous mudstones (grading to limestones), silty mudstones and limestones. The olive black silty mudstones resemble those in Zone D¹ and are obviously, at least dominantly, caved. Below 2380± metres Zone D² consists of medium grey silty shales and shales with minor interbeds of very light brownish grey siltstone. The olive black silty mudstones continue down to 2425± metres.

No fluorescence was detected.

Gas abundances exceed 20,000 ppm above 2260± metres but then drop to 2347-7328(9103) ppm whilst the C₅-C₇ hydrocarbons decrease at the same depth from 655-695 ppm to 117-288(400) ppm. The gases are marginally wet (30-45% C₂₊, 53% at 2440-2470± metres) and their butane ratios commonly approximate 0.7.

Zone E extends from 2476± metres down to 2670± metres and includes the Middle Jurassic (above 2520 metres) and the top of the Lower Jurassic. It comprises a sequence of medium dark grey shales and very light grey siltstones with minor sands above 2560± metres. The well log suggests that the Lower Jurassic should be largely sandy and indeed, cavings are evident in the samples.

No fluorescence was observed.

The C₁-C₄ gases range from (1398)2189 ppm up to 6621 ppm but generally fail to exceed 4350 ppm below 2515± metres (i.e. in the

Lower Jurassic). At 2575± metres their isobutane to normal butane ratios increase from 0.5-0.7 to 1.0 but this break is not reflected in gas wetnesses, as most of the gases are 32-46% wet but the samples from 2545-2590± metres are 50-61% wet. C₅-C₇ abundances are relatively uniform at (258)348-560 ppm.

Zone F 2670± metres to 3005± metres incorporates the rest of the Lower Jurassic. This interval is lithologically varied. Thus the shales comprise very light grey siltstones above 2710± metres and then a sequence of medium dark grey shales with siltstones, light grey mudstones, sands and minor coals. Sand units are indicated at 2770-2785± metres and 2830-2935± metres but otherwise, most of the interval below 2785± metres is dominated by a coaly shale-siltstone-silty mudstone-sandstone sequence.

No fluorescence was observed.

The C₁-C₄ gaseous hydrocarbon abundances are also variable. Thus with the exception of the uppermost shale (12797 ppm) the section above 2740± metres has values of (1597)3410-4923 ppm and appears to become leaner with depth. There is then a significant increase to 10160-19632(32288) ppm at 2740-2860± metres below which depth the values drop to 5215-9513 ppm before increasing, below 2920± metres, to 25103-53091 ppm (peaking at 2935-2980± metres). The richer intervals grossly correlate with the coaly shales but this lithology has little influence on the other parameters. Thus the gases are (14)21-37% wet above 2905± metres and (32)40-46% wet below this depth whilst their butane ratios generally range from 1.0 to 1.6. The C₅-C₇ fraction is relatively uniform at 215-410(595) ppm.

Zone G 3005± metres to 3068± metres (TD) is Triassic in age and is a carbonaceous shale-siltstone-sandstone sequence.

No fluorescence was noted.

Good gas abundances of (4573)21742-34671 ppm were recorded, the gases being 40-44% wet. The heavier C₅-C₇ hydrocarbon lie within the limits of 140-266 ppm.

B. AMOUNT AND TYPE OF ORGANIC MATTER

The amount of organic matter within a sediment is measured by its organic carbon content. Average shales contain approximately one percent organic carbon and this is the standard to which these samples will be compared.

Organic matter type influences not only source richness but also the character of the hydrocarbon product (oil, gas) and the response of the organic matter to thermal maturation. Richness and oiliness decrease in the order: amorphous-algal-herbaceous-woody. Wood has a primary (but not exclusive) potential for gas whilst inertinitic (oxidised, mineral charcoal) material has only a limited hydrocarbon potential.

The silty mudstones of Zone A¹ have low values of 0.22-0.32% organic carbon, their organic matter being woody and inertinitic in type, although with significant proportions of herbaceous debris.

Zone A² is richer. The silty mudstones above 1290± metres contain 0.46-0.70% organic carbon jumping, below this depth, to the range of 1.25-1.75(2.21)% organic carbon, whilst the minor dark olive grey variety from 1290-1320± metres is further enhanced at 3.84-4.05% organic carbon. The dominant silty mudstones are characterised by organic matter which is largely woody in type although with very significant proportions of herbaceous debris and minor to significant inertinitic and algal kerogens. In the rich dark olive grey mudstones amorphous kerogen is the major constituent (although it is not of prime quality) whilst the woody and herbaceous fractions are both significant.

In Zone A³ the very light olive grey mudstones which are dominant above 1425± metres and present as significant interbeds down to 1485± metres (but generally minor below this depth) are lean at 0.11-0.32% organic carbon whilst the shaly mudstones and mudstones which are dominant below 1425± metres have values of (0.62)0.70-1.05% organic carbon. The minor olive grey mudstones from 1560-1605± metres approximate 1.3% organic carbon. The organic matter in these sediments is variously herbaceous and woody (with significant inertinitic and amorphous debris) or amorphous and herbaceous in type, although the amorphous fraction is not of prime quality.

Similar richness values of 0.72-0.96% apply to the dominant medium grey shaly mudstones above 1695± metres in Zone B, but they then drop to 0.38-0.63%

organic carbon. The minor medium grey shales above 1680± metres and the occasional silty mudstones throughout the zone are leaner at 0.23-0.39% and 0.09-0.14% organic carbon respectively. Contaminant amorphous-like material is present in some of the samples (of dominant mudstone) but the indigenous organic matter is believed to be largely inertinitic in type with very significant woody, and less significant herbaceous, debris.

In Zone C (Lower Cretaceous) the shaly mudstones above 1975± metres and the calcareous siltstones below 2020± metres have comparable values of 0.55-0.72(0.80)% and 0.53-0.66% organic carbon respectively whilst the intervening silty mudstones are somewhat leaner with 0.41-0.47% organic carbon. Abundant amorphous material is present but this resemble contamination and it is believed that the indigenous organic matter is inertinitic and woody in type. The limestone from the base of this zone contains 0.19% organic carbon.

In contrast, the silty mudstones of the Kimmeridgian (Zone D¹) are rich at 5.18-8.83% organic carbon, becoming richer with depth. Their organic matter is dominantly amorphous or amorphous and algal in type with a significant proportion of the total being transitional between the two states. The inertinitic, woody and herbaceous fractions tend to be relatively minor.

Olive black silty mudstones of similar richness (i.e. (7.15)7.54-8.51%) occur down to 2425± metres in Zone D² (Heather Formation) but are generally fairly minor below 2245± metres and appear to be dominantly caved. However the medium grey shales which are dominant down to 2380± metres have values of 0.76-0.97% whilst the underlying silty shales and shales are richer at (0.87)1.17-1.73(2.13)% organic carbon. These sediments are characterised by a mixed amorphous-inertinitic-herbaceous-woody-algal assemblage. The calcareous mudstones and limestones above 2380± metres and the siltstones below 2410± metres contain 0.31-0.57% and 0.27-0.47(0.73)% organic carbon respectively.

The medium dark grey shales of Zone E generally contain (1.41)1.78-2.55(2.87)% organic carbon but, below 2635± metres where they are minor, are richer at 3.29-3.72%. Their organic matter is a mixed inertinitic-amorphous-woody-algal-herbaceous assemblage within which the inertinitic and woody fractions comprise half of the total. The amorphous kerogen is frequently incompletely developed and is of variable quality. The interbedded siltstones are much leaner at 0.27-0.37(0.67)% and, below 2560± metres, drop to 0.08-0.19(0.33)% organic carbon. The minor coal from 2620-2635± metres is, of course, rich (63.9%) but

the minor rich olive black silty mudstones are believed to be caved.

Zone F is very varied. Thus the coaly shales which are essentially restricted to the interval below $2750 \pm$ metres range from (10.2)17.2% up to 50.5% organic carbon, their organic matter being dominantly woody but with significant proportions of herbaceous and inertinitic material. The medium dark grey shales above $2785 \pm$ metres (which include abundant cavings) and the grossly medium light grey mudstones from $2740-2935 \pm$ metres (silty below $2815 \pm$ metres) contain (2.11)2.76-3.30(3.80)% and (0.88)1.31-2.11(3.92)% organic carbon respectively. Both facies are characterised by a mixed and variable organic matter assemblage. In the shales it is commonly amorphous-inertinitic-woody-herbaceous in type and includes degraded and partially sapropelised material whilst the amorphous fraction is not of prime quality. The mudstones are dominantly woody and inertinitic above $2830 \pm$ metres whilst the silty facies below this depth are largely amorphous and woody in type but with significant proportions of herbaceous and inertinitic debris. The amorphous material is frequently degraded and is not the typical, oil-prone variety. Finally, the siltstones above $2725 \pm$ metres contain sparse (0.13-0.31%) amounts to largely inertinitic material.

In Zone G the calcareous shales have good values of 12.2-23.2% organic carbon and organic matter which is largely woody in type although with significant proportions of herbaceous, inertinitic and amorphous (degraded) kerogens. Minor coals are occasionally present and these are richer at 34.6-63.8%. The medium brownish grey siltstones contain 0.88-2.28% organic carbon and become leaner with depth. Their organic matter is woody and inertinitic with fairly significant herbaceous and degraded amorphous debris.

Clearly, organically rich sediments are widespread from the top of the Kimmeridge Clay equivalent down to total depth. Organic matter quality is best in the olive black silty mudstones of the Kimmeridge.

C. LEVEL OF THERMAL MATURATION

Thermal maturity has been evaluated with the spore colouration and vitrinite reflectance techniques.

The spore colouration method indicates that a thermal index of 2- is achieved at a depth of $2350 \pm$ metres whilst 2 apparently lies a short distance below total depth.

Organic matter with a thermal index of less than 2- is immature. At 2- the amorphous, herbaceous $\pm$ algal fractions of the total organic matter become marginally mature (minor hydrocarbon generation) whilst they are mature at a thermal index of 2. In contrast, wood only becomes marginally mature at a thermal index of 2.

Hence in this well, the section above 2350 $\pm$ metres is immature. Below this depth, due to the mixed character of the organic matter and the nature of the amorphous fraction, only limited hydrocarbon generation can be anticipated.

A large number of vitrinite reflectance readings were obtained from most of the analysed samples. Plotted against depth the vitrinite data exhibit a lot of scatter but it is obvious that those populations above 2200 $\pm$ metres with reflectivities of 0.50% Ro or greater and those populations below 2200 $\pm$ metres with values of 0.65% Ro or more reflect reworking. If these data points are excluded there is now a clear trend which is further improved if the anomalously low values obtained from the Kimmeridge are omitted. Using the coals at the bottom of the section the best-fit trend line reaches 0.45% Ro at 2760 $\pm$ metres. However, the preferred trend line honours the shales and mudstones rather than the coals and this reaches 0.45% Ro at 2440 $\pm$ metres and 0.53% Ro at 3180 $\pm$ metres. Reflectivities of 0.45% Ro and of 0.53% Ro should be equivalent to thermal indices of 2- and of 2 and hence, there is a reasonable correlation between the two methods and indeed, a perfect correlation could be obtained. Hence the spore colouration data will be adopted in this study.

This section is presently at (approximately) its maximum paleodepth of burial.

Pyrolysis Tmax values are not a preferred maturation parameter. In this well they are clearly affected by organic facies and, making allowance for this, a temperature of 430°C is probably not achieved above approximately 2750 $\pm$ metres and indeed, perhaps not until significantly deeper.

D. SOURCE RICHNESS

Preliminary assessments of present and potential source richness can be obtained from the light hydrocarbon and organic carbon abundances. The light hydrocarbon data suggest that Zones A¹ through A³ are potentially fair source rocks whilst Zones B and C are poor to fair. Zone D¹ is rated as good and very good whilst Zones D² and E are fair. The coaly shales of Zone F are

very good and this rating also applies to Zone G. Ratings based upon the organic carbon data are somewhat different. Thus Zone A¹ is lean, Zone A² is generally good and Zones A³ through C are classified as potentially fair source rocks. Zone D¹ is rich whilst Zone D² and E may grossly be described as good. The coaly shales of Zones F and G are of course, potentially rich source rocks.

Upon extraction, the sample analysed from Zone A¹ yielded 55 ppm C₁₅₊ hydrocarbons, thus indicating a poor source potential. Zones A² through B yielded 119-279 ppm C₁₅₊ hydrocarbons which suggests that these are fair source intervals. However the chromatograms of the paraffin-naphthene hydrocarbon fraction show the presence of contaminant in addition to the source-indigenous hydrocarbons and, making allowance for this, a poor source rating is more likely. The sample from 1915-1930 metres contains a high 1116 ppm resulting in an anomalous hydrocarbon to organic carbon ratio. The hydrocarbons do not constitute a particularly high proportion of the total extract but the paraffin-naphthene chromatogram is rather revealing. It is very paraffinic but is depleted in the light ends, peaks at nC₃₃ and is believed to indicate a young waxy oil.

The olive black silty mudstones of Zone D¹ and at the top of Zone D² yielded 331-1337 ppm C₁₅₊ hydrocarbons. At their present level of maturity they are fair to very good source rocks and will improve with further maturation. The dominant shales of Zones D² and E and the silty mudstones of Zone F have values of 151-486(589) ppm, suggesting that they are fair and good source rocks. However many of the paraffin-naphthene chromatograms indicate the presence of drilling-introduced contamination and hence, at their present level of maturity, most of the analysed samples would be more accurately rated as fair source rocks. The siltstones of Zone G are also fair.

The pyrolysis analysis evaluates source richness under optimum maturity conditions. The silty mudstones below 1290± metres in Zone A² have S2 (pyrolysate) values of 1.26-1.97 mg/g and are rated as poor source rocks whilst Zones A³ (0.28-0.39) and particularly Zones B and C (0.14-0.16) are lean. In contrast the olive black silty mudstones of the Kimmeridge Clay (Zone D¹) and Heather (Zone D²) Formations are potentially rich source rocks yielding 20.7-32.0 mg/g S2. The organically richer medium grey silty shales within Zone D² have a very good potential but otherwise, this interval is a poor source unit. In Zone E the shales are generally poor but that from 2485-2500±

metres (9.98 mg/g) is a potentially very good source rock. Within Zone F the coaly shales are very rich (93.3-132.7 mg/g) whilst the medium dark grey shales above 2785± metres are rated as good (3.7-4.7 mg/g) but the interbedded siltstones are lean and the mudstones below 2740± metres also have a poor potential as source rocks. This pattern continues into Zone G where the coaly shales and the siltstones are rich and poor source rocks respectively.

The mini-pyrolysis data are very similar to the Rockeval results discussed above.

Chromatograms of the S2 (pyrolysate) fraction define whether the mature equivalents of a source rock will yield oil, condensate or gas. Oil-prone source rocks are characterised by chromatograms with a well-defined series of normal alkene-alkane doublets which extend out to the heavy ends. If the doublets are restricted to the front ends a potential for condensate is indicated whilst in gas prone sediments the doublets are (essentially) absent. The silty mudstones of Zone A² will yield gas and condensate but Zones A³, B and C have a primary potential for gas. In contrast Zone D¹ (and the olive black silty mudstones within Zone D²) have a mixed potential for oil and gas. The shales above 2380± metres in Zone D² are gas prone but the richest of the silty shales below 2380± metres will yield gas and oil whilst the leaner varieties together with the shales down to 2500± metres in Zone E have a potential for gas and condensate.

The shales and mudstones throughout the rest of the section will generally yield gas with associated condensate although there are interbeds of shale and silty mudstone within Zone F and of siltstone in Zone G which will yield gas and oil. The coaly shales generally have relatively high hydrogen indices and analysis of that from 3010-3025± metres at the top of Zone G indicates a potential for gas and oil and not just for gas.

The olive black silty mudstones of the Kimmeridgian and within the Heather equivalent (plus, apparently some of the coaly/carbonaceous shales within the Lower Jurassic and the Trias) are the most oil prone facies within this section, but no classically oil-prone sediments were detected.

E. MIGRATED HYDROCARBONS

No fluorescence was detected in this section.

The light hydrocarbons do not indicate any strong, or indeed, any definite shows of liquid hydrocarbons. However there could be weak shows of marginally wet gas in the Kimmeridge Clay Formation equivalent (particularly towards its base) and perhaps extending as minor traces up to 1900± metres. There could also be fairly insignificant traces in Zones D² and in Zone E down to 2600± metres. In Zones F and G the gas abundances appear to be related to the presence of coaly shales, but the richest samples do tend to be the wettest (instead of the driest), thus suggesting the possibility of marginally wet gas below approximately 2900± metres. As noted above, the evidence is not definitive and hence, these conclusions are tentative.

Pyrolysis-derived Production Indices do not indicate the presence of shows except perhaps within the interval 1650-1930± metres and particularly at 1915-1930± metres. Interestingly, upon extraction, the sample from 1915-1930± metres yielded a high 1116 ppm C₁₅₊ hydrocarbons and, although these hydrocarbons constitute less than 36% of the total extract, their paraffin-naphthene chromatogram suggests a show of a young, waxy oil which was derived from a relatively immature source rock. No other shows were indicated by the C₁₅₊ data.

F. CONCLUSIONS

Ten (10) zones are recognised between 915 metres and 3068 metres (TD) in 6609/11-1.

The Tertiary interval is subdivided into Zones A¹, A² and A³.

Zone A¹ (915-1200± metres) comprises lean silty mudstones (0.22-0.32% organic carbon) which are immature and very poor source rocks.

In contrast, the dominant silty mudstones of Zone A² (1200-1380± metres) improve to 0.46-0.70% and then, below 1290± metres to 1.25-1.75(2.21)% organic carbon whilst the minor dark olive grey variety at 1290-1320± metres has very good values of 3.84-4.05% organic carbon. The organic matter in the dominant mudstones is largely woody in type although there are very significant proportions of herbaceous debris. These sediments are immature and, even if mature, would only be poor source rocks for gas and condensate.

Zone A³ (1380-1640± metres) consists of lean mudstones overlying, below 1425± metres, mudstones which contain 0.62-1.05% of organic matter which is variously herbaceous and woody or amorphous and herbaceous in type. However, the amorphous fraction is not of prime quality. Zone A³ is also immature and has a very poor source potential which is primarily for gas.

The Upper Cretaceous corresponds to Zone B (1640-1849± metres). These shaly mudstones contain 0.72-0.96% organic carbon above 1695± metres but then drop to 0.38-0.63% of organic matter which is largely inertinitic although the woody ± herbaceous fractions are also very significant. This interval comprises immature, very poor source rocks with a primary potential for gas, and is of no interest.

The mudstones and calcareous siltstones of the Lower Cretaceous (Zone C, 1849-2069± metres) generally contain 0.53-0.72(0.80)% of inertinitic and woody organic matter, but are leaner at 1975-2020± metres (0.41-0.47%). These sediments are immature but, even in a mature state, would only be very poor source rocks with a primary potential for gas.

In contrast, the silty mudstones of the Kimmeridge Clay Formation equivalent (2069-2228.5± metres, Zone D¹) have high values of 5.18-8.83% organic carbon and tend to improve with depth. This enhancement is also reflected in the quality of their organic matter which is amorphous or amorphous and algal in type. As a result, although immature, these sediments are potentially rich source rocks for oil and gas. Reservoirs in communication with their mature equivalents would be very prospective.

Minor hydrocarbon generation should be initiated in their off-structure lateral equivalents buried to below 2350± metres. Indeed, it is tentatively suggested that there are weak shows of marginally wet gas within the Kimmeridgian interval, with minor traces up to 1900± metres and fairly significant traces down to 2600± metres. There is a show of a young, waxy oil at 1915-1930± metres which was derived from a relatively immature source rock.

The Heather Formation equivalent (2228.5-2476± metres, Zone D²) is more complicated. Olive black silty mudstones which contain 7.15-8.51% organic carbon and resemble those of the Kimmeridgian are present throughout most of this interval, although they are generally rather minor below 2245± metres. They are however, at least largely, caved. The medium grey shales above

2380± metres contain 0.76-0.97% organic carbon whilst the interbeds of calcareous mudstone and of limestone have values of 0.31-0.57%. Below 2380± metres the minor siltstones are lean but the major medium grey silty shales contain (0.87)1.17-1.73(2.13)% organic carbon. All of these sediments are characterised by a mixed amorphous-inertinitic-herbaceous-woody-algal organic matter assemblage. Limited hydrocarbon generation has occurred below 2350± metres but this interval basically comprises poor source rocks for gas (above 2380± metres) or for gas and condensate (below 2380± metres). However the richest shale, which is from 2380-2395± metres, is a potentially very good source rock for gas and oil whilst the olive black silty mudstones, if they are in-situ, are potentially rich source rocks for oil and gas.

Zone E (2476-2670± metres) incorporates the Middle Jurassic and, below 2520± metres, the top of the Lower Jurassic. It comprises a sequence of shales and siltstones within which the latter are lean, but the shales contain (1.41)1.78-2.55(2.87)% organic carbon. The organic matter in these shales is a mixed inertinitic-amorphous-woody-algal-herbaceous assemblage with the amorphous fraction being of variable quality and the inertinitic and woody fractions constituting half of the total. As a result, although limited hydrocarbon generation has occurred, they are only poor source rocks for gas and condensate above 2500± metres and for gas with minor associated liquids below this depth. The only exception is the richest shale (from 2485-2500± metres) which is a potentially very good source rock for gas and condensate.

The rest of the Lower Jurassic belongs to Zone F (2670-3005± metres). It tends to fall into three intervals. The first of these lies above 2710± metres and is composed of lean and uninteresting siltstones. The second extends from 2710± metres down to 2785± metres and consists of a sequence of shales, siltstones, mudstones and sands with minor coals. The siltstones are lean but the shales and mudstones contain (2.11)2.76-3.30(3.80)% and 1.60-1.89% organic carbon respectively. These shales are characterised by a mixed amorphous-inertinitic-woody-herbaceous assemblage which includes degraded and partially sapropelised material. They represent marginally mature but potentially good source rocks for gas or gas and condensate or occasionally, for gas and oil. The mudstones and siltstones are poor. The third subdivision of Zone F lies below 2785± metres and comprises a coaly shale-silty mudstone-sandstone sequence. These silty mudstones contain (0.88)1.31-2.11(3.92)% organic carbon but their organic matter is generally woody and inertinitic above 2830± metres and amorphous and woody below this depth, although the amorphous fraction is

a degraded species which is not oil-prone. The coaly shales (which are also fairly significant up to $2750\pm$ metres) have high values of $(10.2)17.2-50.5\%$ organic carbon and organic matter which is largely woody in type, although with significant proportions of herbaceous and inertinitic debris. The silty mudstones are poor (but occasionally good) source rocks with a mixed potential for gas, gas and condensate and gas and light oil, whilst the coaly shales are rich and the one analysed sample (from Zone G) suggests that they will yield gas and oil. Minor hydrocarbon generation has occurred in these sediments.

Zone G ($3005-3068\pm$ metres) is Triassic in age and consists of a sequence of carbonaceous shales, siltstones and sandstones. The carbonaceous shales contain $12.2-23.2\%$ of organic matter which is largely woody in type (with significant proportions of herbaceous, inertinitic and degraded amorphous debris) whilst the siltstones are much leaner at $0.88-2.28\%$ of woody and inertinitic material and tend to become leaner with depth. Minor hydrocarbon generation has occurred in these sediments and both lithologies will yield gas and oil but, whereas the carbonaceous shales are potentially rich source rocks, the siltstones are only poor.

It is possible, but not certain, that there could be weak shows of marginally wet gas below approximately $2900\pm$ metres.

No strong shows were detected in this well.

Rich source rocks are restricted to the Kimmeridgian, relatively minor interbeds within the Heather Formation which may be caved and to the coaly and carbonaceous shales of the Lower Jurassic and Triassic. There are however potentially very good source horizons within the intervals $2380-2395\pm$ metres and $2485-2500\pm$ metres, whilst the shales from $2710-2785\pm$ metres are rated as good. The most oil-prone sediments are those of the Kimmeridge (plus rich silty mudstones of Heather if not caved) but a mixed potential for gas and oil is also indicated at $2380-2395\pm$ metres and $2755-2770\pm$ metres for the carbonaceous shales of the Triassic and by corollary, perhaps for some of the Lower Jurassic coaly shales. Nevertheless, there are no classically oil-prone intervals.

It is believed that the top of the mature zone of significant oil generation (for suitable organic matter) lies only a short distance below total depth.

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-001	915-930m	A 65% Igneous, blocky, hard, granitic - quartz and mica, fairly coarse grain, light grey to medium light grey B 20% LCM - cement C 15% Silty mudstone, blocky, soft, sl. calc., olive grey Minor basalt	N7-6 5Y4/1	 0.29
772-002	930-945m	A 55% Silty mudstone, as 772-001C, sig. cavings B 35% Igneous, as 772-001A C 10% LCM - cement and rubber Minor other mudstone and basalt	5Y4/1 N7-6	0.26,0.26
772-003	945-960m	A 90% Silty mudstone, blocky, soft, calc., minor to sig. cavings, olive grey B 10% Igneous, as 772-001A	5Y4/1 N7-6	0.25
772-004	960-975m	A 85% Silty mudstone, as 772-003A, sig. cavings B 15% Igneous, as 772-001A	5Y4/1 N7-6	0.25
772-005	975-990m	A 90% Silty mudstone, as 772-003A, sig. cavings B 10% Igneous, as 772-001A	5Y4/1 N7-6	0.31
772-006	990-1005m	A 90% Silty mudstone, as 772-003A, sig. cavings B 10% Igneous, as 772-001A	5Y4/1 N7-6	0.26
772-007	1005-1020m	A 90% Silty mudstone, as 772-003A, sig. cavings B 10% Igneous, as 772-001A	5Y4/1 N7-6	0.22,0.22
772-008	1020-1035m	A 95% Silty mudstone, blocky, soft, sl. calc., sig. cavings, olive grey B 5% Basalt, blocky, hard, greyish black Minor other igneous and shell fragments	5Y4/1 N2	0.26
772-009	1035-1050m	A 95% Silty mudstone, as 772-008A, sig. cavings B 5% Basalt, as 772-008B Minor other igneous	5Y4/1 N2	0.24
772-010	1050-1065m	A 90% Silty mudstone, as 772-008A, sig. cavings B 10% Basalt, as 772-008B Minor other igneous and sand	5Y4/1 N2	0.23
772-011	1065-1080m	A 95% Silty mudstone, as 772-008A, sig. cavings B 5% Basalt, as 772-008B Minor other igneous and sand	5Y4/1 N2	0.26
772-012	1080-1095m	A 95% Silty mudstone, as 772-008A, sig. cavings B 5% Basalt, as 772-008B Minor other igneous and sand	5Y4/1 N2	0.29

Abbreviations = arenaceous, argillaceous, calcareous, Cut, dolomitic, Fluorescence, foraminifera, fossiliferous
Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-013	1095-1110m	A 90% Silty mudstone, blocky, soft, sl. calc., sig. cavings, olive grey B 5% Basalt, blocky, hard, greyish black C 5% Sand, unconsolidated, angular, fine grained, poorly sorted, clear, white Minor other igneous	5Y4/1 N2 N9	0.26,0.29
772-014	1110-1125m	A 80% Silty mudstone, as 772-013A B 15% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.27
772-015	1125-1140m	A 80% Silty mudstone, as 772-013A, sig. cavings B 15% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.31
772-016	1140-1155m	A 85% Silty mudstone, as 772-013A, sig. cavings B 10% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.27
772-017	1155-1170m	A 85% Silty mudstone, as 772-013A, sig. cavings B 10% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.24
772-018	1170-1185m	A 90% Silty mudstone, as 772-013A, sig. cavings B 5% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.27,0.27
772-019	1185-1200m	A 90% Silty mudstone, as 772-013A, sig. cavings B 5% Sand, as 772-013C C 5% Basalt, as 772-013B Minor other igneous	5Y4/1 N9 N2	0.27
772-020	1200-1215m	A 95% Silty mudstone, as 772-013A, sig. cavings B 5% Sand, as 772-013C Minor igneous	5Y4/1 N9	0.30
772-021	1215-1230m	A 95% Silty mudstone, as 772-013A, sig. cavings B 5% Sand, as 772-013C Minor igneous	5Y4/1 N9	0.31
772-022	1230-1245m	A 98% Silty mudstone, blocky, soft, sl. calc., sig. cavings, olive grey Minor sand and igneous	5Y4/1	0.29
772-023	1245-1260m	A 90% Silty mudstone, as 772-022A, sig. cavings	5Y4/1	0.32

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Lost Circulation Material, moderately, occasionally, slightly, very

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ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-023	1245-1260m	B 10% Igneous, blocky, hard, granitic - quartz and mica, fairly coarse grain, caved?, light grey to medium light grey	N7-6	
772-024	1260-1275m	A 90% Silty mudstone, blocky, soft, sl. calc., abundant cavings, olive grey	5Y4/1	0.69,0.71
		B 10% Igneous, as 772-023B	N7-6	
772-025	1275-1290m	A 98% Silty mudstone, as 772-024A, abundant cavings Minor igneous and sand	5Y4/1	0.46
772-026	1290-1305m	A 80% Silty mudstone, blocky, soft, non-calc., minor cavings, medium olive grey	5Y5/1	1.75
		B 20% Silty mudstone, blocky, soft, non-calc., minor to sig. cavings, dark olive grey Minor igneous	5Y3/1	4.05
772-027	1305-1320m	A 85% Silty mudstone, as 772-026A, sig. cavings	5Y5/1	1.66
		B 15% Silty mudstone, as 772-026B, sig. to abundant cavings Minor igneous and sand	5Y3/1	3.84,3.85
772-028	1320-1335m	A 98% Silty mudstone, blocky, soft, non-calc., sig. to abundant cavings, olive grey to medium olive grey	5Y4/1- 5Y5/1	2.21
772-029	1335-1350m	A 98% Silty mudstone, as 772-028A, sig. to abundant cavings Minor igneous	5Y4/1- 5Y5/1	1.47
772-030	1350-1365m	A 98% Silty mudstone, blocky, soft, non-calc., sig. to abundant cavings, medium olive grey to light olive grey	5Y5/1- 5Y6/1	1.47
772-031	1365-1380m	A 80% Silty mudstone, blocky, shaly in part, sig. cavings, medium olive grey to light olive grey	5Y5/1- 5Y6/1	1.25
		B 20% Silty mudstone, blocky, soft, non-calc., sig. cavings, very light olive grey	5Y7/1	0.13
772-032	1380-1395m	A 80% Mudstone, blocky, soft, non-calc., sig. cavings, white to yellowish grey	N9-5Y8/1	0.30,0.29
		B 20% Silty mudstone, as 772-031A, sig. cavings	5Y5/1- 5Y6/1	0.85
772-033	1395-1410m	A 98% Mudstone, as 772-032A, abundant cavings Minor other mudstone	N9-5Y8/1	0.24
772-034	1410-1425m	A 90% Mudstone, as 772-032A, sig. to abundant cavings	N9-5Y8/1	0.29
		B 10% Silty mudstone, as 772-031A, abundant cavings	5Y5/1- 5Y6/1	

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-035	1425-1440m	A 60% Shaly mudstone, subfissile, soft to mod. hard, non-calc., olive grey	5Y4/1	0.62
		B 40% Mudstone, blocky, soft, non-calc., sig. to abundant cavings, white to yellowish grey Minor other caved mudstone	N9-5Y8/1	0.32
772-036	1440-1455m	A 80% Shaly mudstone, as 772-035A, sig. cavings	5Y4/1	0.70,0.72
		B 20% Mudstone, as 772-035B, sig. cavings Minor other mudstone	N9-5Y8/1	0.19
772-037	1455-1470m	A 65% Shaly mudstone, subfissile, soft, non-calc., minor to sig. cavings, light olive grey	5Y6/1	0.20
		B 20% Shaly mudstone, subfissile, soft, non-calc., minor to sig. cavings, pale brown	5YR5/2	0.16
		C 15% Mudstone, as 772-035B, dominant cavings Minor other mudstone	N9-5Y8/1	
772-038	1470-1485m	A 55% Shaly mudstone, subfissile, soft, non-calc., sig. cavings, medium grey to medium olive grey	N5-5Y5/1	0.62
		B 35% Shaly mudstone, subfissile, soft, non-calc., minor cavings, very light olive grey	5Y7/1	0.21
		C 10% Shaly mudstone, as 772-037B, sig. cavings Minor other caved mudstone	5YR5/2	0.19
772-039	1485-1500m	A 85% Shaly mudstone, as 772-038A, sig. to abundant cavings	N5-5Y5/1	0.89,0.90
		B 10% Shaly mudstone, as 772-037B, sig. cavings	5YR5/2	0.13
		C 5% Shaly mudstone, as 772-038B, sig. cavings Minor other caved mudstone	5Y7/1	0.25
772-040	1500-1515m	A 95% Shaly mudstone, as 772-038A, sig. to abundant cavings	N5-5Y5/1	0.96
		B 5% Shaly mudstone, as 772-037B, sig. cavings Minor other caved mudstone	5YR5/2	
772-041	1515-1530m	A 95% Shaly mudstone, platy to subfissile, soft to mod. hard, non-calc., sig. cavings, medium light grey to light grey	N6-7	0.83
		B 5% Mudstone, blocky, soft, non-calc., sig. cavings, medium olive grey Minor other mudstone and igneous	5Y5/1	0.92,0.94
772-042	1530-1545m	A 65% Shaly mudstone, platy, soft to mod. hard, non-calc., sig. cavings, medium olive grey	5Y5/1	0.89

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Lost Circulation Material, moderately, occasionally, slightly, very

