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# GEOCHEMICAL SERVICE REPORT

Prepared for

STATOIL

GEOCHEMICAL EVALUATION OF STATOIL'S 8/3-2

NORTH SEA WELL



April 1983

CHESTER STREET · CHESTER CH4 8RD · ENGLAND

# GEOCHEMICAL EVALUATION OF STATOIL'S 8/3-2 NORTH SEA WELL



## SUMMARY

The analysed section above 2070± metres consists of uninteresting and immature source rocks which, even in a mature state, would have a poor potential for hydrocarbons.

In contrast, the medium dark grey and dark grey Jurassic shales of Zone E (2070-2417± metres) are potentially a fair (above 2220± metres) and good source for gas and condensate. Similar shales represent a good and very good source for gas and condensate within Zone F, although below 2460± metres at least, they are believed to be largely caved. Rich interbeds of brownish grey shaly mudstone are present between 2250-2310± metres in Zone E. Whilst minor hydrocarbon generation has occurred below approximately 2300± metres, on-structure these sediments are limited by lack of maturity.

Traces, occasionally significant, of extremely dry gas are suggested in Zones $A^1$ through B. The strongest shows occur chiefly as wet gas below 2220± metres within Zone E but further minor scattered shows were also detected. These are discussed in detail in Section E of the report.

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## INTRODUCTION

This report presents a geochemical evaluation of the section between 168 metres and 2657 metres in Statoil's 8/3-2 well drilled in the Norwegian sector of the North Sea.

The study was designed to investigate the hydrocarbon source potential of the sediments, and also to detect and characterise shows of migrated hydrocarbons.

This project was authorised by Dr. H. Irwin, Statoil, Stavanger.

## A. ANALYTICAL

A total of eight four (84) canned cuttings samples, composited over 30 metres was received from the interval between 168 metres and 2657 metres in Statoil's 8/3-2 well. The samples were assigned the Geochem job number 714 and numbered sequentially from -001 to -084.

Slight grease was observed, during the sample washing process, in the sample from 1770-1800 metres.

The sediments were screened using the light hydrocarbon ($C_1$-$C_7$), organic carbon and pyrolysis analyses. Samples for further analysis were selected on the basis of the screen results. A total of eight four light hydrocarbon analyses, one hundred and twenty seven organic carbon analyses, forty one screening pyrolysis analyses, thirty four visual kerogen analyses, twenty two vitrinite reflectance determinations, twenty one extractions with chromatography, twenty one paraffin-naphthene analyses and twenty four pyrolysis-GC analyses were performed in this study. In addition, a suite of sulphur chromatograms was prepared free of charge.

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

## B. GENERAL INFORMATION

Three (3) copies of this report have been forwarded to Dr. H. Irwin, Statoil, Stavanger together with the kerogen slides. A copy of this data has been retained by Geochem for future consultation with authorised Statoil personnel.

The remaining sample material will be handled as directed.

The results of this study are proprietary to Statoil, Stavanger.

## RESULTS AND INTERPRETATION

Each of the parameters relevant to the geochemical evaluation of the analysed section will be considered in turn and then combined to form the "Conclusions".

Formation tops were supplied by the client.

### A. ZONATION

The following zonation is based on a synthesis of light hydrocarbon ($C_1$-$C_7$), lithological and stratigraphic data. Eight (8) zones are recognised.

Zone $A^1$ 168 metres to 510± metres consists of poor quality samples dominated by sand or lost circulation material together with variable proportions of shell fragments, igneous material and chert.

No fluorescence was detected.

$C_1$-$C_4$ gas abundances are generally fair at 940-4009 ppm, although the two uppermost samples are leaner (462-514 ppm). The gases are extremely dry (0.5-7.1% $C_{2+}$ hydrocarbons) with the exception of the sample at 168-180± metres (63.8% $C_{2+}$ hydrocarbons), and isobutane to normal butane ratios are low at 0.32 to 0.79. Gasoline range ($C_5$-$C_7$) hydrocarbons do not exceed 77 ppm.

Zone $A^2$ lies between 510± metres and 930± metres and comprises medium olive grey mudstones (as worm casts and bryozoans), frequently glauconitic and highly pyritised, with interbedded limestones above 720± metres and argillaceous limestones below this depth.

No fluorescence was observed in the limestones.

$C_1$-$C_4$ gas abundances fall within the range (575)1155-9850 ppm apart from a 'kick' at 840-900± metres (13163-16035 ppm), and the gases remain very dry (0.8-3.9% $C_{2+}$ hydrocarbons). Butane ratios vary erratically between 0.31 and 1.51(2.88). Gasoline range hydrocarbons are extremely sparse at 0-9(33) ppm.

Zone D is marginally richer than the overlying zone with 1229-2090 ppm of $C_1$-$C_4$ hydrocarbons above 1770± metres but only 328-962 ppm below, while the $C_5$-$C_7$ abundances increase with depth from 2 ppm up to 99 ppm. The gases are extremely dry (3.2-8.2% $C_{2+}$ hydrocarbons) above 1860± metres, but vary between 17.5% and 39.6%(56.4%) $C_{2+}$ hydrocarbons at greater depth. Butane ratios generally exceed 1.0.

Zone E 2070± metres to 2417± metres contains sediments of Jurassic age and comprises medium dark grey and dark grey shales with scattered interbeds of other mudstones and shaly mudstones. Sand and a coal were recovered from the sample at 2370-2400± metres.

Within this zone the $C_1$-$C_4$ abundances are fair (1017-8424 ppm) above 2220± metres but improve to 9095-33340 ppm below this depth, the richest intervals being between 2220-2280± metres and below 2370± metres. The gases are commonly marginally wet ([22.0]28.9-48.7% $C_{2+}$ hydrocarbons) and butane ratios vary randomly from 0.53 up to 1.78. Gasoline range hydrocarbons, although richer than hitherto, are generally only of poor abundance (185-815 ppm), although they are enhanced between 2190-2280± metres (1038-2920 ppm).

Zone F extends from 2417± metres down to the deepest sample at 2657± metres and is characterised by interbedded sands, moderate brown siltstones and dark grey to medium grey shales (largely caved?) of the Skaggerak Formation.

No fluorescence was detected in the sands.

The sediments contain 756-2307 ppm of wet or marginally wet gas ([16.0]31.1-64.1% $C_{2+}$ hydrocarbons) and 41-241 ppm of $C_5$-$C_7$ hydrocarbons. Butane ratios are low (0.35-0.55).

## 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 medium olive grey mudstones of Zone $A^2$ have fair (0.53-0.68% organic carbon), occasionally good (1.03-1.17%) contents of organic matter that is essentially woody with significant algal±herbaceous material. The argillaceous limestones of this zone are of comparable richness at 0.54-0.77% organic carbon while the limestones above 720± metres are only slightly leaner (0.34-0.49[0.83]% organic carbon). Their organic matter, although dominantly amorphous, is not typically oil prone and includes finely disseminated, poor quality material, possibly contaminant.

Zones $A^3$ and B exhibit significant variations. The richest sediments within this interval are the thin olive grey to medium olive grey mudstones present between 960-1050± metres. The organic matter in these very good mudstones (2.61-3.74% organic carbon) is dominantly amorphous with significant wood. The amorphous kerogen includes abundant degraded material and is not typically oil prone. Values of 1.54-1.78% organic carbon seem optimistic for the light grey to greenish grey calcareous mudstones below 960± metres and, indeed, the value falls to 0.53% between 930-960± metres suggesting that the higher values may result from the presence of drilling introduced contamination. Their indigenous organic matter is probably best described as woody with significant herbaceous material and inertinite since the amorphous and algal components of the kerogen are believed to be drilling introduced. A similar organic assemblage characterises the olive grey to dark olive grey shaly mudstone of Zone B (0.98% organic carbon). The medium greenish grey to medium grey shaly mudstone of this zone has an organic carbon content of 1.57%. In contrast, the minor light brown mudstones of Zones $A^3$ and B are extremely lean at 0.09-0.27% organic carbon and the light olive grey mudstones fair (0.46-0.84% organic carbon).

The Zone C limestones contain 0.09-0.23% of mixed inertinitic-algal-woody-herbaceous-amorphous kerogen. Although richer (0.86-1.15% organic carbon),

the thin light grey to medium light grey mudstones at the top of this zone are comparable in terms of organic matter type.

The medium grey mudstones and shales which predominate in Zone D generally have above average (0.98-1.36%) organic contents, comprising inertinite and wood almost exclusively, although their leaner equivalents (0.59-0.69% organic carbon) are present in the interval between 1920-2010± metres. The slightly darker and richer (1.52-1.62% organic carbon) shales below 2010± metres contain better quality organic matter, with significant to major proportions of herbaceous material, inertinite and wood, while that of the lean (0.46% organic carbon) medium greenish grey shaly mudstone recovered from the sample at 1650-80± metres is chiefly amorphous (not typically oil prone) with significant to major inertinite and wood. It is worth emphasising that the amorphous kerogen seen in the sediments to date is not typically oil prone material.

Although apparently similar to the underlying shales, the medium dark grey shales of Zone E above 2160± metres are slightly leaner (1.78-1.92% organic carbon) and are characterised by organic matter consisting chiefly of herbaceous material together with significant wood, inertinite, algal and amorphous kerogen. In contrast, the darker shales below 2190± metres are enhanced at 2.59 to 3.29% organic carbon and their organic assemblages are essentially mixed, good quality amorphous-algal-inertinitic-herbacous-woody, with amorphous material, albeit frequently incompletely developed, commonly the principal constituent. The shale from 2160-90± metres appears to be intermediate both in terms of richness (2.28% organic carbon) and organic matter type. Rich (6.12-7.16% organic carbon) and very good (2.83-2.90% organic carbon) interbeds of brownish grey and dark brownish grey shaly mudstone occur respectively at 2250-2310± metres and 2310-70± metres within this zone. Their organic matter is similar to that of the dominant shales. The thin medium grey to medium olive grey shale/mudstone occuring between 2040-2100± metres bears a close resemblance to the principal shales of Zone D, being of only fair (0.62-0.73%) organic content and with inertinite and wood constituting the bulk of the kerogen. Finally, a thin coal (57.80% of organic carbon) was recovered from the base of Zone E.

Although the medium dark grey to dark grey shales of Zone E apparently persist into Zone F, below 2460± metres at least, they are believed to be largely, if not exclusively, caved. The remaining sediments within this zone, i.e. the moderate brown siltstones (0.08-0.14% organic carbon) and the thin

limestone (0.11% organic carbon) observed at 2490-2520± metres, are extremely lean.

## C. LEVEL OF THERMAL MATURATION

The level of thermal maturity has been assessed by the visual kerogen (spore colour) and vitrinite reflectance techniques.

The spore colouration method gives thermal indices of 1+ and 1+ to 2- down to approximately 2300± metres, and a value of 2- below this depth. All organic matter with a thermal index of less than 2- is immature. At 2- the amorphous, herbaceous±algal fractions become marginally mature (minor hydrocarbon generation) although significant generation is not initiated until 2. In this well, therefore, the section above 2300± metres is immature, and only limited hydrocarbon generation will have occurred below this depth.

The vitrinite reflectance data show a trend of increasing reflectivity with depth, with populations at 0.25-0.30% in Zone $A^2$ and at 0.45% towards the base of Zone E, although, in general, there is considerable scatter of individual values resulting from reworking of the organic matter. Nevertheless, the best trend line through the least mature vitrinite populations reaches a value of 0.45% at approximately 2400± metres. Since a reflectivity of 0.45% normally correlates with a thermal index of 2- there is very good agreement between the two methods.

A suite of sulphur chromatograms was prepared free of charge. In general they are dominated by a single ($C_2$ alkyldibenzthiophene) peak confirming that the sediments are immature, although the presence of contamination is indicated in several of the traces.

## D. SOURCE RICHNESS

Preliminary assessments of present and potential source richness can be obtained from the light hydrocarbon and organic carbon abundances respectively.

The light hydrocarbon data suggest that Zones $A^1$ through B have a generally fair source potential, although Zones $A^2$ and $A^3$ both contain good intervals. In contrast Zone C is poor. Zone E is rated as fair above 2220± metres, but good or very good below this depth, while Zones D and F are fair above 1770±

metres and 2520± metres respectively, but are otherwise poor. However, as migrated hydrocarbons are suspected below approximately 1950± metres, the light hydrocarbon abundances cannot reliable be used to assess source richness for this part of the section, although those intervals rated as poor will remain unaffected.

Organic carbon contents indicate that Zones $A^3$ and B are highly variable though probably fair overall, and confirm that Zones $A^2$ and C are respectively fair and poor. Zone D is good apart from the poor interval above 1680± metres and Zone E is essentially very good but with minor fair and rich interbeds. With the exception of the very good shales believed to be largely, if not exclusively, caved below at least 2490± metres, Zone F is rated as poor by this parameter.

The abundance of indigenous $C_{15+}$ hydrocarbons is normally related to source richness. Upon extraction, the sediments of Zone D yielded 1364-1897 ppm of $C_{15+}$ hydrocarbons above 1800± metres and 484-895 ppm below this depth, suggesting respectively a rich and a very good hydrocarbon potential. However, examination of the paraffin-naphthene chromatograms indicates the presence of a highly naphthenic drilling introduced contaminant. Consequently these ratings are over optimistic. Although immature source indigenous hydrocarbons are apparent in the traces, notably the even carbon preference between $nC_{16}$ or $nC_{18}$ and $nC_{20}$, the odd carbon preference from $nC_{23}$ upward and the sterane/triterpane contribution, it is likely that a poor or, at best, fair rating more accurately describes these sediments. The chromatograms of the medium dark grey to dark grey shales which predominate in Zone E and continue into Zone F are essentially similar, although the source indigenous hydrocarbons are more predominant, suggesting organic matter of better quality. Allowing for the contamination prevalent in these samples, it would appear that these shales are commonly fair or good source rocks, as opposed to good or very good ones. The chromatograms of the remaining extracted samples follow the same pattern - the presence of contamination frequently masking the indigenous hydrocarbons and indicating that any source richness ratings based on $C_{15+}$ abundances are likely to be optimistic.