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ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-042	1530-1545m	B 35% Mudstone, blocky, soft, non-calc., minor to sig. cavings, light grey to very light olive grey Minor other mudstone	N7-5Y7/1	0.61
772-043	1545-1560m	A 55% Shaly mudstone, platy, soft to mod. hard, non-calc., sig. to abundant cavings, medium olive grey B 30% Mudstone, 772-042B, sig. cavings C 15% Mudstone, blocky, soft, non-calc., abundant cavings, medium olive grey Minor other mudstone	5Y5/1 N7-5Y7/1 5Y5/1	0.84 0.86 1.14
772-044	1560-1575m	A 65% Mudstone, blocky, soft, non-calc., sig. cavings, light grey B 25% Shaly mudstone, platy to subfissile, mod. hard, non-calc., sig. cavings, medium olive grey C 10% Mudstone, as 772-043C, dominant cavings Minor other caved mudstone	N7 5Y5/1 5Y5/1	0.91 1.04 1.32, 1.35
772-045	1575-1590m	A 60% Mudstone, as 772-044A, sig. cavings B 20% Shaly mudstone, as 772-044B, sig. cavings C 20% Mudstone, blocky, soft, non-calc., sig. to abundant cavings, olive grey	N7 5Y5/1 5Y4/1	0.64 1.05 1.02
772-046	1590-1605m	A 70% Mudstone, blocky, soft, non-calc., minor to sig. cavings, yellowish grey B 20% Mudstone, as 772-045C, sig. cavings C 10% Shaly mudstone, as 772-044B, sig. cavings Minor other mudstone	5Y8/1 5Y4/1 5Y5/1	0.11 1.31, 1.28 0.70
772-047	1605-1620m	A 80% Shale, platy, mod. hard, non-calc., sig. cavings, light grey to very light olive grey B 15% Mudstone, as 742-046A, sig. to abundant cavings C 5% Shaly mudstone, platy to subfissile, soft to mod. hard, non-calc., minor cavings, very pale brown	N7-5Y7/1 5Y8/1 5YR6/2	0.84 0.14 0.27
772-048	1620-1635m	A 85% Shale, as 772-047A, sig. cavings B 10% Mudstone, as 772-046A, abundant cavings C 5% Shaly mudstone, as 772-047C, sig. cavings Minor other mudstone	N7-5Y7/1 5Y8/1 5YR6/2	0.80 0.18, 0.17 0.18, 0.17
772-049	1635-1650m	A 80% Shaly mudstone, subfissile to platy, mod. hard, non-calc., sig. cavings, medium grey to medium light grey B 20% Shale, platy to mod. hard, non-calc., minor to sig. cavings, medium olive grey Minor other mudstone	N5-6 5Y5/1	0.88 0.39

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Lost Circulation Material, moderately, occasionally, slightly, very

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ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-050	1650-1665m	A 85% Shaly mudstone, subfissile to platy, mod. hard, non-calc., sig. to abundant cavings, medium grey to medium light grey	N5-6	0.96
		B 15% Shale, platy to mod. hard, non-calc., sig. cavings, medium olive grey Minor other mudstone - mostly caved	5Y5/1	0.23
772-051	1665-1680m	A 75% Shale, platy to subfissile, mod. hard, non-calc., sig. to abundant cavings, medium grey	N5	0.94,0.95
		B 15% Shaly mudstone, subfissile, soft, non- calc., sig. cavings, medium olive grey	5Y5/1	0.27
		C 10% Sand, unconsolidated, fine grained, subrounded to subangular, well sorted, clear, white Minor glauconite and other mudstone	N9	
772-052	1680-1695m	A 75% Shale, as 772-051A, sig. to abundant cavings	N5	0.72
		B 20% Sand, as 772-051C	N9	
		C 5% Silty mudstone, blocky, soft, non- calc., minor cavings, greyish red	5R4/2	0.14
772-053	1695-1710m	A 80% Shale, as 772-051A, sig. to abundant cavings	N5	0.56
		B 15% Sand, as 772-051C	N9	
		C 5% Silty mudstone, as 772-052C Minor to sig. cavings	5R4/2	0.09
772-054	1710-1725m	A 85% Shale, platy to subfissile, mod. hard, non-calc., sig. to abundant cavings, medium grey	N5	0.63,0.63
		B 10% Sand, unconsolidated, fine-medium grained, subrounded, fairly well sorted, clear, white	N9	
		C 5% Silty mudstone, blocky, soft, non- calc., sig. to abundant cavings, greyish red	5R4/2	0.11
772-055	1725-1740m	A 90% Shale, as 772-054A, sig. to abundant cavings	N5	0.53
		B 10% Sand, as 772-054B Minor other mudstone	N9	
772-056	1740-1755m	A 95% Shaly mudstone, subfissile to platy, soft to mod. hard, non-calc., sig. cavings, medium grey	N5	0.41
		B 5% Sand, as 772-054B Minor other mudstone	N9	
772-057	1755-1770m	A 95% Shaly mudstone, as 772-056A, sig. cavings	N5	0.38
		B 5% Sand, as 772-054B	N9	
772-058	1770-1785m	A 95% Shaly mudstone, as 772-056A, sig. cavings	N5	0.43,0.45

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Lost Circulation Material, moderately, occasionally, slightly, very

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ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH		GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-058	1770-1785m	B	5% Sand, unconsolidated, fine-medium grained, subrounded, fairly well sorted, clear, white Minor pyrites	N9	
772-059	1785-1800m	A	95% Shaly mudstone, subfissile to platy, soft to mod. hard, non-calc., sig. to abundant cavings, medium grey	N5	0.48
		B	5% Sand, as 772-058B Minor pyrites and glauconite. Minor other mudstone.	N9	
772-060	1800-1815m	A	95% Shaly mudstone, blocky to platy, soft to mod. hard, non-calc., sig. cavings, medium grey	N5	0.46
		B	5% Sand, unconsolidated, fine-medium grained, subangular to subrounded, clear, white Minor pyrites, glauconite and other mudstone	N9	
772-061	1815-1830m	A	95% Shaly mudstone, as 772-060A, abundant cavings	N5	0.55
		B	5% Sand, as 772-060B Minor pyrites and other caved mudstone	N9	
772-062	1830-1845m	A	98% Shaly mudstone, as 772-060A, abundant cavings Minor sand and other caved mudstone	N5	0.60
772-063	1845-1860m	A	98% Shaly mudstone, as 772-060A, abundant cavings Minor caved mudstone	N5	0.55
772-064	1860-1875m	A	85% Shaly mudstone, subfissile to blocky, soft, sl. calc., abundant cavings, medium grey	N5	0.63,0.62
		B	10% Silty mudstone, blocky, soft, sl. calc., sig. cavings, very pale brown	5YR6/2	0.15
		C	5% LCM - cement Minor other mudstone		
772-065	1870-1885m	A	60% Shaly mudstone, as 772-064A, sig. cavings	N5	0.55
		B	25% LCM - cement		
		C	15% Silty mudstone, as 772-064B, minor cavings Minor pyrites and other mudstone	5YR6/2	0.22
772-066	1885-1900m	A	70% Shaly mudstone, as 772-064A, sig. cavings	N5	0.56
		B	25% Silty mudstone, as 772-064B, sig. cavings	5YR6/2	0.27
		C	5% LCM - cement Minor other mudstone		
772-067	1900-1915m	A	70% Shaly mudstone, as 772-064A, sig. cavings	N5	0.62,0.62

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ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-067	1900-1915m	B 25% Silty mudstone, blocky, soft, sl. calc., sig. cavings, very pale brown C 5% Pyrites Minor sand LCM - metal	5YR6/2	0.13
772-068	1915-1930m	A 90% Shaly mudstone, subfissile to blocky, soft to mod. hard, sl. silty, non- calc., sig. cavings, medium grey B 5% Pyrites C 5% LCM - metal Minor other mudstone and sand	N5	0.72
772-069	1930-1945m	A 90% Shaly mudstone, as 772-068A, sig. cavings B 5% Pyrites C 5% LCM - metal Minor other mudstone	N5	0.56
772-070	1945-1960m	A 95% Shaly mudstone, as 772-068A, sig. cavings B 5% LCM - metal Minor pyrites and other mudstone	N5	0.58
772-071	1960-1975m	A 50% Shaly mudstone, subfissile, mod. hard, sl. calc. to non-calc., sig. cavings, medium grey B 35% LCM - cement and metal C 15% Silty mudstone, blocky to subfissile, mod. hard, non-calc., sig. cavings, greyish red Minor pyrites and other mudstone	N5 5R4/2	0.80 0.08
772-072	1975-1990m	A 85% Silty mudstone, grades to siltstone, blocky, mod. hard, sl. calc., minor to sig. cavings, medium light grey B 15% LCM - cement and metal Minor other mudstone	N6	0.41
772-073	1990-2005m	A 90% Silty mudstone, as 772-072A, sig. cavings B 10% LCM - cement and metal Minor other mudstone	N6	0.47
772-074	2005-2020m	A 70% Silty mudstone, as 772-072A, sig. cavings B 30% Shaly mudstone, subfissile, mod. hard, non-calc., sig. cavings, medium grey LCM - metal turnings Minor other mudstone	N6 N5	0.46 0.63, 0.61
772-075	2020-2035m	A 98% Calc. mudstone, blocky, mod. hard, silty, minor to sig. cavings, medium light grey to light grey Minor pyrites and mudstone	N6-7	0.53

Abbreviations = arenaceous, argillaceous, calcareous, Cut, dolomitic, Fluorescence, foraminifera, fossiliferous
Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH		GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-076	2035-2050m	A 98%	Calc. siltstone, blocky, soft to mod. hard, grades to arg. limestone, sig. cavings, medium light grey Minor mudstone - caved	N6	0.58
772-077	2050-2065m	A 85%	Calc. siltstone, as 772-076A, sig. cavings	5Y7/1	0.37
		B 15%	Calc. mudstone, blocky, soft, very light olive grey Minor LCM	5Y7/1	0.37
772-078	2065-2080m	A 75%	Limestone, blocky, soft to mod. hard, sl. arg., minor cavings, very light grey	N8	0.19
		B 25%	Silty mudstone, blocky, soft, sl. calc., minor cavings, dark grey Minor LCM	N3	5.18
772-079	2080-2095m	A 95%	Silty mudstone, as 772-078B, sig. cavings	N3	5.88
		B 5%	Limestone, as 772-078A, sig. cavings	N8	
772-080	2095-2110m	A 98%	Silty mudstone, as 772-078B, sig. to abundant cavings Minor limestone and other mudstone	N3	5.80, 5.89
772-081	2110-2125m	A 98%	Silty mudstone, blocky, soft, non-calc., sig. cavings, olive black	5Y2/1	6.81
772-082	2125-2140m	A 98%	Silty mudstone, as 772-081A, sig. cavings	5Y2/1	7.34
772-083	2140-2155m	A 98%	Silty mudstone, as 772-081A, sig. cavings	5Y2/1	7.18
772-084	2155-2170m	A 98%	Silty mudstone, as 772-081A, sig. cavings	5Y2/1	7.69
772-085	2170-2185m	A 98%	Silty mudstone, blocky, soft, non-calc., sig. cavings, olive black	5Y2/1	7.98
772-086	2185-2200m	A 98%	Silty mudstone, as 772-085A, sig. cavings	5Y2/1	8.27, 8.05
772-087	2200-2215m	A 98%	Silty mudstone, as 772-085A, sig. cavings	5Y2/1	8.37
772-088	2215-2230m	A 98%	Silty mudstone, as 772-085A, sig. cavings	5Y2/1	8.83
772-089	2230-2245m	A 75%	Silty mudstone, as 772-085A, sig. cavings	5Y2/1	7.95
		B 25%	Dolomitic limestone, blocky, hard, very light brownish grey Minor shale	5YR7/1	0.68
772-090	2245-2260m	A 55%	Shale, platy, mod. hard, non-calc., minor cavings, medium grey to medium light grey	N5-6	0.87, 0.86

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-090	2245-2260m	B 30% Limestone, blocky, muddy, soft, grades to calc. mudstone, very light brownish grey to pinkish grey	5YR7/1-5YR8/1	0.45
		C 15% Silty mudstone, blocky, soft, non-calc., sig. to abundant cavings, olive black	5Y2/1	7.87
772-091	2260-2275m	A 70% Shale, platy, mod. hard, non-calc., minor cavings, medium grey to medium light grey	N5-6	0.81
		B 20% Calc. mudstone, blocky, soft, grades to arg. limestone, very light brownish grey to pinkish grey	5YR7/1-5YR8/1	0.33
		C 10% Silty mudstone, as 772-090C, sig. to abundant cavings	5Y2/1	7.54
772-092	2275-2290m	A 75% Shale, as 772-091A, sig. cavings	N5-6	0.80, 0.80
		B 15% Calc. mudstone, as 772-091B, minor cavings	5YR7/1-5YR8/1	0.31
		C 10% Silty mudstone, as 772-090C, abundant cavings	5Y2/1	8.51
772-093	2290-2305m	A 75% Shale, platy, mod. hard, non-calc., sig. cavings, medium grey	N5	0.76
		B 20% Calc. mudstone, blocky, soft, grades in part to arg. limestone, very light brownish grey to pinkish grey	5YR7/1-5YR8/1	0.38
		C 5% Silty mudstone, blocky, soft, non-calc., olive black	5Y2/1	7.88, 7.61
772-094	2305-2320m	A 80% Shale, as 772-093A, sig. cavings	N5	0.97
		B 10% Silty mudstone, as 772-093C, abundant cavings	5Y2/1	8.48
		C 10% Calc. mudstone, as 772-093B, minor cavings	5YR7/1-5YR8/1	0.53
772-095	2320-2335m	A 50% Shale, as 772-093A, sig. cavings	N5	0.82
		B 35% Calc. mudstone, as 772-093B, minor cavings	5YR7/1-5YR8/1	0.57, 0.56
		C 15% Silty mudstone, as 772-093C, sig. cavings	5Y2/1	7.61
772-096	2335-2350m	A 55% Shale, subfissile, soft to mod. hard, non-calc., abundant cavings, medium grey	N5	0.93
		B 30% Silty mudstone, as 772-093C, abundant cavings	5Y2/1	7.66
		C 15% Limestone, blocky, mod. hard, muddy in part, very light brownish grey	5YR7/1	0.40
772-097	2350-2365m	A 35% Shale, as 772-096A, abundant cavings	N5	0.86
		B 35% Silty mudstone, as 772-093C, abundant cavings	5Y2/1	7.20, 7.15
		C 30% Limestone, as 772-096C, minor cavings	5YR7/1	0.38
772-098	2365-2380m	A 40% Silty mudstone, as 772-093C, <u>dominant</u> cavings	5Y2/1	8.08

Abbreviations = arenaceous, argillaceous, calcareous, Cut, dolomitic, Fluorescence, foraminifera, fossiliferous
Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-098	2365-2380m	B 40% Shale, subfissile, soft to mod. hard, non-calc., abundant to dominant cavings, medium grey	N5	0.87
		C 20% Limestone, blocky, mod. hard, muddy in part, minor cavings, very light brownish grey	5YR7/1	0.47
772-099	2380-2395m	A 85% Silty mudstone, blocky, soft, sl. calc., minor to sig. cavings, medium grey	N5	2.13, 2.05
		B 15% Silty mudstone, blocky, soft, calc., minor cavings, light grey to very light brownish grey Minor shale, limestone and other mudstone	N7-5YR7/1	0.61
772-100	2395-2410m	A 60% Silty shale, subfissile, soft, v. sl. calc. to non-calc., minor cavings, medium grey to medium olive grey	N5-5Y5/1	1.17
		B 20% Silty mudstone, blocky, soft, non- calc., sig. to abundant cavings, olive black	5Y2/1	8.39
		C 20% Limestone, blocky, soft to mod. hard, muddy in part, pinkish grey	5YR8/1	0.45
772-101	2410-2425m	A 65% Silty shale, as 772-100A, minor to sig. cavings	N5-5Y5/1	0.87
		B 20% Siltstone, blocky, soft, calc., very light brownish grey	5YR7/1	0.27, 0.27
		C 15% Silty mudstone, as 772-100B, sig. cavings	5Y2/1	7.79
772-102	2425-2440m	A 80% Silty shale, as 772-100A, sig. cavings	N5-5Y5/1	1.73
		B 20% Siltstone, as 772-101B, minor cavings Minor mudstone	5YR7/1	0.44
772-103	2440-2455m	A 80% Shale, platy to subfissile, mod. hard, non-calc., sl. silty in part, medium dark grey to medium grey	N4-5	1.72
		B 20% Siltstone, blocky, soft, sl. silty, very light brownish grey Minor mudstone	5YR7/1	0.47, 0.47
772-104	2455-2470m	A 85% Shale, as 772-103A, minor to sig. cavings	N4-5	1.29
		B 15% Siltstone, as 772-103B, minor cavings Minor mudstone	5YR7/1	0.42
772-105	2470-2485m	A 70% Shale, platy to thinly fissile, mod. hard, non-calc., sig. cavings, medium dark grey	N4	1.37, 1.39
		B 30% Siltstone, blocky, soft to mod. hard, non-calc. to v. sl. calc., minor cavings, light grey to very light brownish grey Minor mudstone	N7-5YR7/1	0.73
772-106	2485-2500m	A 75% Shale, as 772-105A, minor cavings	N4	2.87

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-106	2485-2500m	B 25% Siltstone, blocky, soft to mod. hard, non-calc. to v. sl. calc., minor cavings, light grey to very light brownish grey Minor mudstone	N7-5YR7/1	0.67
772-107	2500-2515m	A 50% Shale, platy to thinly fissile, mod. hard, non-calc., minor to sig. cavings, medium dark grey B 35% Siltstone, as 772-106B, minor cavings C 15% Silty mudstone, blocky, soft, non- calc., abundant? cavings, olive black	N4 N7-5YR7/1 5Y2/1	1.79, 1.78 0.54 8.42
772-108	2515-2530m	A 60% Siltstone, blocky, soft to mod. hard, calc., sig. cavings, very light grey to very light brownish grey B 20% Shale, as 772-107A, abundant cavings C 15% Sand, unconsolidated, fine-medium grained, subrounded, fairly well sorted, clear, white D 5% Silty mudstone, as 772-107C, dominant cavings Minor other mudstone	N8-5YR7/1 N4 N9 5Y2/1	0.35 2.31 7.87, 7.92
772-109	2530-2545m	A 40% Siltstone, as 772-108A, sig. cavings B 35% Sand, as 772-108C C 15% Shale, as 772-107A, abundant cavings D 10% Silty mudstone, as 772-107C, dominant? cavings	N8-5YR7/1 N9 N4 5Y2/1	0.37 2.11 7.27
772-110	2545-2560m	A 60% Shale, subfissile to platy, soft to mod. hard, non-calc., sig. cavings, medium dark grey B 15% Sand, as 772-108C C 15% Siltstone, as 772-108A D 10% Silty mudstone, as 772-107C, dominant? cavings	N4 N9 N8-5YR7/1 5Y2/1	1.79, 1.81 0.27 5.69
772-111	2560-2575m	A 70% Shale, as 772-110A, sig. cavings B 20% Siltstone, blocky, mod. hard, calc., grades to fine sandstone, very light grey C 10% Silty mudstone, blocky, soft, non- calc., abundant? cavings, medium grey to medium brownish grey Minor sand	N4 N8 N5-5YR5/1	1.46 0.08 2.93, 2.97
772-112	2575-2590m	A 50% Shale, as 772-110A, sig. cavings B 35% Siltstone, as 772-111B C 15% Silty mudstone, as 772-111C, abundant cavings	N4 N8 N5-5YR5/1	2.51 0.19 2.43
772-113	2590-2605m	A 60% Shale, platy to subfissile, mod. hard, non-calc., sig. cavings, medium dark grey	N4	2.55

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-113	2590-2605m	B 40% Siltstone, blocky, soft, non-calc., grades to fine sandstone, very light grey Minor mudstone	N8	0.19,0.17
772-114	2605-2620m	A 75% Shale, platy to subfissile, mod. hard, non-calc., sig. to abundant cavings, medium dark grey	N4	1.41
		B 25% Siltstone, as 772-113B, minor cavings Minor mudstone	N8	0.12
772-115	2620-2635m	A 45% Shale, platy to subfissile, mod. hard, non-calc., sl. silty, sig. cavings, medium grey	N5	2.34
		B 35% Silty mudstone, blocky, soft, non- calc., sig. cavings, medium light grey to light grey	N6-7	1.50
		C 15% Siltstone, blocky, soft, non-calc., sig. cavings, very light grey	N8	0.33,0.30
		D <5% Coal, blocky, brittle, sig? cavings, greyish black	N2	63.90
772-116	2635-2650m	A 85% Siltstone, as 772-115C, sig. cavings	N8	0.21
		B 15% Shale, as 772-115A, abundant cavings Minor mudstone - caved	N5	3.29
772-117	2650-2665m	A 85% Siltstone, as 772-115C, sig. cavings	N8	0.13
		B 10% Anhydrite, blocky, soft, white	N9	
		C 5% Shale, as 772-115A, <u>abundant</u> cavings	N5	3.72
772-118	2665-2680m	A 80% Siltstone, as 772-115C, sig. cavings	N8	0.25,0.26
		B 10% Anhydrite, as 772-117B	N9	
		C 5% Coal, blocky, brittle, greyish black	N2	61.90
		D <5% Shale, as 772-115A, <u>dominant cavings</u> Minor caved mudstone	N5	
772-119	2680-2695m	A 75% Siltstone, as 772-115C, sig. cavings	N8	0.22
		B 15% Shale, subfissile, mod. hard, non- calc., <u>abundant cavings</u> , medium dark grey	N4	2.76
		C 10% Anhydrite, as 772-117B Minor mudstone and coal	N9	
772-120	2695-2710m	A 85% Siltstone, blocky, soft, non-calc., sig. cavings, very light grey to pinkish grey	N8-5YR8/1	0.20
		B 15% Shale, as 772-119B, <u>dominant cavings</u> Minor anhydrite and caved mudstone	N4	2.13,2.09
772-121	2710-2725m	A 90% Siltstone, as 772-120A, sig. cavings	N8-5YR8/1	0.13
		B 10% Shale, as 772-119B, <u>dominant cavings</u> Minor anhydrite	N4	
772-122	2725-2740m	A 60% Shale, subfissile to blocky, soft to mod. hard, sl. silty in part, non- calc., <u>abundant</u> cavings, medium dark grey	N4	3.80
		B 40% Siltstone, as 772-120A, sig. cavings Minor anhydrite and mudstone	N8-5YR8/1	0.18

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-123	2740-2755m	A 45% Shale, subfissile to blocky, soft to mod. hard, sl. silty in part, non-calc., sig. cavings, medium dark grey	N4	3.30
		B 30% Mudstone, blocky, mod. hard, sl. silty, non-calc., minor to sig. cavings, light grey	N7	1.60,1.62
		C 15% Siltstone, blocky, soft, non-calc., sig. cavings, very light grey to pinkish grey	N8-5YR8/1	0.20
		D 10% Coal, blocky, brittle, sig. cavings, greyish black	N2	48.40
772-124	2755-2770m	A 45% Shale, as 772-123A, sig. cavings	N4	3.21
		B 20% Sand, unconsolidated, fine grained, subrounded to subangular, well sorted, clear, white	N9	
		C 15% Mudstone, as 772-123B, sig. cavings	N7	1.89
		D 15% Siltstone, v. fine grained, mod. hard, sl. calc. matrix, white to pinkish grey	N9-5YR8/1	
		E 5% Shaly coal, blocky, soft to mod. hard, greyish black Minor siltstone	N2	50.50
772-125	2770-2785m	A 60% Sand, as 772-124B	N9	
		B 20% Siltstone, as 772-124D, sig. cavings	N9-5YR8/1	0.14,0.13
		C 15% Shale, as 772-123A, dominant cavings	N4	2.81
		D 5% Shaly coal, as 772-124E, minor cavings Minor mudstone	N2	21.30
772-126	2785-2800m	A 55% Shaly coal, as 772-124E, sig. cavings	N2	36.80
		B 20% Sand, as 772-124B	N9	
		C 15% Shaly mudstone, subfissile, soft to mod. hard, sl. silty, non-calc., sig. cavings, medium grey to medium olive grey	N5-5Y5/1	2.06
		D 10% Siltstone, as 772-124D, sig. cavings Minor shale	N9-5YR8/1	0.19,0.19
772-127	2800-2815m	A 55% Coaly shale, subfissile, mod. hard, non-calc., abundant cavings, dark grey to greyish black	N3-2	31.00
		B 30% Shaly mudstone, as 772-126C, sig. cavings	N5-5Y5/1	1.31
		C 15% Sand, as 772-124B Minor siltstone	N9	
772-128	2815-2830m	A 55% Silty mudstone, blocky, soft, non-calc., sig. cavings, medium grey to medium brownish grey	N5-5YR5/1	2.11
		B 20% Siltstone, blocky, mod. hard, sl. calc., sig. cavings, very light brownish grey	5YR7/1	0.17
		C 15% Sand, as 772-124B	N9	
		D 10% Coaly shale, as 772-127A, sig. cavings	N3-2	42.50

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

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772-129	2830-2845m	A 55% Sand, unconsolidated, fine grained, subrounded to subangular, well sorted, clear, white	N9	
		B 25% Silty mudstone, blocky, mod. hard, sl. calc., sig. cavings, very light brownish grey	5YR7/1	2.02, 1.97
		C 15% Coaly shale, subfissile, mod. hard, non-calc., sig. cavings, dark grey to greyish black	N3-2	30.90
		D 5% Siltstone, blocky, mod. hard, sl. calc., sig. cavings, very light brownish grey	5YR7/1	0.31
772-130	2845-2860m	A 70% Sand, unconsolidated, fine-medium grained, subrounded to subangular, fairly well sorted, clear, white	N9	
		B 15% Silty mudstone, blocky, mod. hard, non-calc., sig. to abundant cavings, light grey	N7	1.95
		C 10% Coaly shale, subfissile, mod. hard, non-calc., greyish black to dark grey	N2-3	41.80
		D 5% Siltstone, as 772-129D, abundant to dominant cavings	5YR7/1	
772-131	2860-2875m	A 70% Sand, as 772-130A	N9	
		B 10% Silty mudstone, as 772-130B, sig. to abundant cavings	N7	0.88
		C 10% Anhydrite, blocky, soft, white	N9	
		D 5% Coaly shale, as 772-130C, sig. cavings	N2-3	
		E 5% Siltstone, as 772-129D, dominant cavings	5YR7/1	
772-132	2875-2890m	A 50% Sand, as 772-130A	N9	
		B 25% Silty mudstone, as 772-130B, sig. to abundant cavings	N7	1.49
		C 10% Anhydrite, as 772-131C	N9	
		D 10% Coaly shale, as 772-130C, abundant cavings	N2-3	18.30
		E 5% Siltstone, as 772-129D, dominant cavings	5YR7/1	
772-133	2890-2905m	A 55% Silty mudstone, blocky to subfissile, soft to mod. hard, non-calc., sig. cavings, light grey to very light olive grey	N7-5Y7/1	1.78
		B 35% Sand, unconsolidated, fine-medium grained, subrounded to subangular, well sorted, clear, white	N9	
		C 10% Shale, sl. coaly, platy, mod. hard, non-calc., sig. cavings, dark grey Minor anhydrite and siltstone	N3	10.20
772-134	2905-2920m	A 65% Sand, as 772-133B	N9	
		B 20% Sandstone, blocky, fine grained, subrounded to subangular, non-calc. matrix, pinkish grey	5YR8/1	

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Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-134	2905-2920m	C 10% Silty mudstone, blocky to subfissile, soft to mod. hard, non-calc., abundant cavings, light grey to very light olive grey	N7-5Y7/1	1.81
		D 5% Shale, sl. coaly, platy, mod. hard, non-calc., abundant cavings, dark grey	N3	17.30,17.20
772-135	2920-2935m	A 50% Sandstone, blocky, fine grained, subrounded to subangular, non-calc. matrix, pinkish grey	5YR8/1	
		B 25% Sand, unconsolidated, fine-medium grained, subrounded to subangular, well sorted, clear, white	N9	
		C 20% Shale, sl. carbonaceous, subfissile to blocky, mod. hard, non-calc., sig. cavings, greyish black to dark grey	N2-3	40.70
		D 5% Silty mudstone, 772-134C, dominant cavings	N7-5Y7/1	3.92
772-136	2935-2950m	A 85% Shale, as 772-135C, sig. to abundant cavings	N2-3	41.70
		B 15% Sandstone, as 772-135A Minor mudstone	5YR8/1	
772-137	2950-2965m	A 98% Shale, as 772-135C, sig. to abundant cavings Minor sandstone	N2-3	43.50
772-138	2965-2980m	A 80% Shale, as 772-135C, sig. to abundant cavings	N2-3	35.70
		B 10% Sandstone, blocky, fine grained, subangular to subrounded, fairly well sorted, non-calc. matrix, pinkish grey	5YR8/1	
		C 10% Sand, unconsolidated, fine-medium grained, subrounded to subangular, well sorted, clear, white	N9	
772-139	2980-2995m	A 60% Shale, as 772-135C, sig. to abundant cavings	N2-3	32.80,31.50
		B 30% Sandstone, as 772-138B, sig. cavings	5YR8/1	
		C 10% Sand, as 772-138C Minor siltstone	N9	
772-140	2995-3010m	A 70% Shale, carbonaceous, subfissile, mod. hard, non-calc., sig. cavings, dark grey to greyish black	N3-2	27.50
		B 20% Sandstone, as 772-138B, sig. cavings	5YR8/1	
		C 10% Sand, as 772-138C Minor siltstone	N9	
772-141	3010-3025m	A 70% Shale, as 772-140A, sig. cavings	N3-2	19.00
		B 15% Siltstone, blocky, soft, non-calc., minor cavings, medium brownish grey	5YR5/1	2.28
		C 10% Coal. blocky, brittle, vitreous lustre, greyish black	N2	63.80
		D 5% Sandstone, as 772-138B, sig. cavings Minor sand	5YR8/1	

Abbreviations = arenaceous, argillaceous, calcareous, Cut, dolomitic, Fluorescence, foraminifera, fossiliferous
Lost Circulation Material, moderately, occasionally, slightly, very

TABLE 1
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (Wt. % of Rock)
772-142	3025-3040m	A 60% Siltstone, blocky, soft, non-calc., sig. to abundant cavings, medium brownish grey	5YR5/1	1.34
		B 20% Shale, carbonaceous, subfissile, mod. hard, non-calc., sig. to abundant cavings, dark grey to greyish black	N3-2	12.30,12.20
		C 10% Sandstone, blocky, fine grained, sub- angular to subrounded, fairly well sorted, non-calc. matrix, sig. cavings, pinkish grey	5YR8/1	
		D 10% Sand, unconsolidated, fine-grained, subrounded to subangular, well sorted, clear, white Minor coal	N9	
772-143	3040-3055m	A 45% Siltstone, as 772-142A, sig. to abundant cavings	5YR5/1	1.20
		B 35% Shale, as 7720142B, sig. to abundant cavings	N3-2	22.40
		C 10% Sandstone, as 772-142C, sig. cavings	5YR8/1	
		D 10% Sand, as 772-142D Minor coal	N9	
772-144	3055-3068m	A 55% Shale, as 772-142B, sig. to abundant cavings	N3-2	23.20
		B 25% Siltstone, as 772-142A, sig. to abundant cavings	5YR5/1	0.88
		C 10% Sand, as 772-142D	N9	
		D 5% Sandstone, as 772-142C, sig. cavings	5YR8/1	
		E <5% Coal, blocky, brittle, greyish black	N2	34.60

TABLE 2A
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN AIR SPACE GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-001	915-930	1835	0	0	0	0	1836	0	0.0	0	0.00
772-002	930-945	1570	0	0	0	0	1570	0	0.0	0	0.00
772-003	945-960	2987	0	0	0	0	2988	0	0.0	0	0.00
772-004	960-975	2897	1	0	0	0	2898	1	0.0	0	0.00
772-005	975-990	2925	0	0	0	0	2926	0	0.0	0	0.00
772-006	990-1005	2164	0	0	0	0	2164	0	0.0	0	0.00
772-007	1005-1020	2162	0	0	0	0	2163	0	0.0	0	0.00
772-008	1020-1035	3843	1	0	0	0	3843	1	0.0	0	0.00
772-009	1035-1050	2000	0	0	0	0	2001	0	0.0	0	0.00
772-010	1050-1065	3084	0	0	0	0	3084	0	0.0	0	0.00
772-011	1065-1080	1832	0	0	0	0	1832	0	0.0	0	0.00
772-012	1080-1095	2330	0	0	0	0	2331	0	0.0	0	0.00
772-013	1095-1110	503	0	0	0	0	504	0	0.1	0	0.00
772-014	1110-1125	2227	0	0	0	0	2227	0	0.0	0	0.00
772-015	1125-1140	959	0	0	0	0	960	0	0.0	0	0.00
772-016	1140-1155	925	0	0	0	0	925	0	0.0	0	0.00
772-017	1155-1170	2278	0	0	0	0	2278	0	0.0	0	0.00
772-018	1170-1185	912	0	0	0	0	912	0	0.0	0	0.00
772-019	1185-1200	907	0	0	0	0	907	0	0.0	0	0.00
772-020	1200-1215	1045	0	0	0	0	1046	1	0.1	0	0.00
772-021	1215-1230	888	0	0	0	0	888	0	0.0	0	0.00
772-022	1230-1245	2561	1	0	0	0	2562	1	0.0	0	0.00
772-023	1245-1260	2802	9	7	8	3	2829	27	0.9	0	2.79
772-024	1260-1275	1493	16	12	1	2	1523	30	2.0	0	0.68
772-025	1275-1290	2511	14	9	1	1	2537	26	1.0	8	0.98
772-026	1290-1305	2238	13	17	1	1	2270	31	1.4	9	1.18
772-027	1305-1320	4076	60	18	12	14	4180	104	2.5	4	0.89
772-028	1320-1335	2337	14	6	2	4	2362	25	1.1	0	0.45
772-029	1335-1350	2151	23	5	6	4	2188	37	1.7	0	1.64
772-030	1350-1365	3021	29	7	3	7	3067	46	1.5	0	0.39