Hydrocarbon potential at optimum maturity is measured using the pyrolysis technique and, with the exception of Zone $A^1$ which is of no exploration significance, a complete mini pyrolysis profile was generated for this well. However, as the initial analyses suggested enhanced pyrolysate yields resulting from the presence of drilling introduced contamination, the richer samples were

all reanalysed by screening pyrolysis after removal of contamination. Although the interpretation is based on a synthesis of the data, both sets are reproduced in full at the back of the report. On the basis of pyrolysate yield, the entire section down to 2010± metres (i.e. close to the base of Zone D) must be rated as poor apart from the thin interbeds of olive grey to medium olive grey mudstone between 960-1050± metres which at 2064 ppm is potentially a fair source. The medium dark grey to olive grey shales at the base of Zone D (2010-70± metres) are poor to fair (1853-1860 ppm). Although a value of 3300 ppm indicates a good rating for the light grey to medium greenish grey calcareous mudstone at 960-990± metres, its equivalent in the underlying sample generated only 780 ppm. With pyrolysate yields (2079)3148-5110 ppm, the medium dark grey to dark grey shales of Zone E below 2220± metres clearly represent a good potential source while within Zone F they are still better at (3330)4139-7815 ppm, suggesting that some of these shales within Zone F may not, in fact, be caved. The interbeds of brownish grey shale occurring between 2250-2310± metres (10416-12421 ppm) are potentially the richest sediments of the entire section, with the single exception of the thin coal at 2370-2400± metres (63348 ppm). In contrast, the medium dark grey shales of Zone E above 2220± metres have only fair values of 2125-2784 ppm pyrolysate.

Chromatograms of the pyrolysate material determine whether a mature source rock will yield oil, gas or condensate. Despite the contamination which is readily apparent in many of these traces (although efforts were made to remove it) the following interpretation is made. The sediments of Zones $A^2$ through D are characterised by chromatograms which are restricted to the $C_{15-}$ faction and consist in general of methane and a sparse distribution of aromatic peaks indicating a potential essentially for gas, or in which additional tiny peaks are also present to approximately $nC_{20}$ suggesting a potential for gas and associated condensate. The chromatograms generated by the medium dark grey and dark grey shales of Zones E and F are essentially similar to those of the latter group, comprising a methane peak together with a series chiefly of aromatic peaks extending out to $nC_{20}$. Alkane-alkene doublets are notable only by their absence. These shales would if mature, yield gas and condensate.

In summary therefore:

- Zone $A^1$: poor sequence of no significance as a source.
- Zones $A^3$ and B: generally poor source essentially for gas - poor and fair interbeds for gas and associated condensate.

- Zones $A^2$, C and D: poor source rocks with a potential for gas, poor to fair in Zone D below 2010± metres.
- Zone E: fair above 2220± metres, otherwise a potentially good source unit for gas and condensate. Rich interbeds below 2250± metres.
- Zone F: a poor source for gas with the notable exception of the shales at the top of this zone which have a very good and good potential for gas and condensate.

## E. MIGRATED HYDROCARBONS

No fluorescence was detected in any of the potential reservoir facies.

Zones $A^1$ through B are, in general, characterised by fair and occasionally good abundances of extremely dry gas (0.5-7.1% $C_{2+}$ hydrocarbons) notably in the intervals 540-600± metres, 840-900± metres and 960-990± metres. Although the source indigenous gases in such immature sediments should be dry, it is likely that these data are not fully explained in terms of source indigenous hydrocarbons, but reflect in addition the presence of traces, occasionally significant, of extremely dry (biogenic) gas.

Within Zone C the light hydrocarbons are commonly sparse and dry. The exceptions are provided by the sample from 1110-1140± metres which is enhanced at 1500 ppm of extremely dry gas and the interval between 1500-60± metres, where the gases are extremely lean at 69-88 ppm, but marginally wet (28.1-30.0% $C_{2+}$ hydrocarbons). In addition, the sample from 1290-1320± metres is anomalous with 84.4% $C_{2+}$ hydrocarbons, resulting from an abnormal ethane concentration (385 ppm out of a total of 460 ppm $C_1$-$C_4$ hydrocarbons).

The light hydrocarbons of Zone D above 1770± metres are extremely dry (2.0-4.0% $C_{2+}$ hydrocarbons) and of fair abundance (1229-2090 ppm). These values indicate that migrated hydrocarbons can, at best, only be present as minor traces of biogenic gas. Below 1860± metres insignificantly minor traces of marginally wet gas are suggested by the data. The intervening interval between 1770 and 1860± metres is both lean and extremely dry.

In contrast, Zone E contains enhanced $C_1$-$C_4$ abundances with strong shows between 2220-80± metres and 2370-2400± metres. Hydrocarbon generation has barely commenced in the shales of Zone E, but in view of their richness, a significant proportion of the gases associated with them are likely to be indigenous. However, as the gases are marginally wet throughout this zone it

is likely that minor lateral migration within Zone E from its more mature, off-structure equivalents has taken place. The low abundances of $C_5$-$C_7$ hydrocarbons, apart from the interval between 2190-2280± metres, indicates that the migrated species occur chiefly as wet gas. The strongest shows occur below 2220± metres. Minor traces of wet gas are also present in Zone F above 2520± metres together with insignificantly minor traces below this depth.

The heavy $C_{15+}$ hydrocarbon fraction does not provide any evidence of crude oil in any of the analysed samples.

## F. CONCLUSIONS

Eight (8) zones are recognised in the interval between 168 metres and 2657 metres in the 8/3-2 well.

Zone $A^1$ (168-510± metres) consists of poor quality samples dominated by sand or lost circulation material together with variable proportions of shell fragments, igneous material and chert. These sediments are of no significance as source rocks.

The medium olive grey mudstones of Zone $A^2$ (510-930± metres) have fair (0.53-0.68% organic carbon), occasionally good (1.03-1.17%) contents of organic matter that is essentially woody with significant algal±herbaceous material. The argillaceous limestones of this zone are of comparable richness at 0.54-0.77% organic carbon while the limestones above 720± metres are only slightly leaner (0.34-0.49[0.83]% organic carbon). Their organic matter, although dominantly amorphous, is not typically oil prone and includes finely disseminated, poor quality material. These sediments are immature but, even if mature, would only be poor and uninteresting source rocks.

Zones $A^3$ (930-1044± metres) and B (1044-1116± metres, Palaeocene) exhibit significant variations. The richest sediments within this interval are the thin olive grey to medium olive grey mudstones (2.61-3.74% organic carbon) present between 960-1050± metres. Their organic matter is dominantly amorphous with significant wood, though the amorphous kerogen is not typically oil prone and includes abundant degraded material. Organic carbon values for the light grey to greenish grey calcareous mudstones vary between 1.54-1.78% below 960± metres, but fall to 0.53% between 930-960± metres. Their organic matter is probably best described as woody with significant herbaceous material and inertinite. A similar organic assemblage characterises the olive grey to dark

olive grey shaly mudstone of Zone B (0.98% organic carbon). The medium greenish grey to medium grey shaly mudstone of this zone has an organic carbon value of 1.57%. In contrast, the minor light brown mudstones of Zones $A^3$ and B are extremely lean at 0.09-0.27% organic carbon and the light olive grey mudstones from (0.46-0.84% organic carbon). These sediments are in general only a poor source essentially for gas, although interbeds with a poor or fair potential for gas and associated condensate are present above 1050± metres. They are further limited by immaturity.

Zones $A^1$ through B are, in general, characterised by fair and occasionally good abundances of extremely dry gas notably in the interval 540-600± metres, 840-900± metres and 960-990± metres. It is likely that these are not fully explained in terms of source indigenous hydrocarbons, but reflect, in addition, the presence of traces, occasionally significant, of biogenic gas.

Zone C (1116-1604± metres) is dominated by limestones (Ekofisk) containing 0.09-0.23% of mixed inertinitic-algal-woody-herbaceous-amorphous kerogen. Although richer (0.86-1.15% organic carbon), the thin light grey to medium light grey mudstones above 1170± metres are comparable in terms of organic matter type. These are poor, immature source rocks with a negligible hydrocarbon potential.

Zone D (1604-2070± metres) comprises sediments of the Cromer Knoll Group. The medium grey mudstones and shales which dominate this zone generally have above average (0.98-1.36%) organic contents consisting of inertinite and wood almost exclusively, although their leaner equivalents (0.59-0.69% organic carbon) are present in the interval between 1920-2010± metres. The slightly darker and richer (1.52-1.62% organic carbon) shales below 2010± metres contain better quality organic matter, with significant to major proportions of herbaceous material, inertinite and wood. Insignificantly minor traces of marginally wet gas were detected below 1860± metres in this zone. This interval is a poor (poor to fair below 2010± metres), immature source with a primary potential for gas.

Zone E (2070-2417± metres) comprises sediments of Jurassic age. Although apparently similar to the underlying shales, the medium dark grey shales of Zone E above 2160± metres are marginally leaner (1.78-1.92% organic carbon), and are characterised by organic matter consisting chiefly of herbaceous material together with significant wood, inertinite and algal and amorphous kerogen. In contrast, the slightly darker shales below 2190± metres are

enhanced at 2.59-3.29% organic carbon and their organic assemblages are essentially mixed, good quality amorphous-algal-inertinitic-herbaceous-woody, with amorphous material, albeit frequently incompletely developed, commonly the principal constituent. Rich (6.12-7.16% organic carbon) and very good interbeds of brownish grey and dark brownish grey shaly mudstone occur respectively at 2250-2310± metres and 2310-70± metres within this zone. Their organic matter is similar to that of the dominant shales. A thin coal (57.80% organic carbon) was recovered at the base of Zone E. These sediments represent potentially fair (above 2220± metres) and good source rocks for gas and condensate, together with rich interbeds between 2250-2310± metres. Although minor hydrocarbon generation has occurred below approximately 2300± metres, on-structure these sediments are limited by lack of maturity. Shows of marginally wet/wet gas chiefly occur below 2220± metres in this zone together with traces above this depth.

Zone F extends from 2417± metres down to the deepest sample at 2657± metres and is characterised by interbedded sands, moderate brown siltstones and dark grey to medium dark grey shales of the Skagerrak Formation. These shales are comparable in richness (2.38-3.58% organic carbon) and organic matter type to the dominant shales of Zone E, although below 2460± metres at least, they are believed to be largely caved. They have a good and very good potential for gas and condensate. The siltstones of this zone are extremely lean (0.08-0.14% organic carbon) and have a minimal hydrocarbon potential. Minor traces of wet gas were detected above 2520± metres together with insignificantly minor traces below this depth.

There is no evidence of crude oil in any of the analysed samples.

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) |
|---|---|---|---|---|
| 714-001 | 168-180m | A 65% LCM - cement | | |
| | | B 25% Basalt, blocky, hard, greyish black | N2 | |
| | | C 10% Sand, unconsolidated, coarse grained, rounded, clear, white | N9 | |
| 714-002 | 180-210m | A 98% LCM - cement | | |
| | | Minor basalt and sand | | |
| 714-003 | 210-240m | A 50% LCM - cement and fibre | | |
| | | B 40% Sand, as 714-001C | N9 | |
| | | C 10% Basalt, as 714-001B, caved | N2 | |
| 714-004 | 240-270m | A 45% Sand, unconsolidated, coarse grained, subrounded to rounded, poorly sorted, clear, white | N9 | |
| | | B 20% Basalt, blocky, hard, greyish black | N2 | |
| | | C 20% Acid igneous, blocky, medium grained, possibly pegmatite, med. greenish grey to moderate reddish orange | 5GY7/1-10R6/6 | |
| | | D 10% Chert, blocky, hard, very pale yellowish brown | 10YR7/2 | |
| | | E 5% LCM - cement | | |
| 714-005 | 270-300m | A 75% Sand, unconsolidated, v. fine grained to coarse grained, subrounded to subangular, poorly sorted, clear, white | N9 | |
| | | B 15% Shell fragments - mostly bivalve | | |
| | | C 10% Basalt, as 714-004B | N2 | |
| | | Minor other igneous and chert | | |
| 714-006 | 300-330m | A 35% Basalt, as 714-004B | N2 | |
| | | B 35% Sand, as 714-005A | N9 | |
| | | C 20% Shell fragments, as 714-005B | | |
| | | D 10% Igneous, as 714-004C | 5GY7/1-10R6/6 | |
| | | Minor chert | | |
| 714-007 | 330-360m | A 65% Sand, as 714-005A | N9 | |
| | | B 20% Basalt, as 714-004B | N2 | |
| | | C 15% Shell fragments | | |
| | | Minor other igneous and chert | | |
| 714-008 | 360-390m | A 50% Sand, as 714-005A | N9 | |
| | | B 35% Basalt, as 714-004B | N2 | |
| | | C 15% Shell fragments | | |
| | | Minor chert and other igneous | | |
| | | Minor LCM | | |
| 714-009 | 390-420m | A 90% Sand, unconsolidated, v. fine grained, subrounded to subangular, well sorted, clear, white | N9 | |
| | | B 10% Shell fragments | | |
| | | Minor igneous and sandstone | | |
| 714-010 | 420-450m | A 98% Sand, as 714-009A | N9 | |
| | | Minor igneous and pyrites | | |
| | | Minor LCM | | |
| 714-011 | 450-480m | A 90% Sand, as 714-009A | N9 | |
| | | B 10% Pyrites | | |

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) |
|---|---|---|---|---|
| 714-012 | 480-510m | A 90% LCM - cement<br>B 10% Pyrites<br>Minor sand | | |
| 714-013 | 510-540m | A 60% LCM - cement<br>B 40% Limestone, blocky, v. hard, microcrys-talline, sl. dolomitic, sl. arg., med. dark to olive grey<br>Minor pyrites and calcite, minor worm casts - glauconite | N4-5Y4/1 | 0.34 |
| 714-014 | 540-570m | A 70% Limestone, as 714-013B<br>B 25% Mudstone, blocky, mod. hard, non-calc., occuring as Worm casts/bryozoans - heavily pyritised & glauconitic, med. olive grey<br>C 5% Calcite, blocky, moderate yellowish brown<br>Minor LCM | N4-5Y4/1<br>5Y5/1<br>10YR5/4 | 0.43<br>1.03 |
| 714-015 | 570-600m | A 70% Limestone, as 714-013B<br>B 20% Mudstone, as 714-014B<br>C 10% LCM - cement<br>Minor calcite | N4-5Y4/1<br>5Y5/1 | 0.83 |
| 714-016 | 600-630m | A 65% Mudstone, as 714-014B<br>B 35% Limestone, as 714-013B<br>Minor shell fragments and calcite<br>Minor LCM | 5Y5/1<br>N4-5Y4/1 | 0.68<br>0.46,0.49 |
| 714-017 | 630-660m | A 55% Mudstone, as 714-014B<br>B 25% Shell fragments<br>C 20% Limestone, as 714-013B<br>Minor calcite and bitumen<br>Minor LCM | 5Y5/1<br>N4-5Y4/1 | 0.66<br>0.43 |
| 714-018 | 660-690m | A 85% Mudstone, as 714-014B<br>B 10% Shell fragments<br>C 5% Limestone, as 714-013B<br>Minor LCM | 5Y5/1<br>N4-5Y4/1 | 0.53 |
| 714-019 | 690-720m | A 95% Mudstone, as 714-014B<br>B 5% Limestone, as 714-013B<br>Minor calcite and shell fragments | 5Y5/1<br>N4-5Y4/1 | |
| 714-020 | 720-750m | A 70% Mudstone, as 714-014B<br>B 30% Arg. limestone, blocky, hard, micro-crystalline, med. dark to brownish grey<br>Minor calcite and shell fragments<br>Minor bitumen<br>Minor LCM | 5Y5/1<br>N4-5YR4/1 | 0.64 |
| 714-021 | 750-780m | A 65% Mudstone, as 714-014B<br>B 35% Limestone, as 714-020B, minor cavings<br>Minor shell fragments and calcite<br>Minor bitumen<br>Minor LCM | 5Y5/1<br>N4-5YR4/1 | 0.54 |