TABLE 2A
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN AIR SPACE GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-031	1365-1380	838	2	1	1	1	842	4	0.5	0	1.58
772-032	1380-1395	1445	6	2	1	2	1457	11	0.8	0	0.38
772-033	1395-1410	2064	3	2	7	1	2076	13	0.6	3	8.58
772-034	1410-1425	583	3	1	2	0	589	6	1.1	1	3.60
772-035	1425-1440	263	3	0	0	0	266	3	1.2	0	0.00
772-036	1440-1455	394	5	1	0	0	400	6	1.5	0	0.00
772-037	1455-1470	1024	15	12	0	0	1051	27	2.5	0	0.00
772-038	1470-1485	1152	22	8	0	0	1181	30	2.5	0	0.00
772-039	1485-1500	1388	6	3	0	0	1396	8	0.6	0	0.00
772-040	1500-1515	686	4	0	0	0	690	4	0.6	0	0.00
772-041	1515-1530	1519	6	0	0	0	1525	7	0.4	0	0.00
772-042	1530-1545	477	3	0	0	0	480	3	0.7	0	0.00
772-043	1545-1560	916	7	0	0	0	924	8	0.9	0	1.18
772-044	1560-1575	1032	9	1	0	0	1042	10	0.9	0	0.00
772-045	1575-1590	1254	11	1	0	0	1266	12	1.0	0	1.32
772-046	1590-1605	940	7	0	0	0	947	8	0.8	0	1.88
772-047	1605-1620	1002	1	0	0	0	1004	2	0.2	0	0.00
772-048	1620-1635	852	1	0	0	0	854	1	0.1	0	0.00
772-049	1635-1650	135	2	1	0	0	138	3	2.2	0	0.67
772-050	1650-1665	659	4	2	0	0	666	7	1.0	0	0.25
772-051	1665-1680	1028	2	1	0	0	1031	2	0.2	0	0.00
772-052	1680-1695	534	2	0	0	0	536	2	0.4	0	0.70
772-053	1695-1710	774	1	0	0	0	775	2	0.2	0	0.00
772-054	1710-1725	699	1	0	0	0	701	2	0.2	0	0.00
772-055	1725-1740	798	1	0	0	0	800	2	0.3	0	0.98
772-056	1740-1755	816	2	1	0	0	819	3	0.4	0	0.82
772-057	1755-1770	442	2	2	0	1	447	5	1.1	0	0.52
772-058	1770-1785	447	2	1	0	0	450	3	0.7	0	0.73
772-059	1785-1800	552	1	0	0	0	553	1	0.2	0	0.00
772-060	1800-1815	817	2	1	0	0	820	3	0.4	0	1.06

TABLE 2A
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN AIR SPACE GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-061	1815-1830	996	3	1	0	0	1001	5	0.5	1	1.00
772-062	1830-1845	1007	3	1	0	0	1011	5	0.5	1	0.94
772-063	1845-1860	755	4	1	0	0	760	5	0.7	1	1.09
772-064	1860-1875	42	0	0	0	0	42	0	0.0	0	0.00
772-065	1870-1885	76	0	0	0	0	76	0	0.0	0	0.00
772-066	1885-1900	252	3	2	1	1	258	6	2.3	6	1.64
772-067	1900-1915	485	7	7	8	4	511	26	5.1	5	2.01
772-068	1915-1930	664	21	16	9	9	719	55	7.6	26	1.02
772-069	1930-1945	454	15	10	6	5	489	35	7.1	24	1.27
772-070	1945-1960	980	14	14	13	7	1028	48	4.7	44	1.82
772-071	1960-1975	54	0	0	0	0	54	0	0.0	0	0.00
772-072	1975-1990	424	10	6	9	3	452	28	6.2	5	2.97
772-073	1990-2005	502	21	9	5	5	543	40	7.4	11	1.05
772-074	2005-2020	582	19	15	8	7	632	49	7.8	11	1.26
772-075	2020-2035	660	18	18	9	9	713	53	7.5	21	1.01
772-076	2035-2050	552	25	21	14	14	625	74	11.8	23	1.00
772-077	2050-2065	401	18	21	11	9	461	60	12.9	26	1.32
772-078	2065-2080	2682	182	157	67	40	3128	446	14.3	134	1.69
772-079	2080-2095	5516	629	420	168	114	6846	1331	19.4	257	1.48
772-080	2095-2110	4783	481	229	80	85	5659	875	15.5	128	0.95
772-081	2110-2125	3169	582	403	118	111	4383	1214	27.7	133	1.06
772-082	2125-2140	3219	618	554	124	139	4655	1436	30.8	151	0.89
772-083	2140-2155	7212	894	738	206	245	9296	2084	22.4	333	0.84
772-084	2155-2170	3626	504	395	118	137	4779	1153	24.1	232	0.86
772-085	2170-2185	3897	609	476	139	158	5279	1382	26.2	284	0.88
772-086	2185-2200	3218	501	405	119	123	4367	1149	26.3	224	0.97
772-087	2200-2215	7958	1398	1419	311	448	11534	3576	31.0	303	0.69
772-088	2215-2230	2844	966	568	147	154	4679	1835	39.2	108	0.96
772-089	2230-2245	1734	462	313	71	81	2661	928	34.9	70	0.88
772-090	2245-2260	1421	164	156	43	50	1833	412	22.5	61	0.86

TABLE 2A
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN AIR SPACE GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-091	2260-2275	1181	122	115	34	42	1494	313	20.9	46	0.80
772-092	2275-2290	1018	129	120	35	41	1344	326	24.2	30	0.85
772-093	2290-2305	1312	127	125	32	42	1637	325	19.9	28	0.76
772-094	2305-2320	1387	125	97	25	24	1657	270	16.3	12	1.03
772-095	2320-2335	686	58	69	23	53	890	203	22.9	42	0.44
772-096	2335-2350	1489	115	106	31	38	1779	290	16.3	25	0.81
772-097	2350-2365	3262	252	227	62	72	3876	614	15.8	28	0.86
772-098	2365-2380	3705	307	270	72	76	4430	725	16.4	48	0.95
772-099	2380-2395	2605	249	235	64	65	3218	614	19.1	20	0.99
772-100	2395-2410	2579	236	211	61	69	3156	577	18.3	22	0.88
772-101	2410-2425	3592	368	320	80	89	4449	857	19.3	37	0.90
772-102	2425-2440	929	90	79	21	24	1143	214	18.7	12	0.87
772-103	2440-2455	685	116	158	64	73	1096	411	37.5	33	0.87
772-104	2455-2470	927	121	130	54	48	1281	354	27.6	25	1.12
772-105	2470-2485	1647	176	184	66	65	2137	490	22.9	31	1.02
772-106	2485-2500	2054	348	287	72	97	2857	804	28.1	53	0.74
772-107	2500-2515	2086	249	238	85	109	2766	680	24.6	95	0.78
772-108	2515-2530	1590	213	232	100	92	2227	637	28.6	75	1.09
772-109	2530-2545	1460	182	181	70	71	1963	503	25.6	59	0.98
772-110	2545-2560	124	24	32	14	20	215	91	42.2	25	0.71
772-111	2560-2575	1362	177	203	79	127	1948	585	30.1	77	0.63
772-112	2575-2590	242	44	68	48	43	445	203	45.6	100	1.11
772-113	2590-2605	1094	184	216	121	74	1689	595	35.2	123	1.63
772-114	2605-2620	1023	243	249	114	74	1703	680	39.9	80	1.55
772-115	2620-2635	2152	196	102	48	30	2529	376	14.9	46	1.57
772-116	2635-2650	956	83	99	60	31	1229	273	22.2	57	1.93
772-117	2650-2665	1529	141	158	86	77	1991	462	23.2	128	1.12
772-118	2665-2680	3151	296	181	76	45	3749	598	16.0	73	1.68
772-119	2680-2695	2299	218	247	121	80	2965	666	22.5	157	1.51
772-120	2695-2710	1770	181	172	77	45	2245	475	21.2	65	1.73

TABLE 2A
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN AIR SPACE GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-121	2710-2725	1820	190	271	130	76	2487	668	26.8	141	1.70
772-122	2725-2740	746	84	79	36	27	972	226	23.2	71	1.35
772-123	2740-2755	4019	579	278	88	41	5005	986	19.7	55	2.12
772-124	2755-2770	1691	80	64	26	15	1875	184	9.8	30	1.73
772-125	2770-2785	2891	258	158	51	33	3391	501	14.8	52	1.52
772-126	2785-2800	3969	1188	510	109	48	5824	1855	31.9	43	2.30
772-127	2800-2815	3468	952	429	99	42	4991	1523	30.5	29	2.33
772-128	2815-2830	2900	406	278	71	40	3695	795	21.5	33	1.76
772-129	2830-2845	3645	919	428	92	38	5123	1478	28.8	30	2.41
772-130	2845-2860	2939	366	230	57	33	3624	686	18.9	56	1.75
772-131	2860-2875	2333	244	162	41	24	2802	470	16.8	53	1.69
772-132	2875-2890	2179	404	270	71	42	2966	787	26.5	48	1.69
772-133	2890-2905	2163	208	174	46	35	2626	463	17.6	42	1.31
772-134	2905-2920	1444	167	155	44	34	1844	400	21.7	55	1.28
772-135	2920-2935	3422	1122	543	88	55	5230	1808	34.6	38	1.59
772-136	2935-2950	10372	2170	846	116	62	13567	3194	23.5	36	1.87
772-137	2950-2965	9051	2886	1177	148	89	13352	4301	32.2	47	1.65
772-138	2965-2980	8141	2983	1913	238	163	13437	5296	39.4	79	1.46
772-139	2980-2995	1315	1023	613	72	43	3066	1751	57.1	17	1.65
772-140	2995-3010	2828	882	536	59	34	4339	1511	34.8	19	1.73
772-141	3010-3025	3305	1026	520	61	44	4956	1651	33.3	31	1.39
772-142	3025-3040	2481	1322	411	49	41	4304	1823	42.4	46	1.18
772-143	3040-3055	6102	1996	1357	121	121	9697	3595	37.1	90	1.01
772-144	3055-3068	3874	1579	1066	88	98	6704	2830	42.2	58	0.90

TABLE 2B
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN CUTTING GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-001	915-930	1040	3	1	0	0	1044	4	0.3	0	0.00
772-002	930-945	678	2	0	0	0	680	2	0.3	0	0.00
772-003	945-960	1067	1	0	0	0	1069	2	0.2	0	0.00
772-004	960-975	807	2	1	0	0	810	2	0.3	0	0.00
772-005	975-990	883	0	0	0	0	883	0	0.1	0	0.00
772-006	990-1005	1311	2	1	0	0	1313	2	0.2	0	0.00
772-007	1005-1020	849	3	1	0	0	854	4	0.5	0	0.00
772-008	1020-1035	418	1	1	0	0	420	2	0.5	0	0.00
772-009	1035-1050	538	2	1	0	0	540	3	0.5	0	0.00
772-010	1050-1065	368	1	0	0	0	369	2	0.4	0	0.00
772-011	1065-1080	563	1	1	0	0	565	2	0.3	0	0.00
772-012	1080-1095	838	1	1	0	0	840	2	0.2	0	0.00
772-013	1095-1110	504	1	0	0	0	505	1	0.2	0	0.00
772-014	1110-1125	321	1	0	0	0	323	1	0.4	0	0.00
772-015	1125-1140	311	1	0	0	0	313	1	0.5	0	0.00
772-016	1140-1155	241	1	0	0	0	242	1	0.4	0	0.00
772-017	1155-1170	307	0	0	0	0	308	1	0.2	0	0.00
772-018	1170-1185	594	1	0	0	0	596	1	0.2	0	0.00
772-019	1185-1200	284	1	0	0	0	285	1	0.4	0	0.00
772-020	1200-1215	137	0	0	0	0	138	1	0.4	0	0.00
772-021	1215-1230	243	1	0	0	0	244	1	0.4	0	0.00
772-022	1230-1245	243	0	0	0	0	244	1	0.2	0	0.00
772-023	1245-1260	1168	36	44	0	8	1256	88	7.0	0	0.00
772-024	1260-1275	1280	50	51	0	34	1415	135	9.6	5	0.00
772-025	1275-1290	1155	16	11	2	2	1186	31	2.6	0	1.30
772-026	1290-1305	938	18	14	3	4	977	39	4.0	23	0.66
772-027	1305-1320	3985	26	38	8	18	4075	91	2.2	7	0.45
772-028	1320-1335	2104	43	44	24	29	2244	140	6.2	9	0.81
772-029	1335-1350	3404	79	25	8	33	3549	145	4.1	23	0.26
772-030	1350-1365	4286	88	35	14	26	4448	163	3.7	4	0.54

TABLE 2B
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN CUTTING GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-031	1365-1380	844	16	8	2	5	875	30	3.4	0	0.32
772-032	1380-1395	336	16	13	2	4	370	34	9.3	2	0.53
772-033	1395-1410	403	51	8	16	37	516	112	21.8	11	0.44
772-034	1410-1425	174	14	8	3	33	232	58	25.0	7	0.09
772-035	1425-1440	144	29	27	4	3	208	64	30.8	3	1.29
772-036	1440-1455	90	26	19	3	1	140	50	35.5	1	1.95
772-037	1455-1470	211	15	8	6	2	243	31	12.8	9	2.55
772-038	1470-1485	74	11	21	1	0	108	34	31.3	0	4.71
772-039	1485-1500	192	18	16	2	1	229	37	16.0	1	2.36
772-040	1500-1515	119	7	1	0	0	128	8	6.5	0	0.00
772-041	1515-1530	161	3	1	0	0	166	5	2.8	0	0.00
772-042	1530-1545	106	2	1	0	0	110	4	3.3	0	0.00
772-043	1545-1560	359	5	1	0	0	365	6	1.6	0	0.00
772-044	1560-1575	171	4	0	0	0	175	4	2.4	0	0.00
772-045	1575-1590	279	3	1	0	0	283	4	1.5	0	0.00
772-046	1590-1605	163	2	1	0	0	166	3	1.9	0	0.00
772-047	1605-1620	111	4	2	0	0	117	6	5.1	0	0.00
772-048	1620-1635	108	2	0	0	0	110	2	2.1	0	0.00
772-049	1635-1650	157	2	1	0	0	161	4	2.3	0	0.57
772-050	1650-1665	130	3	1	0	0	134	4	2.8	0	0.00
772-051	1665-1680	387	7	3	0	1	397	10	2.5	0	0.33
772-052	1680-1695	165	4	1	0	0	170	5	2.9	0	0.00
772-053	1695-1710	200	3	2	0	0	205	5	2.5	0	0.00
772-054	1710-1725	145	2	1	0	0	147	3	1.9	0	0.00
772-055	1725-1740	162	1	0	0	0	164	1	0.8	0	0.00
772-056	1740-1755	168	1	0	0	0	170	1	0.9	0	0.00
772-057	1755-1770	121	3	1	0	0	125	4	2.9	0	0.00
772-058	1770-1785	141	3	1	0	0	145	4	2.6	0	0.00
772-059	1785-1800	138	1	1	0	0	140	2	1.3	0	0.00
772-060	1800-1815	400	3	1	0	0	404	4	1.0	0	0.00

TABLE 2B
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN CUTTING GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-061	1815-1830	176	2	0	0	0	178	2	1.2	0	0.00
772-062	1830-1845	355	3	1	0	0	360	5	1.3	0	0.00
772-063	1845-1860	201	4	2	0	0	206	5	2.7	0	0.00
772-064	1860-1875	103	2	1	0	0	107	4	3.6	3	0.00
772-065	1870-1885	53	2	0	0	0	55	3	4.7	0	0.00
772-066	1885-1900	101	5	2	0	0	109	8	7.0	2	1.21
772-067	1900-1915	165	10	6	1	1	183	18	9.8	14	1.56
772-068	1915-1930	205	18	20	18	38	300	95	31.6	67	0.48
772-069	1930-1945	191	35	32	14	9	281	91	32.3	66	1.52
772-070	1945-1960	175	10	10	49	33	277	102	36.8	116	1.50
772-071	1960-1975	207	19	32	5	4	267	60	22.6	141	1.13
772-072	1975-1990	235	17	39	10	9	310	75	24.3	123	1.14
772-073	1990-2005	445	26	55	36	21	583	138	23.7	120	1.77
772-074	2005-2020	524	34	34	38	49	679	155	22.8	120	0.79
772-075	2020-2035	454	38	56	35	35	618	164	26.5	125	1.01
772-076	2035-2050	753	48	62	40	36	938	185	19.7	146	1.10
772-077	2050-2065	405	25	28	26	43	527	121	23.1	91	0.59
772-078	2065-2080	539	106	171	146	66	1028	489	47.6	281	2.21
772-079	2080-2095	2102	431	526	273	207	3538	1437	40.6	410	1.32
772-080	2095-2110	3157	604	836	331	269	5197	2040	39.3	247	1.23
772-081	2110-2125	3796	1042	1158	427	414	6837	3041	44.5	578	1.03
772-082	2125-2140	3197	1111	1216	464	448	6435	3239	50.3	585	1.04
772-083	2140-2155	4059	1187	1275	524	527	7571	3512	46.4	644	0.99
772-084	2155-2170	4381	1345	1392	601	615	8333	3953	47.4	1030	0.98
772-085	2170-2185	4300	1302	1340	614	633	8189	3890	47.5	702	0.97
772-086	2185-2200	9514	1694	2467	703	1043	15421	5907	38.3	729	0.67
772-087	2200-2215	11672	4855	4606	1167	1746	24046	12374	51.5	1853	0.67
772-088	2215-2230	11332	4850	4880	1483	2127	24672	13340	54.1	4199	0.70
772-089	2230-2245	10554	2810	3490	851	1086	18790	8237	43.8	625	0.78
772-090	2245-2260	10554	2810	3490	851	1086	18790	8236	43.8	593	0.78

TABLE 2B
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN CUTTING GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-091	2260-2275	1864	369	801	289	486	3809	1946	51.1	354	0.60
772-092	2275-2290	1218	250	508	183	288	2447	1230	50.2	328	0.64
772-093	2290-2305	1681	318	602	191	378	3169	1488	47.0	171	0.50
772-094	2305-2320	2337	511	863	240	347	4296	1960	45.6	137	0.69
772-095	2320-2335	1246	186	250	82	93	1857	611	32.9	115	0.88
772-096	2335-2350	1461	321	624	196	296	2897	1437	49.6	150	0.66
772-097	2350-2365	1896	383	686	207	280	3452	1556	45.1	143	0.74
772-098	2365-2380	2391	617	954	243	468	4673	2282	48.8	135	0.52
772-099	2380-2395	857	243	548	184	385	2216	1360	61.3	97	0.48
772-100	2395-2410	1939	479	815	228	316	3777	1838	48.7	119	0.72
772-101	2410-2425	1205	304	648	213	299	2669	1463	54.8	106	0.71
772-102	2425-2440	770	241	470	179	264	1925	1154	60.0	105	0.68
772-103	2440-2455	432	143	345	136	196	1251	819	65.5	143	0.70
772-104	2455-2470	1008	326	761	370	378	2842	1834	64.5	198	0.98
772-105	2470-2485	890	169	352	155	265	1831	942	51.4	257	0.58
772-106	2485-2500	1824	409	786	260	485	3764	1940	51.5	420	0.54
772-107	2500-2515	1859	382	734	275	472	3723	1864	50.1	464	0.58
772-108	2515-2530	828	201	436	188	343	1996	1168	58.5	184	0.55
772-109	2530-2545	969	191	511	280	412	2363	1394	59.0	481	0.68
772-110	2545-2560	730	180	406	213	444	1973	1243	63.0	526	0.48
772-111	2560-2575	766	265	621	262	427	2340	1574	67.3	366	0.61
772-112	2575-2590	308	100	183	173	188	953	644	67.6	369	0.92
772-113	2590-2605	773	208	330	170	210	1690	918	54.3	256	0.81
772-114	2605-2620	962	207	397	215	211	1991	1029	51.7	357	1.02
772-115	2620-2635	2100	205	246	156	162	2869	769	26.8	407	0.96
772-116	2635-2650	375	78	170	111	132	866	490	56.6	291	0.84
772-117	2650-2665	782	118	242	130	136	1407	625	44.4	284	0.96
772-118	2665-2680	6055	943	1123	524	403	9049	2994	33.1	522	1.30
772-119	2680-2695	1135	193	314	183	132	1958	823	42.0	195	1.38
772-120	2695-2710	1329	325	461	228	167	2511	1181	47.0	248	1.36

TABLE 2B
CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS IN CUTTING GAS

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-121	2710-2725	409	94	210	109	100	923	513	55.6	174	1.09
772-122	2725-2740	279	69	131	76	71	625	346	55.4	179	1.07
772-123	2740-2755	9954	1159	1026	379	232	12752	2798	21.9	275	1.63
772-124	2755-2770	10161	1359	1307	431	298	13555	3394	25.0	309	1.45
772-125	2770-2785	8615	494	547	177	165	9998	1383	13.8	239	1.07
772-126	2785-2800	10847	1257	1148	302	254	13808	2961	21.4	259	1.19
772-127	2800-2815	16733	5889	3525	768	383	27297	10565	38.7	218	2.01
772-128	2815-2830	4404	808	884	237	132	6465	2061	31.9	204	1.79
772-129	2830-2845	9726	1060	1071	254	194	12305	2579	21.0	194	1.31
772-130	2845-2860	5614	761	838	216	178	7607	1993	26.2	269	1.21
772-131	2860-2875	3770	504	557	145	131	5107	1337	26.2	237	1.11
772-132	2875-2890	4436	826	888	203	195	6548	2112	32.2	280	1.04
772-133	2890-2905	1638	526	795	217	212	3388	1750	51.7	256	1.02
772-134	2905-2920	1397	562	916	235	260	3371	1973	58.5	305	0.91
772-135	2920-2935	13587	3360	2233	357	337	19873	6286	31.6	294	1.06
772-136	2935-2950	15320	7090	5379	822	542	29154	13834	47.5	305	1.52
772-137	2950-2965	17118	7863	5738	720	472	31911	14793	46.4	230	1.53
772-138	2965-2980	20914	9443	7516	1026	754	39654	18740	47.3	332	1.36
772-139	2980-2995	15393	5298	4436	555	482	26165	10772	41.2	277	1.15
772-140	2995-3010	15262	6704	4595	536	395	27492	12230	44.5	196	1.36
772-141	3010-3025	13631	5189	3781	411	336	23348	9716	41.6	159	1.22
772-142	3025-3040	187	33	34	6	9	269	81	30.3	94	0.60
772-143	3040-3055	13374	5724	4897	511	468	24974	11600	46.4	165	1.09
772-144	3055-3068	8905	2551	2906	314	362	15038	6133	40.8	208	0.87

TABLE 2 C
TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS (2A + 2B)

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-001	915-930	2876	3	1	0	0	2880	4	0.1	0	0.00
772-002	930-945	2248	2	0	0	0	2250	2	0.1	0	0.00
772-003	945-960	4054	2	0	0	0	4056	2	0.0	0	0.00
772-004	960-975	3704	3	1	0	0	3707	3	0.1	0	0.00
772-005	975-990	3808	0	0	0	0	3809	1	0.0	0	0.00
772-006	990-1005	3475	2	1	0	0	3477	2	0.1	0	0.00
772-007	1005-1020	3012	3	1	0	0	3016	4	0.1	0	0.00
772-008	1020-1035	4261	2	1	0	0	4263	3	0.1	0	0.00
772-009	1035-1050	2538	2	1	0	0	2541	3	0.1	0	0.00
772-010	1050-1065	3452	1	0	0	0	3454	2	0.1	0	0.00
772-011	1065-1080	2394	1	1	0	0	2397	2	0.1	0	0.00
772-012	1080-1095	3168	2	1	0	0	3170	2	0.1	0	0.00
772-013	1095-1110	1007	1	0	0	0	1008	1	0.1	0	0.00
772-014	1110-1125	2548	1	0	0	0	2550	2	0.1	0	0.00
772-015	1125-1140	1270	1	0	0	0	1272	2	0.1	0	0.00
772-016	1140-1155	1165	1	0	0	0	1166	1	0.1	0	0.00
772-017	1155-1170	2585	1	0	0	0	2586	1	0.0	0	0.00
772-018	1170-1185	1506	1	0	0	0	1508	2	0.1	0	0.00
772-019	1185-1200	1190	1	1	0	0	1192	2	0.1	0	0.00
772-020	1200-1215	1182	1	0	0	0	1183	1	0.1	0	0.00
772-021	1215-1230	1131	1	0	0	0	1132	1	0.1	0	0.00
772-022	1230-1245	2804	1	0	0	0	2806	2	0.1	0	0.00
772-023	1245-1260	3970	45	51	8	10	4085	115	2.8	0	0.79
772-024	1260-1275	2773	67	63	1	35	2938	165	5.6	5	0.03
772-025	1275-1290	3666	30	21	3	3	3723	57	1.5	8	1.18
772-026	1290-1305	3176	31	31	4	5	3247	70	2.2	32	0.76
772-027	1305-1320	8060	87	56	20	32	8255	195	2.4	10	0.64
772-028	1320-1335	4442	57	49	26	33	4607	165	3.6	9	0.77
772-029	1335-1350	5555	101	30	15	36	5737	182	3.2	23	0.40
772-030	1350-1365	7307	117	41	17	33	7516	209	2.8	4	0.50

TABLE 2 C
TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS (2A + 2B)

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-031	1365-1380	1683	18	8	3	6	1717	34	2.0	0	0.44
772-032	1380-1395	1781	22	14	3	6	1826	45	2.5	2	0.47
772-033	1395-1410	2467	55	10	23	38	2592	125	4.8	14	0.61
772-034	1410-1425	757	17	10	5	33	821	64	7.8	7	0.14
772-035	1425-1440	407	32	28	4	3	474	67	14.2	3	1.29
772-036	1440-1455	485	31	21	3	1	540	56	10.3	1	1.95
772-037	1455-1470	1236	30	20	6	2	1294	58	4.5	9	2.55
772-038	1470-1485	1226	33	29	1	0	1290	64	4.9	0	4.71
772-039	1485-1500	1580	23	18	2	1	1625	45	2.8	1	2.36
772-040	1500-1515	805	10	2	0	0	818	13	1.6	0	0.00
772-041	1515-1530	1680	9	2	0	0	1691	11	0.7	0	0.00
772-042	1530-1545	583	5	1	0	0	590	7	1.1	0	0.00
772-043	1545-1560	1274	12	1	0	0	1288	14	1.1	0	1.18
772-044	1560-1575	1203	13	1	0	0	1217	14	1.1	0	0.00
772-045	1575-1590	1532	14	2	0	0	1549	17	1.1	0	1.32
772-046	1590-1605	1102	9	1	0	0	1113	11	1.0	0	1.88
772-047	1605-1620	1113	5	2	0	0	1121	8	0.7	0	0.00
772-048	1620-1635	960	3	1	0	0	963	4	0.4	0	0.00
772-049	1635-1650	292	4	2	0	1	298	7	2.3	0	0.60
772-050	1650-1665	789	7	3	0	0	799	10	1.3	0	0.25
772-051	1665-1680	1415	8	3	0	1	1428	12	0.9	0	0.33
772-052	1680-1695	699	5	2	0	0	706	7	1.0	0	0.70
772-053	1695-1710	974	4	2	0	0	981	7	0.7	0	0.00
772-054	1710-1725	844	3	1	0	0	848	5	0.5	0	0.00
772-055	1725-1740	960	2	1	0	0	963	3	0.3	0	0.98
772-056	1740-1755	984	3	1	0	0	989	4	0.4	0	0.82
772-057	1755-1770	564	5	3	0	1	572	9	1.5	0	0.52
772-058	1770-1785	588	4	2	0	0	596	7	1.2	0	0.73
772-059	1785-1800	690	2	1	0	0	693	3	0.4	0	0.00
772-060	1800-1815	1217	5	2	0	0	1224	7	0.6	0	1.06

TABLE 2C
TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS (2A + 2B)

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-061	1815-1830	1172	5	1	0	0	1179	7	0.6	1	1.00
772-062	1830-1845	1362	7	2	0	0	1371	10	0.7	1	0.94
772-063	1845-1860	956	7	3	0	0	966	10	1.1	1	1.09
772-064	1860-1875	145	2	1	0	0	149	4	2.6	3	0.00
772-065	1870-1885	129	2	0	0	0	131	3	2.0	0	0.00
772-066	1885-1900	353	7	4	1	1	367	14	3.7	8	1.48
772-067	1900-1915	650	18	13	9	5	694	44	6.4	19	1.93
772-068	1915-1930	869	39	36	27	47	1019	150	14.7	93	0.58
772-069	1930-1945	645	50	42	20	14	770	126	16.3	90	1.44
772-070	1945-1960	1155	24	25	62	40	1305	150	11.5	159	1.56
772-071	1960-1975	261	19	32	5	4	321	60	18.7	141	1.13
772-072	1975-1990	659	27	45	19	12	763	103	13.5	128	1.60
772-073	1990-2005	947	47	63	42	26	1125	178	15.8	131	1.63
772-074	2005-2020	1107	54	49	46	55	1311	205	15.6	131	0.84
772-075	2020-2035	1114	56	73	44	44	1331	217	16.3	145	1.01
772-076	2035-2050	1305	72	83	54	50	1563	258	16.5	168	1.08
772-077	2050-2065	806	43	49	37	52	987	181	18.3	117	0.71
772-078	2065-2080	3221	289	328	213	106	4156	935	22.5	416	2.02
772-079	2080-2095	7617	1060	946	441	321	10385	2767	26.6	667	1.38
772-080	2095-2110	7940	1085	1065	412	354	10856	2915	26.9	375	1.16
772-081	2110-2125	6965	1624	1561	545	526	11220	4255	37.9	711	1.04
772-082	2125-2140	6416	1729	1770	588	587	11090	4674	42.1	736	1.00
772-083	2140-2155	11271	2081	2013	730	772	16866	5596	33.2	977	0.95
772-084	2155-2170	8007	1849	1787	718	752	13113	5106	38.9	1262	0.96
772-085	2170-2185	8197	1911	1816	753	791	13468	5272	39.1	986	0.95
772-086	2185-2200	12732	2196	2872	822	1166	19788	7056	35.7	952	0.71
772-087	2200-2215	19629	6253	6025	1478	2194	35580	15950	44.8	2156	0.67
772-088	2215-2230	14176	5816	5448	1630	2281	29351	15175	51.7	4307	0.71
772-089	2230-2245	12287	3273	3803	922	1167	21452	9164	42.7	695	0.79
772-090	2245-2260	11975	2974	3645	894	1136	20623	8648	41.9	655	0.79

TABLE 2 C
TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS (2A + 2B)

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-091	2260-2275	3045	491	916	323	528	5303	2259	42.6	400	0.61
772-092	2275-2290	2236	379	628	219	330	3791	1555	41.0	357	0.66
772-093	2290-2305	2993	445	727	222	420	4806	1813	37.7	199	0.53
772-094	2305-2320	3723	636	960	264	371	5954	2230	37.5	149	0.71
772-095	2320-2335	1932	244	320	105	146	2747	814	29.6	156	0.72
772-096	2335-2350	2950	436	730	227	334	4676	1726	36.9	175	0.68
772-097	2350-2365	5158	635	913	269	353	7328	2170	29.6	171	0.76
772-098	2365-2380	6096	925	1224	315	543	9103	3007	33.0	183	0.58
772-099	2380-2395	3461	492	783	248	450	5434	1973	36.3	117	0.55
772-100	2395-2410	4518	714	1026	289	386	6933	2415	34.8	141	0.75
772-101	2410-2425	4797	672	968	294	387	7117	2320	32.6	143	0.76
772-102	2425-2440	1699	332	549	200	288	3068	1369	44.6	117	0.69
772-103	2440-2455	1117	259	503	200	269	2347	1230	52.4	176	0.74
772-104	2455-2470	1935	446	891	424	426	4123	2187	53.1	223	0.99
772-105	2470-2485	2536	346	536	221	330	3969	1432	36.1	288	0.67
772-106	2485-2500	3878	757	1073	331	582	6621	2743	41.4	474	0.57
772-107	2500-2515	3945	631	972	360	581	6488	2544	39.2	560	0.62
772-108	2515-2530	2418	415	667	288	435	4223	1805	42.7	258	0.66
772-109	2530-2545	2428	373	691	350	483	4325	1897	43.9	540	0.72
772-110	2545-2560	855	205	438	227	464	2189	1334	60.9	551	0.49
772-111	2560-2575	2128	442	823	341	553	4288	2159	50.4	443	0.62
772-112	2575-2590	550	144	251	221	231	1398	847	60.6	469	0.96
772-113	2590-2605	1867	392	545	291	284	3380	1512	44.8	379	1.02
772-114	2605-2620	1986	449	646	329	285	3694	1709	46.3	437	1.15
772-115	2620-2635	4253	401	348	203	193	5398	1145	21.2	453	1.06
772-116	2635-2650	1331	161	269	171	163	2095	763	36.4	348	1.05
772-117	2650-2665	2311	259	400	216	212	3398	1087	32.0	412	1.02
772-118	2665-2680	9206	1239	1304	600	449	12797	3592	28.1	595	1.34
772-119	2680-2695	3434	412	561	304	213	4923	1489	30.2	351	1.43
772-120	2695-2710	3099	507	633	305	212	4756	1656	34.8	313	1.44

TABLE 2 C
TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C₁ - C₇ HYDROCARBONS (2A + 2B)