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) |
|---|---|---|---|---|
| 714-022 | 780-810m | A 75% Mudstone, blocky, mod. hard, mostly as worm casts and bryozoans, heavily pyritised, glauconitic, non-calc., med. olive grey | 5Y5/1 | 0.58,0.53 |
| | | B 25% Limestone, blocky, hard, microcrystalline, minor cavings, med. dark to brownish grey | N4-5YR4/1 | 0.58 |
| | | Minor calcite and shell fragments | | |
| | | Minor LCM | | |
| 714-023 | 810-840m | A 70% Mudstone, as 714-022A | 5Y5/1 | 0.60 |
| | | B 30% Limestone, as 714-022B, minor cavings | N4-5YR4/1 | 0.61 |
| | | Minor calcite, sand and shell fragments | | |
| | | Minor bitumen | | |
| | | Minor LCM | | |
| 714-024 | 840-870m | A 50% Limestone, as 714-022B, sig. caved to caved | N4-5YR4/1 | 0.75 |
| | | B 50% Mudstone, as 714-022A | 5Y5/1 | 1.17 |
| | | Minor calcite and shell fragments | | |
| | | Minor bitumen | | |
| 714-025 | 870-900m | A 50% LCM - cement | | |
| | | B 50% Mudstone, as 714-022A | 5Y5/1 | |
| | | Minor shell fragments | | |
| 714-026 | 900-930m | A 95% Mudstone, as 714-022A | 5Y5/1 | |
| | | B 5% Limestone, as 724-022B, minor cavings | N4-5YR4/1 | |
| | | Minor calcite and shell fragments | | |
| | | Minor LCM | | |
| 714-027 | 930-960m | A 80% Calc. mudstone, blocky, soft, minor cavings, light to very light olive grey | N7-5Y7/1 | 0.52,0.53 |
| | | B 20% Mudstone, as 714-022A | 5Y5/1 | |
| | | Minor limestone and shell fragments | | |
| | | Minor LCM | | |
| 714-028 | 960-990m | A 70% Mudstone, platy to blocky, soft, non-calc., light olive grey | 5Y6/1 | 0.84 |
| | | B 25% Calc. mudstone, as 714-027A, minor cavings | N7-5Y7/1 | 1.77,1.78 |
| | | C 5% Mudstone, blocky, soft, non-calc., sl. oil stain?, olive to med. olive grey | 5Y4/1-5Y5/1 | 3.74 |
| 714-029 | 990-1020m | A 60% Mudstone, as 714-028A | 5Y6/1 | 0.68 |
| | | B 25% Calc. mudstone, as 714-027A, minor cavings | N7-5Y7/1 | 1.54 |
| | | C 10% Mudstone, as 714-028C, minor cavings | 5Y4/1-5Y5/1 | 2.70,2.68 |
| | | D 5% Mudstone, blocky, soft, sl. calc., minor cavings, light brown | 5YR6/4 | 0.27 |
| 714-030 | 1020-1050m | A 80% Shaly mudstone, blocky to subfissile, soft to mod. hard, non-calc., minor to sig. cavings, med. olive to med. grey | 5Y5/1-N5 | 1.57 |
| | | B 15% Mudstone, as 714-028C, sig. cavings | 5Y4/1-5Y5/1 | 2.61 |
| | | C 5% Mudstone, as 714-029D, minor cavings | 5YR6/4 | 0.11 |
| | | Minor other mudstone | | |

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 | GSA Colour Code | TOTAL ORGANIC CARBON (Wt. % of Rock) |
|---|---|---|---|---|
| 714-031 | 1050-1080m | A 55% Shaly mudstone, blocky to subfissile, soft to mod. hard, non-calc., minor cavings, olive to dark olive grey | 5Y4/1-5Y3/1 | 0.98,0.97 |
| | | B 40% Mudstone, blocky, soft, non-calc., minor cavings, light olive grey | 5Y6/1 | 0.46 |
| | | C 5% Mudstone, blocky, soft to mod. hard, non-calc., minor cavings, light brown | 5YR6/4 | 0.09 |
| | | Minor other mudstone | | |
| 714-032 | 1080-1110m | A 65% Mudstone, blocky, soft, calc., minor cavings, light olive grey | 5Y6/1 | 0.64 |
| | | B 30% Shaly mudstone, platy, soft, v. sl. calc. to non-calc., minor cavings, light greenish to med. greenish grey | 5GY8/1-5GY7/1 | 0.36 |
| | | C 5% Mudstone, as 714-031C, minor cavings | 5YR6/4 | |
| | | Minor other caved mudstone | | |
| 714-033 | 1110-1140m | A 40% Mudstone, shaly, platy to blocky, soft to mod. hard, calc., minor cavings, med. light to light grey | N6-7 | 1.15,1.14 |
| | | B 30% Shaly mudstone, as 714-032B, minor cavings | 5GY8/1-5GY7/1 | 0.28 |
| | | C 25% Limestone, blocky, soft to mod. hard, dolomitic in part, white | N9 | 0.20 |
| | | D 5% Mudstone, as 714-031C, minor cavings | 5YR6/4 | |
| | | Minor chert and other mudstone | | |
| | | Minor anhydrite | | |
| 714-034 | 1140-1170m | A 55% Limestone, as 714-033C | N9 | 0.09 |
| | | B 25% Mudstone, as 714-033A, minor cavings | N6-7 | 0.86 |
| | | C 10% Chert, blocky, hard, very light brownish grey | 5YR7/1 | |
| | | D 10% Shaly mudstone, as 714-032B, minor cavings | 5GY8/1-5GY7/1 | 0.27,0.27 |
| | | Minor other mudstone | | |
| 714-035 | 1170-1200m | A 80% Limestone, blocky, soft, chalky, minor cavings, white to pinkish grey | N9-5YR8/1 | 0.08 |
| | | B 20% Chert, blocky, hard, very light brownish grey | 5YR7/1 | |
| | | Minor caved mudstone | | |
| 714-036 | 1200-1230m | A 75% Limestone, as 714-035A, minor cavings | N9-5YR8/1 | 0.09 |
| | | B 25% Chert, blocky, hard, light grey occ. very light brownish grey | N7 occ. 5YR7/1 | |
| 714-037 | 1230-1260m | A 85% Limestone, as 714-035A, minor cavings | N9-5YR8/1 | 0.13 |
| | | B 15% Chert, as 714-035B | 5YR7/1 | |
| 714-038 | 1260-1290m | A 98% Limestone, blocky, soft, chalky, pinkish grey to white | 5YR8/1-N9 | 0.08 |
| | | Minor chert | | |
| 714-039 | 1290-1320m | A 98% Limestone, as 714-038A, minor cavings | 5YR8/1-N9 | 0.12,0.11 |
| | | Minor chert | | |
| 714-040 | 1320-1350m | A 98% Limestone, as 714-038A, minor cavings | 5YR8/1-N9 | 0.11 |
| | | Minor chert | | |
| 714-041 | 1350-1380m | A 98% Limestone, blocky, soft, chalky, white | N9 | 0.15 |
| | | Minor chert | | |

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) |
|---|---|---|---|---|
| 714-042 | 1380-1410m | A 98% Limestone, blocky, soft, chalky, white | N9 | 0.09 |
| 714-043 | 1410-1440m | A 98% Limestone, as 714-042A | N9 | 0.08 |
| 714-044 | 1440-1470m | A 98% Limestone, blocky, soft, chalky, white | N9 | 0.08 |
| 714-045 | 1470-1500m | A 90% Limestone, as 714-044A<br>B 10% LCM - walnut shell and mica<br>Minor bitumen | N9 | 0.09,0.12 |
| 714-046 | 1500-1530m | A 98% Limestone, blocky, soft to mod. hard, chalky, white<br>Minor bitumen and shale | N9 | 0.13 |
| 714-047 | 1530-1560m | A 95% Limestone, as 714-046A<br>B 5% LCM - walnut shell and mica<br>Minor bitumen | N9 | 0.23 |
| 714-048 | 1560-1590m | A 98% Limestone, as 714-046A<br>Minor bitumen<br>Minor LCM | N9 | 0.17 |
| 714-049 | 1590-1620m | A 90% Limestone, blocky, soft, chalky, glauconitic, white<br>B 10% Glauconite, blocky, soft, greyish olive green to greyish green<br>Minor bitumen | N9<br>5GY3/2-10GY5/2 | 0.13 |
| 714-050 | 1620-1650m | A 60% Glauconite, as 714-049B<br>B 25% Limestone, as 714-049A<br>C 15% Pyrites<br>Minor other limestone and mudstone<br>Minor bitumen and chert | 5GY3/2-10GY5/2<br>N9 | 0.11 |
| 714-051 | 1650-1680m | A 50% Shaly mudstone, platy to blocky, soft, non-calc., minor cavings, med. dark to dark greenish grey<br>B 25% Limestone, as 714-049A, minor cavings<br>C 15% Glauconite, as 714-049B<br>D 10% Pyrites<br>Minor other limestone and mudstone<br>Minor bitumen and chert | 5G5/1<br>N9<br>5GY3/2-10GY5/2 | 0.46<br>0.21 |
| 714-052 | 1680-1710m | A 65% Mudstone, blocky, soft, calc., minor cavings, med. to med. light grey<br>B 20% Limestone, as 714-049A, sig. caved<br>C 15% Glauconite, as 714-049B<br>Minor pyrites, chert, bitumen and other limestone | N5-6<br>N9<br>5GY3/2-10GY5/2 | 1.20 |
| 714-053 | 1710-1740m | A 98% Mudstone, as 714-052A, minor cavings<br>Minor bitumen, pyrites and limestone | N5-6 | 1.12,1.12 |
| 714-054 | 1740-1770m | A 95% Mudstone, as 714-052A, minor cavings<br>B 5% Bitumen, blocky, soft, greyish black<br>Minor pyrites, limestone and glauconite<br>Minor sponge spicules | N5-6<br>N2 | 1.36 |

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) |
|---|---|---|---|---|
| 714-055 | 1770-1800m | A 98% Mudstone, blocky, soft, sl. calc., minor cavings, med. grey<br>Minor pyrites, bitumen and limestone | N5 | 1.26 |
| 714-056 | 1800-1830m | A 95% Shaly mudstone, blocky to platy, soft, sl. calc., minor cavings, med. grey | N5 | 1.00 |
| | | B 5% Bitumen, blocky, soft, greyish black<br>Minor limestone and pyrites | N2 | |
| 714-057 | 1830-1860m | A 95% Shaly mudstone, as 714-056A, minor cavings | N5 | 0.98 |
| | | B 5% LCM - walnut shell<br>Minor bitumen | | |
| 714-058 | 1860-1890m | A 98% Shale, platy to subfissile, soft to mod. hard, sl. calc., minor cavings, med. grey<br>Minor mudstone and bitumen | N5 | 1.20,1.18 |
| 714-059 | 1890-1920m | A 98% Shale, as 714-058A, minor cavings<br>Minor mudstone and bitumen<br>Minor LCM | N5 | 1.20 |
| 714-060 | 1920-1950m | A 98% Shale, as 714-058A, minor cavings<br>Minor mudstone and bitumen | N5 | 0.59 |
| 714-061 | 1950-1980m | A 98% Shale, platy to thinly fissile, soft, non-calc., minor cavings, med. to med. light grey<br>Minor mudstone and bitumen | N5-6 | 0.63 |
| 714-062 | 1980-2010m | A 98% Shale, as 714-061A, minor cavings<br>Minor mudstone and bitumen | N5-6 | 0.69 |
| 714-063 | 2010-2040m | A 95% Shale, platy to thinly fissile, soft to mod. hard, non-calc., minor cavings, med. dark to olive grey occ. med. grey | N4-5Y4/1 occ. N5 | 1.58,1.62 |
| | | B 5% Bitumen, blocky, soft, greyish black<br>Minor mudstone | N2 | |
| 714-064 | 2040-2070m | A 80% Shale, as 714-063A, minor cavings | N4-5Y4/1 occ. N5 | 1.52 |
| | | B 20% Mudstone, blocky, soft, non-calc., minor cavings, med. olive grey<br>Minor bitumen | 5Y5/1 | 0.72 |
| 714-065 | 2070-2100m | A 85% Shale, platy, soft to mod. hard, non-calc., minor cavings, med. to med. olive grey | N5-5Y5/1 | 0.73 |
| | | B 15% Mudstone, as 714-064B, minor cavings<br>Minor limestone | 5Y5/1 | 0.62 |
| 714-066 | 2100-2130m | A 98% Shale, platy to thinly fissile, mod. hard, non-calc., minor cavings, med. dark grey<br>Minor mudstone | N4 | 1.78,1.80 |
| 714-067 | 2130-2160m | A 60% Shale, as 714-066A, minor cavings | N4 | 1.92 |
| | | B 40% Shaly mudstone, platy to blocky, mod. hard, v. sl. calc. to non-calc., minor cavings, med. light to light grey<br>Minor bitumen | N6-7 | 0.71 |

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) |
|---|---|---|---|---|
| 714-068 | 2160-2190m | A 95% Shale, platy to thinly fissile, mod. hard, non-calc.,sig. cavings, med. dark grey | N4 | 2.28 |
| | | B 5% Shaly mudstone, platy to blocky, mod. hard, v. sl. calc. to non-calc., minor cavings, med. light to light grey | N6-7 | |
| 714-069 | 2190-2220m | A 85% Shale, platy to thinly fissile, brittle, non-calc., minor cavings, dark to med. dark grey | N3-4 | 2.68 |
| | | B 15% Mudstone, shaly, blocky to platy, soft to mod. hard, non-calc., minor to sig. cavings, med. grey | N5 | 1.43,1.40 |
| 714-070 | 2220-2250m | A 90% Shale, as 714-069A, minor cavings | N3-4 | 2.92 |
| | | B 10% Mudstone, as 714-069B, minor cavings | N5 | 1.85 |
| 714-071 | 2250-2280m | A 65% Shale, platy to thinly fissile, brittle, non-calc., minor cavings, dark to med. dark grey | N3-4 | 2.59 |
| | | B 35% Shaly mudstone, subfissile, soft, non-calc., sig. cavings, brownish grey<br>Minor other mudstone | 5YR4/1 | 7.16 |
| 714-072 | 2280-2310m | A 70% Shale, as 714-071A, minor cavings | N3-4 | 3.26,3.26 |
| | | B 30% Shaly mudstone, as 714-071B, sig. cavings<br>Minor other mudstone | 5YR4/1 | 6.12 |
| 714-073 | 2310-2340m | A 65% Shale, thinly fissile to platy, brittle, non-calc., minor cavings, dark grey | N3 | 2.65 |
| | | B 35% Shaly mudstone, blocky to subfissile, soft to mod. hard, non-calc., minor cavings, dark brownish grey<br>Minor shell fragments (bivalve/brachiopod) and other mudstone | 5YR3/1 | 2.90 |
| 714-074 | 2340-2370m | A 85% Shale, as 714-073A, minor cavings | N3 | 4.16 |
| | | B 15% Mudstone, as 714-073B, minor cavings<br>Minor limestone | 5YR3/1 | 2.85,2.83 |
| 714-075 | 2370-2400m | A 80% Shale, platy to blocky, mod. hard, brittle, non-calc., minor cavings, dark to med. dark grey | N3-4 | 3.29 |
| | | B 15% Sand, unconsolidated, v. fine grained, subangular, well sorted, clear, white | N9 | |
| | | C 5% Coal, blocky, brittle, conchoidal fracture, greyish black<br>Minor shell fragments, limestone and mudstone | N2 | 57.80 |
| 714-076 | 2400-2430m | A 65% Shale, as 714-075A, minor cavings | N3-4 | 3.05 |
| | | B 35% Sand, as 714-075B<br>Minor other shale | N9 | |
| 714-077 | 2430-2460m | A 70% Shale, as 714-075A, minor cavings | N3-4 | 3.34 |
| | | B 30% Sand, as 714-075B<br>Minor other shale and siltstone | N9 | |

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) |
|---|---|---|---|---|
| 714-078 | 2460-2490m | A 55% Sand, unconsolidated, fine-medium grained, subrounded to subangular, fairly well sorted, clear, white | N9 | |
| | | B 25% Shale, platy to subfissile, mod. hard, non-calc., minor to sig. cavings, med. grey | N5 | 2.71,2.71 |
| | | C 20% Siltstone, blocky to platy, soft to mod. hard, non-calc., minor cavings, moderate brown | 5YR3/4 | 0.14 |
| | | Minor other shale and bitumen and coal | | |
| 714-079 | 2490-2520m | A 55% Limestone, blocky, mod. hard, sl. bitumen? staining, very light to pinkish grey | N8-5YR8/1 | 0.11 |
| | | B 25% Sand, as 714-078A | N9 | |
| | | C 15% Shale, platy to thinly fissile, mod. hard, non-calc., minor cavings, med. dark to med. grey | N4-5 | 3.58 |
| | | D 5% Siltstone, as 714-078C, minor cavings | 5YR3/4 | 0.12 |
| | | Minor coal and bitumen? | | |
| 714-080 | 2520-2550m | A 40% Shale, subfissile, mod. hard, non-calc., minor to sig. cavings, dark to med. dark grey | N3-4 | 2.86,2.84 |
| | | B 35% Sand, unconsolidated, medium grained, subrounded to subangular, fairly well sorted, clear, white | N9 | |
| | | C 25% Siltstone, blocky to platy, mod. hard, non-calc., minor cavings, moderate brown | 5YR3/4 | 0.11 |
| | | Minor limestone and other shale | | |
| | | Minor LCM | | |
| 714-081 | 2550-2580m | A 45% Siltstone, as 714-080C, minor cavings | 5YR3/4 | 0.14 |
| | | B 40% Sand, as 714-080B | N9 | |
| | | C 15% Shale, as 714-080A, minor to sig. cavings | N3-4 | 3.00 |
| | | Minor limestone | | |
| 714-082 | 2580-2610m | A 75% Sand, as 714-080B | N9 | |
| | | B 20% Siltstone, as 714-080C, minor cavings | 5YR3/4 | 0.09 |
| | | C 5% Shale, as 714-080A, sig. cavings | N3-4 | 2.41,2.38 |
| | | Minor limestone | | |
| 714-083 | 2610-2640m | A 70% Sand, as 714-080B | N9 | |
| | | B 20% Siltstone, as 714-080C, minor cavings | 5YR3/4 | 0.08 |
| | | C 10% Shale, as 714-080A, sig. cavings | N3-4 | 3.41 |
| 714-084 | 2640-2657m | A 98% Sand, as 714-080B | N9 | |
| | | Minor shale and siltstone | | |

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

## TABLE 2A
## CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-001 | 168-180 | 30 | 0 | 0 | 0 | 0 | 30 | 0 | 0.0 | 0 | 0.00 |
| 714-002 | 180-210 | 21 | 4 | 0 | 0 | 0 | 25 | 4 | 15.5 | 0 | 0.00 |
| 714-003 | 210-240 | 9 | 0 | 0 | 0 | 0 | 9 | 0 | 0.0 | 0 | 0.00 |
| 714-004 | 240-270 | 260 | 1 | 1 | 0 | 1 | 262 | 2 | 0.8 | 2 | 0.32 |
| 714-005 | 270-300 | 651 | 2 | 0 | 0 | 0 | 653 | 2 | 0.4 | 5 | 0.64 |
| 714-006 | 300-330 | 2012 | 3 | 0 | 0 | 0 | 2015 | 4 | 0.2 | 3 | 0.29 |
| 714-007 | 330-360 | 1841 | 10 | 1 | 0 | 0 | 1853 | 11 | 0.6 | 0 | 0.61 |
| 714-008 | 360-390 | 2149 | 9 | 1 | 0 | 0 | 2159 | 10 | 0.5 | 0 | 0.48 |
| 714-009 | 390-420 | 2956 | 11 | 1 | 0 | 0 | 2968 | 11 | 0.4 | 0 | 0.00 |
| 714-010 | 420-450 | 2602 | 14 | 2 | 0 | 1 | 2618 | 16 | 0.6 | 1 | 0.73 |
| 714-011 | 450-480 | 2513 | 16 | 2 | 1 | 1 | 2533 | 20 | 0.8 | 1 | 0.48 |
| 714-012 | 480-510 | 1352 | 3 | 1 | 0 | 0 | 1357 | 5 | 0.3 | 1 | 0.75 |
| 714-013 | 510-540 | 3891 | 9 | 5 | 1 | 1 | 3907 | 16 | 0.4 | 3 | 0.60 |
| 714-014 | 540-570 | 9698 | 41 | 22 | 1 | 3 | 9766 | 67 | 0.7 | 4 | 0.29 |
| 714-015 | 570-600 | 7826 | 26 | 25 | 17 | 6 | 7900 | 74 | 0.9 | 7 | 2.88 |
| 714-016 | 600-630 | 469 | 2 | 4 | 0 | 0 | 475 | 6 | 1.3 | 0 | 0.53 |
| 714-017 | 630-660 | 2680 | 9 | 7 | 1 | 2 | 2699 | 18 | 0.7 | 1 | 0.48 |
| 714-018 | 660-690 | 1589 | 5 | 4 | 0 | 1 | 1600 | 11 | 0.7 | 1 | 0.48 |
| 714-019 | 690-720 | 5858 | 18 | 16 | 2 | 7 | 5902 | 43 | 0.7 | 3 | 0.32 |
| 714-020 | 720-750 | 3234 | 16 | 20 | 5 | 6 | 3282 | 48 | 1.5 | 3 | 0.82 |
| 714-021 | 750-780 | 1498 | 10 | 8 | 1 | 1 | 1518 | 20 | 1.3 | 1 | 1.51 |
| 714-022 | 780-810 | 4786 | 27 | 22 | 5 | 7 | 4847 | 61 | 1.3 | 29 | 0.81 |
| 714-023 | 810-840 | 1051 | 13 | 12 | 3 | 3 | 1081 | 30 | 2.8 | 1 | 1.10 |
| 714-024 | 840-870 | 12903 | 71 | 40 | 10 | 9 | 13033 | 130 | 1.0 | 6 | 1.13 |
| 714-025 | 870-900 | 15807 | 82 | 30 | 6 | 6 | 15931 | 124 | 0.8 | 5 | 0.96 |
| 714-026 | 900-930 | 1658 | 14 | 4 | 1 | 1 | 1677 | 19 | 1.1 | 0 | 1.64 |
| 714-027 | 930-960 | 3318 | 12 | 4 | 2 | 2 | 3337 | 19 | 0.6 | 1 | 0.79 |
| 714-028 | 960-990 | 12397 | 146 | 18 | 4 | 6 | 12571 | 174 | 1.4 | 7 | 0.77 |
| 714-029 | 990-1020 | 4981 | 49 | 5 | 1 | 1 | 5037 | 56 | 1.1 | 1 | 0.71 |
| 714-030 | 1020-1050 | 4157 | 30 | 4 | 0 | 1 | 4192 | 35 | 0.8 | 1 | 0.52 |

## TABLE 2A
## CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-031 | 1050-1080 | 1946 | 32 | 2 | 0 | 0 | 1980 | 35 | 1.7 | 0 | 1.64 |
| 714-032 | 1080-1110 | 3576 | 53 | 3 | 0 | 1 | 3632 | 56 | 1.6 | 1 | 0.83 |
| 714-033 | 1110-1140 | 1388 | 28 | 3 | 1 | 1 | 1421 | 32 | 2.3 | 0 | 1.04 |
| 714-034 | 1140-1170 | 43 | 3 | 1 | 2 | 1 | 50 | 7 | 13.2 | 0 | 4.44 |
| 714-035 | 1170-1200 | 239 | 8 | 3 | 1 | 2 | 253 | 14 | 5.7 | 1 | 0.66 |
| 714-036 | 1200-1230 | 195 | 4 | 3 | 1 | 2 | 205 | 11 | 5.2 | 1 | 0.42 |
| 714-037 | 1230-1260 | 139 | 5 | 0 | 0 | 0 | 143 | 5 | 3.3 | 0 | 0.00 |
| 714-038 | 1260-1290 | 59 | 3 | 0 | 0 | 0 | 63 | 4 | 5.7 | 0 | 0.00 |
| 714-039 | 1290-1320 | 56 | 311 | 3 | 0 | 0 | 370 | 315 | 85.0 | 2 | 0.00 |
| 714-040 | 1320-1350 | 27 | 1 | 0 | 0 | 0 | 29 | 2 | 6.0 | 0 | 0.99 |
| 714-041 | 1350-1380 | 50 | 1 | 0 | 0 | 0 | 51 | 1 | 2.4 | 0 | 0.00 |
| 714-042 | 1380-1410 | 31 | 1 | 0 | 0 | 0 | 32 | 1 | 3.8 | 0 | 0.00 |
| 714-043 | 1410-1440 | 28 | 2 | 0 | 0 | 0 | 30 | 2 | 5.1 | 0 | 0.00 |
| 714-044 | 1440-1470 | 26 | 1 | 1 | 0 | 0 | 28 | 2 | 7.1 | 0 | 0.00 |
| 714-045 | 1470-1500 | 33 | 0 | 0 | 0 | 0 | 33 | 1 | 2.5 | 0 | 0.00 |
| 714-046 | 1500-1530 | 34 | 2 | 1 | 0 | 1 | 39 | 4 | 11.4 | 0 | 0.65 |
| 714-047 | 1530-1560 | 26 | 3 | 1 | 1 | 1 | 32 | 6 | 18.7 | 0 | 1.09 |
| 714-048 | 1560-1590 | 44 | 2 | 1 | 0 | 0 | 47 | 3 | 6.3 | 0 | 2.07 |
| 714-049 | 1590-1620 | 1408 | 22 | 9 | 4 | 2 | 1445 | 37 | 2.6 | 1 | 2.28 |
| 714-050 | 1620-1650 | 1713 | 18 | 6 | 3 | 1 | 1741 | 28 | 1.6 | 1 | 2.07 |
| 714-051 | 1650-1680 | 1951 | 20 | 8 | 4 | 2 | 1986 | 35 | 1.8 | 1 | 2.07 |
| 714-052 | 1680-1710 | 1262 | 10 | 5 | 2 | 1 | 1280 | 18 | 1.4 | 0 | 2.04 |
| 714-053 | 1710-1740 | 1622 | 18 | 9 | 4 | 2 | 1655 | 33 | 2.0 | 6 | 2.00 |
| 714-054 | 1740-1770 | 1071 | 13 | 7 | 3 | 2 | 1096 | 25 | 2.3 | 1 | 1.73 |
| 714-055 | 1770-1800 | 445 | 8 | 6 | 3 | 2 | 464 | 19 | 4.0 | 1 | 1.78 |
| 714-056 | 1800-1830 | 716 | 14 | 11 | 5 | 3 | 749 | 32 | 4.3 | 9 | 1.89 |
| 714-057 | 1830-1860 | 326 | 8 | 5 | 2 | 1 | 342 | 16 | 4.8 | 9 | 1.90 |
| 714-058 | 1860-1890 | 308 | 89 | 9 | 4 | 3 | 413 | 105 | 25.4 | 14 | 1.73 |
| 714-059 | 1890-1920 | 231 | 25 | 6 | 4 | 2 | 267 | 37 | 13.7 | 10 | 2.01 |
| 714-060 | 1920-1950 | 220 | 12 | 10 | 8 | 4 | 253 | 33 | 12.9 | 37 | 2.03 |