GEOCHEM SAMPLE NUMBER	DEPTH	C ₁ Methane	C ₂ Ethane	C ₃ Propane	iC ₄ Isobutane	nC ₄ Butane	TOTAL C ₁ - C ₄	TOTAL C ₂ - C ₄	% GAS WETNESS	TOTAL C ₅ - C ₇	$\frac{iC_4}{nC_4}$
772-121	2710-2725	2229	284	482	239	176	3410	1181	34.6	315	1.35
772-122	2725-2740	1025	153	210	112	98	1597	572	35.8	250	1.15
772-123	2740-2755	13973	1738	1304	467	274	17757	3784	21.3	331	1.71
772-124	2755-2770	11852	1439	1371	456	312	15430	3578	23.2	339	1.46
772-125	2770-2785	11506	751	705	228	199	13389	1883	14.1	291	1.15
772-126	2785-2800	14816	2445	1658	412	302	19632	4816	24.5	301	1.36
772-127	2800-2815	20201	6841	3955	866	425	32288	12087	37.4	246	2.04
772-128	2815-2830	7305	1214	1162	308	172	10160	2856	28.1	237	1.79
772-129	2830-2845	13371	1979	1499	346	232	17428	4056	23.3	224	1.49
772-130	2845-2860	8553	1126	1068	274	211	11232	2679	23.9	325	1.30
772-131	2860-2875	6103	748	718	185	155	7909	1806	22.8	290	1.20
772-132	2875-2890	6615	1229	1158	274	237	9513	2898	30.5	328	1.15
772-133	2890-2905	3801	734	969	263	247	6014	2213	36.8	299	1.06
772-134	2905-2920	2841	729	1072	279	294	5215	2374	45.5	359	0.95
772-135	2920-2935	17009	4481	2776	445	392	25103	8094	32.2	332	1.13
772-136	2935-2950	25693	9261	6225	939	604	42721	17029	39.9	341	1.55
772-137	2950-2965	26168	10749	6916	868	561	45263	19094	42.2	277	1.55
772-138	2965-2980	29055	12426	9429	1264	917	53091	24036	45.3	410	1.38
772-139	2980-2995	16708	6321	5050	627	525	29231	12523	42.8	294	1.19
772-140	2995-3010	18090	7586	5130	595	429	31831	13741	43.2	215	1.39
772-141	3010-3025	16937	6215	4301	472	380	28304	11367	40.2	190	1.24
772-142	3025-3040	2669	1355	445	55	51	4573	1905	41.6	140	1.08
772-143	3040-3055	19477	7720	6254	632	589	34671	15195	43.8	255	1.07
772-144	3055-3068	12779	4129	3972	402	460	21742	8963	41.2	266	0.87

TABLE 3
KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION INDEX
		TYPES 40%; 10-40%; 10%	REMARKS	REWORKED (%)	PARTICLE SIZE	PRESERV- ATION	
772-020A	1200-1215m	W; I-H; Al-Am		50	M	F-G	1+ to 2-
772-026A	1290-1305m	W; H-Am**; I-Al	**not prime quality	15	F-M	G	1+
772-027B	1305-1320m	Am**; W-H; Al-I	**as 026A	15	F-M	F	1+
772-030A	1350-1365m	W; H; I-Al-Am		10	M	G	1+
772-040A	1500-1515m	H-W; I-Am; Al		20	F-M/C	F-G	1+
772-047A	1605-1620m	Am**-H; W; I-Al	**not prime quality	15	F-M	F	1+
772-054A	1710-1725m	I; W-H; Al		85	F-M	F-G	1+/1+ to 2-
772-060A	1800-1815m	Am**; I-W; H-Al	**v. poor quality, resembles contaminant	25	F-C	P-F	1+ to 2-(?)
772-068A	1915-1930m	Am**; I-W; H-Al	**as 060A	35	F-M	P-F	1+/1+ to 2-
772-078B	2065-2080m	Am**-Al*; -; W-I-H	**includes incompletely developed material *includes material passing to Am	10	F-C	F-G	1+ to 2-
772-079A	2080-2095m	Am**-Al*; -; H-I-W	** * as 078B	5	F-M	F	1+ to 2-
772-081A	2110-2125m	Am**; Al*-W; I-H	** * as 078B	10	F-C	F-G	1+ to 2-
772-083A	2140-2155m	Am**; Al*; I-W-H	** * as 078B H at 2- to 2	10	F-VC	G	1+ to 2-
772-085A	2170-2185m	Am**; Al*; H-W-I	**includes incompletely developed material, and poor quality material *as 078B	5	F-M	F	1+ to 2-
772-087A	2200-2215m	Am**-Al*; I-W; H	**as 085A *as 078B H at 2- to 2	25	F-VC	F-G	1+ to 2-

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

postsript = coarse, cuticle, cysts, degraded, fine, other, structured, spore-pollen, thick-walled, unstructured

TABLE 3
KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION INDEX
		TYPES 40%; 10-40%; 10%	REMARKS	REWORKED (%)	PARTICLE SIZE	PRESERV- ATION	
772-088A	2215-2230m	Am**-Al*;W;I-H	**includes incompletely developed and poor quality material *includes Al passing to Am H at 2- through 2	15	F-M	F	1+ to 2-
772-089A	2230-2245m	Am**-Al*;I-W;H	** as 088A H at 2- to 2	20	F-C	F-G	1+ to 2-
772-091A	2260-2275m	-,Am**-I-H-W;Al	**as 088A	35	F-C	F-G	1+ to 2-
772-099A	2380-2395m	-,Am**-I-Al*-W-H;-	** as 078B minor H at 1+ to 2-	40	F-M/C	G	2-
772-104A	2455-2470m	-,I-Am**-H-W;Al	**as 078B	50	F-C	G	2-
772-106A	2485-2500m	-,Am**-I-W-H-Al*;-	**includes incompletely developed and poor quality material *includes material passing to Am H at 2- to 2	45	F-C	G	2-
772-110A	2545-2560m	-,I-Am**-Al*-W-H;-	**includes incompletely developed material *includes material passing to Am	45	M-VC	G	2-
772-113A	2590-2605m	-,I-Am**-W-Al*;-	**includes degraded and incompletely developed material *includes material passing to Am	45	F-VC	G	2-
772-115A	2620-2635m	-,I-W-H-Am**-Al*;-	** as 110A H at 1+ to 2-	50	F-M	G	2-
772-118A	2665-2680m	I;W-H;Am-Al	H at 2- to 2	65	M-VC	G	2-
772-122A	2725-2740m	-,Am**-Al*-I-W-H*;-	**includes incompletely developed material *includes material passing to Am	35	F-VC	G	2-

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

postscript = coarse, cuticle, cysts, degraded, fine, other,, structured, spore-pollen, thick-walled, unstructured

TABLE 3
KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION INDEX
		TYPES 40%; 10-40%; 10%	REMARKS	REWORKED (%)	PARTICLE SIZE	PRESERV- ATION	
772-123A	2740-2755m	-; I-W-H-Am**; Al	**not typically oil prone H at 1+ to 2- and 2- to 2	50	F-M/C	G	2-
772-123B	2740-2755m	I; W-Am**; H-Al	**not prime quality H at 2- to 2	60	M	G	2-
772-124A	2755-2770m	Am**; W-H*-I; Al	**largely unrecognisable, degraded, includes incompletely developed material *includes material apparently passing to Am	25	F-M	F-G	2-
772-126A	2785-2800m	W; H*-I; Am	*includes material apparently passing to Am	15	F-M/C	G	2- to 2
772-128A	2815-2830m	W-I; H; Am-Al		50	M	G	2- to 2
772-129B	2830-2845m	-; Am**-W-H-I; -	**frequently degraded, unrecog- nisable, not typically oil prone, includes incompletely developed material *includes material apparently passing to Am	25	F-M/C	G	2- to 2
772-132B	2875-2890m	Am**-W; I-H; Al	**as 129B	20	F-C	F-G	2- to 2
772-134C	2905-2920m	Am**; W-H*; I-Al	** * as 129B	15	F-C	G	2- to 2
772-141A	3010-3025m	W; H*-I-Am**; -	** * as 129B approaching 2	25	F-C	F-G	2- to 2
772-141B	3010-3025m	W-I; H-Am**; Al	**as 129B	40	F-M/C	F-G	2- to 2

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

postscript = coarse, cuticle, cysts, degraded, fine, other, structured, spore-pollen, thick-walled, unstructured

TABLE 4
VITRINITE REFLECTANCE DATA

GEOCHEM SAMPLE NUMBER	DEPTH	SAMPLE TYPE	AVERAGE REFLECTIVITY R _o (%), (NUMBER OF PARTICLES)				REMARKS
			1	2	3	4	
772-020A	1200-1215m	WR	<u>0.34</u> (6)	0.51(1)	0.82(5)	-	
772-026A	1290-1305m	WR	0.31(25)	-	-	-	
772-030A	1350-1365m	WR	0.29(25)	-	-	-	
772-035A	1425-1440m	WR	0.37(9)	0.48(7)	-	-	
772-040A	1500-1515m	WR	<u>0.36</u> (19)	0.86(3)	-	-	
772-045A	1575-1590m	WR	<u>0.37</u> (3)	0.55(1)	0.74(4)	0.93(1)	
772-050A	1650-1665m	WR	0.91(4)	-	-	-	
772-054A	1710-1725m	WR	0.43(1)	1.02(16)	-	-	
772-055A	1725-1740m	WR	0.53(2)	1.09(19)	1.39(1)	-	
772-060A	1800-1815m	WR	0.59(9)	1.05(15)	-	-	
772-065A	1870-1885m	WR	1.13(25)	-	-	-	
772-068A	1915-1930m	WR	0.36(17)	0.49(3)	-	-	
772-075A	2020-2035m	WR	<u>0.38</u> (15)	<u>0.49</u> (3)	<u>1.03</u> (2)	-	
772-078B	2065-2080m	KC	0.32(50) *	-	-	-	*anoma- lously low
772-079A	2080-2095m	KC	0.33(60) *	-	-	-	*as 078B
772-081A	2110-2125m	KC	0.35(21) *	0.53(4)	0.82(12) *	-	*as 078B
772-083A	2140-2155m	KC	0.31(49) *	0.50(1)	-	-	*as 078B
772-085A	2170-2185m	KC	0.34(50) *	-	-	-	*as 078B
772-087A	2200-2215m	KC	0.38(44)	-	-	-	
772-088A	2215-2230m	KC	0.40(28)	0.64(3)	-	-	
772-089A	2230-2245m	KC	0.35(49) *	0.57(1)	-	-	*as 078B
772-094A	2305-2320m	WR	0.32(6)	0.58(8)	1.00(8)	-	
772-098B	2365-2380m	WR	0.31(1)	1.00(16)	1.33(3)	-	
772-099A	2380-2395m	KC	<u>0.44</u> (22)	0.60(6)	0.77(3)	-	
772-102A	2425-2440m	WR/KC	0.30(6)	<u>0.43</u> (17)	0.92(23)	-	
772-104A	2455-2470m	KC	0.50(17)	0.65(1)	1.10(35)	1.40(2)	
772-106A	2485-2500m	KC	<u>0.47</u> (9)	0.93(13)	1.12(8)	-	
772-110A	2545-2560m	KC	0.43(12)	0.93(8)	-	-	
772-113A	2590-2605m	KC	0.41(8)	0.74(12)	1.09(16)	-	
772-115D	2620-2635m	WR	0.42(79)	-	-	-	
772-118A	2665-2680m	WR	NO DETERMINATION POSSIBLE				
772-122A	2725-2740m	KC	0.34(20)	<u>0.49</u> (27)	0.74(3)	-	
772-123D	2740-2755m	WR	0.52(79)	-	-	-	
772-124A	2755-2770m	KC	0.47(38)	-	-	-	
772-126A	2785-2800m	WR	0.45(79)	-	-	-	
772-129B	2830-2845m	KC	0.48(66)	-	-	-	

CT—ditch cuttings; CO—core; WR—whole rock; KC—kerogen concentrate.

Colours — spore fluorescence.

*Reworked

TABLE 4
VITRINITE REFLECTANCE DATA

GEOCHEM SAMPLE NUMBER	DEPTH	SAMPLE TYPE	AVERAGE REFLECTIVITY R _o (%), (NUMBER OF PARTICLES)				REMARKS
			1	2	3	4	
772-131D	2860- 2875 m	KC	<u>0.46</u> (79)	-	-	-	
772-132B	2875-2890m	KC	0.45 (50)	-	-	-	
772-135C	2920-2935m	KC	0.47 (79)	-	-	-	
772-141A	3010-3025m	KC	0.56 (54)	-	-	-	
772-141B	3010-3025m 	KC	<u>0.51</u> (25)	-	-	-	

TABLE 5a
CONCENTRATION (PPM) OF EXTRACTED C₁₅₊ MATERIAL IN ROCK

GEOCHEM SAMPLE NUMBER	DEPTH	TOTAL EXTRACT	HYDROCARBONS			NON HYDROCARBONS			
			Paraffin- Naphthenes	Aromatics	TOTAL	Precipitd. Asphaltenes	Eluted NSO's	Non-eluted NSO's	Sulphur
772-020	1200-1215	202	40	15	55	63	52	33	0
772-026B	1290-1305	1914	189	90	279	1023	369	50	194
772-028	1320-1335	912	141	30	171	575	120	42	4
772-040	1500-1515	368	85	35	119	144	55	23	27
772-054A	1710-1725	707	165	66	231	329	93	54	0
772-068A	1915-1930	3133	647	469	1116	1506	336	158	17
772-079A	2080-2095	2347	252	382	634	1241	333	139	0
772-081A	2110-2125	2015	188	217	405	1221	353	35	0
772-083A	2140-2155	4500	309	402	711	2898	627	245	18
772-085A	2170-2185	4797	570	767	1337	2242	953	258	7
772-087A	2200-2215	1467	137	193	331	880	252	4	0
772-089A	2230-2245	2457	771	521	1292	512	391	242	20
772-091A	2260-2275	1246	252	177	429	605	102	49	62
772-099A	2380-2395	1374	160	176	336	739	176	31	92
772-104A	2455-2470	1002	135	90	225	452	126	97	101
772-106A	2485-2500	2093	229	257	486	1125	292	155	35
772-110A	2545-2560	1227	188	198	386	637	164	2	39
772-113A	2590-2605	567	59	92	151	269	74	12	61
772-118A	2665-2680	906	114	144	259	415	135	58	39
772-122A	2725-2740	2122	267	322	589	1101	333	80	20
772-124A	2755-2770	1558	146	165	310	957	155	69	67
772-129B	2830-2845	1535	103	137	241	1118	74	63	39
772-132B	2875-2890	2159	192	283	474	1348	159	121	56
772-133A	2890-2905	1527	75	127	202	1128	92	93	12
772-137A	2950-2965	13635	633	2328	2960	9295	633	626	121
772-141B	3010-3025	851	84	157	241	390	177	43	0

TABLE 5b
COMPOSITION (NORMALISED %) OF C₁₅+ MATERIAL EXTRACTED FROM ROCK

GEOCHEM SAMPLE NUMBER	DEPTH	HYDROCARBONS		NON HYDROCARBONS			
		Paraffin – Naphthenes	Aromatics	Precipitd. Asphaltenes	Eluted NSO's	Non eluted NSO's	Sulphur
772-020	1200-1215	19.89	7.26	31.18	25.54	16.13	0.00
772-026B	1290-1305	9.88	4.71	53.41	19.29	2.59	10.12
772-028	1320-1335	15.46	3.33	62.97	13.14	4.63	0.46
772-040	1500-1515	23.00	9.40	39.20	14.80	6.20	7.40
772-054A	1710-1725	23.31	9.32	46.61	13.14	7.63	0.00
772-068A	1915-1930	20.66	14.97	48.08	10.73	5.03	0.53
772-079A	2080-2095	10.74	16.29	52.86	14.20	5.91	0.00
772-081A	2110-2125	9.35	10.76	60.61	17.53	1.76	0.00
772-083A	2140-2155	6.86	8.94	64.41	13.94	5.45	0.40
772-085A	2170-2185	11.88	15.99	46.74	19.86	5.39	0.14
772-087A	2200-2215	9.36	13.17	59.99	17.20	0.27	0.00
772-089A	2230-2245	31.37	21.21	20.84	15.91	9.86	0.82
772-091A	2260-2275	20.21	14.18	48.57	8.14	3.92	4.98
772-099A	2380-2395	11.64	12.84	53.77	12.84	2.23	6.68
772-104A	2455-2470	13.46	9.03	45.14	12.61	9.71	10.05
772-106A	2485-2500	10.93	12.28	53.75	13.96	7.42	1.67
772-110A	2545-2560	15.36	16.11	51.88	13.38	0.14	3.14
772-113A	2590-2605	10.45	16.20	47.39	13.07	2.09	10.80
772-118A	2665-2680	12.63	15.94	45.76	14.91	6.42	4.35
772-122A	2725-2740	12.57	15.17	51.88	15.71	3.75	0.92
772-124A	2755-2770	9.34	10.57	61.41	9.95	4.44	4.29
772-129B	2830-2845	6.74	8.93	72.84	4.84	4.08	2.56
772-132B	2875-2890	8.87	13.10	62.45	7.36	5.63	2.60
772-133A	2890-2905	4.91	8.31	73.89	6.01	6.09	0.79
772-137A	2950-2965	4.64	17.07	68.17	4.64	4.59	0.88
772-141B	3010-3025	9.87	18.42	45.83	20.83	5.04	0.00

TABLE 6
SIGNIFICANT RATIOS (%) OF C₁₅+ FRACTIONS AND ORGANIC CARBON

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON (wt. %)	HYDROCARBONS	HYDROCARBONS	TOTAL EXTRACT	P-NAPHTHENES
			TOTAL EXTRACT	ORG. CARBON	ORG. CARBON	AROMATICS
772-020	1200-1215	0.28	27.15	1.96	7.22	2.74
772-026B	1290-1305	3.92	14.59	0.71	4.88	2.10
772-028	1320-1335	1.86	18.79	0.92	4.91	4.64
772-040	1500-1515	0.60	32.40	1.99	6.14	2.45
772-054A	1710-1725	0.64	32.63	3.60	11.04	2.50
772-068A	1915-1930	0.64	35.63	17.44	48.95	1.38
772-079A	2080-2095	5.49	27.03	1.16	4.28	0.66
772-081A	2110-2125	6.14	20.11	0.66	3.28	0.87
772-083A	2140-2155	6.82	15.80	1.04	6.60	0.77
772-085A	2170-2185	6.94	27.87	1.93	6.91	0.74
772-087A	2200-2215	8.17	22.54	0.40	1.80	0.71
772-089A	2230-2245	7.31	52.58	1.77	3.36	1.48
772-091A	2260-2275	1.47	34.39	2.92	8.48	1.43
772-099A	2380-2395	2.07	24.49	1.63	6.64	0.91
772-104A	2455-2470	1.65	22.49	1.37	6.07	1.49
772-106A	2485-2500	3.13	23.21	1.55	6.69	0.89
772-110A	2545-2560	2.15	31.47	1.80	5.71	0.95
772-113A	2590-2605	1.77	26.66	0.85	3.20	0.65
772-118A	2665-2680	0.85	28.57	3.05	10.66	0.79
772-122A	2725-2740	3.18	27.74	1.85	6.67	0.83
772-124A	2755-2770	3.92	19.91	0.79	3.98	0.88
772-129B	2830-2845	1.48	15.67	1.63	10.37	0.76
772-132B	2875-2890	2.21	21.97	2.15	9.77	0.68
772-133A	2890-2905	1.72	13.21	1.17	8.88	0.59
772-137A	2950-2965	35.90	21.71	0.82	3.80	0.27
772-141B	3010-3025	2.56	28.29	0.94	3.32	0.54

TABLE 7
COMPOSITION (NORMALISED %) OF C₁₅+ PARAFFIN – NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	-020	-026B	-028	-040	-054A	-068A
DEPTH	1200- 1215m	1290- 1305m	1320- 1335m	1500- 1515m	1710- 1725m	1915- 1930m
SAMPLE TYPE						
nC ₁₅	3.89	19.74	18.21	9.48	14.66	0.96
nC ₁₆	16.59	18.26	22.51	10.47	17.60	0.52
nC ₁₇	19.43	17.11	18.73	12.31	16.13	0.61
nC ₁₈	16.59	10.20	13.57	13.30	11.14	0.44
nC ₁₉	11.81	9.87	9.28	17.82	6.74	0.52
nC ₂₀	6.88	6.91	4.30	10.47	6.45	0.52
nC ₂₁	5.08	3.29	2.75	7.92	3.52	0.87
nC ₂₂	3.14	3.78	1.72	5.23	3.23	1.22
nC ₂₃	3.74	2.30	1.89	3.68	3.23	1.66
nC ₂₄	2.99	2.14	1.37	2.40	2.64	2.35
nC ₂₅	4.19	1.81	1.20	2.26	3.52	3.84
nC ₂₆	1.79	1.48	1.03	1.27	2.64	4.45
nC ₂₇	1.64	0.82	0.86	1.13	2.64	6.02
nC ₂₈	0.75	0.82	0.86	0.57	1.76	6.97
nC ₂₉	0.45	0.33	0.52	0.57	1.17	8.63
nC ₃₀	0.30	0.33	0.34	0.28	0.88	9.15
nC ₃₁	0.15	0.16	0.17	0.28	0.59	10.46
nC ₃₂	0.15	0.16	0.17	0.14	0.59	10.46
nC ₃₃	0.15	0.16	0.17	0.14	0.29	12.21
nC ₃₄	0.15	0.16	0.17	0.14	0.29	9.42
nC ₃₅	0.15	0.16	0.17	0.14	0.29	8.72
PARAFFIN	27.38	17.57	25.97	29.97	15.04	71.20
ISOPRENOID	6.30	2.86	4.86	3.05	2.16	0.43
NAPHTHENE	66.31	79.57	69.17	66.98	82.80	28.37
CPI INDEX A	1.34	0.79	1.07	1.18	1.06	1.14
CPI INDEX B	1.63	0.89	0.95	1.41	1.17	1.10
PRISTANE/PHYTANE	0.95	1.54	1.72	0.89	1.04	1.33
PRISTANE/nC ₁₇	0.58	0.58	0.63	0.39	0.45	0.57

TABLE 7
COMPOSITION (NORMALISED %) OF C₁₅+ PARAFFIN – NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	-079A	-081A	-083A	-085A	-087A	-089A
DEPTH	2080- 2095m	2110- 2125m	2140- 2155m	2170- 2185m	2200- 2215m	2230- 2245m
SAMPLE TYPE						
nC ₁₅	15.07	19.77	33.70	26.84	21.45	21.04
nC ₁₆	9.57	13.95	13.26	16.22	13.86	15.53
nC ₁₇	10.43	12.79	12.15	13.86	12.21	12.94
nC ₁₈	7.54	8.72	6.08	8.55	7.26	8.74
nC ₁₉	5.80	6.98	6.08	7.67	8.25	7.44
nC ₂₀	4.35	3.49	3.31	5.90	4.62	5.50
nC ₂₁	3.48	4.65	3.31	3.24	3.96	4.21
nC ₂₂	2.90	3.49	2.21	2.95	3.63	3.88
nC ₂₃	4.06	3.49	3.87	2.95	3.30	4.85
nC ₂₄	3.48	2.91	2.76	2.65	2.97	3.24
nC ₂₅	4.64	2.33	2.21	2.36	3.30	2.91
nC ₂₆	7.25	4.65	2.21	1.77	3.96	2.59
nC ₂₇	9.57	3.49	1.66	1.47	4.29	1.94
nC ₂₈	3.77	1.74	1.66	0.88	1.98	1.29
nC ₂₉	3.48	2.33	1.10	0.59	1.98	0.97
nC ₃₀	2.03	1.74	1.10	0.59	0.99	0.65
nC ₃₁	1.16	1.16	1.10	0.29	0.66	0.65
nC ₃₂	0.58	0.58	0.55	0.29	0.33	0.65
nC ₃₃	0.29	0.58	0.55	0.29	0.33	0.32
nC ₃₄	0.29	0.58	0.55	0.29	0.33	0.32
nC ₃₅	0.29	0.58	0.55	0.29	0.33	0.32
PARAFFIN	18.57	20.02	14.95	18.68	18.39	16.16
ISOPRENOID	7.43	10.13	7.27	14.10	13.35	11.87
NAPHTHENE	74.00	69.85	77.79	67.22	68.26	71.97
CPI INDEX A	1.23	1.03	1.15	0.98	1.08	1.09
CPI INDEX B	1.26	0.95	0.94	1.07	1.22	1.04
PRISTANE/PHYTANE	0.84	0.85	1.05	0.90	0.63	0.67
PRISTANE/nC ₁₇	1.75	1.82	2.05	2.57	2.30	2.28

TABLE 7
COMPOSITION (NORMALISED %) OF C₁₅+ PARAFFIN < NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	-091A	-099A	-104A	-106A	-110A	-113A
DEPTH	2260- 2275m	2380- 2395m	2455- 2470m	2485- 2500m	2545- 2560m	2590- 2605m
SAMPLE TYPE						
nC ₁₅	32.48	39.06	15.38	27.34	18.40	17.76
nC ₁₆	16.42	16.50	16.25	17.06	13.50	9.44
nC ₁₇	11.68	12.12	16.13	13.08	10.57	10.72
nC ₁₈	8.03	7.41	13.40	8.41	6.65	7.52
nC ₁₉	4.01	4.38	7.82	5.37	5.09	4.96
nC ₂₀	2.92	3.03	4.84	3.27	3.91	5.12
nC ₂₁	2.19	2.69	3.47	3.50	4.11	5.60
nC ₂₂	2.55	2.02	3.72	3.04	3.33	4.96
nC ₂₃	3.28	2.02	4.34	3.04	4.31	7.52
nC ₂₄	1.82	2.02	3.10	3.27	3.72	5.44
nC ₂₅	3.65	1.68	3.47	3.97	5.68	7.20
nC ₂₆	1.82	1.68	1.61	2.57	4.50	3.84
nC ₂₇	2.55	1.35	1.99	1.64	5.87	5.12
nC ₂₈	2.19	0.67	1.86	1.87	5.09	1.92
nC ₂₉	1.46	0.67	1.36	0.93	2.94	0.80
nC ₃₀	0.73	0.67	0.37	0.47	0.78	0.80
nC ₃₁	0.73	0.67	0.25	0.23	0.59	0.48
nC ₃₂	0.36	0.34	0.25	0.23	0.39	0.32
nC ₃₃	0.36	0.34	0.12	0.23	0.20	0.16
nC ₃₄	0.36	0.34	0.12	0.23	0.20	0.16
nC ₃₅	0.36	0.34	0.12	0.23	0.20	0.16
PARAFFIN	21.78	19.92	29.31	21.71	29.78	26.93
ISOPRENOID	5.33	4.63	5.56	7.91	7.58	6.38
NAPHTHENE	72.89	75.45	65.13	70.37	62.65	66.70
CPI INDEX A	1.34	1.05	1.14	1.07	1.25	1.44
CPI INDEX B	1.46	1.08	1.37	1.07	1.23	1.56
PRISTANE/PHYTANE	1.23	1.38	1.19	1.00	1.10	1.18
PRISTANE/nC ₁₇	1.16	1.11	0.64	1.39	1.26	1.19

TABLE 7
COMPOSITION (NORMALISED %) OF C₁₅+ PARAFFIN – NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	-118A	-122A	-124A	-129B	-132B	-133A
DEPTH	2665- 2680m	2725- 2740m	2755- 2770m	2830- 2845m	2875- 2890m	2890- 2905m
SAMPLE TYPE						
nC ₁₅	38.80	28.57	13.67	17.47	12.29	6.48
nC ₁₆	13.25	17.48	10.46	12.76	8.31	8.80
nC ₁₇	9.78	15.57	8.68	9.95	8.31	9.95
nC ₁₈	7.89	9.38	7.37	8.93	6.28	9.84
nC ₁₉	4.73	5.76	7.49	7.02	6.81	9.26
nC ₂₀	4.42	3.84	6.54	5.87	5.22	6.83
nC ₂₁	3.47	2.35	5.47	4.46	5.75	5.21
nC ₂₂	3.15	2.13	5.95	4.97	4.86	5.56
nC ₂₃	3.79	2.99	7.37	5.23	7.69	7.06
nC ₂₄	2.84	2.13	5.35	5.10	6.63	6.02
nC ₂₅	2.84	2.77	7.02	4.85	6.81	6.94
nC ₂₆	0.95	2.35	3.80	3.44	4.33	4.98
nC ₂₇	0.95	1.07	3.69	4.08	4.77	5.44
nC ₂₈	0.63	1.28	2.97	2.30	1.95	3.24
nC ₂₉	0.63	0.64	2.62	2.04	2.92	2.66
nC ₃₀	0.32	0.43	0.71	0.51	0.97	0.69
nC ₃₁	0.32	0.43	0.24	0.38	2.83	0.46
nC ₃₂	0.32	0.21	0.24	0.26	1.06	0.23
nC ₃₃	0.32	0.21	0.12	0.13	1.15	0.12
nC ₃₄	0.32	0.21	0.12	0.13	0.71	0.12
nC ₃₅	0.32	0.21	0.12	0.13	0.35	0.12
PARAFFIN	22.86	25.76	26.98	30.22	38.76	27.93
ISOPRENOID	3.46	7.41	5.97	6.55	5.86	5.59
NAPHTHENE	73.68	66.83	67.05	63.22	55.38	66.47
CPI INDEX A	1.22	1.02	1.20	1.07	1.30	1.15
CPI INDEX B	1.57	0.97	1.40	1.37	1.67	1.37
PRISTANE/PHYTANE	1.18	1.18	2.58	3.15	3.07	2.84
PRISTANE/nC ₁₇	0.84	1.00	1.84	1.65	1.37	1.49

TABLE 7
COMPOSITION (NORMALISED %) OF C₁₅+ PARAFFIN – NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	-137A	-141B
DEPTH	2950- 2965m	3010- 3025m
SAMPLE TYPE		
nC ₁₅	4.78	1.85
nC ₁₆	5.22	5.69
nC ₁₇	5.94	9.25
nC ₁₈	6.23	10.53
nC ₁₉	6.96	9.39
nC ₂₀	6.52	8.25
nC ₂₁	7.39	8.39
nC ₂₂	6.81	7.68
nC ₂₃	7.54	11.10
nC ₂₄	7.10	7.54
nC ₂₅	7.83	8.96
nC ₂₆	5.94	3.70
nC ₂₇	8.26	2.70
nC ₂₈	4.35	2.28
nC ₂₉	5.51	1.00
nC ₃₀	1.59	0.57
nC ₃₁	1.30	0.43
nC ₃₂	0.29	0.28
nC ₃₃	0.14	0.14
nC ₃₄	0.14	0.14
nC ₃₅	0.14	0.14
PARAFFIN	55.92	25.39
ISOPRENOID	13.29	7.01
NAPHTHENE	30.79	67.61
CPI INDEX A	1.31	1.31
CPI INDEX B	1.54	1.42
PRISTANE/PHYTANE	6.13	2.13
PRISTANE/nC ₁₇	3.44	2.03

6609/11-1 Trona-bunker

TABLE 8

ROCKEVAL PYROLYSIS DATA

H.I

Plotter N.r.	GEOCHEM SAMPLE NUMBER	DEPTH	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	HYDROGEN INDEX	PRODUCTION INDEX	Tmax	Alder
	772-026A	1290-1305	0.10	1.84	1.21	105.14	0.05	416	
	772-027B	1305-1320	0.11	1.97	1.32	51.30	0.05	415	
	772-030A	1350-1365	0.07	1.26	1.02	85.71	0.05	412	
	772-035A	1425-1440	0.08	0.32	1.33	51.61	0.20	413	
	772-040A	1500-1515	0.05	0.39	1.13	40.62	0.11	421	
	772-047A	1605-1620	0.03	0.28	1.37	33.33	0.10	419	
	772-050A	1650-1665	0.04	0.16	1.19	16.67	0.20	415	
	772-054A	1710-1725	0.03	0.14	0.73	22.22	0.18	409	
	772-068A	1915-1930	0.05	0.16	0.84	22.22	0.24	375	
1	772-078B	2065-2080	0.36	20.72	1.08 Silty mudst	400.00	0.02	414	M. Volgren
2	772-079A	2080-2095	0.18	21.02	1.92 Hgt. cr. mud	357.48	0.01	418	
3	772-081A	2110-2115	0.13	21.91	2.37 off the black silty mudst	321.73	0.01	416	L. Ryuz
4	772-083A	2140-2155	0.39	27.05	1.39	376.74	0.01	420	E. Mid
5	772-085A	2170-2185	0.54	31.96	2.17	400.50	0.02	419	Volgren
6	772-087A	2200-2215	0.47	26.51	1.76	316.73	0.02	415	kin
7	772-088A	2215-2230	0.61	28.33	1.19	320.84	0.02	415	L-Oxf
8	772-089A	2230-2245	0.43	26.50	1.91	333.33	0.02	415	E-L Oxf
9	772-091A	2260-2275	0.13	6.62	1.13 sh. mudst	317.28	0.02	421	E-L Oxf
10	772-099A	2380-2395	0.15	6.49	1.26	310.53	0.02	422	E. B. JOC
11	772-100B	2395-2410	0.37	20.89	1.07	248.99	0.02	417	-D. bath.
12	772-104A	2455-2470	0.13	1.79	0.55	138.76	0.07	430	
13	772-106A	2485-2500	0.11	9.98	0.67	347.74	0.01	421	E-L TOAR
14	772-110A	2545-2560	0.04	0.76	0.20	42.22	0.05	436	
15	772-113A	2590-2605	0.05	1.06	0.22	41.57	0.05	433	Hettang
16	772-115A	2620-2635	0.04	1.49	0.28	63.68	0.03	434	Lake Pl. Rha
17	772-118A	2665-2680	0.03	0.34	0.30	136.00	0.08	435	Low jur. Rha. S.
18	772-122A	2725-2740	0.07	4.70	0.46	123.68	0.01	428	
19	772-123A	2740-2755	0.08	4.37	0.57	132.42	0.02	431	Hettang
20	772-123B	2741-2755	0.07	1.62	2.09	100.62	0.04	429	Lake-Pl. Rha
21	772-124A	2755-2770	0.07	3.73	0.89	116.20	0.02	433	Coal
22	772-126A	2785-2800	1.55	93.33	3.00	253.61	0.02	433	Sequene
23	772-128A	2815-2830	0.07	3.46	0.21	163.98	0.02	430	
24	772-129B	2830-2845	0.04	1.42	0.34	71.00	0.03	440	
25	772-132B	2875-2890	0.05	0.87	3.07	58.39	0.05	436	
26	772-134C	2905-2920	0.06	1.54	1.15	85.08	0.04	439	
27	772-135C	2920-2935	3.16	132.66	3.66	325.95	0.02	430	
28	772-141A	3010-3025	1.28	61.48	4.05	323.58	0.02	435	Nor-Rha
29	772-141B	3010-3025	0.04	0.98	0.52	42.98	0.04	439	Coal Sequene

TABLE 9
PYROLYSIS RESULTS

GEOCHEM SAMPLE NUMBER	DEPTH	WT. % ORGANIC CARBON (OC)	WT. PPM		RATIOS		Tmax (°C) Pyrolysate
			Thermal Bitumen (P1)	Pyrolysate (P2)	$\frac{P1}{P1 + P2}$	$\frac{P2}{OC}$	
772-026A	1290-1305	1.75	27	2531	0.01	0.14	
772-027B	1305-1320	3.84	16	1850	0.01	0.05	
772-030A	1350-1365	1.47	102	2250	0.04	0.15	
772-035A	1425-1440	0.62	55	418	0.12	0.07	
772-040A	1500-1515	0.96	45	480	0.09	0.05	
772-047A	1605-1620	0.84	40	350	0.10	0.04	
772-050A	1650-1665	0.96	33	220	0.13	0.02	
772-054A	1710-1725	0.63	20	218	0.08	0.03	
772-068A	1915-1930	0.72	42	244	0.15	0.03	
772-078B	2065-2080	5.18	230	18560	0.01	0.36	
772-079A	2080-2095	5.88	237	19861	0.01	0.34	
772-081A	2110-2115	6.81	411	21617	0.02	0.32	
772-083A	2140-2155	7.18	436	24321	0.02	0.34	
772-085A	2170-2185	7.98	390	29450	0.01	0.37	
772-087A	2200-2215	8.37	349	24920	0.01	0.30	
772-088A	2215-2230	8.83	550	29001	0.02	0.33	
772-089A	2230-2245	7.95	710	25300	0.03	0.32	
772-091A	2260-2275	0.81	66	4950	0.01	0.61	
772-099A	2380-2395	2.09	118	7628	0.02	0.36	
772-100B	2395-2410	8.39	328	21210	0.02	0.25	
772-104A	2455-2470	1.29	103	2030	0.05	0.16	
772-106A	2485-2500	2.87	152	10198	0.01	0.36	
772-110A	2545-2560	1.80	28	1520	0.02	0.08	
772-113A	2590-2605	2.55	20	2767	0.01	0.11	
772-115A	2620-2635	2.34	29	2173	0.01	0.09	
772-118A	2665-2680	0.25	40	270	0.13	0.11	
772-122A	2725-2740	3.80	68	5056	0.01	0.13	
772-123A	2740-2755	3.30	72	4286	0.02	0.13	
772-123B	2740-2755	1.61	51	1728	0.03	0.11	
772-124A	2755-2770	3.21	104	4220	0.02	0.13	
772-126A	2785-2800	36.80	1745	86239	0.02	0.23	
772-128A	2815-2830	2.11	40	3522	0.01	0.17	
772-129B	2830-2845	2.00	55	2012	0.03	0.10	
772-132B	2875-2890	1.49	34	667	0.05	0.04	
772-134C	2905-2920	1.81	87	2182	0.04	0.12	
772-135C	2920-2935	40.70	3146	97667	0.03	0.24	
772-141A	3010-3025	19.00	1730	57878	0.03	0.30	
772-141B	3010-3025	2.28	26	1423	0.02	0.06	

Thermal Bitumen (Peak 1) evolved up to 340°C. Pyrolysate (Peak 2) evolved 340 – 550°C.