## TABLE 2A
## CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-061 | 1950-1980 | 183 | 210 | 11 | 6 | 3 | 413 | 231 | 55.8 | 22 | 2.07 |
| 714-062 | 1980-2010 | 245 | 33 | 25 | 18 | 8 | 329 | 84 | 25.7 | 52 | 2.16 |
| 714-063 | 2010-2040 | 157 | 14 | 16 | 11 | 3 | 201 | 44 | 22.0 | 12 | 3.18 |
| 714-064 | 2040-2070 | 503 | 40 | 35 | 22 | 8 | 608 | 105 | 17.3 | 30 | 2.64 |
| 714-065 | 2070-2100 | 550 | 88 | 101 | 50 | 21 | 810 | 261 | 32.2 | 75 | 2.36 |
| 714-066 | 2100-2130 | 1825 | 229 | 180 | 69 | 33 | 2336 | 511 | 21.9 | 105 | 2.05 |
| 714-067 | 2130-2160 | 2301 | 307 | 302 | 105 | 61 | 3077 | 776 | 25.2 | 136 | 1.72 |
| 714-068 | 2160-2190 | 4339 | 1003 | 826 | 185 | 164 | 6518 | 2179 | 33.4 | 228 | 1.13 |
| 714-069 | 2190-2220 | 2989 | 593 | 733 | 154 | 202 | 4671 | 1682 | 36.0 | 308 | 0.76 |
| 714-070 | 2220-2250 | 7587 | 1456 | 1812 | 395 | 496 | 11747 | 4160 | 35.4 | 742 | 0.80 |
| 714-071 | 2250-2280 | 12124 | 3095 | 3258 | 687 | 907 | 20071 | 7947 | 39.6 | 2008 | 0.76 |
| 714-072 | 2280-2310 | 2757 | 533 | 709 | 142 | 214 | 4355 | 1599 | 36.7 | 213 | 0.67 |
| 714-073 | 2310-2340 | 4379 | 1224 | 903 | 154 | 118 | 6777 | 2399 | 35.4 | 116 | 1.30 |
| 714-074 | 2340-2370 | 4699 | 1067 | 916 | 149 | 86 | 6917 | 2218 | 32.1 | 75 | 1.73 |
| 714-075 | 2370-2400 | 17151 | 2021 | 930 | 134 | 105 | 20341 | 3190 | 15.7 | 161 | 1.27 |
| 714-076 | 2400-2430 | 174 | 22 | 23 | 4 | 5 | 228 | 54 | 23.6 | 7 | 0.71 |
| 714-077 | 2430-2460 | 251 | 53 | 57 | 9 | 15 | 384 | 133 | 34.7 | 19 | 0.57 |
| 714-078 | 2460-2490 | 431 | 114 | 214 | 43 | 76 | 879 | 447 | 50.9 | 102 | 0.57 |
| 714-079 | 2490-2520 | 652 | 188 | 287 | 47 | 92 | 1266 | 614 | 48.5 | 103 | 0.51 |
| 714-080 | 2520-2550 | 304 | 92 | 135 | 24 | 41 | 597 | 292 | 49.0 | 56 | 0.60 |
| 714-081 | 2550-2580 | 288 | 77 | 147 | 27 | 52 | 591 | 303 | 51.3 | 12 | 0.53 |
| 714-082 | 2580-2610 | 172 | 55 | 103 | 18 | 32 | 380 | 208 | 54.8 | 43 | 0.56 |
| 714-083 | 2610-2640 | 139 | 143 | 77 | 16 | 27 | 402 | 263 | 65.3 | 43 | 0.60 |
| 714-084 | 2640-2657 | 102 | 20 | 37 | 8 | 14 | 183 | 80 | 44.0 | 58 | 0.59 |

TABLE 2B

CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-001 | 168-180 | 156 | 11 | 154 | 40 | 122 | 484 | 328 | 67.8 | 77 | 0.33 |
| 714-002 | 180-210 | 409 | 12 | 8 | 2 | 6 | 437 | 29 | 6.6 | 32 | 0.32 |
| 714-003 | 210-240 | 1247 | 42 | 11 | 3 | 5 | 1308 | 61 | 4.7 | 6 | 0.58 |
| 714-004 | 240-270 | 704 | 25 | 14 | 2 | 4 | 749 | 45 | 6.0 | 12 | 0.48 |
| 714-005 | 270-300 | 274 | 7 | 3 | 1 | 1 | 287 | 12 | 4.4 | 10 | 0.48 |
| 714-006 | 300-330 | 333 | 15 | 5 | 3 | 10 | 366 | 32 | 8.9 | 35 | 0.32 |
| 714-007 | 330-360 | 554 | 7 | 2 | 1 | 2 | 565 | 11 | 1.9 | 3 | 0.34 |
| 714-008 | 360-390 | 844 | 12 | 5 | 4 | 5 | 870 | 26 | 3.0 | 4 | 0.81 |
| 714-009 | 390-420 | 624 | 10 | 6 | 2 | 4 | 646 | 23 | 3.5 | 3 | 0.48 |
| 714-010 | 420-450 | 1360 | 12 | 11 | 3 | 4 | 1391 | 31 | 2.2 | 3 | 0.72 |
| 714-011 | 450-480 | 892 | 12 | 3 | 1 | 2 | 911 | 19 | 2.0 | 3 | 0.55 |
| 714-012 | 480-510 | 70 | 2 | 0 | 0 | 0 | 72 | 2 | 3.4 | 0 | 0.00 |
| 714-013 | 510-540 | 145 | 7 | 3 | 2 | 3 | 160 | 15 | 9.3 | 1 | 0.54 |
| 714-014 | 540-570 | 75 | 5 | 3 | 0 | 1 | 85 | 10 | 11.3 | 2 | 0.38 |
| 714-015 | 570-600 | 65 | 2 | 2 | 0 | 0 | 69 | 4 | 5.9 | 0 | 0.00 |
| 714-016 | 600-630 | 86 | 5 | 8 | 0 | 0 | 99 | 13 | 13.0 | 0 | 0.00 |
| 714-017 | 630-660 | 16 | 2 | 0 | 0 | 0 | 19 | 2 | 13.2 | 0 | 0.00 |
| 714-018 | 660-690 | 151 | 2 | 10 | 0 | 0 | 162 | 12 | 7.4 | 0 | 0.00 |
| 714-019 | 690-720 | 75 | 2 | 0 | 0 | 0 | 78 | 2 | 3.2 | 0 | 0.00 |
| 714-020 | 720-750 | 108 | 5 | 6 | 1 | 2 | 121 | 14 | 11.4 | 1 | 0.68 |
| 714-021 | 750-780 | 118 | 2 | 6 | 0 | 0 | 127 | 9 | 6.9 | 0 | 0.00 |
| 714-022 | 780-810 | 231 | 5 | 11 | 2 | 4 | 254 | 22 | 8.9 | 4 | 0.49 |
| 714-023 | 810-840 | 59 | 2 | 7 | 2 | 4 | 74 | 15 | 20.5 | 2 | 0.42 |
| 714-024 | 840-870 | 113 | 7 | 8 | 1 | 1 | 130 | 17 | 13.0 | 3 | 0.77 |
| 714-025 | 870-900 | 102 | 2 | 0 | 0 | 0 | 105 | 2 | 2.4 | 0 | 0.00 |
| 714-026 | 900-930 | 285 | 5 | 4 | 1 | 2 | 296 | 12 | 3.9 | 1 | 0.68 |
| 714-027 | 930-960 | 97 | 5 | 5 | 1 | 2 | 110 | 13 | 11.7 | 1 | 0.49 |
| 714-028 | 960-990 | 86 | 5 | 2 | 1 | 1 | 94 | 8 | 8.9 | 1 | 0.66 |
| 714-029 | 990-1020 | 81 | 5 | 0 | 0 | 0 | 86 | 5 | 5.8 | 0 | 0.00 |
| 714-030 | 1020-1050 | 194 | 5 | 2 | 1 | 1 | 202 | 8 | 4.1 | 1 | 0.66 |

## TABLE 2B
## CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-031 | 1050-1080 | 215 | 7 | 2 | 0 | 0 | 224 | 9 | 4.1 | 0 | 0.00 |
| 714-032 | 1080-1110 | 102 | 7 | 1 | 0 | 1 | 112 | 10 | 8.5 | 0 | 0.59 |
| 714-033 | 1110-1140 | 70 | 7 | 2 | 0 | 0 | 79 | 9 | 11.5 | 0 | 0.00 |
| 714-034 | 1140-1170 | 22 | 2 | 0 | 0 | 0 | 24 | 2 | 10.3 | 0 | 0.00 |
| 714-035 | 1170-1200 | 38 | 7 | 6 | 0 | 0 | 51 | 13 | 25.5 | 0 | 0.00 |
| 714-036 | 1200-1230 | 27 | 0 | 0 | 0 | 0 | 27 | 0 | 0.0 | 0 | 0.00 |
| 714-037 | 1230-1260 | 27 | 0 | 0 | 0 | 0 | 27 | 0 | 0.0 | 0 | 0.00 |
| 714-038 | 1260-1290 | 22 | 0 | 0 | 0 | 0 | 22 | 0 | 0.0 | 0 | 0.00 |
| 714-039 | 1290-1320 | 16 | 74 | 0 | 0 | 0 | 90 | 74 | 82.1 | 0 | 0.00 |
| 714-040 | 1320-1350 | 16 | 2 | 0 | 0 | 0 | 19 | 2 | 13.2 | 0 | 0.00 |
| 714-041 | 1350-1380 | 9 | 0 | 0 | 0 | 0 | 9 | 0 | 0.0 | 0 | 0.00 |
| 714-042 | 1380-1410 | 27 | 7 | 4 | 0 | 0 | 38 | 11 | 29.2 | 0 | 0.00 |
| 714-043 | 1410-1440 | 16 | 2 | 2 | 0 | 0 | 20 | 4 | 21.1 | 0 | 0.00 |
| 714-044 | 1440-1470 | 27 | 2 | 0 | 0 | 0 | 29 | 2 | 8.4 | 0 | 0.00 |
| 714-045 | 1470-1500 | 27 | 5 | 2 | 0 | 0 | 34 | 7 | 20.1 | 0 | 0.00 |
| 714-046 | 1500-1530 | 27 | 6 | 12 | 1 | 2 | 49 | 22 | 44.7 | 0 | 0.71 |
| 714-047 | 1530-1560 | 24 | 6 | 5 | 1 | 1 | 37 | 13 | 36.3 | 1 | 1.35 |
| 714-048 | 1560-1590 | 26 | 5 | 2 | 0 | 0 | 33 | 7 | 20.7 | 0 | 0.00 |
| 714-049 | 1590-1620 | 90 | 5 | 4 | 2 | 1 | 102 | 12 | 11.9 | 1 | 1.19 |
| 714-050 | 1620-1650 | 84 | 3 | 3 | 2 | 1 | 93 | 8 | 9.1 | 1 | 1.41 |
| 714-051 | 1650-1680 | 90 | 8 | 4 | 2 | 1 | 104 | 14 | 13.9 | 1 | 1.66 |
| 714-052 | 1680-1710 | 219 | 19 | 17 | 4 | 3 | 262 | 44 | 16.6 | 3 | 1.10 |
| 714-053 | 1710-1740 | 168 | 9 | 8 | 4 | 4 | 193 | 25 | 12.8 | 3 | 1.10 |
| 714-054 | 1740-1770 | 112 | 10 | 8 | 2 | 1 | 133 | 20 | 15.4 | 2 | 1.45 |
| 714-055 | 1770-1800 | 67 | 5 | 14 | 3 | 2 | 91 | 23 | 25.9 | 2 | 1.19 |
| 714-056 | 1800-1830 | 90 | 13 | 14 | 3 | 4 | 123 | 33 | 27.0 | 3 | 0.61 |
| 714-057 | 1830-1860 | 79 | 10 | 6 | 2 | 2 | 98 | 20 | 19.9 | 1 | 0.82 |
| 714-058 | 1860-1890 | 95 | 49 | 17 | 3 | 6 | 171 | 75 | 44.1 | 4 | 0.42 |
| 714-059 | 1890-1920 | 67 | 23 | 15 | 8 | 9 | 123 | 56 | 45.4 | 5 | 0.85 |
| 714-060 | 1920-1950 | 50 | 8 | 9 | 3 | 4 | 75 | 25 | 32.7 | 2 | 0.77 |

## TABLE 2B
## CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-061 | 1950-1980 | 67 | 59 | 21 | 6 | 7 | 160 | 93 | 57.9 | 5 | 0.86 |
| 714-062 | 1980-2010 | 56 | 18 | 23 | 10 | 14 | 122 | 66 | 54.0 | 4 | 0.72 |
| 714-063 | 2010-2040 | 101 | 26 | 54 | 27 | 18 | 226 | 125 | 55.3 | 65 | 1.55 |
| 714-064 | 2040-2070 | 157 | 41 | 68 | 52 | 36 | 354 | 197 | 55.7 | 68 | 1.44 |
| 714-065 | 2070-2100 | 56 | 21 | 54 | 44 | 32 | 207 | 151 | 72.9 | 202 | 1.39 |
| 714-066 | 2100-2130 | 112 | 49 | 106 | 62 | 61 | 389 | 277 | 71.2 | 296 | 1.02 |
| 714-067 | 2130-2160 | 163 | 67 | 151 | 68 | 83 | 531 | 368 | 69.4 | 319 | 0.83 |
| 714-068 | 2160-2190 | 589 | 272 | 584 | 172 | 290 | 1906 | 1317 | 69.1 | 587 | 0.59 |
| 714-069 | 2190-2220 | 247 | 179 | 636 | 170 | 410 | 1642 | 1395 | 85.0 | 730 | 0.41 |
| 714-070 | 2220-2250 | 14190 | 3321 | 2836 | 673 | 574 | 21593 | 7403 | 34.3 | 749 | 1.17 |
| 714-071 | 2250-2280 | 3365 | 1333 | 1556 | 741 | 837 | 7832 | 4467 | 57.0 | 912 | 0.89 |
| 714-072 | 2280-2310 | 2558 | 1017 | 1166 | 366 | 842 | 5949 | 3391 | 57.0 | 439 | 0.43 |
| 714-073 | 2310-2340 | 993 | 565 | 1274 | 224 | 286 | 3341 | 2349 | 70.3 | 270 | 0.78 |
| 714-074 | 2340-2370 | 437 | 449 | 961 | 164 | 165 | 2177 | 1740 | 79.9 | 110 | 1.00 |
| 714-075 | 2370-2400 | 6585 | 1637 | 1452 | 236 | 187 | 10096 | 3511 | 34.8 | 235 | 1.26 |
| 714-076 | 2400-2430 | 903 | 249 | 555 | 132 | 240 | 2078 | 1175 | 56.6 | 234 | 0.55 |
| 714-077 | 2430-2460 | 129 | 70 | 267 | 55 | 151 | 673 | 544 | 80.8 | 41 | 0.36 |
| 714-078 | 2460-2490 | 56 | 18 | 60 | 20 | 58 | 211 | 155 | 73.5 | 27 | 0.34 |
| 714-079 | 2490-2520 | 196 | 28 | 104 | 36 | 129 | 493 | 296 | 60.2 | 107 | 0.28 |
| 714-080 | 2520-2550 | 84 | 23 | 42 | 11 | 31 | 191 | 107 | 56.0 | 129 | 0.35 |
| 714-081 | 2550-2580 | 62 | 13 | 46 | 12 | 62 | 194 | 132 | 68.1 | 29 | 0.20 |
| 714-082 | 2580-2610 | 466 | 20 | 33 | 10 | 37 | 566 | 100 | 17.7 | 139 | 0.27 |
| 714-083 | 2610-2640 | 617 | 40 | 19 | 5 | 15 | 697 | 80 | 11.4 | 112 | 0.38 |
| 714-084 | 2640-2657 | 533 | 15 | 12 | 4 | 9 | 573 | 40 | 7.0 | 80 | 0.42 |

## TABLE 2 C

## TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-001 | 168-180 | 186 | 11 | 154 | 40 | 122 | 514 | 328 | 63.8 | 77 | 0.33 |
| 714-002 | 180-210 | 429 | 16 | 8 | 2 | 6 | 462 | 33 | 7.1 | 32 | 0.32 |
| 714-003 | 210-240 | 1256 | 42 | 11 | 3 | 5 | 1317 | 61 | 4.7 | 6 | 0.58 |
| 714-004 | 240-270 | 964 | 25 | 15 | 2 | 5 | 1011 | 47 | 4.7 | 14 | 0.46 |
| 714-005 | 270-300 | 925 | 9 | 4 | 1 | 2 | 940 | 15 | 1.6 | 15 | 0.51 |
| 714-006 | 300-330 | 2345 | 18 | 5 | 3 | 10 | 2381 | 36 | 1.5 | 37 | 0.32 |
| 714-007 | 330-360 | 2395 | 17 | 2 | 1 | 2 | 2417 | 22 | 0.9 | 4 | 0.39 |
| 714-008 | 360-390 | 2993 | 21 | 5 | 4 | 5 | 3028 | 36 | 1.2 | 5 | 0.79 |
| 714-009 | 390-420 | 3580 | 21 | 7 | 2 | 4 | 3614 | 34 | 0.9 | 3 | 0.48 |
| 714-010 | 420-450 | 3961 | 26 | 13 | 4 | 5 | 4009 | 47 | 1.2 | 4 | 0.72 |
| 714-011 | 450-480 | 3405 | 29 | 5 | 2 | 3 | 3444 | 39 | 1.1 | 3 | 0.53 |
| 714-012 | 480-510 | 1422 | 5 | 1 | 0 | 0 | 1429 | 7 | 0.5 | 1 | 0.75 |
| 714-013 | 510-540 | 4036 | 16 | 8 | 2 | 4 | 4067 | 31 | 0.8 | 4 | 0.56 |
| 714-014 | 540-570 | 9774 | 46 | 25 | 1 | 4 | 9850 | 77 | 0.8 | 6 | 0.31 |
| 714-015 | 570-600 | 7890 | 29 | 27 | 17 | 6 | 7969 | 78 | 1.0 | 7 | 2.88 |
| 714-016 | 600-630 | 555 | 7 | 12 | 0 | 0 | 574 | 19 | 3.3 | 0 | 0.53 |
| 714-017 | 630-660 | 2697 | 11 | 7 | 1 | 2 | 2717 | 21 | 0.8 | 1 | 0.48 |
| 714-018 | 660-690 | 1739 | 8 | 14 | 0 | 1 | 1762 | 23 | 1.3 | 1 | 0.48 |
| 714-019 | 690-720 | 5934 | 20 | 16 | 2 | 7 | 5979 | 46 | 0.8 | 3 | 0.32 |
| 714-020 | 720-750 | 3341 | 21 | 26 | 6 | 8 | 3403 | 62 | 1.8 | 5 | 0.80 |
| 714-021 | 750-780 | 1617 | 12 | 14 | 1 | 1 | 1645 | 28 | 1.7 | 1 | 1.51 |
| 714-022 | 780-810 | 5017 | 32 | 33 | 7 | 11 | 5101 | 84 | 1.6 | 33 | 0.68 |
| 714-023 | 810-840 | 1110 | 16 | 19 | 5 | 6 | 1155 | 46 | 3.9 | 3 | 0.70 |
| 714-024 | 840-870 | 13016 | 78 | 49 | 11 | 10 | 13163 | 147 | 1.1 | 9 | 1.09 |
| 714-025 | 870-900 | 15909 | 85 | 30 | 6 | 6 | 16035 | 126 | 0.8 | 5 | 0.96 |
| 714-026 | 900-930 | 1943 | 19 | 7 | 2 | 2 | 1973 | 31 | 1.6 | 2 | 0.94 |
| 714-027 | 930-960 | 3414 | 17 | 8 | 3 | 4 | 3446 | 32 | 0.9 | 3 | 0.64 |
| 714-028 | 960-990 | 12483 | 151 | 20 | 5 | 7 | 12665 | 182 | 1.4 | 8 | 0.75 |
| 714-029 | 990-1020 | 5062 | 54 | 5 | 1 | 1 | 5123 | 61 | 1.2 | 1 | 0.71 |
| 714-030 | 1020-1050 | 4351 | 35 | 5 | 1 | 2 | 4394 | 43 | 1.0 | 1 | 0.60 |

## TABLE 2C
## TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-031 | 1050-1080 | 2161 | 39 | 4 | 0 | 0 | 2204 | 44 | 2.0 | 0 | 1.64 |
| 714-032 | 1080-1110 | 3678 | 60 | 4 | 1 | 1 | 3744 | 66 | 1.8 | 1 | 0.71 |
| 714-033 | 1110-1140 | 1458 | 35 | 4 | 1 | 1 | 1500 | 41 | 2.7 | 0 | 1.04 |
| 714-034 | 1140-1170 | 65 | 5 | 1 | 2 | 1 | 74 | 9 | 12.3 | 0 | 4.44 |
| /14-035 | 1170-1200 | 277 | 15 | 9 | 1 | 2 | 304 | 27 | 9.0 | 1 | 0.66 |
| 714-036 | 1200-1230 | 222 | 4 | 3 | 1 | 2 | 232 | 11 | 4.6 | 1 | 0.42 |
| 714-037 | 1230-1260 | 165 | 5 | 0 | 0 | 0 | 170 | 5 | 2.8 | 0 | 0.00 |
| 714-038 | 1260-1290 | 81 | 3 | 0 | 0 | 0 | 85 | 4 | 4.3 | 0 | 0.00 |
| 714-039 | 1290-1320 | 72 | 385 | 3 | 0 | 0 | 460 | 388 | 84.4 | 2 | 0.00 |
| 714-040 | 1320-1350 | 44 | 4 | 0 | 0 | 0 | 48 | 4 | 8.8 | 0 | 0.99 |
| 714-041 | 1350-1380 | 59 | 1 | 0 | 0 | 0 | 60 | 1 | 2.0 | 0 | 0.00 |
| 714-042 | 1380-1410 | 58 | 8 | 4 | 0 | 0 | 70 | 12 | 17.5 | 0 | 0.00 |
| 714-043 | 1410-1440 | 44 | 4 | 2 | 0 | 0 | 50 | 6 | 11.6 | 0 | 0.00 |
| 714-044 | 1440-1470 | 53 | 3 | 1 | 0 | 0 | 58 | 4 | 7.8 | 0 | 0.00 |
| 714-045 | 1470-1500 | 59 | 5 | 2 | 0 | 0 | 67 | 8 | 11.3 | 0 | 0.00 |
| 714-046 | 1500-1530 | 61 | 9 | 13 | 2 | 2 | 88 | 26 | 30.0 | 0 | 0.69 |
| 714-047 | 1530-1560 | 50 | 8 | 7 | 3 | 2 | 69 | 19 | 28.1 | 1 | 1.22 |
| 714-048 | 1560-1590 | 71 | 7 | 2 | 0 | 0 | 81 | 10 | 12.2 | 0 | 2.07 |
| 714-049 | 1590-1620 | 1497 | 27 | 13 | 6 | 3 | 1547 | 50 | 3.2 | 2 | 1.82 |
| 714-050 | 1620-1650 | 1797 | 20 | 9 | 5 | 3 | 1834 | 36 | 2.0 | 2 | 1.76 |
| 714-051 | 1650-1680 | 2041 | 28 | 12 | 6 | 3 | 2090 | 49 | 2.4 | 2 | 1.93 |
| 714-052 | 1680-1710 | 1481 | 29 | 22 | 6 | 4 | 1542 | 61 | 4.0 | 4 | 1.33 |
| 714-053 | 1710-1740 | 1790 | 27 | 16 | 8 | 6 | 1848 | 58 | 3.1 | 9 | 1.44 |
| 714-054 | 1740-1770 | 1183 | 24 | 14 | 4 | 3 | 1229 | 45 | 3.7 | 2 | 1.62 |
| 714-055 | 1770-1800 | 512 | 13 | 19 | 6 | 4 | 554 | 42 | 7.6 | 3 | 1.45 |
| 714-056 | 1800-1830 | 806 | 27 | 24 | 7 | 7 | 872 | 66 | 7.5 | 13 | 1.08 |
| 714-057 | 1830-1860 | 405 | 18 | 11 | 4 | 3 | 440 | 36 | 8.2 | 10 | 1.21 |
| 714-058 | 1860-1890 | 404 | 138 | 26 | 7 | 9 | 584 | 180 | 30.9 | 17 | 0.79 |
| 714-059 | 1890-1920 | 298 | 48 | 21 | 12 | 11 | 390 | 93 | 23.7 | 15 | 1.05 |
| 714-060 | 1920-1950 | 270 | 19 | 19 | 11 | 8 | 328 | 57 | 17.5 | 39 | 1.36 |

## TABLE 2 C
## TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF $C_1$ - $C_7$ 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 $C_5$ - $C_7$ | $\frac{iC_4}{nC_4}$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 714-061 | 1950-1980 | 250 | 269 | 33 | 12 | 10 | 573 | 323 | 56.4 | 27 | 1.24 |
| 714-062 | 1980-2010 | 301 | 51 | 48 | 29 | 23 | 451 | 150 | 33.3 | 56 | 1.25 |
| 714-063 | 2010-2040 | 258 | 40 | 70 | 38 | 21 | 427 | 169 | 39.6 | 78 | 1.81 |
| 714-064 | 2040-2070 | 660 | 81 | 103 | 74 | 45 | 962 | 303 | 31.4 | 99 | 1.66 |
| 714-065 | 2070-2100 | 606 | 109 | 155 | 94 | 53 | 1017 | 412 | 40.5 | 277 | 1.78 |
| 714-066 | 2100-2130 | 1937 | 278 | 286 | 130 | 94 | 2725 | 788 | 28.9 | 402 | 1.38 |
| 714-067 | 2130-2160 | 2464 | 374 | 453 | 173 | 144 | 3608 | 1144 | 31.7 | 455 | 1.21 |
| 714-068 | 2160-2190 | 4928 | 1275 | 1410 | 357 | 454 | 8424 | 3496 | 41.5 | 815 | 0.79 |
| 714-069 | 2190-2220 | 3236 | 773 | 1369 | 324 | 611 | 6313 | 3077 | 48.7 | 1038 | 0.53 |
| 714-070 | 2220-2250 | 21777 | 4777 | 4648 | 1067 | 1070 | 33340 | 11563 | 34.7 | 1491 | 1.00 |
| 714-071 | 2250-2280 | 15490 | 4427 | 4815 | 1428 | 1744 | 27903 | 12413 | 44.5 | 2920 | 0.82 |
| 714-072 | 2280-2310 | 5314 | 1550 | 1875 | 508 | 1056 | 10304 | 4990 | 48.4 | 653 | 0.48 |
| 714-073 | 2310-2340 | 5371 | 1789 | 2178 | 377 | 404 | 10119 | 4747 | 46.9 | 386 | 0.93 |
| 714-074 | 2340-2370 | 5136 | 1516 | 1877 | 314 | 251 | 9095 | 3958 | 43.5 | 185 | 1.25 |
| 714-075 | 2370-2400 | 23736 | 3657 | 2382 | 369 | 293 | 30437 | 6701 | 22.0 | 395 | 1.26 |
| 714-076 | 2400-2430 | 1077 | 271 | 578 | 135 | 245 | 2307 | 1229 | 53.3 | 241 | 0.55 |
| 714-077 | 2430-2460 | 380 | 123 | 324 | 63 | 166 | 1057 | 677 | 64.1 | 60 | 0.38 |
| 714-078 | 2460-2490 | 487 | 132 | 274 | 63 | 134 | 1090 | 603 | 55.3 | 129 | 0.47 |
| 714-079 | 2490-2520 | 849 | 215 | 391 | 83 | 221 | 1759 | 910 | 51.7 | 209 | 0.38 |
| 714-080 | 2520-2550 | 389 | 115 | 177 | 35 | 72 | 788 | 399 | 50.7 | 184 | 0.49 |
| 714-081 | 2550-2580 | 350 | 89 | 193 | 40 | 114 | 785 | 435 | 55.4 | 41 | 0.35 |
| 714-082 | 2580-2610 | 637 | 75 | 137 | 28 | 69 | 946 | 309 | 32.6 | 182 | 0.40 |
| 714-083 | 2610-2640 | 756 | 184 | 96 | 21 | 41 | 1099 | 342 | 31.1 | 155 | 0.52 |
| 714-084 | 2640-2657 | 635 | 35 | 50 | 12 | 23 | 756 | 121 | 16.0 | 137 | 0.52 |