FIGURE

2

RICHNESS

WELL 6609/11-1

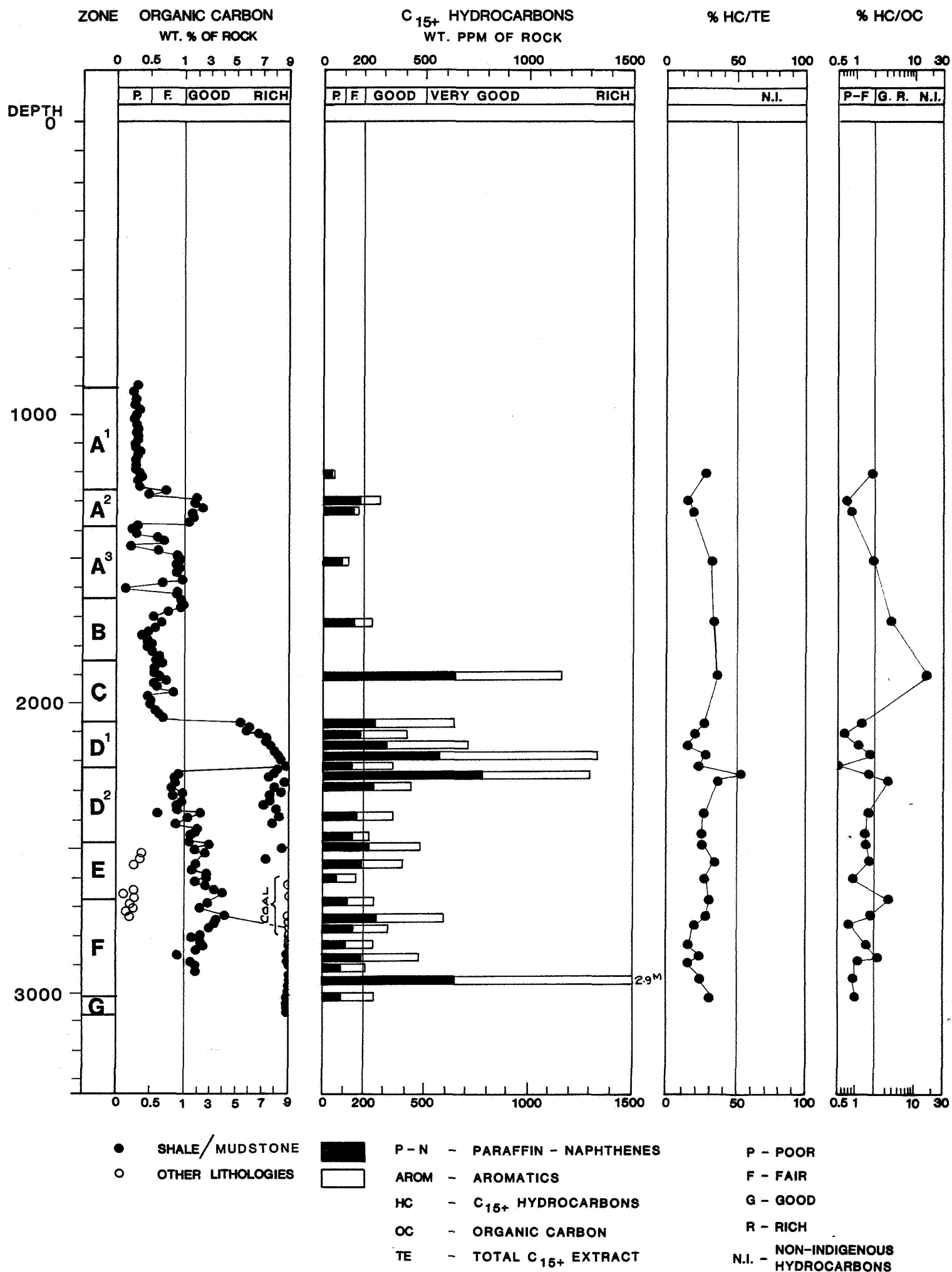
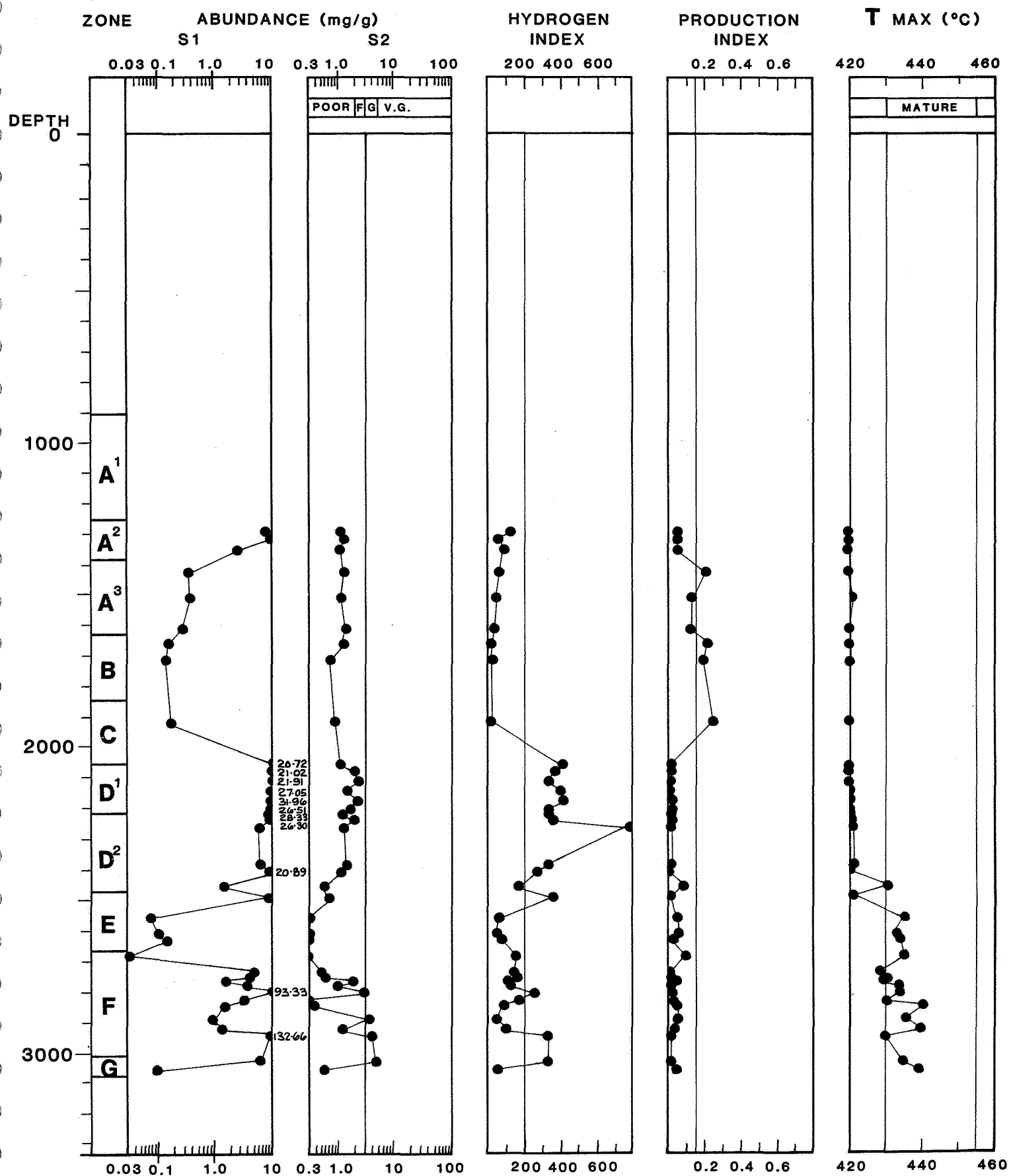


FIGURE 3

ROCKEVAL DATA

WELL 6609/11-1

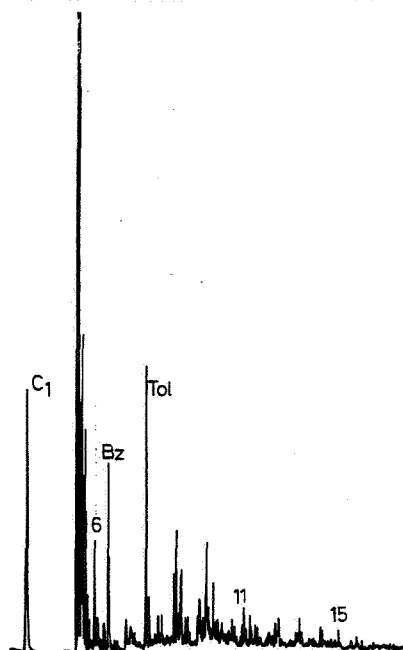
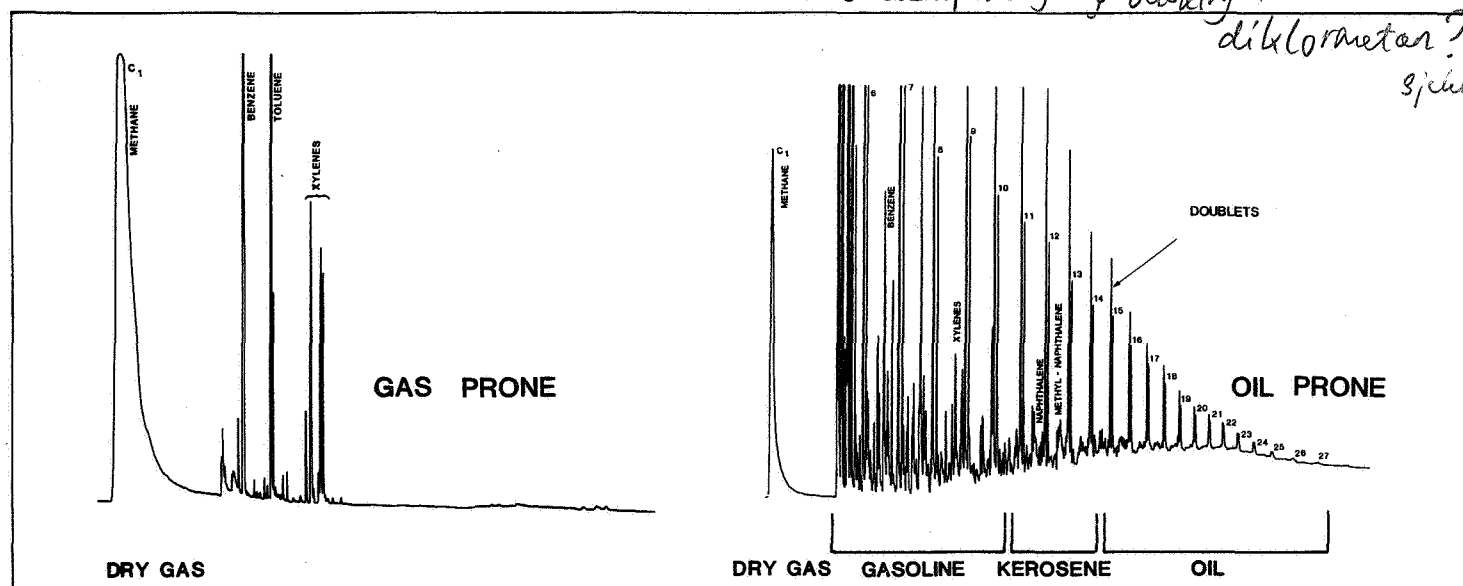


FIGURE

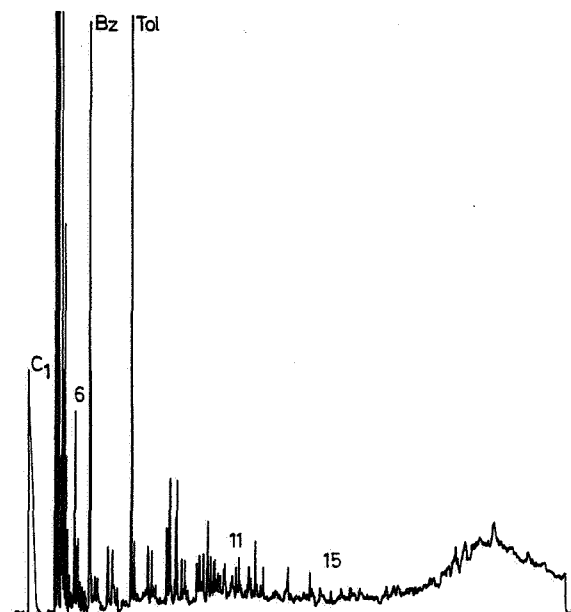
4a

PYROLYSIS GC

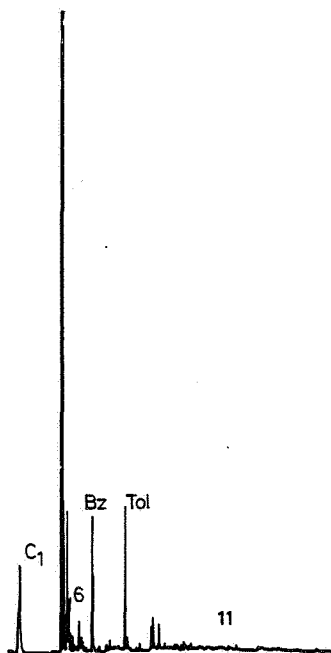
WELL 6609/11-1
*with
 after deasphalting & washing i
 dichloromethane?
 3/11/81*



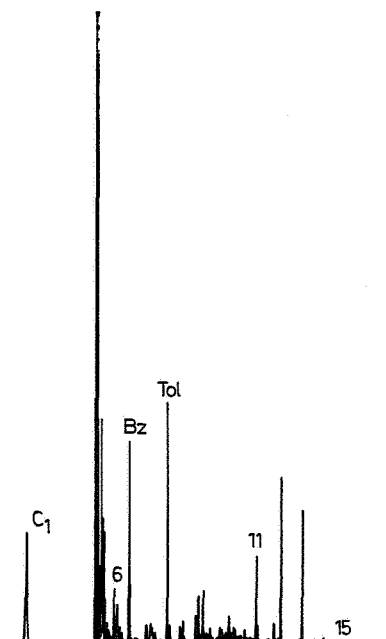
1290-1305m A



1305-1320m B



1500-1515m A



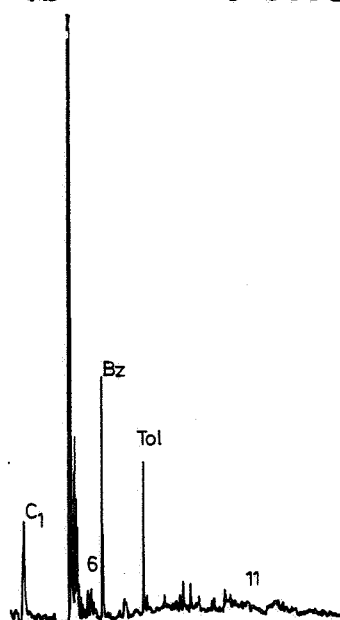
1650-1665m A

FIGURE

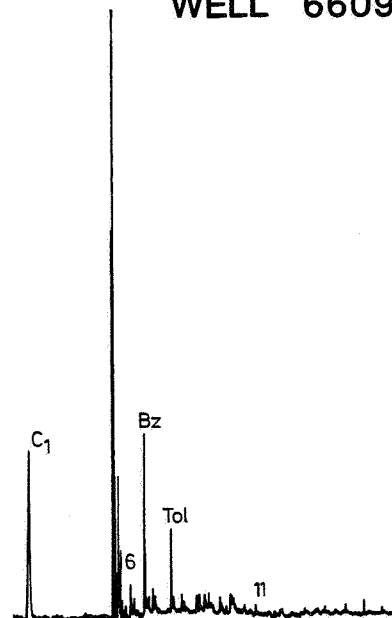
4b

PYROLYSIS GC

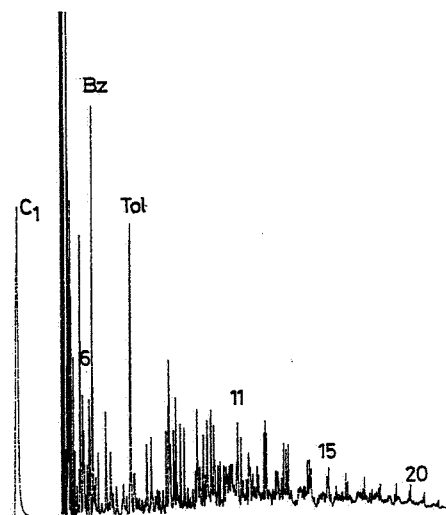
WELL 6609/11-1



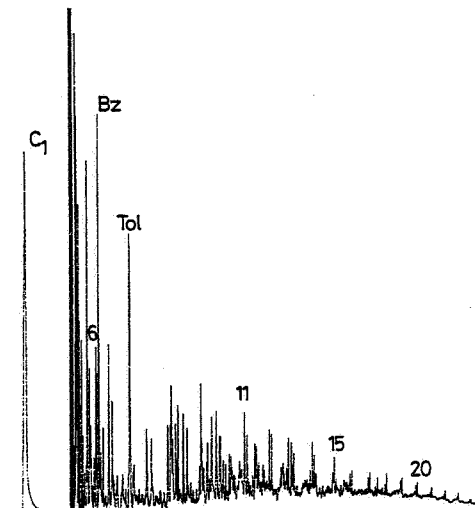
1800-1815m A



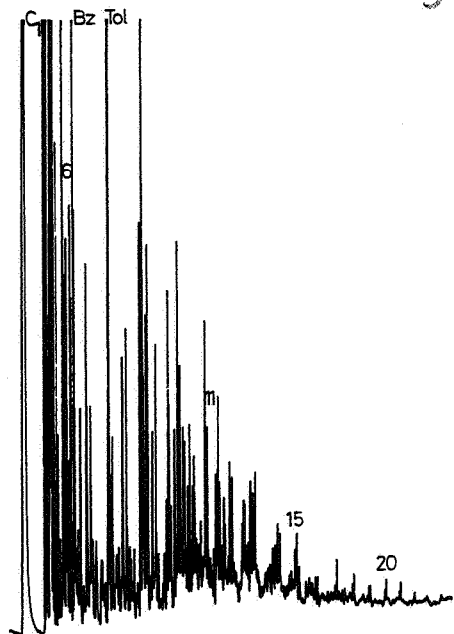
1915-1930m A



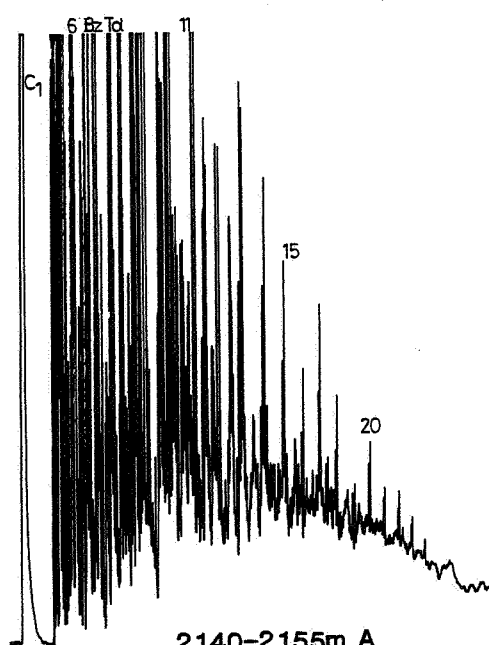
2065-2080m B *L. Valang L. Ryazan
Si Hg mud 86*



2080-2095m A *L. Ryazan-M. Volg.
"*



2110-2125m A *L. Ryazan - M. Volg.
Ch. mudst. olive black*



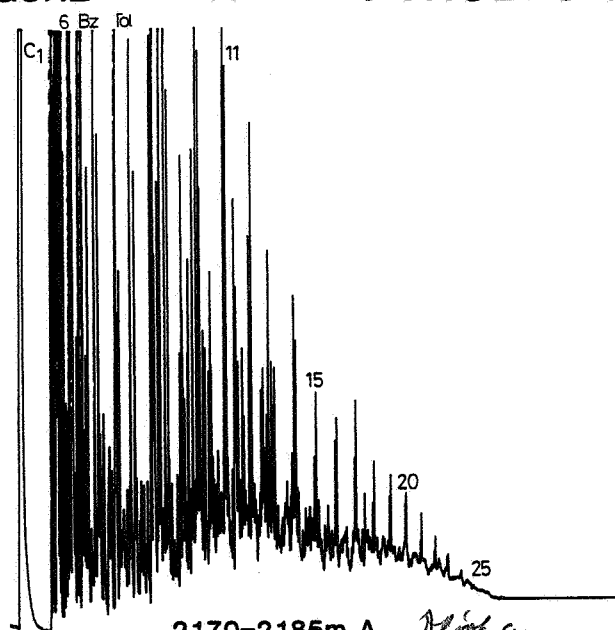
2140-2155m A *Middle Volg.
"*

FIGURE

4c

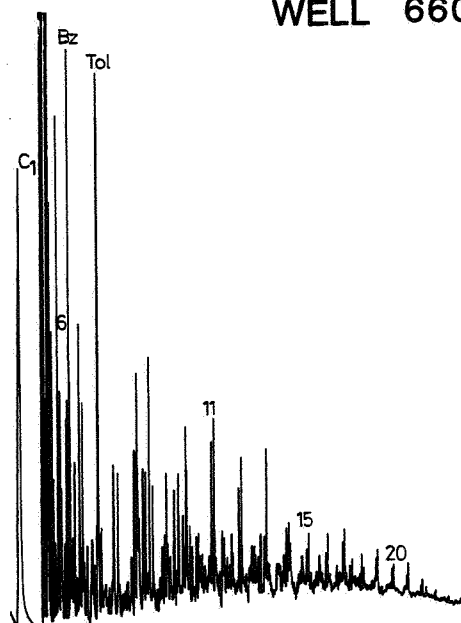
PYROLYSIS GC

WELL 6609/11-1



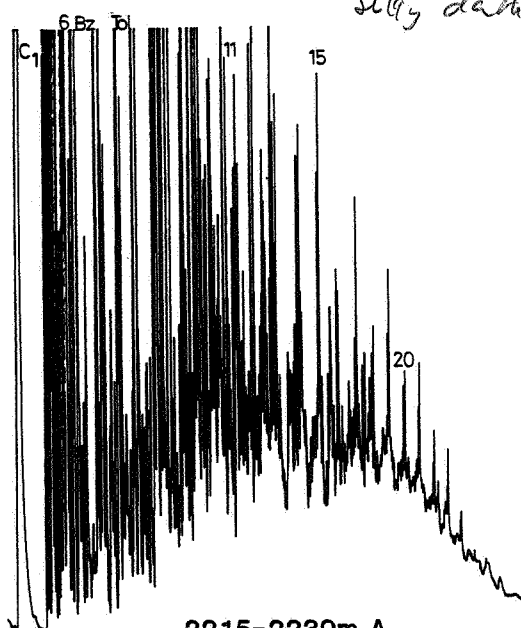
2170-2185m A

Highly silty dark mudst



2200-2215m A

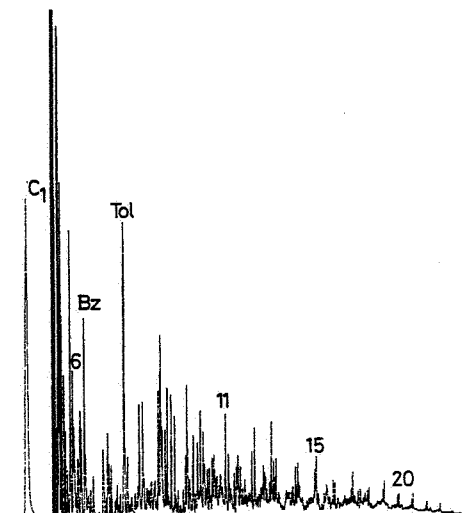
Rom. L. Oxford



2215-2230m A

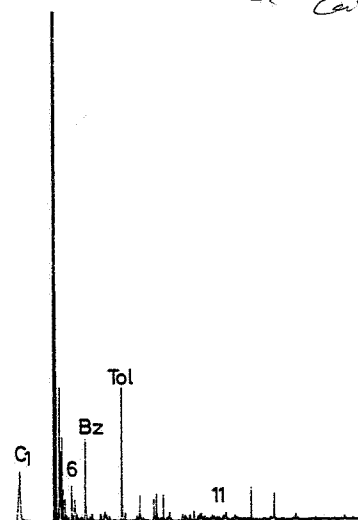
Kim. Oxf.