## 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 | |
| 714-013B | 510–540m | Am**;-;I-W-H | **disseminated, not typically oil prone | 10 | F-M | F | --- |
| 714-015A | 570–600m | Am;-;H-W-I | | 5 | F-M | F | 1+ to 2-(??) |
| 714-017C | 630–660m | Am**;W-H-I;A | **very finely disseminated, poor quality, possibly contaminant | 25 | F-M | P-F | 1+ |
| 714-018A | 660–690m | W;H-Al;I-Am | lean, unreliable apart from fine pyrite | - | F-M | P-F | 1+(?) |
| 714-020B | 720–750m | Am**;H*-W;I-Al | **not typical oil prone, includes incompletely developed material<br>*atypical, includes material apparently passing to Am | 5 | F-M/C | F | 1+(?) |
| 714-023A | 810–840m | W;Al;H-I-Am | | - | F-C | P-F | 1+ |
| 714-023B | 810–840m | Am**;-;W-I-H-Al | **not typically oil prone | 10 | F-M | F | --- |
| 714-027A | 930–960m | -;Am**-Al-W;I-H | **as 017C Amorphous and algal factions atypical - possibly derived from drilling additions | 25 | F-M/C | P | 1+(?) |
| 714-028B | 960–990m | Am**-W;H-Al;I | **as 017C | - | F-M | P | 1+(?) |
| 714-030B | 1020–1050m | Am**;W;H-I-Al | **not typically oil prone, includes abundant degraded material | 10 | F-M | F | 1+ |
| 714-031A | 1050–1080m | W;H;Am-I-Al | | 10 | M | F | 1+/1+ to 2- |
| 714-033A | 1110–1140m | -;I-Am**-W-Al-H;- | **poor quality, frequently finely disseminated | 40 | M | F | 1+/1+ to 2- |
| 714-047A | 1530–1560m | -;I-Al-W-H-Am;- | sapropelisation H at 2- foram linings | 45 | M-C | G | 1+ to 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 | |
| 714-051A | 1650-1680m | Am**;I-W;H-Al | **not typically oil prone | 50 | F-M | P-F | --- |
| 714-052A | 1680-1710m | I-W;-;H-Al-Am | frequent H at 2- through 2 | 90 | M-C | G | 1+ to 2- |
| 714-054A | 1740-1770m | I-W;-;H-Am-Al | frequent H at 2- through 2 | 85 | M | F-G | 1+ to 2- |
| 714-056A | 1800-1830m | I-W;H;Al-Am | frequent H at 2- and 2- to 2 | 80 | M-C | G | 1+ to 2- |
| 714-058A | 1860-1890m | -;I-W-H-Am**;Al | frequent H at 2- and 2- to 2<br>**highly disseminated, poor quality, contaminant? | 60 | F-M/C | F-G | 1+ to 2- |
| 714-059A | 1890-1920m | I-W;-;H-Am-Al | reworked H | 85 | M-C | G | 1+ to 2- |
| 714-061A | 1950-1980m | I-W;H;Am**-Al | **as 058A foram linings material at 2- through 2 | 80 | F-M/C | F-G | 1+ to 2- |
| 714-063A | 2010-2040m | -;H-I-W;Am**-Al | **poor quality foram linings significant H at 2- | 50 | M | G | 1+ to 2- |
| 714-065A | 2070-2100m | I;W-Am**;H-Al | **disseminated, poor quality, unrecognisable - not oil prone | 85 | M | F | 1+ to 2-(?) |
| 714-066A | 2100-2130m | H;I-W-Am**-Al;- | **frequently disseminated, not typically oil prone sapropelisation | 30 | M | G | 1+ to 2- |
| 714-068A | 2160-2190m | -;H**-Am**-Al**-I-W;- | significant material at 2-<br>**inlcudes material passing to Am | 30 | M-VC | G | 1+ to 2-/2- |
| 714-069B | 2190-2220m | Am**;I-H**-Al**;W | **as 068A | 30 | M-VC | F-G | 1+ to 2-/2- |
| 714-070A | 2220-2250m | Am**;I-Al**-H**;W | **as 068A | 30 | M-VC | G | 1+ to 2-/2- |
| 714-071B | 2250-2280m | Am**;Al*-I;H-W | **includes incompletely developed material<br>*generally passing to Am | 20 | F-VC | F-G | 1+ to 2- |
| 714-073B | 2310-2340m | Am**;I-Al**-H**-W;- | **as 072A | 30 | M-VC | F-G | 2- max |
| 714-074A | 2340-2370m | -;H**-I-Al**-W-Am;- | **as 072A foram linings H at 2- to 2 and 2 | 45 | M-C | 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 | |
| 714-076A | 2400-2430m | -;H**-I-Al**-Am**-W;- | **includes incompletely developed material | 45 | M-C | G | 2- |
| 714-078B | 2460-2490m | -;Al**-Am*-I-H**-W;- | **as 076A<br>*includes material passing to Am | 35 | M-VC | F-G | 2- |
| 714-080A | 2520-2550m | -;Al**-Am**-I-H**-W;- | **as 076A foram linings H at 1+ to 2- | 30 | M-VC | G | 2- |
| 714-081C | 2550-2580m | -;Am*-I-Al**-H**-W;- | **as 076A<br>*as 078B | 35 | M-VC | F-G | 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 Ro (%), (NUMBER OF PARTICLES) | | | | REMARKS |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | |
| 714-015A | 570-600m | WR | 0.31(15) | 0.96(2) | - | - | |
| 714-020B | 720-750m | WR | 0.30(3) | - | - | - | |
| 714-023B | 810-840m | WR | 0.26(3) | - | - | - | |
| 714-028B | 960-990m | WR | 0.37(2) | 0.84(1) | - | - | |
| 714-030B | 1020-1050m | KC | 0.29(13) | 0.43(3) | 0.76(2) | - | |
| 714-031A | 1050-1080m | KC | 0.38(21) | - | - | - | |
| 714-033A | 1110-1140m | WR | 0.54(2) | 0.76(1) | - | - | |
| 714-052A | 1680-1710m | KC | 0.26(2) | 0.39(1) | 0.63(1) | 1.12(32) | |
| 714-054A | 1740-1770m | KC | 0.40(1) | 0.50(5) | 0.76(7) | 1.12(28) | |
| 714-056A | 1800-1830m | KC | 0.37(30) | 0.79(27) | - | - | |
| 714-058A | 1860-1890m | KC | 0.43(3) | 0.56(1) | 1.09(19) | - | |
| 714-063A | 2010-2040m | KC | 0.39(12) | 0.79(14) | - | - | |
| 714-066A | 2100-2130m | KC | 0.39(29) | 1.04(4) | - | - | |
| 714-068A | 2160-2190m | KC | 0.39(38) | 0.65(3) | 0.95(24) | 1.26(8) | |
| 714-070A | 2220-2250m | KC | 0.39(1) | 0.96(20) | 1.30(5) | - | |
| 714-072A | 2280-2310m | KC | 0.45(16) | 0.79(5) | 1.14(18) | - | |
| 714-073B | 2310-2340m | KC | 0.49(15) | 0.68(14) | 1.03(23) | - | |
| 714-074A | 2340-2370m | KC | 0.45(15) | 0.65(5) | 0.98(6) | - | |
| 714-075C | 2370-2400m | KC | 0.44(60) | - | - | - | |
| 714-076A | 2400-2460m | KC | 0.43(9) | 0.66(2) | 1.09(3) | 1.40(1) | |
| 714-078B | 2460-2490m | KC | 0.51(3) | 0.69(8) | 1.01(13) | - | |
| 714-080A | 2520-2550m | KC | 0.30(1) | 0.46(6) | 0.64(14) | 0.91(14) | 1.22(3) |

CT—ditch cuttings; CO—core; WR—whole rock; KC—kerogen concentrate. Colours — spore fluorescence. *Reworked

TABLE 5a

CONCENTRATION (PPM) OF EXTRACTED $C_{15+}$ MATERIAL IN ROCK

| GEOCHEM SAMPLE NUMBER | DEPTH | TOTAL EXTRACT | HYDROCARBONS | | | NON HYDROCARBONS | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | Paraffin - Naphthenes | Aromatics | TOTAL | Precipt'd. Asphaltenes | Eluted NSO's | Non-eluted NSO's | Sulphur |
| 714-019 | 690-720 | 1912 | 335 | 640 | 975 | 710 | 166 | 61 | 0 |
| 714-028 | 960-990 | 468 | 54 | 126 | 180 | 218 | 58 | 11 | 0 |
| 714-031 | 1050-1080 | 460 | 62 | 93 | 156 | 168 | 104 | 33 | 0 |
| 714-047 | 1530-1560 | 845 | 114 | 213 | 326 | 391 | 114 | 15 | 0 |
| 714-051 | 1650-1680 | 4228 | 607 | 1290 | 1897 | 1486 | 610 | 235 | 0 |
| 714-054A | 1740-1770 | 3119 | 530 | 834 | 1364 | 1086 | 384 | 285 | 0 |
| 714-056A | 1800-1830 | 1184 | 211 | 273 | 484 | 441 | 223 | 36 | 0 |
| 714-058A | 1860-1890 | 1692 | 263 | 469 | 732 | 484 | 399 | 76 | 0 |
| 714-059A | 1890-1920 | 1541 | 332 | 275 | 607 | 619 | 142 | 81 | 91 |
| 714-061A | 1950-1980 | 1747 | 366 | 355 | 721 | 801 | 188 | 37 | 0 |
| 714-063A | 2010-2040 | 2300 | 422 | 473 | 895 | 924 | 275 | 106 | 101 |
| 714-065A | 2070-2100 | 676 | 156 | 117 | 273 | 238 | 156 | 8 | 0 |
| 714-066A | 2100-2130 | 1787 | 264 | 472 | 736 | 638 | 365 | 47 | 0 |
| 714-068A | 2160-2190 | 1817 | 237 | 255 | 492 | 1095 | 178 | 52 | 0 |
| 714-070A | 2220-2250 | 2440 | 362 | 431 | 793 | 1134 | 357 | 155 | 0 |
| 714-071B | 2250-2280 | 3400 | 549 | 734 | 1284 | 1026 | 731 | 309 | 51 |
| 714-074 | 2340-2370 | 1372 | 259 | 335 | 595 | 597 | 163 | 17 | 0 |
| 714-076 | 2400-2430 | 1185 | 138 | 243 | 382 | 611 | 171 | 21 | 0 |
| 714-078 | 2460-2490 | 745 | 97 | 125 | 221 | 390 | 96 | 37 | 0 |
| 714-080 | 2520-2550 | 429 | 76 | 68 | 144 | 202 | 67 | 16 | 0 |
| 714-083 | 2610-2640 | 629 | 146 | 203 | 349 | 169 | 91 | 20 | 0 |

TABLE 5b

COMPOSITION (NORMALISED %) OF $C_{15+}$ MATERIAL EXTRACTED FROM ROCK

| GEOCHEM SAMPLE NUMBER | DEPTH | HYDROCARBONS | | NON HYDROCARBONS | | | |
|---|---|---|---|---|---|---|---|
| | | Paraffin – Naphthenes | Aromatics | Preciptd. Asphaltenes | Eluted NSO's | Non eluted NSO's | Sulphur |
| /14-019 | 690-720 | 17.52 | 33.45 | 37.14 | 8.69 | 3.19 | 0.00 |
| /14-028 | 960-990 | 11.55 | 27.02 | 46.62 | 12.42 | 2.40 | 0.00 |
| 714-031 | 1050-1080 | 13.54 | 20.31 | 36.46 | 22.57 | 7.12 | 0.00 |
| 714-047 | 1530-1560 | 13.44 | 25.15 | 46.23 | 13.44 | 1.73 | 0.00 |
| 714-051 | 1650-1680 | 14.35 | 30.51 | 35.14 | 14.43 | 5.56 | 0.00 |
| 714-054A | 1740-1770 | 16.99 | 26.75 | 34.82 | 12.31 | 9.13 | 0.00 |
| 714-056A | 1800-1830 | 17.85 | 23.03 | 37.24 | 18.81 | 3.07 | 0.00 |
| 714-058A | 1860-1890 | 15.56 | 27.74 | 28.61 | 23.60 | 4.49 | 0.00 |
| 714-059A | 1890-1920 | 21.58 | 17.85 | 40.21 | 9.19 | 5.29 | 5.89 |
| 714-061A | 1950-1980 | 20.94 | 20.32 | 45.85 | 10.78 | 2.11 | 0.00 |
| 714-063A | 2010-2040 | 18.35 | 20.54 | 40.15 | 11.95 | 4.62 | 4.38 |
| 714-065A | 2070-2100 | 23.15 | 17.30 | 35.20 | 23.15 | 1.19 | 0.00 |
| 714-066A | 2100-2130 | 14.76 | 26.44 | 35.70 | 20.45 | 2.64 | 0.00 |
| 714-068A | 2160-2190 | 13.04 | 14.03 | 60.27 | 9.79 | 2.87 | 0.00 |
| 714-070A | 2220-2250 | 14.84 | 17.67 | 46.50 | 14.63 | 6.36 | 0.00 |
| 714-071B | 2250-2280 | 16.15 | 21.60 | 30.17 | 21.51 | 9.08 | 1.49 |
| 714-074 | 2340-2370 | 18.91 | 24.43 | 43.54 | 11.85 | 1.26 | 0.00 |
| 714-076 | 2400-2430 | 11.68 | 20.54 | 51.52 | 14.45 | 1.81 | 0.00 |
| 714-078 | 2460-2490 | 12.99 | 16.72 | 52.42 | 12.91 | 4.96 | 0.00 |
| 714-080 | 2520-2550 | 17.67 | 15.93 | 47.16 | 15.62 | 3.63 | 0.00 |
| 714-083 | 2610-2640 | 23.28 | 32.24 | 26.89 | 14.43 | 3.17 | 0.00 |

TABLE 6
SIGNIFICANT RATIOS (%) OF $C_{15+}$ FRACTIONS AND ORGANIC CARBON

| GEOCHEM SAMPLE NUMBER | DEPTH | ORGANIC CARBON (wt. %) | HYDROCARBONS / TOTAL EXTRACT | HYDROCARBONS / ORG. CARBON | TOTAL EXTRACT / ORG. CARBON | P-NAPHTHENES / AROMATICS |
|---|---|---|---|---|---|---|
| 714-019 | 690-720 | 0.62 | 50.98 | 15.72 | 30.84 | 0.52 |
| 714-028 | 960-990 | 1.83 | 38.56 | 0.99 | 2.56 | 0.43 |
| 714-031 | 1050-1080 | 0.90 | 33.85 | 1.73 | 5.11 | 0.67 |
| 714-047 | 1530-1560 | 0.66 | 38.59 | 4.94 | 12.81 | 0.53 |
| 714-051 | 1650-1680 | 1.00 | 44.87 | 18.97 | 42.28 | 0.47 |
| 714-054A | 1740-1770 | 1.29 | 43.74 | 10.58 | 24.18 | 0.63 |
| 714-056A | 1800-1830 | 1.03 | 40.88 | 4.70 | 11.50 | 0.77 |
| 714-058A | 1860-1890 | 1.18 | 43.30 | 6.21 | 14.33 | 0.56 |
| 714-059A | 1890-1920 | 0.96 | 39.43 | 6.33 | 16.05 | 1.21 |
| 714-061A | 1950-1980 | 0.68 | 41.26 | 10.60 | 25.69 | 1.03 |
| 714-063A | 2010-2040 | 1.53 | 38.90 | 5.85 | 15.03 | 0.89 |
| 714-065A | 2070-2100 | 0.78 | 40.45 | 3.50 | 8.66 | 1.34 |
| 714-066A | 2100-2130 | 1.61 | 41.20 | 4.57 | 11.10 | 0.56 |
| 714-068A | 2160-2190 | 2.23 | 27.07 | 2.21 | 8.15 | 0.93 |
| 714-070A | 2220-2250 | 2.73 | 32.51 | 2.91 | 8.94 | 0.84 |
| 714-071B | 2250-2280 | 5.63 | 37.76 | 2.28 | 6.04 | 0.75 |
| 714-074 | 2340-2370 | 3.15 | 43.34 | 1.89 | 4.35 | 0.77 |
| 714-076 | 2400-2430 | 2.26 | 32.22 | 1.69 | 5.24 | 0.57 |
| 714-078 | 2460-2490 | 1.49 | 29.71 | 1.49 | 5.00 | 0.78 |
| 714-080 | 2520-2550 | 0.95 | 33.60 | 1.52 | 4.52 | 1.11 |
| 714-083 | 2610-2640 | 0.30 | 55.52 | 11.65 | 20.98 | 0.72 |