L. cavity



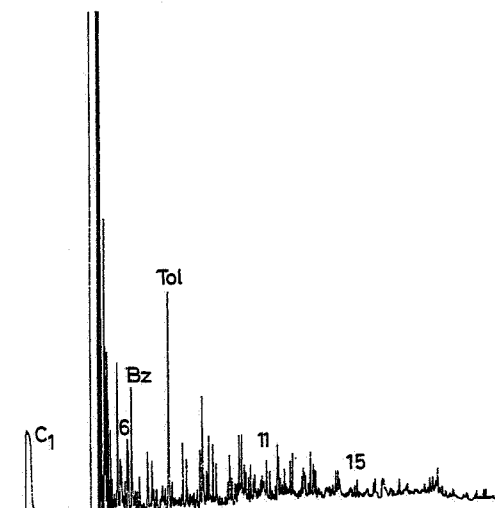
2230-2245m A

Late early Oxf silty mudst



2260-2275m A

Early Carbon med. gy light gy sh



2380-2395m A

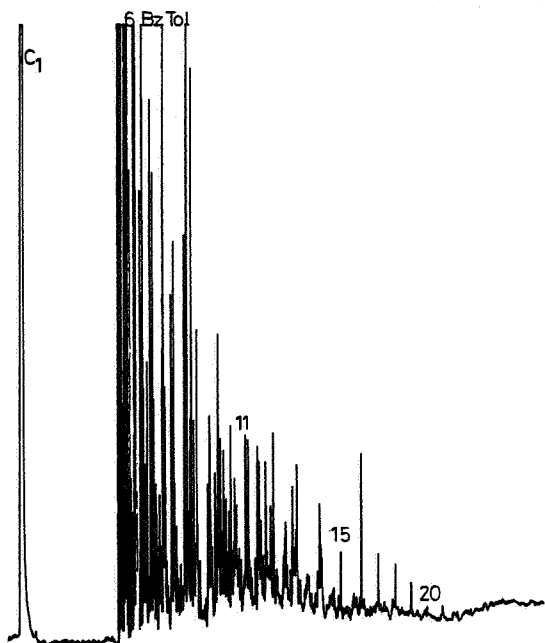
Bathon-Late Bapoc sh. silty med gy

FIGURE

4d

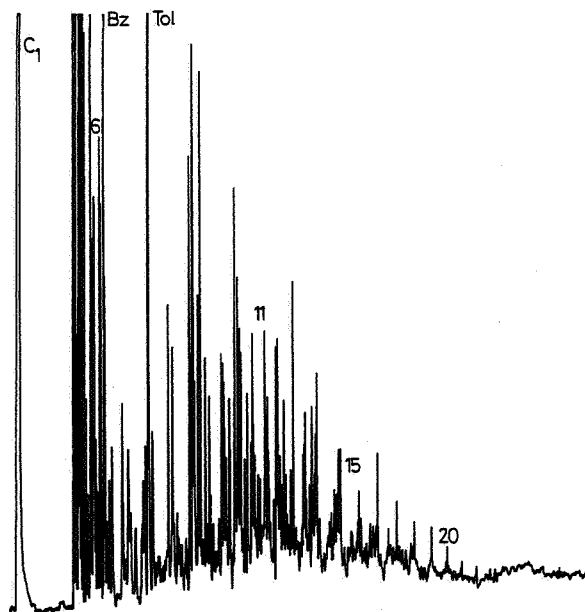
PYROLYSIS GC

WELL 6609/11-1



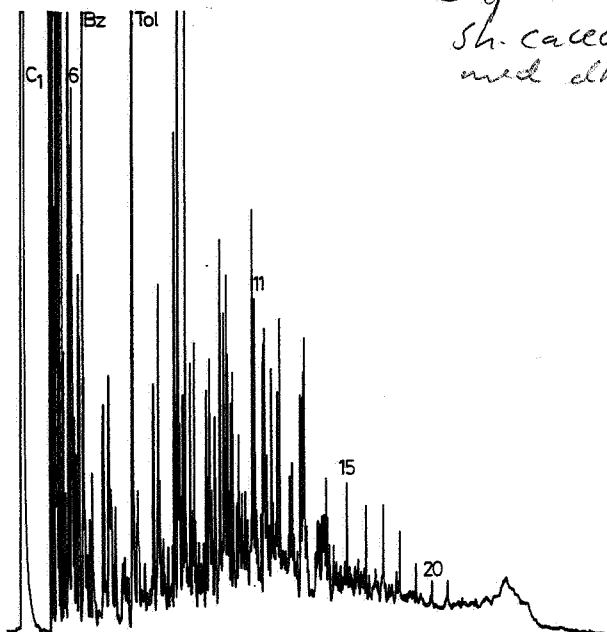
2455-2470m A

*Baroc
sh. cased?
med dk gy*



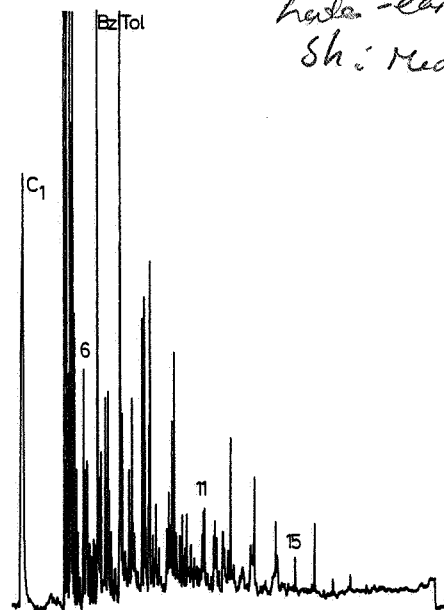
2485-2500m A

*late - early Forc
Sh: Med dk gy*



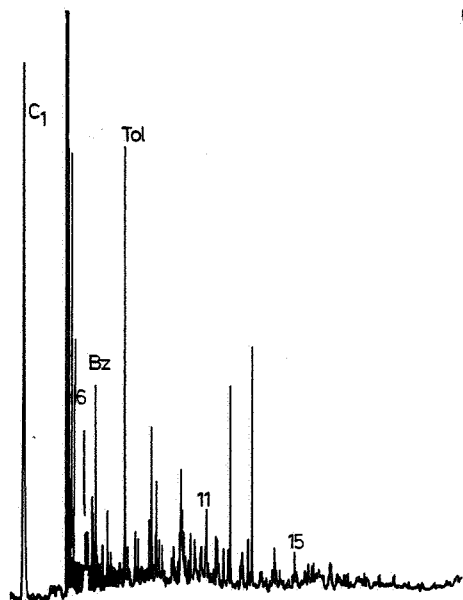
2545-2560m A

*Late Pilsenbach - Kelling
Coal with*



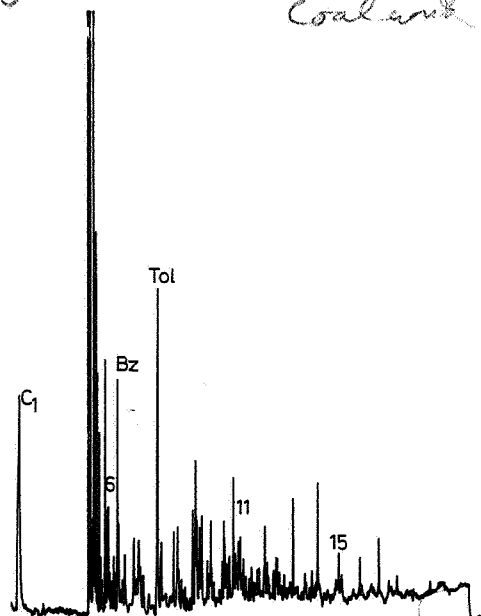
2590-2605m A

*Coal with late Pilsen
Kelling*



2665-2680m A

*Late Pilsenbach
Kelling
Silstone carbon?*



2725-2740m A

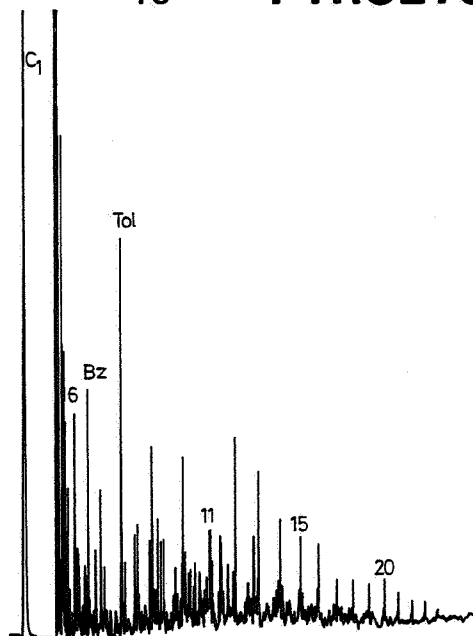
*Late Pilsenbach
Shale dk gy? Kelling*

FIGURE

4e

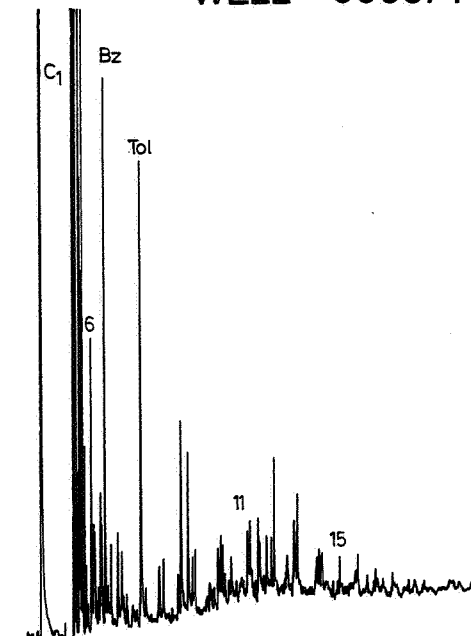
PYROLYSIS GC

WELL 6609/11-1



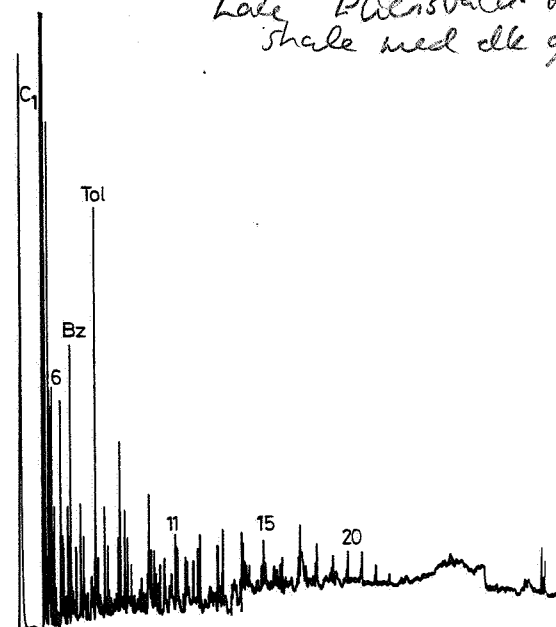
2755-2770m A

*Late Devonian. Hettangian.
Shale med dk gy, laved?*



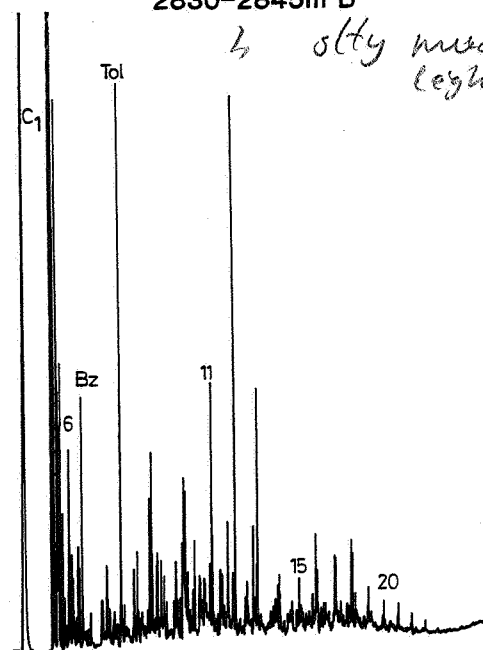
2830-2845m B

stty mudst, light gy



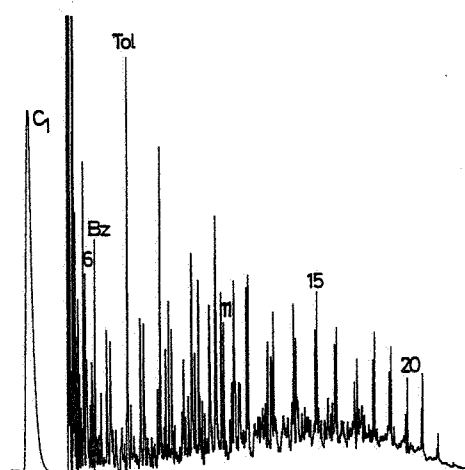
2875-2890m B

stty mudst, laved?



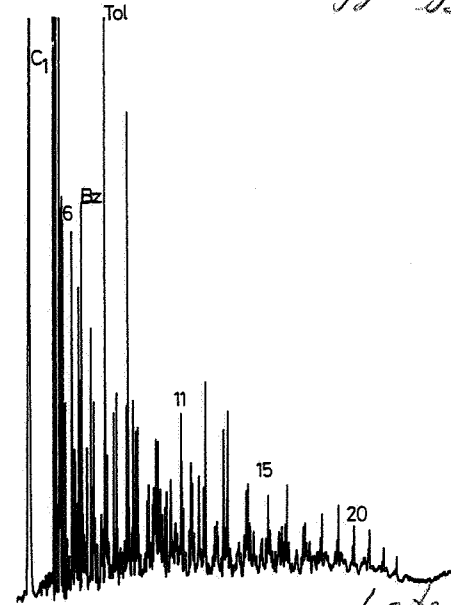
2905-2920m C

stty mudst, laved?



3010-3025m A

*Late Devonian
Coal and
shale med dk gy*

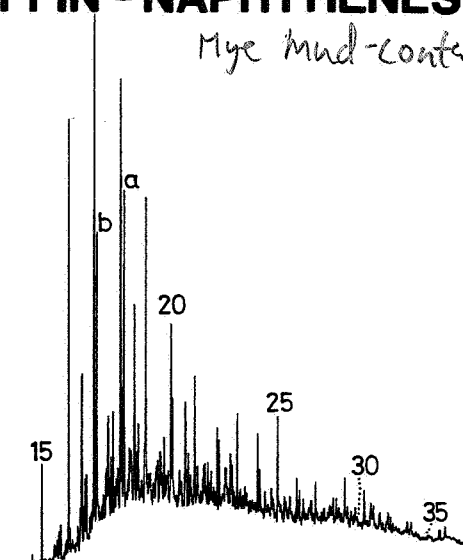
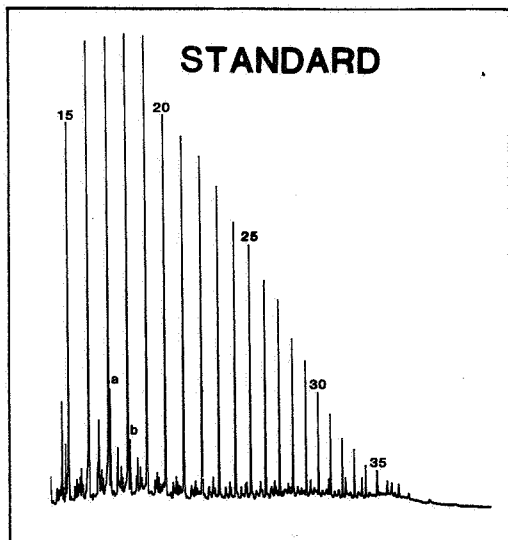


3010-3025m B

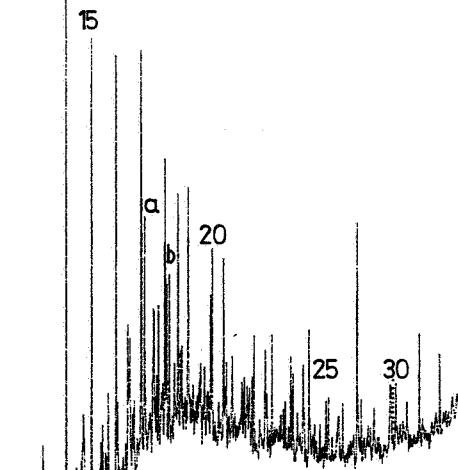
*Late Devonian
Coal and
shale med dk gy*

FIGURE 5a C₁₅₊ PARAFFIN-NAPHTHENES WELL 6609/11-1

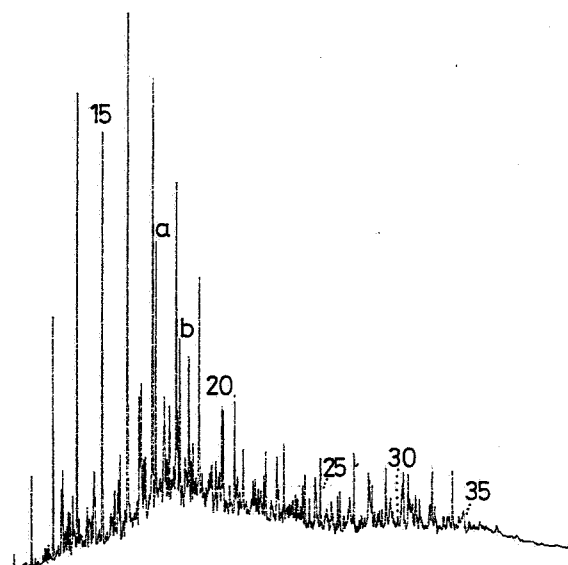
Mye mud-content for better fraction



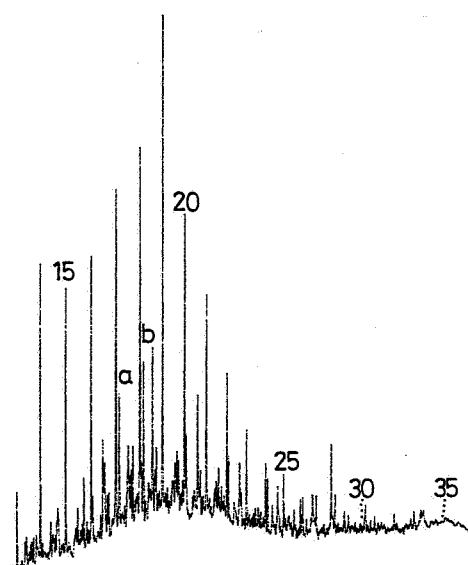
1200-1215m



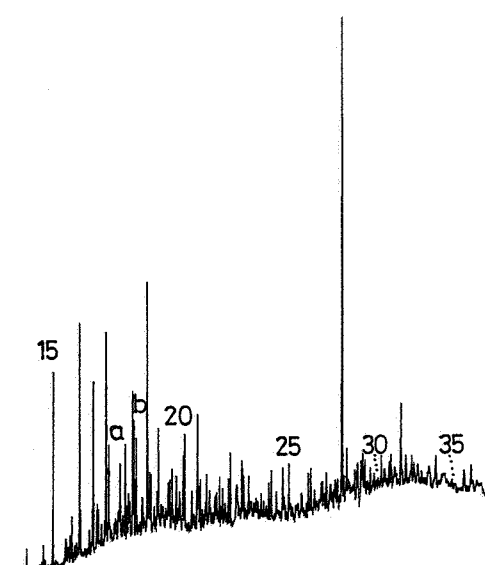
1290-1305m B



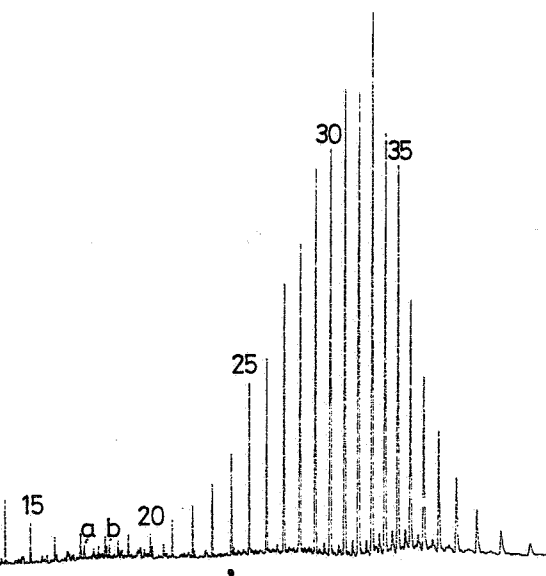
1320-1335m



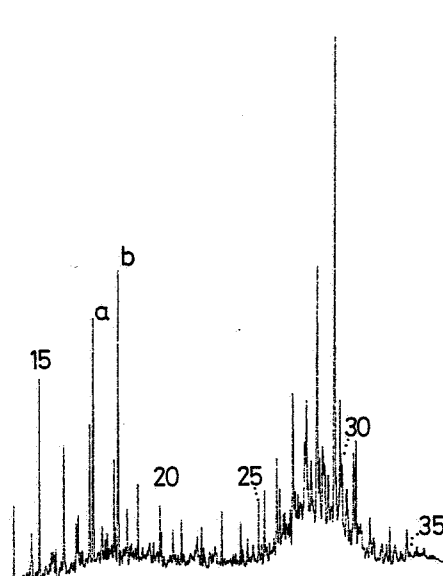
1500-1515m



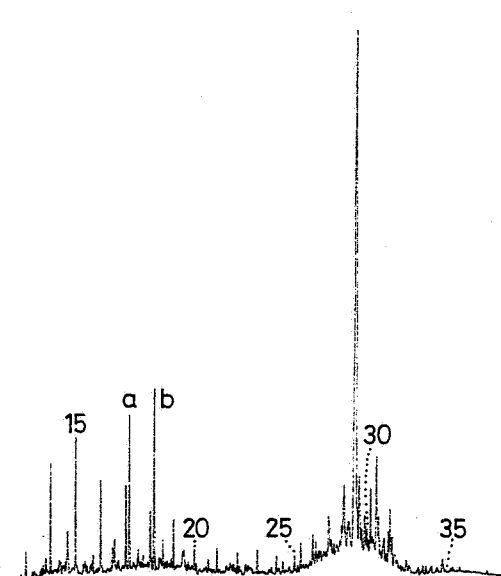
1710-1725m A



1915-1930m A



2080-2095m A



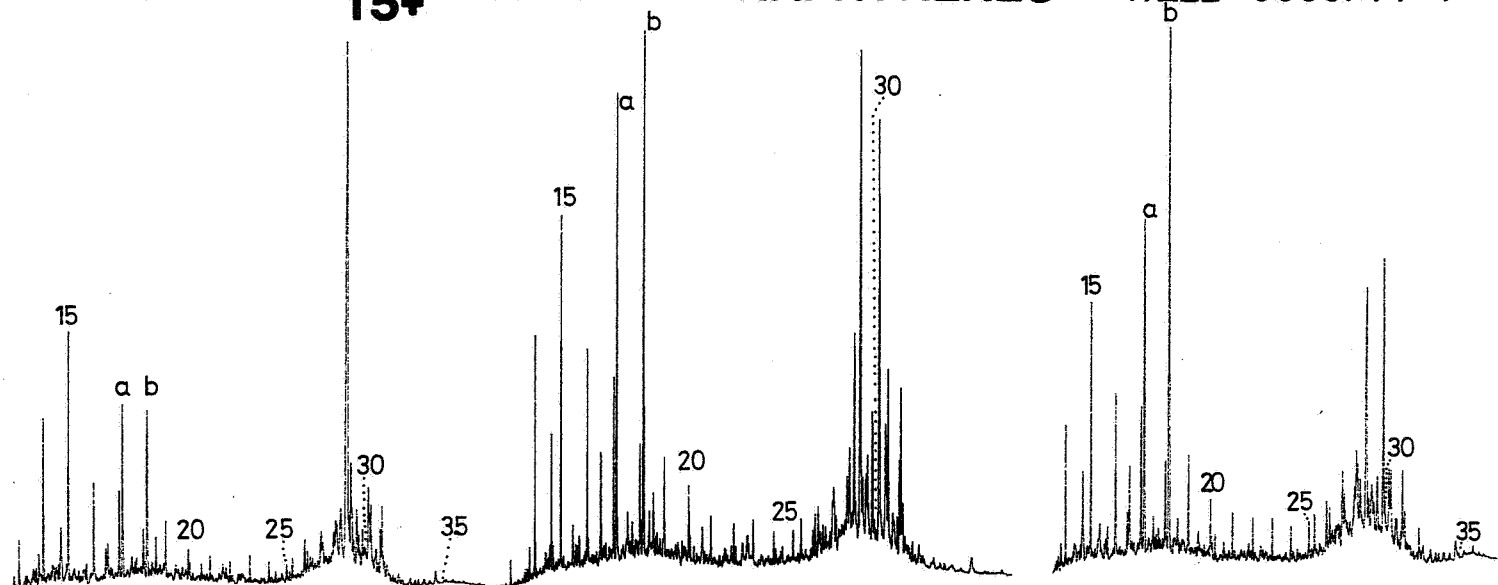
2110-2125m A

a - PRISTANE
b - PHYTANE

CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 - nC₂₀)

FIGURE 5b C₁₅₊ PARAFFIN - NAPHTHENES

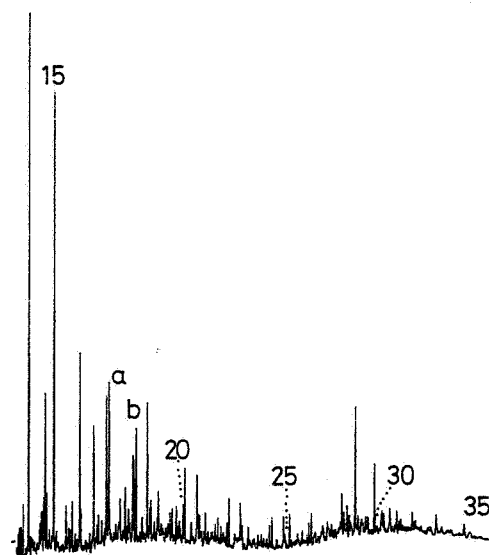
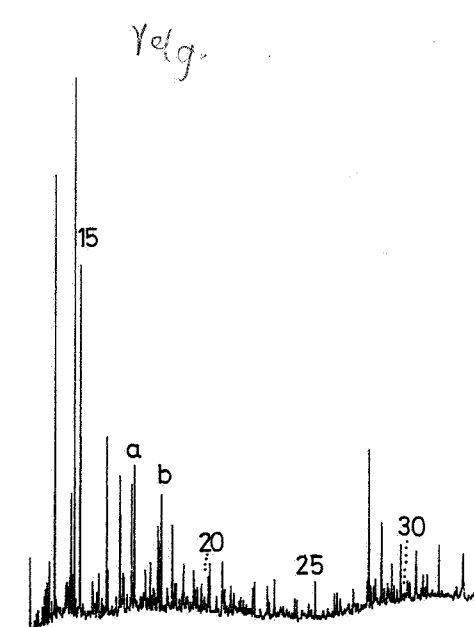
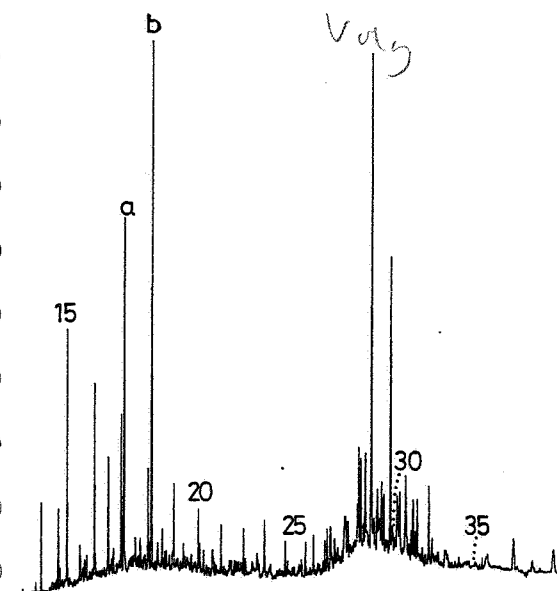
WELL 6609/11-1



2140-2155m A

2170-2185m A

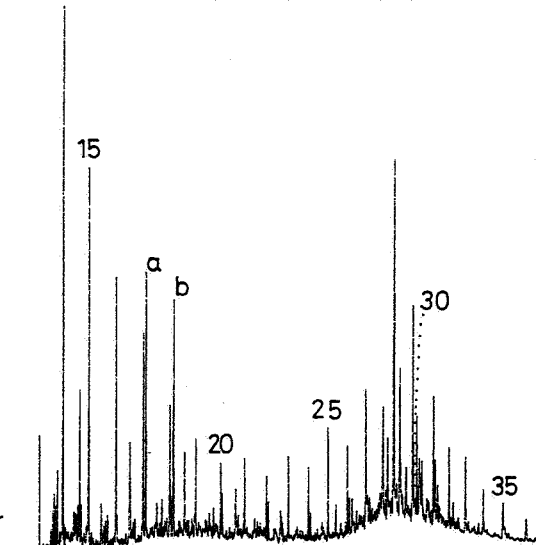
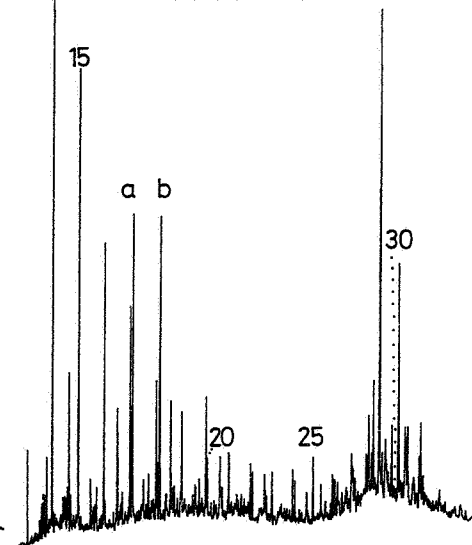
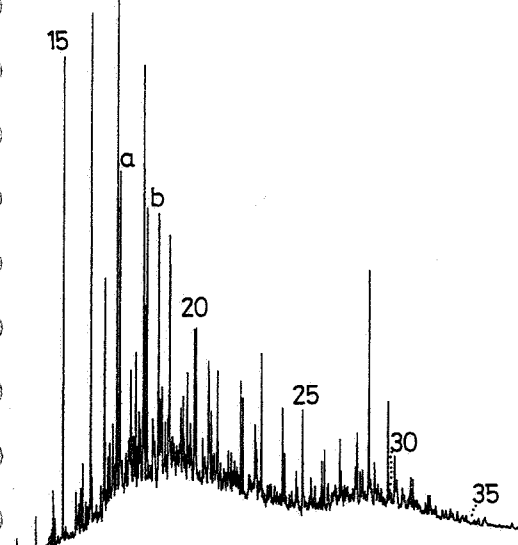
2200-2215m A



2230-2245m A

2260-2275m A

2380-2395m A



2455-2470m A

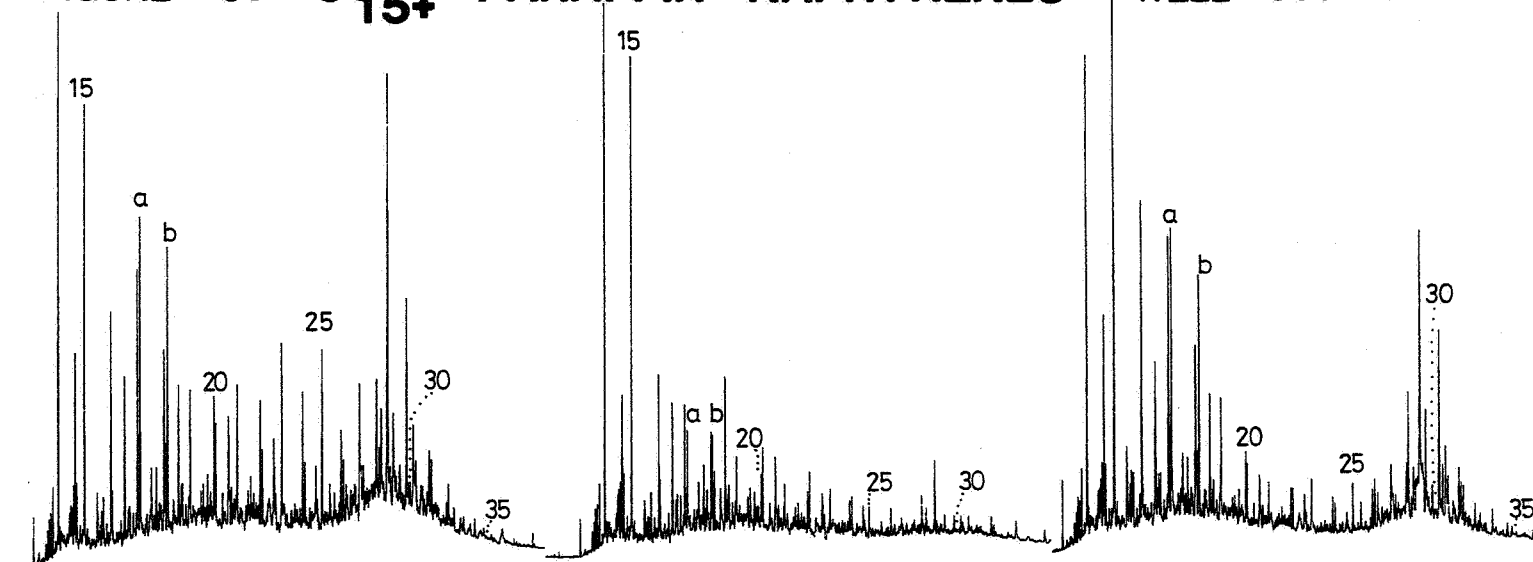
2485-2500m A

2545-2560m A

a - PRISTANE
b - PHYTANE

CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 - nC₂₀)

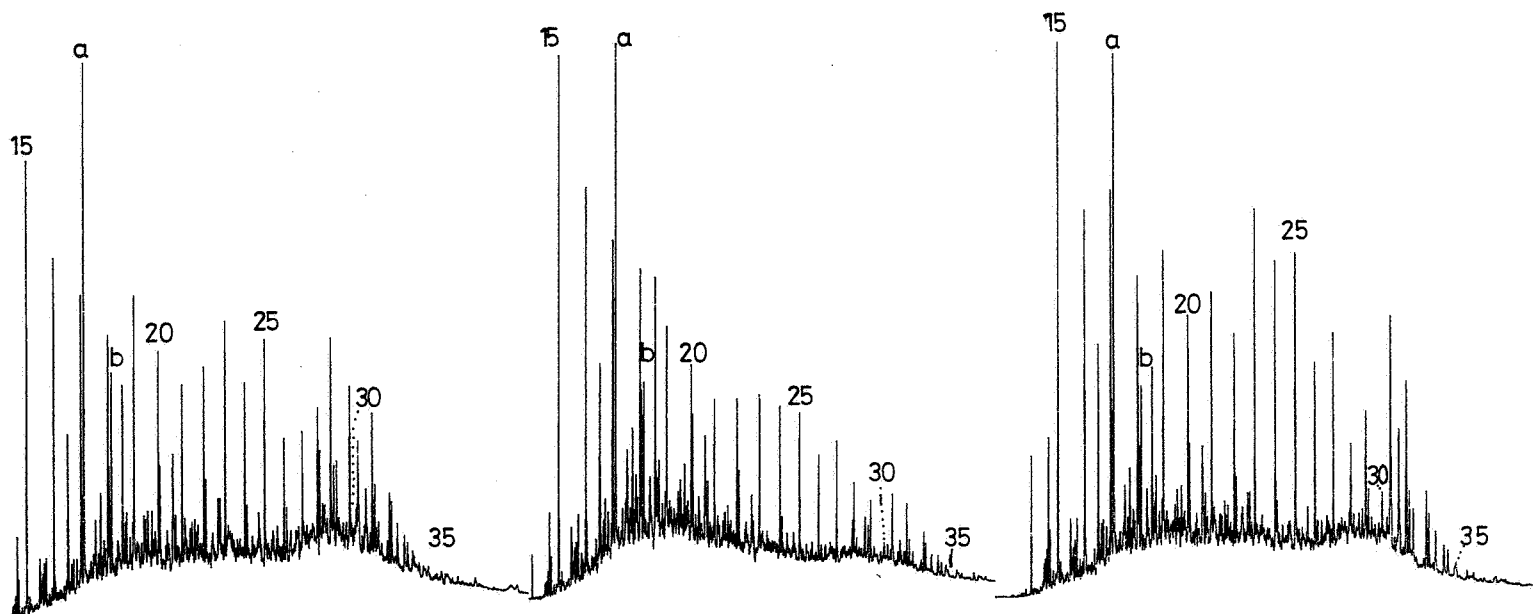
FIGURE 5c **C₁₅₊ PARAFFIN - NAPHTHENES** 15 WELL 6609/11-1



2590-2605m A

2665-2680m A

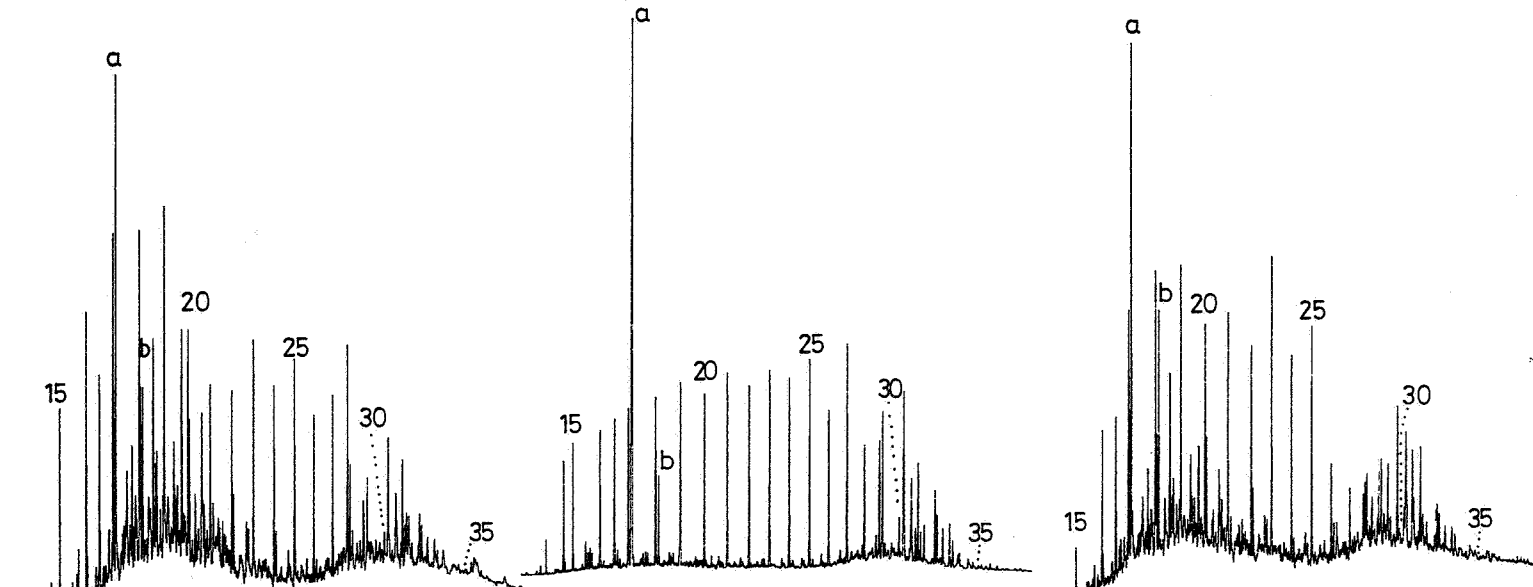
2725-2740m A



2755-2770m A

2830-2845m B

2875-2890m B



2890-2905m A

2950-2965m A

3010-3025m B

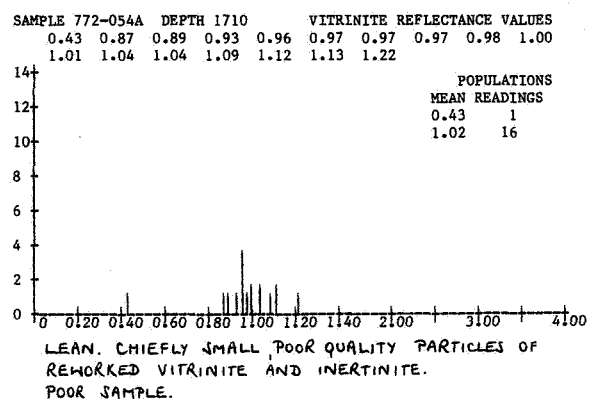
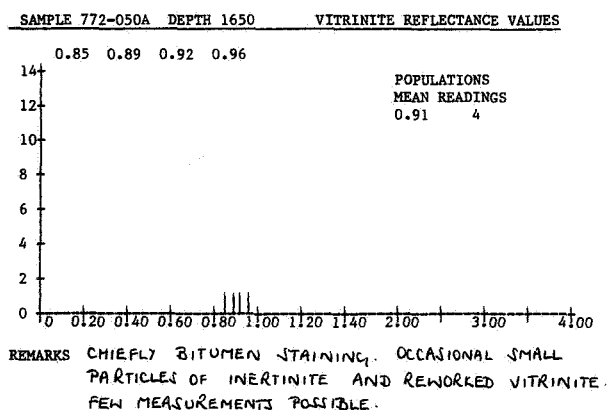
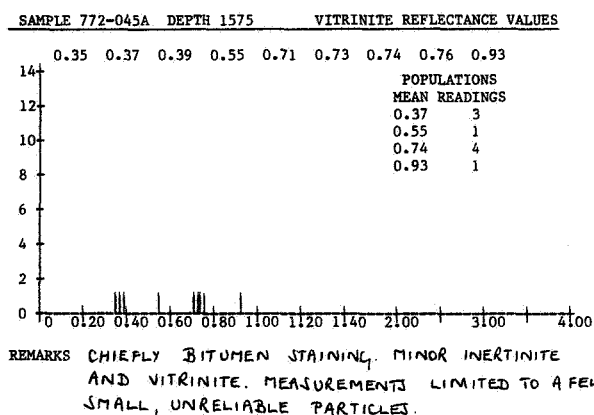
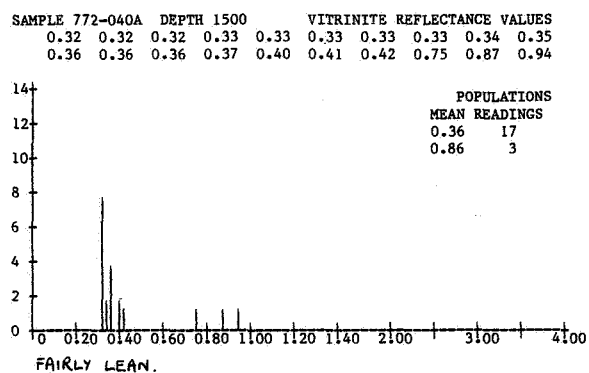
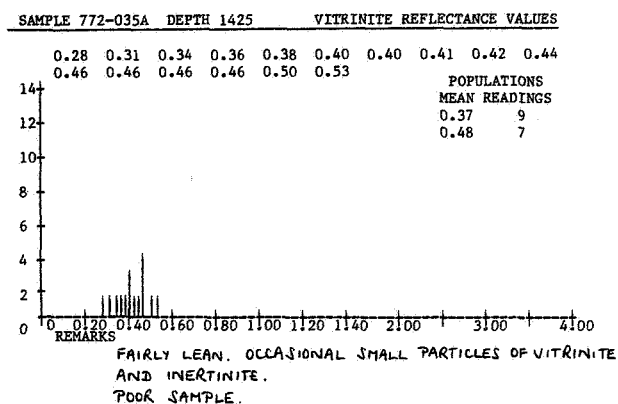
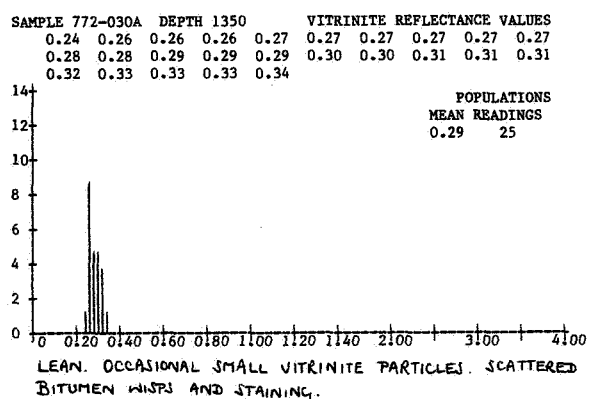
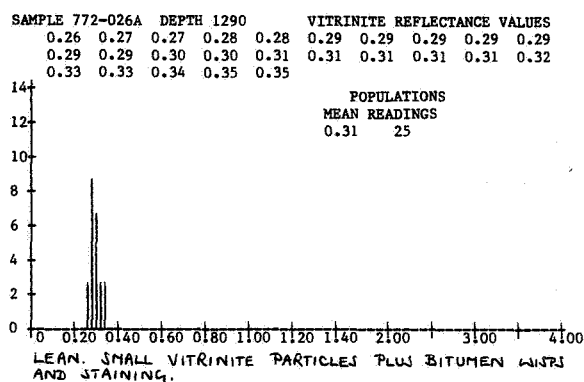
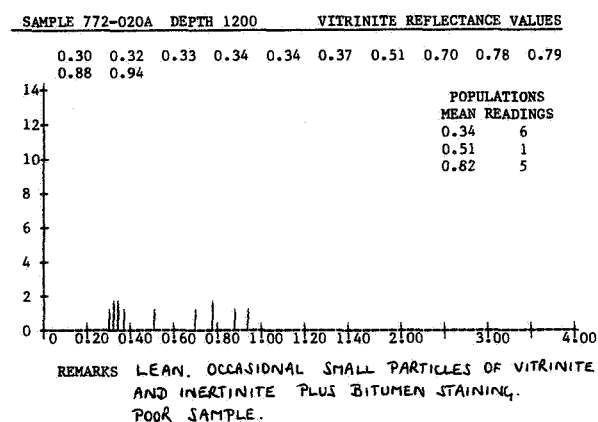
a - PRISTANE
b - PHYTANE

CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 - nC₂₀)

FIGURE 6a

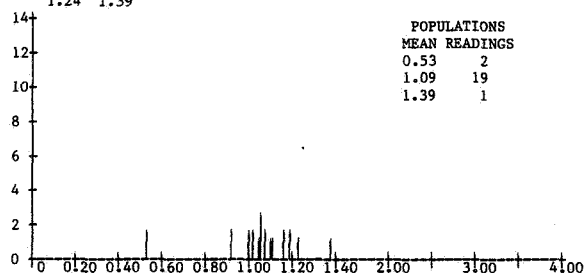
VITRINITE REFLECTANCE

WELL 6609/11-1



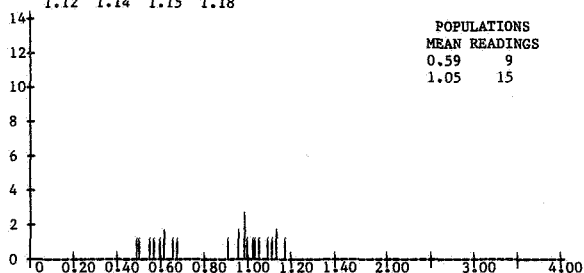
SAMPLE 772-055A DEPTH 1725 VITRINITE REFLECTANCE VALUES

0.53	0.53	0.92	0.93	1.00	1.01	1.02	1.03	1.05	1.06
1.06	1.07	1.08	1.09	1.11	1.12	1.17	1.17	1.20	1.21
1.24	1.39								

REMARKS VITRINITE VERY DOMINANTLY REWORKED.
POOR SAMPLE.

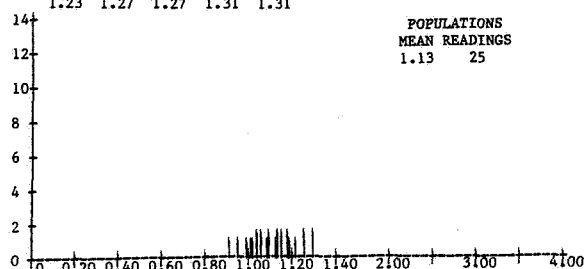
SAMPLE 772-060A DEPTH 1800 VITRINITE REFLECTANCE VALUES

0.49	0.50	0.55	0.57	0.60	0.62	0.62	0.66	0.68	0.91
0.96	0.96	0.99	0.99	0.99	1.00	1.03	1.04	1.06	1.10
1.12	1.14	1.15	1.18						

REMARKS FAIRLY LEAN. VITRINITE LARGELY REWORKED.
POOR SAMPLE.

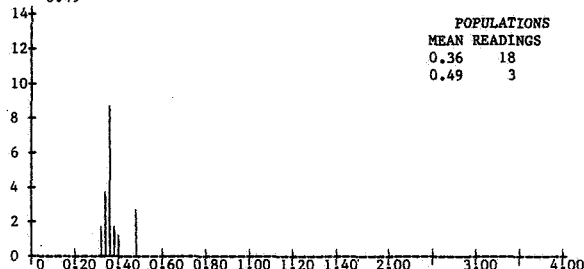
SAMPLE 772-065A DEPTH 1870 VITRINITE REFLECTANCE VALUES

0.91	0.95	0.99	1.01	1.02	1.04	1.05	1.06	1.06	1.09
1.10	1.11	1.13	1.14	1.15	1.16	1.16	1.19	1.19	1.20
1.23	1.27	1.27	1.31	1.31					

REMARKS PARTICLES OF INERTINITE AND REWORKED VITRINITE.
POOR SAMPLE.

SAMPLE 772-068A DEPTH 1915 VITRINITE REFLECTANCE VALUES

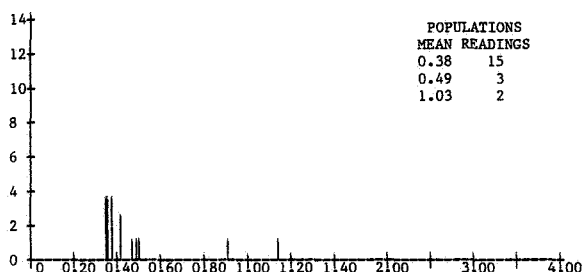
0.32	0.33	0.34	0.34	0.34	0.35	0.36	0.36	0.36	0.37
0.37	0.37	0.37	0.37	0.37	0.38	0.38	0.40	0.48	0.48
0.49									



VITRINITE FREQUENTLY REWORKED.

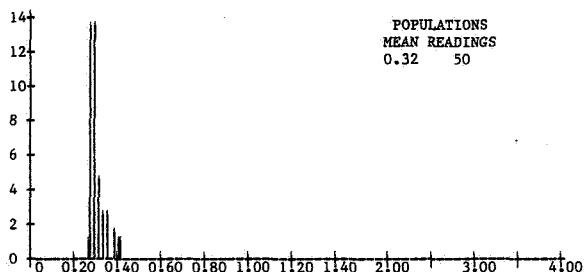
SAMPLE 772-075A DEPTH 2020 VITRINITE REFLECTANCE VALUES

0.35	0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.38	0.38
0.39	0.39	0.42	0.42	0.42	0.47	0.49	0.50	0.91	1.14

REMARKS FAIRLY LEAN. OCCASIONAL SMALL PARTICLES OF
INERTINITE AND VITRINITE.

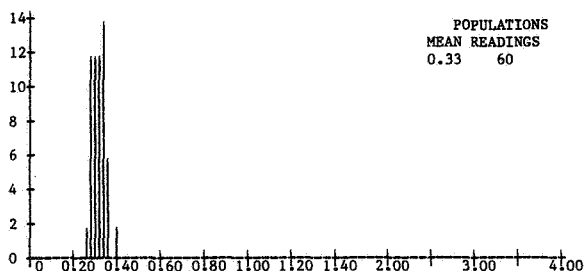
SAMPLE 772-078B DEPTH 2065 VITRINITE REFLECTANCE VALUES

0.27	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
0.28	0.28	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.33
0.34	0.34	0.34	0.36	0.36	0.37	0.39	0.39	0.41	0.42

REMARKS DOMINANTLY AMORPHOUS / ALGAL. SIGNIFICANT
VITRINITE - FREQUENTLY OF ANOMALOUSLY LOW
REFLECTANCE. MINOR INERTINITE.

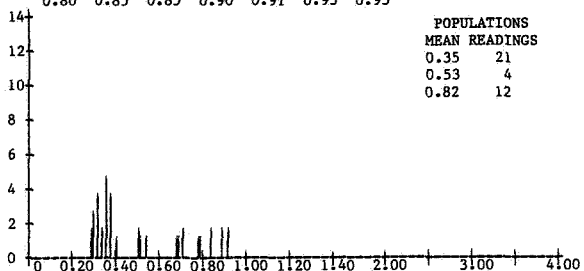
SAMPLE 772-079A DEPTH 2080 VITRINITE REFLECTANCE VALUES

0.26	0.26	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.29
0.29	0.29	0.29	0.29	0.30	0.30	0.30	0.30	0.31	0.31
0.31	0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.32
0.32	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.34	0.34
0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35
0.35	0.35	0.36	0.36	0.36	0.36	0.36	0.36	0.40	0.41

VERY DOMINANTLY AMORPHOUS / ALGAL. MINOR VITRINITE
AND INERTINITE.

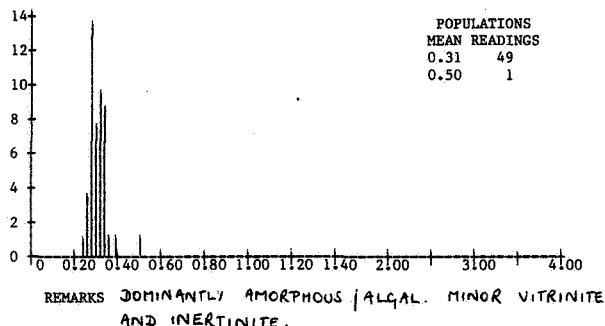
SAMPLE 772-081A DEPTH 2110 VITRINITE REFLECTANCE VALUES

0.29	0.29	0.30	0.30	0.31	0.32	0.32	0.32	0.33	0.34
0.34	0.36	0.36	0.37	0.37	0.37	0.38	0.39	0.39	0.39
0.41	0.51	0.51	0.52	0.55	0.69	0.70	0.72	0.73	0.79
0.80	0.85	0.85	0.90	0.91	0.93	0.93			

REMARKS DOMINANTLY AMORPHOUS / ALGAL. SIGNIFICANT VITRINITE
AS SMALL PARTICLES OF VARIABLE REFLECTANCE.
MINOR INERTINITE.

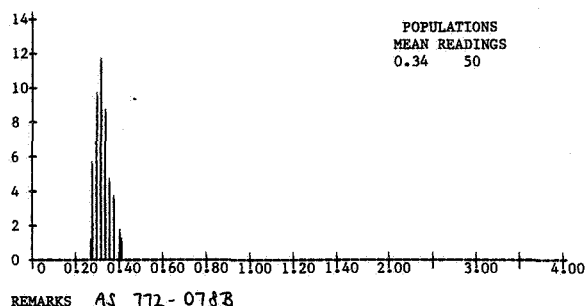
SAMPLE 772-083A DEPTH 2140 VITRINITE REFLECTANCE VALUES

0.24	0.26	0.26	0.26	0.27	0.28	0.28	0.28	0.28	0.28
0.28	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29	0.29
0.30	0.30	0.30	0.31	0.31	0.31	0.31	0.31	0.32	0.32
0.32	0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.34	0.34
0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.36	0.39	0.50



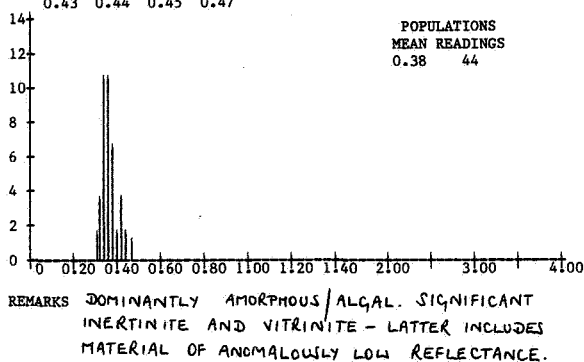
SAMPLE 772-085A DEPTH 2170 VITRINITE REFLECTANCE VALUES

0.27	0.28	0.28	0.28	0.29	0.29	0.29	0.30	0.30	0.30
0.30	0.30	0.30	0.30	0.31	0.31	0.31	0.32	0.32	0.32
0.32	0.32	0.32	0.32	0.33	0.33	0.33	0.33	0.33	0.34
0.34	0.34	0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.36
0.37	0.37	0.37	0.38	0.38	0.39	0.39	0.41	0.41	0.42



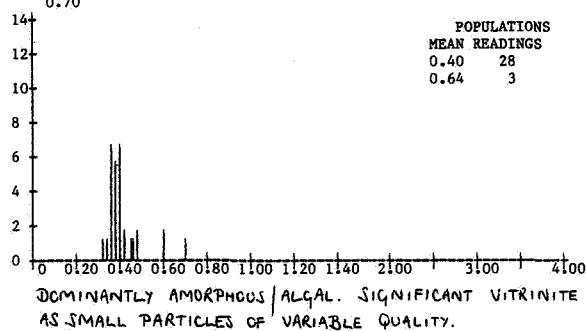
SAMPLE 772-087A DEPTH 2200 VITRINITE REFLECTANCE VALUES

0.31	0.31	0.32	0.32	0.33	0.33	0.34	0.34	0.34	0.34
0.34	0.34	0.35	0.35	0.35	0.35	0.36	0.36	0.36	0.36
0.36	0.37	0.37	0.37	0.37	0.37	0.37	0.38	0.39	0.39
0.39	0.39	0.39	0.39	0.39	0.40	0.41	0.42	0.42	0.43
0.43	0.44	0.45	0.47						



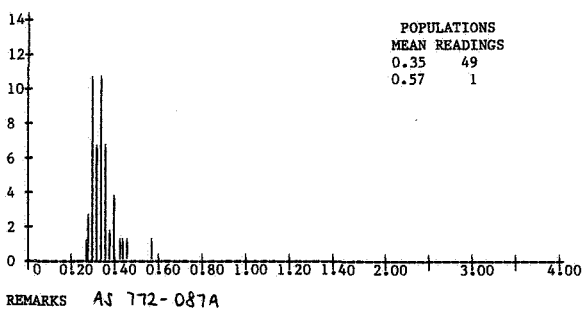
SAMPLE 772-088A DEPTH 2215 VITRINITE REFLECTANCE VALUES

0.32	0.34	0.36	0.36	0.36	0.36	0.37	0.37	0.37	0.38
0.38	0.39	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.40
0.41	0.41	0.42	0.42	0.45	0.46	0.48	0.49	0.60	0.60
0.70									



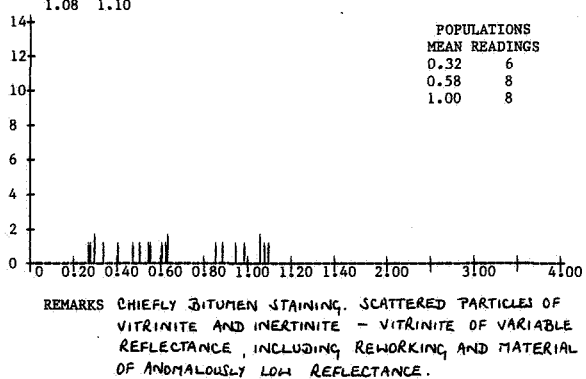
SAMPLE 772-089A DEPTH 2230 VITRINITE REFLECTANCE VALUES

0.27	0.28	0.28	0.29	0.30	0.30	0.30	0.30	0.30	0.30
0.31	0.31	0.31	0.31	0.31	0.32	0.32	0.32	0.32	0.33
0.33	0.33	0.34	0.34	0.34	0.34	0.34	0.35	0.35	0.35
0.35	0.35	0.35	0.36	0.36	0.37	0.37	0.37	0.37	0.37
0.38	0.39	0.40	0.41	0.41	0.41	0.43	0.44	0.46	0.57



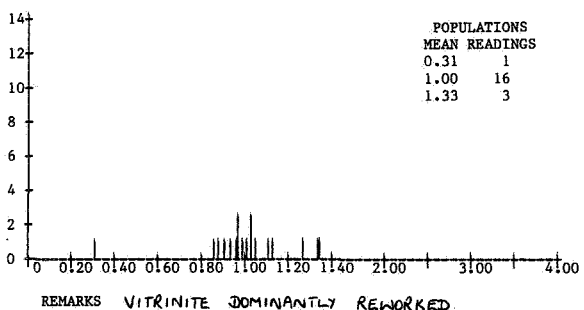
SAMPLE 772-094A DEPTH 2305 VITRINITE REFLECTANCE VALUES

0.27	0.28	0.30	0.31	0.34	0.41	0.48	0.51	0.55	0.56
0.61	0.63	0.64	0.64	0.86	0.89	0.95	0.99	1.06	1.07
1.08	1.10								



SAMPLE 772-098B DEPTH 2365 VITRINITE REFLECTANCE VALUES

0.31	0.86	0.88	0.91	0.94	0.97	0.98	0.98	0.99	1.00
1.02	1.04	1.04	1.05	1.06	1.12	1.14	1.28	1.35	1.36



SAMPLE 772-099A DEPTH 2380 VITRINITE REFLECTANCE VALUES

0.33	0.36	0.38	0.38	0.39	0.39	0.40	0.42	0.42	0.42
0.43	0.44	0.44	0.44	0.46	0.47	0.48	0.50	0.50	0.51
0.52	0.53	0.56	0.58	0.59	0.59	0.61	0.63	0.73	0.74
0.82									

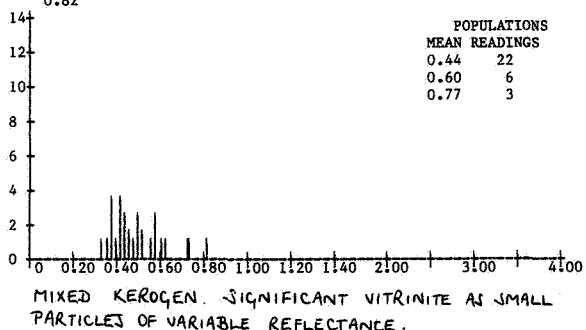


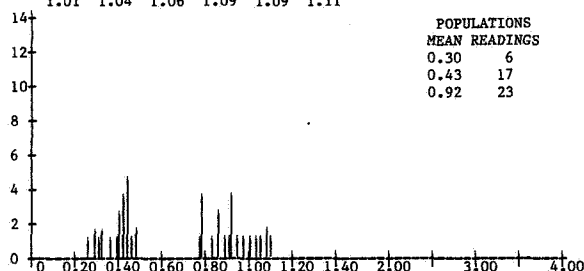
FIGURE 6d VITRINITE REFLECTANCE

WELL 6609/11-1

SAMPLE 772-102A DEPTH 2425 VITRINITE REFLECTANCE VALUES

0.26	0.29	0.29	0.31	0.32	0.32	0.36	0.39	0.40	0.40
0.41	0.42	0.43	0.43	0.43	0.44	0.44	0.44	0.45	0.45
0.46	0.48	0.48	0.77	0.78	0.78	0.78	0.78	0.83	0.86
0.86	0.87	0.89	0.91	0.92	0.92	0.92	0.93	0.95	0.98
1.01	1.04	1.06	1.09	1.09	1.11				

POPULATIONS
MEAN READINGS
0.30 6
0.43 17
0.92 23

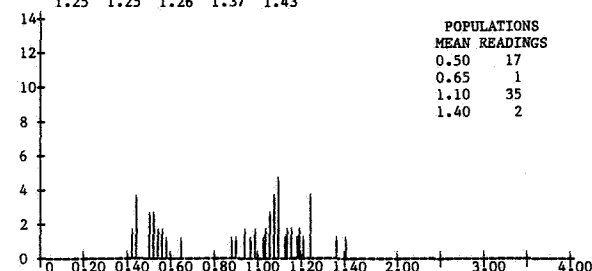


REMARKS DOMINANTLY AMORPHOUS/ALGAL. SIGNIFICANT INERTINITE AND VITRINITE - LATTER CHIEFLY REWORKED.

SAMPLE 772-104A DEPTH 2455 VITRINITE REFLECTANCE VALUES

0.42	0.42	0.44	0.44	0.45	0.45	0.50	0.50	0.50	0.52
0.52	0.53	0.54	0.54	0.56	0.57	0.58	0.65	0.88	0.90
0.94	0.95	0.97	0.99	0.99	1.03	1.04	1.05	1.06	1.06
1.07	1.08	1.09	1.09	1.09	1.10	1.10	1.10	1.11	1.11
1.13	1.14	1.15	1.16	1.16	1.19	1.20	1.20	1.22	1.25
1.25	1.25	1.26	1.37	1.43					

POPULATIONS
MEAN READINGS
0.50 17
0.65 1
1.10 35
1.40 2

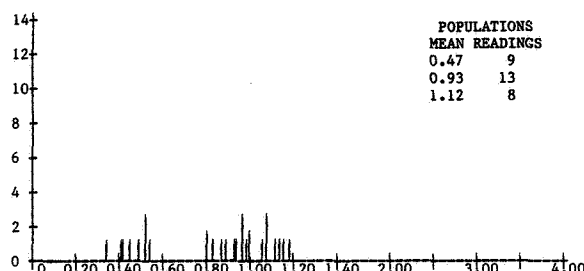


REMARKS MIXED KEROGEN. VITRINITE LARGELY REWORKED

SAMPLE 772-106A DEPTH 2485 VITRINITE REFLECTANCE VALUES

0.34	0.41	0.42	0.45	0.49	0.52	0.52	0.53	0.54	0.80
0.81	0.83	0.87	0.89	0.93	0.94	0.97	0.97	0.97	0.99
1.00	1.01	1.06	1.08	1.08	1.09	1.12	1.14	1.16	1.19

POPULATIONS
MEAN READINGS
0.47 9
0.93 13
1.12 8

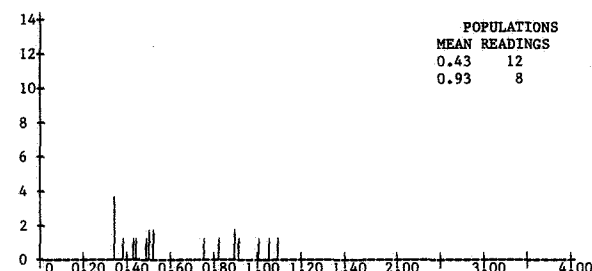


REMARKS AS 772-102A

SAMPLE 772-110A DEPTH 2545 VITRINITE REFLECTANCE VALUES

0.34	0.34	0.35	0.35	0.38	0.43	0.44	0.49	0.50	0.50
0.52	0.52	0.75	0.82	0.89	0.89	0.91	1.00	1.05	1.09

POPULATIONS
MEAN READINGS
0.43 12
0.93 8

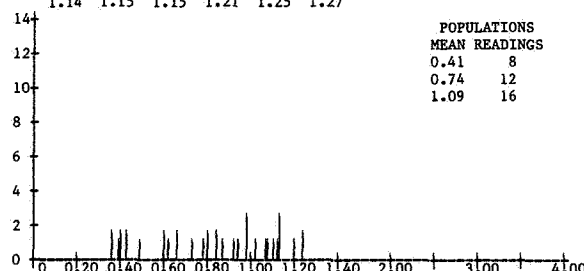


MIXED KEROGEN. VITRINITE OF VARIABLE REFLECTANCE.

SAMPLE 772-113A DEPTH 2590 VITRINITE REFLECTANCE VALUES

0.36	0.37	0.39	0.40	0.40	0.43	0.43	0.49	0.60	0.61
0.62	0.66	0.66	0.73	0.78	0.80	0.81	0.84	0.85	0.87
0.92	0.94	0.98	0.98	0.98	1.02	1.07	1.08	1.11	1.13
1.14	1.15	1.15	1.21	1.25	1.27				

POPULATIONS
MEAN READINGS
0.41 8
0.74 12
1.09 16

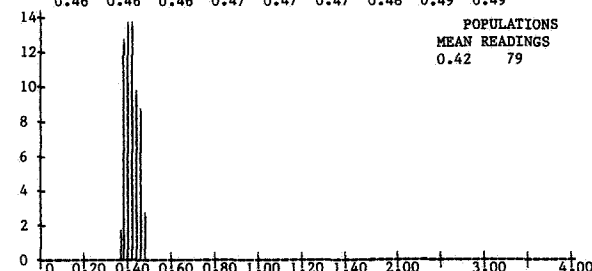


REMARKS MIXED KEROGEN. VITRINITE OF VERY VARIABLE REFLECTANCE.

SAMPLE 772-115D DEPTH 2620 VITRINITE REFLECTANCE VALUES

0.37	0.37	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
0.38	0.38	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.40
0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.41
0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41
0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.43
0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.44
0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.46	0.46
0.46	0.46	0.46	0.47	0.47	0.47	0.48	0.49	0.49	

POPULATIONS
MEAN READINGS
0.42 79

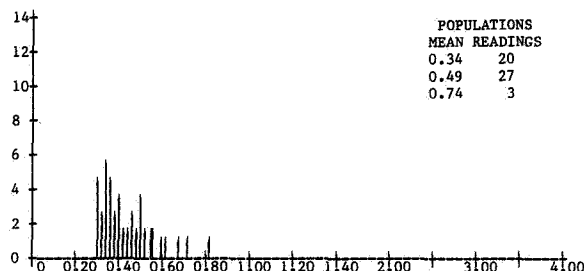


COAL. DOMINANTLY VITRINITE. MINOR INERTINITE AND EXINITE.

SAMPLE 772-122A DEPTH 2725 VITRINITE REFLECTANCE VALUES

0.30	0.30	0.31	0.31	0.31	0.32	0.33	0.33	0.34	0.34
0.34	0.34	0.35	0.35	0.36	0.36	0.36	0.36	0.37	0.38
0.39	0.39	0.40	0.40	0.41	0.41	0.42	0.43	0.44	0.45
0.46	0.46	0.47	0.48	0.48	0.50	0.50	0.50	0.51	0.52
0.53	0.55	0.55	0.56	0.56	0.60	0.62	0.68	0.72	0.82

POPULATIONS
MEAN READINGS
0.34 20
0.49 27
0.74 3

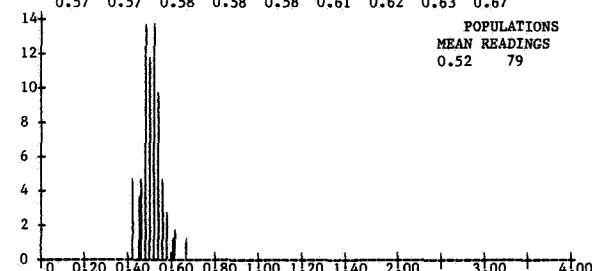


REMARKS MIXED KEROGEN. VITRINITE OF VERY VARIABLE REFLECTANCE.

SAMPLE 772-123D DEPTH 2740 VITRINITE REFLECTANCE VALUES

0.42	0.42	0.42	0.42	0.42	0.45	0.45	0.45	0.45	0.46
0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.48	0.48	0.48
0.48	0.48	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.51	0.51
0.51	0.51	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
0.52	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.54	0.54
0.54	0.54	0.55	0.55	0.55	0.55	0.55	0.55	0.56	0.56
0.57	0.57	0.58	0.58	0.58	0.61	0.62	0.63	0.67	

POPULATIONS
MEAN READINGS
0.52 79

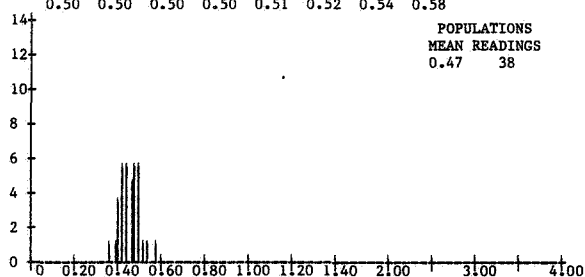


COAL. VARIABLE COMPOSITION. VITRINITE DOMINANT. SIGNIFICANT INERTINITE. MINOR EXINITE.

SAMPLE 772-124A DEPTH 2755 VITRINITE REFLECTANCE VALUES

0.36	0.39	0.40	0.41	0.41	0.41	0.42	0.42	0.43	0.43
0.43	0.43	0.44	0.45	0.45	0.45	0.45	0.45	0.47	0.47
0.47	0.47	0.47	0.48	0.48	0.48	0.48	0.49	0.49	0.50
0.50	0.50	0.50	0.50	0.51	0.52	0.54	0.58		

POPULATIONS
MEAN READINGS
0.47 38

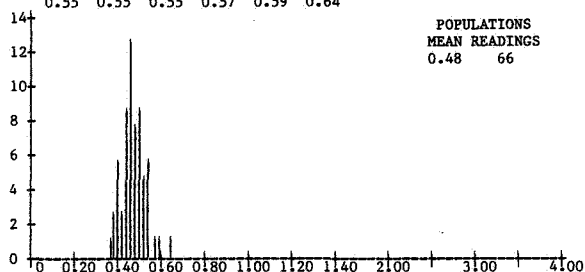


REMARKS CHIEFLY AMORPHOUS MATERIAL. FREQUENT SMALL PARTICLES OF VITRINITE AND INERTINITE.

SAMPLE 772-129B DEPTH 2830 VITRINITE REFLECTANCE VALUES

0.37	0.38	0.39	0.39	0.40	0.40	0.41	0.41	0.41	0.41
0.42	0.42	0.43	0.44	0.44	0.44	0.45	0.45	0.45	0.45
0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
0.46	0.46	0.46	0.47	0.47	0.48	0.48	0.48	0.49	0.49
0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50	0.50	0.51
0.51	0.51	0.52	0.53	0.53	0.53	0.53	0.54	0.54	0.55
0.55	0.55	0.55	0.57	0.59	0.64				

POPULATIONS
MEAN READINGS
0.48 66

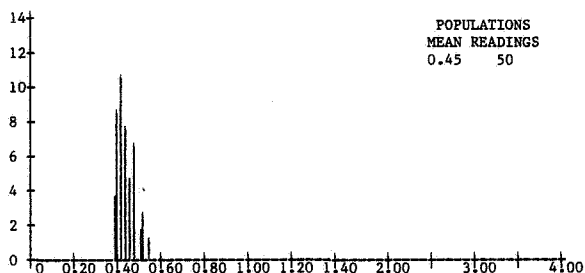


REMARKS MIXED KEROGEN.

SAMPLE 772-132B DEPTH 2875 VITRINITE REFLECTANCE VALUES

0.39	0.39	0.39	0.39	0.40	0.40	0.40	0.40	0.41	0.41
0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.43	0.43	0.43
0.43	0.43	0.43	0.43	0.44	0.44	0.45	0.45	0.45	0.45
0.45	0.45	0.46	0.46	0.47	0.47	0.47	0.48	0.48	0.48
0.49	0.49	0.49	0.49	0.51	0.51	0.52	0.53	0.53	0.55

POPULATIONS
MEAN READINGS
0.45 50

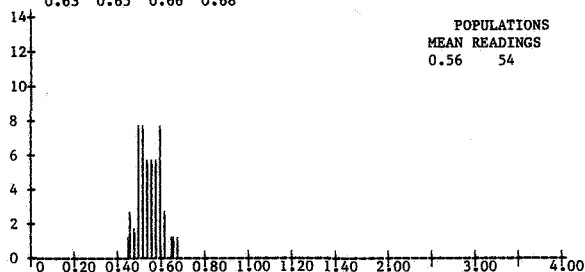


REMARKS CHIEFLY AMORPHOUS MATERIAL AND VITRINITE PARTICLES. SIGNIFICANT INERTINITE.

SAMPLE 772-141A DEPTH 3010 VITRINITE REFLECTANCE VALUES

0.45	0.46	0.46	0.47	0.48	0.49	0.50	0.51	0.51	0.51
0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.53	0.53	0.53
0.53	0.53	0.54	0.54	0.54	0.55	0.55	0.55	0.56	0.56
0.56	0.57	0.57	0.57	0.58	0.58	0.59	0.59	0.59	0.59
0.60	0.60	0.60	0.60	0.60	0.61	0.61	0.61	0.62	0.63
0.63	0.65	0.66	0.68						

POPULATIONS
MEAN READINGS
0.56 54

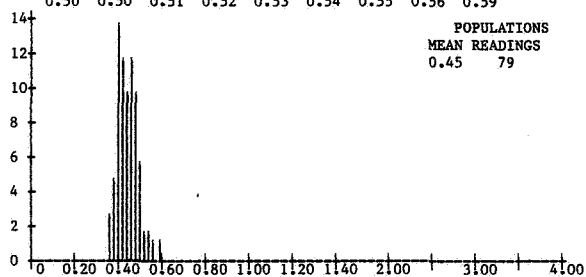


COAL. VITRINITE DOMINANT.

SAMPLE 772-126A DEPTH 2785 VITRINITE REFLECTANCE VALUES

0.36	0.37	0.37	0.38	0.39	0.39	0.39	0.39	0.40	0.40
0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.41	0.41	0.41
0.41	0.41	0.41	0.42	0.42	0.42	0.42	0.42	0.43	0.43
0.43	0.43	0.43	0.43	0.43	0.44	0.44	0.44	0.44	0.44
0.44	0.45	0.45	0.45	0.45	0.46	0.46	0.46	0.46	0.46
0.46	0.46	0.47	0.47	0.47	0.47	0.47	0.48	0.48	0.48
0.48	0.48	0.49	0.49	0.49	0.50	0.50	0.50	0.50	0.50
0.50	0.50	0.51	0.52	0.53	0.54	0.55	0.56	0.59	

POPULATIONS
MEAN READINGS
0.45 79

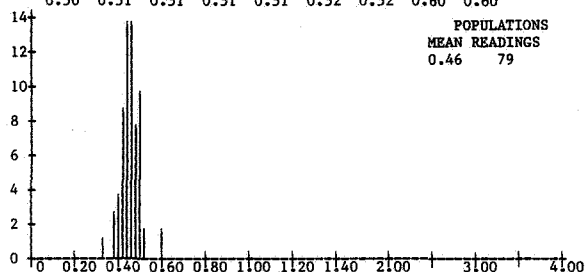


SHALY COAL.

SAMPLE 772-131D DEPTH 2860 VITRINITE REFLECTANCE VALUES

0.33	0.38	0.38	0.39	0.40	0.40	0.41	0.41	0.42	0.42
0.42	0.42	0.42	0.42	0.42	0.43	0.43	0.44	0.44	0.44
0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
0.44	0.44	0.44	0.45	0.45	0.45	0.45	0.45	0.45	0.45
0.45	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
0.46	0.47	0.47	0.47	0.47	0.47	0.47	0.48	0.48	0.48
0.48	0.48	0.48	0.48	0.48	0.50	0.50	0.50	0.50	0.50
0.50	0.51	0.51	0.51	0.51	0.52	0.52	0.60	0.60	

POPULATIONS
MEAN READINGS
0.46 79

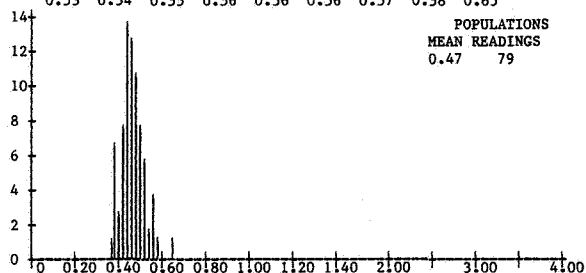


VITRINITE DOMINANT. SIGNIFICANT INERTINITE.

SAMPLE 772-135C DEPTH 2920 VITRINITE REFLECTANCE VALUES

0.37	0.38	0.38	0.39	0.39	0.39	0.39	0.39	0.40	0.40
0.41	0.42	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.44
0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.45	0.45
0.45	0.45	0.45	0.46	0.46	0.46	0.46	0.46	0.46	0.46
0.46	0.46	0.47	0.47	0.47	0.47	0.48	0.48	0.48	0.48
0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.50	0.50	0.51
0.51	0.51	0.51	0.51	0.51	0.52	0.52	0.52	0.52	0.53
0.53	0.54	0.55	0.56	0.56	0.56	0.57	0.58	0.65	

POPULATIONS
MEAN READINGS
0.47 79

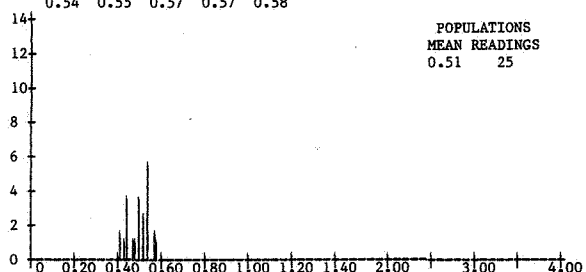


VITRINITE DOMINANT. MINOR INERTINITE AND EXINITE.

SAMPLE 772-141B DEPTH 3010 VITRINITE REFLECTANCE VALUES

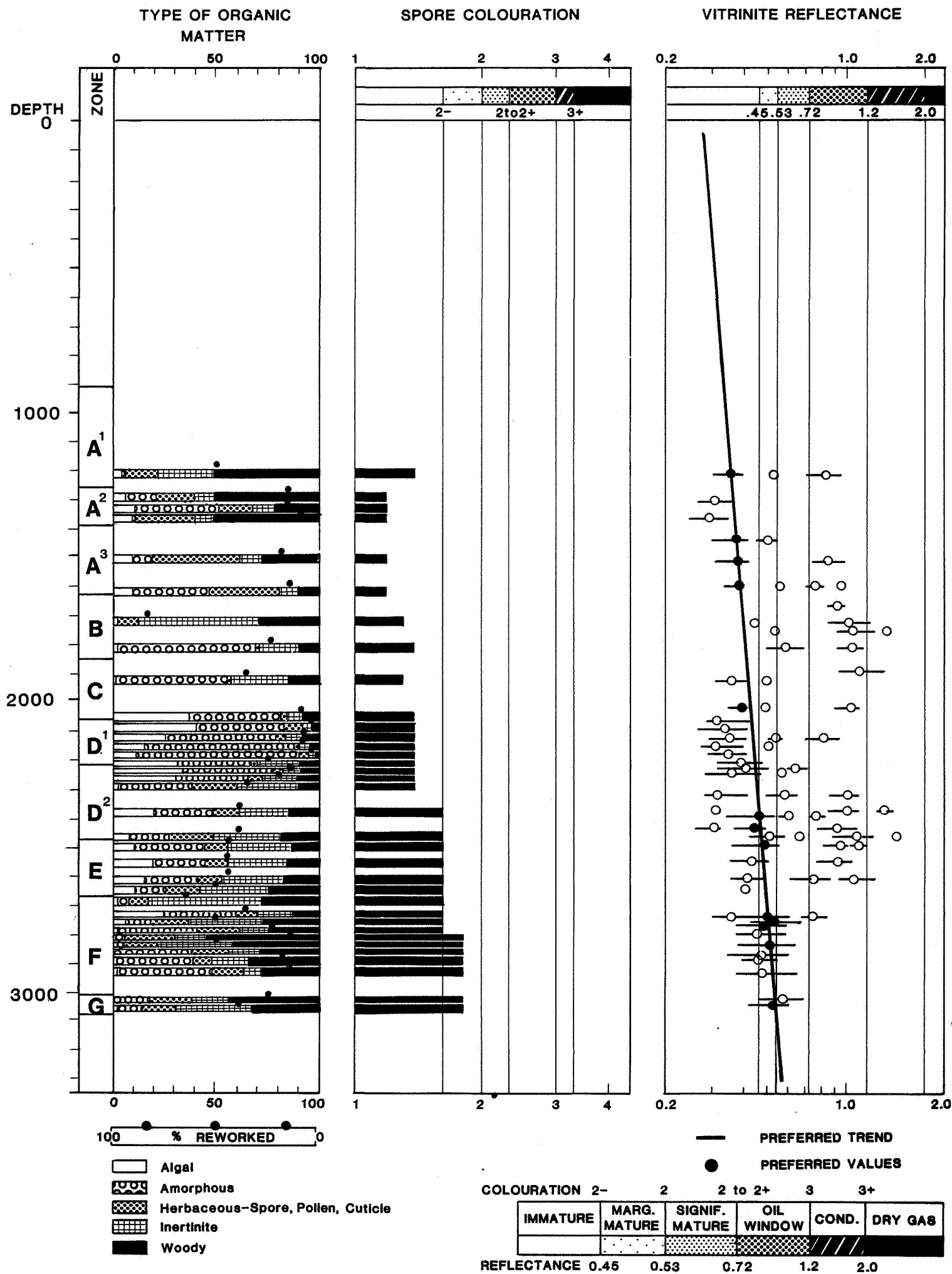
0.41	0.41	0.43	0.44	0.44	0.45	0.45	0.47	0.48	0.50
0.50	0.50	0.51	0.52	0.53	0.53	0.54	0.54	0.54	0.54
0.54	0.55	0.57	0.57	0.58					

POPULATIONS
MEAN READINGS
0.51 25



REMARKS FREQUENT PARTICLES OF VITRINITE AND INERTINITE. SIGNIFICANT AMORPHOUS MATERIAL.

FIGURE 7 ORGANIC FACIES & MATURITY WELL 6609/11-1

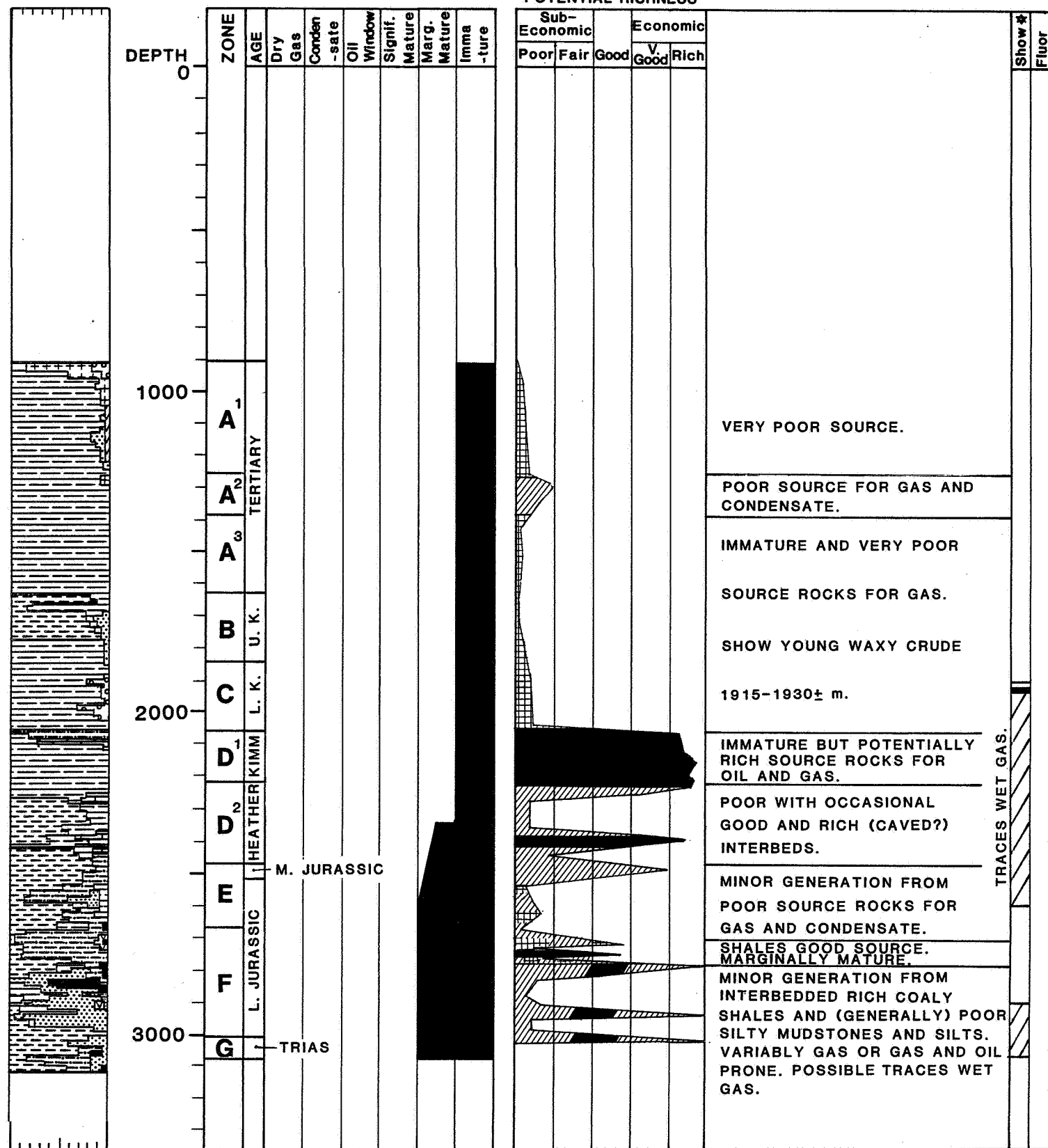


LITHO % LOG

MATURITY

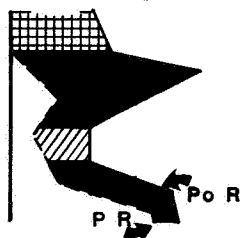
PRESENT AND
POTENTIAL RICHNESS

COMMENTS



LIMESTONE
 DOLOMITE
 SHALE
 MUDSTONE/CLAYSTONE
 COAL

SILTSTONE
 SANDSTONE
 EVAPORITE
 IGNEOUS
 L.C.M.



GAS PRONE
 GAS AND CONDENSATE
 OIL PRONE
 Shows Recognised by Analysis
 Po R Potential Richness
 PR Present Richness

BRIEF DESCRIPTION OF THE ANALYSES PERFORMED BY GEOCHEM

"Screen Analyses" are described in sections A, C and D, "Sample Preparation" in section B, "Follow-up Analyses" in sections E through K and "Correlation Studies" in section L. The analyses can be run on either core or cuttings material with the proviso that samples must be canned for the C₁-C₇ analysis and should be canned (or at least wet) for the C₄-C₇ analysis. The other analyses can be run on both canned and bagged samples.

A) C₁-C₇ LIGHT HYDROCARBON ANALYSIS

The abundance and composition of the C₁-C₇ hydrocarbons in sediments reflects their source richness, maturity and the character of the hydrocarbons they can yield. Most importantly, it is extremely sensitive to the presence of migrated hydrocarbons and is an excellent method for their detection. As it provides the information on most of the critical parameters and is also economical, this analysis is excellent for screening samples to decide which of them merit further analysis.

During the time which elapses between the collection of the sample at the wellsite and its analysis in the laboratory, a fraction of the total gas passes from the rock to the air space at the top of the can. For this reason, both the air space and the cuttings are analysed.

The analysis involves the gas chromatographic separation of the individual C₁-C₄ gaseous hydrocarbons (methane, ethane, propane, isobutane and normal butane) and a partial resolution of the C₅-C₇ gasoline-range hydrocarbons (for their complete resolution see Section E). The ppm abundance of the five gases and of the total C₅-C₇ hydrocarbons are calculated from their electronically integrated peak areas (not from peak height) by comparison with a standard.

In the report, the following data are tabulated: the abundance and composition of the air space gas, of the cuttings gas and of the combined air space and cuttings gases. The combined results are also presented graphically.

B) SAMPLE WASHING AND HAND PICKING

All of the analyses described in subsequent sections are run on washed and hand picked samples.

Cuttings are washed to remove the drilling mud, care being taken not to remove soft clays and fine sand during the washing procedure. Using the C₁-C₇ hydrocarbon data profile of the well, or the organic carbon profile (if this analysis is used for screening), electric logs (if supplied) and the appearance of the cuttings under the binocular microscope, samples are selected to represent the lithological and geochemical zones penetrated by the well. These samples are then carefully hand picked and the lithology of the uncaved material is described. It is these samples which are submitted for further analysis.

Sample material remaining after analysis is retained for six months. Unless instructions are received to the contrary, Geochem Laboratories may then destroy the samples.

Our reports incorporate a gross lithological description of all the samples which have been analysed and litho percentage logs. As screen analyses are recommended at narrow intervals, a complete lithological profile is obtained.

C) ORGANIC CARBON ANALYSIS

The organic carbon content of a rock is a measure of its total organic richness. Combined with the visual kerogen, C₁-C₇, C₄-C₇, pyrolysis and C₁₅+ analyses, the organic carbon content is used to evaluate the potential (not necessarily actual) hydrocarbon source richness of the sediment. This analysis is an integral part of a total evaluation and it can also be used as an economical screen analysis for dry samples (when the C₁-C₇ analysis cannot be used).

Hand picked samples are dried, crushed and then acidised to remove the inorganic calcium and magnesium carbonates. The actual analysis involves combustion in a Leco carbon analyser. Blanks, standards and duplicates are run routinely for purposes of quality control at no extra cost to the client.

The data are tabulated and presented diagrammatically in our reports in a manner which facilitates comparison with the gross lithology (see Section B) of the samples.

D) MINI-PYROLYSIS

An ideal screen analysis which provides a definitive measure of potential source richness upon those samples whose organic carbon contents suggest fair or good source potential. This is described in detail in section K.

E) DETAILED C₄-C₇ HYDROCARBON ANALYSIS

The abundance and composition of the C₄-C₇ gasoline-range hydrocarbons in sediments reflects their source quality, level of thermal maturation and organic facies. In addition, the data also reveal the presence of migrated hydrocarbons and can be used for crude oil-parent source rock correlation studies.

This powerful analysis, performed upon hand picked lithologies, is employed as a follow-up to confirm the potential of samples which have been selected using the initial screen analysis. It is used in conjunction with the organic carbon, visual kerogen and C₁₅+ analyses.

The individual normal paraffins, isoparaffins, naphthenes and aromatics with between four and seven carbon atoms in the molecule (but also including toluene) are resolved by capillary gas chromatography and their peak areas electronically integrated.

Normalised compositions, selected ratios and the ppm abundance of the total gasoline-range fraction are tabulated in the report and also presented graphically.

F) KEROGEN TYPE AND MATURATION

Kerogen is the insoluble organic matter in rocks. Visual examination of the kerogen gives a direct measure of thermal maturity and of the composition of the organic matter (organic facies) and indicates the source quality of the sediment - which is confirmed using the organic carbon, light hydrocarbon, pyrolysis and C₁₅+ analyses.

The type of hydrocarbon (oil or gas) generated by a source rock is a function of the types and level of thermal maturation of the organic matter which are present. Both of these parameters are measured directly by this method.

Kerogen is separated from the inorganic rock matrix by acid digestion and flotation methods which avoid oxidation of the organic matter. It is then mounted on a glass slide and examined at high and low magnifications with a Leitz microscope. Chemical methods measure the total kerogen population but, with this technique, individual particles can be selected for examination and spurious material identified. This is particularly valuable in reworked, contaminated and turbodrilled sediments.

The following data are generated: the types of organic matter present and their relative abundances, an estimate of the proportion of reworked material, preservation state, the thermal maturity of the non-reworked organic matter using the spore colouration technique.

Our maturation scale has been developed to digitise small but recognisable changes in organic matter colouration resulting from increasing maturity and to place particular emphasis upon the immature to mature transition. In the absence of a universal colouration scale, the most significant points on our scale have been calibrated against equivalent vitrinite reflectance values. The following maturation stages are recognised at the low end of the scale:-

- a) immature; thermal index less than 2- (0.45% Ro)
- b) marginally mature; indices between 2- and 2.
Minor hydrocarbon generation from amorphous and herbaceous ($\pm$ algal) organic matter
- c) mature; indices between 2 (0.53% Ro) and 2 to 2+ (0.72% Ro),
significant generation from amorphous, algal and herbaceous organic matter but wood only marginally mature
- d) oil window; indices of 2 to 2+ (0.72% Ro) through to 3 (1.2% Ro). Peak hydrocarbon generation.

The condensate zone starts at a thermal index of 3 whilst indices of 3+ (2.0% Ro) and higher indicate the eometamorphic dry gas stage.

A total of fourteen types of organic matter are sought based upon the major categories of algal, amorphous, herbaceous (spore, pollen, cuticle), wood, inertinite and resin. This detail is essential for a proper understanding of hydrocarbon source potential as the different sub-groups within each category have different properties.

Upon completion of the study, the kerogen slides are sent to the client.

G) VITRINITE REFLECTANCE

Vitrinite reflectance is an alternative/confirmatory method for evaluating thermal maturation which is used in conjunction with the visual kerogen analysis. The reflectivity of vitrinite macerals increases in response to thermal alteration and is used to define maturation levels and, by projection, to predict maturity at depth or the thicknesses of section removed by erosion.

Measurements are made upon kerogen separations in conjunction with polished whole rock samples. In general, this analysis is performed upon the same samples as the visual kerogen analysis, thus facilitating a direct comparison of the two sets of results.

If possible, forty to fifty measurements are taken per sample - unless the sediments are organically lean, vitrinite is sparse or only a single uniform population is present. The data are plotted in a histogram which distinguishes the indigenous vitrinite from possible reworked or caved material. Averages are calculated for each population. Comments upon exinite fluorescence and upon the character of the phytoclasts are noted on the histograms. The reports contain the tabulated data, histograms and the reflectivities plotted against depth.

The vitrinite and visual kerogen techniques provide mutually complementary information upon maturity, organic matter type and diagenesis.

H) C₁₅+ EXTRACTION, DEASPHALTENING AND CHROMATOGRAPHIC SEPARATION

Sections "A" and "E" dealt with analyses covering the light end of the hydrocarbon spectrum. This section is concerned with the solvent extractable organic material in the rock with more than fourteen carbon atoms in the molecule (i.e. the heavy end). The amount and composition of this extract indicates source richness and type, the level of thermal maturation and the possible presence of migrated hydrocarbons.

These results are integrated with those derived from the pyrolysis, visual kerogen, organic carbon and light hydrocarbon analyses.

The techniques involved in this analysis employ pure solvents and have been designed to give reproducible results. Hand picked samples are ground and then solvent extracted in a soxhlet apparatus, or by blending, with dichloromethane (the solvent system can be adapted to client's specifications). After asphaltene precipitation, the total extract is separated by column chromatography or high pressure liquid chromatography into the following fractions: paraffin-naphthene hydrocarbons, aromatic hydrocarbons, eluted NSO's (nitrogen-, sulphur-, and oxygen- containing non-hydrocarbons) and non-eluted NSO's. Note that the non-hydrocarbons are split into three fractions and not reported as a gross value. These fractions can be submitted for further analyses (carbon isotopes, gas chromatography, high mass spectroscopy) including correlation studies.

For convenience and thoroughness, the data are reported in three formats: the weights of the fractions, ppm abundances and normalised percentage compositions. The data are also presented diagrammatically.

J) GC ANALYSIS OF C₁₅+ PARAFFIN-NAPHTHENE HYDROCARBONS

The gas chromatographic configurations of the heavy C₁₅+ paraffin-naphthene hydrocarbons reflect source type, the degree of thermal maturation and the presence and character of migrated hydrocarbons or contamination.

Not only is this analysis an integral part of any source rock study but it also provides a fingerprint for correlation purposes and helps to define the geochemical/palynological environmental character of the source rocks from which crude oils were derived.

The paraffin-naphthene hydrocarbons obtained by column chromatography are separated by high resolution capillary chromatography. Excellent resolution of the individual normal paraffins, isoprenoids and significant individual isoparaffins and naphthenes is achieved. Runs are normally terminated at nC₃₅. A powerful in-house microprocessor system is being introduced to correct for the change in response factor with chain length.

The normal paraffin carbon preference indices (C.P.I.) indicate if odd (values in excess of 1) or even (values less than 1) normal paraffins are dominant. Strong odd preferences ($\neq$ strong pristane peaks) are characteristic of immature land plant organic matter whilst even preferences ($\neq$ strong phytane peaks) suggest a reducing environment of deposition. With increasing maturity, values approach 1.0 and oils are typically close to 1.0. The indices are calculated using the following formulae:

$$C.P.I.A = \frac{C_{21} + C_{23} + C_{25} + C_{27}}{C_{20} + C_{22} + C_{24} + C_{26}} + \frac{C_{21} + C_{23} + C_{25} + C_{27}}{C_{22} + C_{24} + C_{26} + C_{28}}$$

$$C.P.I.B = \frac{C_{25} + C_{27} + C_{29} + C_{31}}{C_{24} + C_{26} + C_{28} + C_{30}} + \frac{C_{25} + C_{27} + C_{29} + C_{31}}{C_{26} + C_{28} + C_{30} + C_{32}}$$

Chromatograms are reproduced in the report for use as visual fingerprints and in addition, the following data are tabulated: normalised normal paraffin distributions; proportions of paraffins, isoprenoids and naphthenes in the total paraffin-naphthene fraction; C.P.IA and C.P.IB; pristane to phytane ratio; pristane to nC₁₇ ratio.

K) PYROLYSIS

The process of thermal maturation can be simulated in the laboratory by pyrolysis, which involves heating the sample under specified conditions and measuring the oil-like material which is freed/generated from the rock. With this analysis, the potential richness of immature sediments can be determined and, by coupling the pyrolysis unit to a gas chromatograph, the liberated material can be characterised. These results are correlated with those obtained from the organic carbon, kerogen and C₁₅₊ analyses.

Small amounts of powdered sample are heated in helium to release the thermal bitumen (up to 340°C) and pyrolysate (340-550°C). The thermal bitumen correlates with the solvent extractable material (see above) whilst the pyrolysate fraction does not exist in a "free" state but is generated from the kerogen, thus simulating maturation in the subsurface. Abundances (weight ppm of rock) are measured with a flame ionisation detector against a standard. Thermal bitumen includes source indigenous, contaminant and migrated hydrocarbons but the pyrolysate abundance is a measure of ultimate source richness. The capillary gas chromatogram of the pyrolysate is used to evaluate the character of the parent organic matter and whether it is oil or gas prone. Peak temperature(s) of pyrolysate evolution is recorded. Carbon dioxide can be measured if requested but is normally ignored as the separation of the organic and inorganic species has been found to be artificial and unreliable.

Pyrolysate yields provide a definitive measure of potential source richness which avoids the ambiguities of the organic carbon data and the problem of contamination. This analysis is also used to evaluate the quality and character of the organic matter and the degree to which it has realised its ultimate hydrocarbon potential. Geochem does not employ the pyrolysis technique to evaluate maturation, preferring the kerogen and vitrinite reflectance analyses which avoid the problem of reworking and hence, are more reliable.

Capillary chromatograms produced for the pyrolysate hydrocarbons range from C₁ (methane) out towards C₃₅ but exhibit considerable variations. They are used to define whether a source rock will yield oil, condensate or gas. With this new technique, it is now possible to complete the evaluation of a source rock.

The data are tabulated and presented graphically. MINI-PYROLYSIS includes ppm thermal bitumen and ppm pyrolysate. PYROLYSIS also provides the above together with the temperature of peak pyrolysate evolution. The capillary chromatograms of the pyrolysate obtained by PYROLYSIS-GC are reproduced in the report. The Mini-Pyrolysis analysis is recommended as a screening technique.

L) CORRELATION STUDY ANALYSES

Oil to oil and oil to parent source rock correlation studies require high resolution analytical techniques. This requirement is satisfied by some of the analyses discussed above but others have been selected specifically for correlation work. Many of these analyses also provide information upon the character of the environment of deposition of the parent source rocks.

- detailed C₄-C₇ hydrocarbon (gasoline range) analysis. See Section E. Although these hydrocarbons can be affected by migrational/alteration processes, they commonly provide a very useful correlation parameter.
- capillary gas chromatography of the C₁₅+ paraffin-naphthenes. See section J. The branched+normal paraffin distributions are used to "fingerprint" the samples.
- capillary chromatograms of whole oils and of the C₈+ fraction of source rocks.
- capillary gas chromatography of C₁₅+ aromatic hydrocarbons. Separate chromatograms of the hydrocarbons and of the sulphur-bearing species are reproduced.
- high pressure liquid chromatograms.
- mass spectrometric carbon isotope analyses of crude oil and rock extract fractions and of kerogen separations. A powerful tool for comparing hydrocarbons and correlating hydrocarbons to organic matter. With this technique the problem of source rock contamination can be avoided. The data are recorded on x-y or Galimov plots.
- mass fragmentograms (mass chromatograms) of fragment ions characteristic of selected hydrocarbon groups such as the steranes and terpanes. The fragmentograms provide a convenient and simple means of presenting detailed mass spectrometric data and are used as a sophisticated fingerprinting technique. This provides the ultimate resolution for correlating hydrocarbons and facilitates the examination of hydrocarbon classes.
- vanadium and nickel contents.

Suites of (rather than single) analyses are employed in correlation studies, the actual selection depending upon the complexity of the problem. See also section N.

M) ANALYSES FOR SPECIAL CASES

M-1) ELEMENTAL KEROGEN ANALYSIS

This analysis evaluates source quality, whether the sediments are oil or gas prone, the character of the organic matter and its level of thermal maturation. It is the chemical equivalent of the visual kerogen analysis. The pyrolysis analysis is generally preferred to this technique, both methods providing similar information.

M-2) SULPHUR ANALYSIS

The abundance of sulphur in source rocks and crude oils.

M-3) CARBONATE CONTENT

The mineral carbonate content of sediments is determined by acid treatment. These data are particularly useful when used in conjunction with organic carbon contents as a screening technique.

M-4) NORMAL PARAFFIN ANALYSIS

Following the removal of the branched paraffins and naphthenes from the total paraffin-naphthene fraction, a chromatogram of the normal paraffins is obtained. The resulting less complicated chromatogram facilitates the examination of normal paraffin distributions.

M-5) SOLID BITUMEN EVALUATION

Residual solid bitumen after crude oil is generated by three prime processes: the action of waters, gas deasphalting, thermal alteration. Thus it provides a means of determining the reservoir history of a crude and of evaluating whether adjacent traps will or will not be prospective for oil. In carbonate sections, where organic matter is sometimes sparse, this technique is also used to evaluate thermal maturation levels.

The analysis involves the determination of the solubility (in CS_2) of the solid bitumen and of the atomic hydrogen to carbon ratio of the insoluble fraction.

N) CRUDE OIL ANALYSIS

N-1) API GRAVITY

This can be performed upon large (hydrometer) and small (SG bottle, pycnometer) samples and even upon stains extracted from sediments (refractive index).

N-2) SULPHUR CONTENTS (ASTM E30-47)

N-3) POUR POINT (ASTM D97-66, IP15/67)

N-4) VISCOSITY (ASTM D445-72, IP71/75)

N-5) FRACTIONAL DISTILLATION

Graph of cumulative distillation yield against temperature.. Five percent cuts taken for further analysis. Mass spectrometric studies of these fractions provide a detailed picture of the distribution of paraffins and of the various naphthene and aromatic groups within a crude, which is useful both for correlation and for refinery evaluation purposes.