## TABLE 7
## PYROLYSIS RESULTS

| GEOCHEM SAMPLE NUMBER | DEPTH | WT. % ORGANIC CARBON (OC) | WT. PPM | | RATIOS | | Tmax (°C) Pyrolysate |
|---|---|---|---|---|---|---|---|
| | | | Thermal Bitumen (P1) | Pyrolysate (P2) | $\frac{P1}{P1+P2}$ | $\frac{P2}{OC}$ | |
| 714-015A | 570-600 | 0.83 | 433 | 778 | 0.36 | 0.09 | |
| 714-017C | 630-660 | 0.43 | 34 | 856 | 0.04 | 0.20 | |
| 714-020B | 720-750 | 0.64 | 36 | 525 | 0.06 | 0.08 | |
| 714-021B | 750-780 | 0.54 | 35 | 693 | 0.05 | 0.13 | |
| 714-023B | 810-840 | 0.61 | 68 | 1607 | 0.04 | 0.26 | |
| 714-024A | 840-870 | 0.75 | 153 | 327 | 0.32 | 0.07 | |
| 714-027A | 930-960 | 0.53 | 795 | 576 | 0.58 | 0.11 | |
| 714-028B | 960-990 | 1.78 | 13521 | 8923 | 0.60 | 0.36 | |
| 714-029B | 990-1020 | 1.54 | 6242 | 3007 | 0.67 | 0.20 | |
| 714-030B | 1020-1050 | 2.61 | 305 | 2691 | 0.10 | 0.10 | |
| 714-031A | 1050-1080 | 0.98 | 1414 | 4697 | 0.23 | 0.48 | |
| 714-032A | 1080-1110 | 0.64 | 38 | 445 | 0.08 | 0.07 | |
| 714-033A | 1110-1140 | 1.15 | 1245 | 1406 | 0.47 | 0.12 | |
| 714-051A | 1650-1680 | 0.46 | 293 | 294 | 0.50 | 0.06 | |
| 714-052A | 1680-1710 | 1.20 | 487 | 555 | 0.47 | 0.05 | |
| 714-054A | 1740-1770 | 1.36 | 103 | 591 | 0.15 | 0.04 | |
| 714-058A | 1860-1890 | 1.19 | 97 | 2008 | 0.05 | 0.17 | |
| 714-059A | 1890-1920 | 1.20 | 213 | 821 | 0.21 | 0.07 | |
| 714-061A | 1950-1980 | 0.63 | 40 | 606 | 0.06 | 0.10 | |
| 714-062A | 1980-2010 | 0.69 | 28 | 718 | 0.04 | 0.10 | |
| 714-063A | 2010-2040 | 1.60 | 62 | 7129 | 0.01 | 0.45 | |
| 714-064A | 2040-2070 | 1.52 | 119 | 1853 | 0.06 | 0.12 | |
| 714-065A | 2070-2100 | 0.73 | 163 | 677 | 0.19 | 0.09 | |
| 714-066A | 2100-2130 | 1.79 | 206 | 3497 | 0.06 | 0.20 | |
| 714-067A | 2130-2160 | 1.92 | 53 | 4931 | 0.01 | 0.26 | |
| 714-068A | 2160-2190 | 2.28 | 225 | 5811 | 0.04 | 0.25 | |
| 714-069B | 2190-2220 | 1.42 | 169 | 2486 | 0.06 | 0.18 | |
| 714-070A | 2220-2250 | 2.92 | 609 | 12500 | 0.05 | 0.43 | |
| 714-071B | 2250-2280 | 7.16 | 919 | 17478 | 0.05 | 0.24 | |
| 714-071A | 2250-2280 | 2.59 | 223 | 16807 | 0.01 | 0.65 | |
| 714-072B | 2280-2310 | 6.12 | 765 | 16309 | 0.04 | 0.27 | |
| 714-072A | 2280-2310 | 3.26 | 117 | 5144 | 0.02 | 0.16 | |
| 714-073B | 2310-2340 | 2.90 | 72 | 3253 | 0.02 | 0.11 | |
| 714-074A | 2340-2370 | 4.16 | 352 | 7685 | 0.04 | 0.18 | |
| 714-075C | 2370-2400 | 57.80 | 8716 | 63348 | 0.12 | 0.11 | |
| 714-076A | 2400-2430 | 3.05 | 365 | 7749 | 0.05 | 0.25 | |
| 714-078B | 2460-2490 | 2.71 | 158 | 8936 | 0.02 | 0.33 | |
| 714-079C | 2490-2520 | 3.58 | 323 | 8531 | 0.04 | 0.24 | |
| 714-080A | 2520-2550 | 2.85 | 132 | 6624 | 0.02 | 0.23 | |
| 714-081A | 2550-2580 | 0.14 | 27 | 146 | 0.15 | 0.10 | |
| 714-081C | 2550-2580 | 3.00 | 223 | 5776 | 0.04 | 0.19 | |

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

TABLE 8

SCREENING PYROLYSIS

| SAMPLE NUMBER | DEPTH | ORGANIC CARBON ( Wt % ) | PYROLYSATE (P2,Wt PPM) | PYROLYSATE ORGANIC CARBON |
|---|---|---|---|---|
| 714-023B | 810-840 | 0.61 | 322 | 0.05 |
| 714-028B | 960-990 | 1.78 | 3300 | 0.13 |
| 714-029B | 990-1020 | 1.54 | 780 | 0.05 |
| 714-030B | 1020-1050 | 2.61 | 2064 | 0.08 |
| 714-031A | 1050-1080 | 0.98 | 1060 | 0.11 |
| 714-033A | 1110-1140 | 1.15 | 1511 | 0.13 |
| 714-052A | 1680-1710 | 1.20 | 439 | 0.04 |
| 714-058A | 1860-1890 | 1.19 | 434 | 0.04 |
| 714-059A | 1890-1920 | 1.20 | 622 | 0.05 |
| 714-063A | 2010-2040 | 1.60 | 1860 | 0.12 |
| 714-066A | 2100-2130 | 1.79 | 2125 | 0.12 |
| 714-067A | 2130-2160 | 1.92 | 2751 | 0.14 |
| 714-068A | 2160-2190 | 2.28 | 2784 | 0.12 |
| 714-069B | 2190-2220 | 1.42 | 2088 | 0.15 |
| 714-070A | 2220-2250 | 2.92 | 4747 | 0.16 |
| 714-071B | 2250-2280 | 7.16 | 10416 | 0.15 |
| 714-071A | 2250-2280 | 2.59 | 3512 | 0.14 |
| 714-072B | 2280-2310 | 6.12 | 12421 | 0.20 |
| 714-072A | 2280-2310 | 3.26 | 5110 | 0.16 |
| 714-073B | 2310-2340 | 2.90 | 2079 | 0.07 |
| 714-074A | 2340-2370 | 4.16 | 3148 | 0.08 |
| 714-075C | 2370-2400 | 57.80 | 69094 | 0.12 |
| 714-076A | 2400-2430 | 3.05 | 6765 | 0.22 |
| 714-078B | 2460-2490 | 2.71 | 3338 | 0.12 |
| 714-079C | 2490-2520 | 3.58 | 7815 | 0.22 |
| 714-081C | 2550-2580 | 3.00 | 4139 | 0.14 |

**TABLE 9**

**COMPOSITION (NORMALISED %) OF $C_{15+}$ PARAFFIN – NAPHTHENE HYDROCARBONS**

| GEOCHEM SAMPLE NUMBER | -019 | -028 | -031 | -047 | -051 | -054A | -056A |
|---|---|---|---|---|---|---|---|
| DEPTH | 690-720m | 960-990m | 1050-1080m | 1530-1560m | 1650-1680m | 1740-1770m | 1800-1830m |
| SAMPLE TYPE | | | | | | | |
| $nC_{15}$ | 7.53 | 11.96 | 3.29 | 2.53 | 5.31 | 1.76 | 8.45 |
| $nC_{16}$ | 8.43 | 11.74 | 8.59 | 5.39 | 7.73 | 6.20 | 15.21 |
| $nC_{17}$ | 7.53 | 11.52 | 11.15 | 8.17 | 8.83 | 9.38 | 16.51 |
| $nC_{18}$ | 9.62 | 29.78 | 24.31 | 9.44 | 9.77 | 8.88 | 13.91 |
| $nC_{19}$ | 7.23 | 7.17 | 11.15 | 9.77 | 9.84 | 8.71 | 10.66 |
| $nC_{20}$ | 7.31 | 5.22 | 8.23 | 10.11 | 9.06 | 8.79 | 8.45 |
| $nC_{21}$ | 6.49 | 4.57 | 6.76 | 8.51 | 8.44 | 9.80 | 6.11 |
| $nC_{22}$ | 5.37 | 3.91 | 5.48 | 7.92 | 7.34 | 10.39 | 4.81 |
| $nC_{23}$ | 5.29 | 4.35 | 5.48 | 6.91 | 6.17 | 11.47 | 3.77 |
| $nC_{24}$ | 4.47 | 3.26 | 4.75 | 6.99 | 4.61 | 9.13 | 2.86 |
| $nC_{25}$ | 3.80 | 2.39 | 3.84 | 5.48 | 3.75 | 6.78 | 2.47 |
| $nC_{26}$ | 3.65 | 1.09 | 2.93 | 4.63 | 3.36 | 4.02 | 1.82 |
| $nC_{27}$ | 3.58 | 0.65 | 1.83 | 3.96 | 2.73 | 2.18 | 1.69 |
| $nC_{28}$ | 3.13 | 0.43 | 0.91 | 3.37 | 2.66 | 1.17 | 1.04 |
| $nC_{29}$ | 3.21 | 0.43 | 0.55 | 2.44 | 2.27 | 0.59 | 1.17 |
| $nC_{30}$ | 3.13 | 0.43 | 0.18 | 1.35 | 1.95 | 0.34 | 0.39 |
| $nC_{31}$ | 2.98 | 0.22 | 0.18 | 1.10 | 1.72 | 0.17 | 0.13 |
| $nC_{32}$ | 2.76 | 0.22 | 0.18 | 0.67 | 1.41 | 0.08 | 0.13 |
| $nC_{33}$ | 2.46 | 0.22 | 0.18 | 0.59 | 1.33 | 0.08 | 0.13 |
| $nC_{34}$ | 1.34 | 0.22 | 0.00 | 0.42 | 1.17 | 0.08 | 0.13 |
| $nC_{35}$ | 0.67 | 0.22 | 0.00 | 0.25 | 0.55 | 0.00 | 0.13 |
| PARAFFIN | 33.68 | 32.83 | 30.97 | 27.02 | 36.73 | 49.32 | 39.46 |
| ISOPRENOID | 2.31 | 2.50 | 2.89 | 2.82 | 3.64 | 5.25 | 6.11 |
| NAPHTHENE | 64.01 | 64.67 | 66.14 | 70.16 | 59.63 | 45.44 | 54.44 |
| CPI INDEX A | 1.04 | 1.13 | 1.06 | 0.96 | 1.02 | 1.08 | 1.06 |
| CPI INDEX B | 1.01 | 1.20 | 1.13 | 1.04 | 0.97 | 1.20 | 1.25 |
| PRISTANE/PHYTANE | 1.19 | 0.94 | 1.04 | 1.03 | 1.12 | 1.23 | 1.53 |
| PRISTANE/$nC_{17}$ | 0.50 | 0.32 | 0.43 | 0.65 | 0.59 | 0.63 | 0.57 |

TABLE 9

COMPOSITION (NORMALISED %) OF $C_{15+}$ PARAFFIN – NAPHTHENE HYDROCARBONS

| GEOCHEM SAMPLE NUMBER | -058A | -059A | -061A | -063A | -065A | -066A | -068A |
|---|---|---|---|---|---|---|---|
| DEPTH | 1860-1890m | 1890-1920m | 1950-1980m | 2010-2040m | 2070-2100m | 2100-2130m | 2160-2190m |
| SAMPLE TYPE | | | | | | | |
| $nC_{15}$ | 5.12 | 1.08 | 0.35 | 2.71 | 1.50 | 2.65 | 1.96 |
| $nC_{16}$ | 8.59 | 7.43 | 4.04 | 7.67 | 7.36 | 7.13 | 6.76 |
| $nC_{17}$ | 9.19 | 10.78 | 10.15 | 10.76 | 9.32 | 10.15 | 9.41 |
| $nC_{18}$ | 10.67 | 14.37 | 14.42 | 11.41 | 14.04 | 11.15 | 12.16 |
| $nC_{19}$ | 8.76 | 10.06 | 13.84 | 9.73 | 8.75 | 10.33 | 9.41 |
| $nC_{20}$ | 9.19 | 10.42 | 13.15 | 8.51 | 9.21 | 10.24 | 7.84 |
| $nC_{21}$ | 7.20 | 6.59 | 9.34 | 7.02 | 6.67 | 7.95 | 7.06 |
| $nC_{22}$ | 6.59 | 5.39 | 7.15 | 5.43 | 5.29 | 6.49 | 5.29 |
| $nC_{23}$ | 5.38 | 4.79 | 5.42 | 5.14 | 5.52 | 6.03 | 7.25 |
| $nC_{24}$ | 4.60 | 3.71 | 4.15 | 3.74 | 4.03 | 4.57 | 5.29 |
| $nC_{25}$ | 4.68 | 4.07 | 3.69 | 4.21 | 6.44 | 4.75 | 7.16 |
| $nC_{26}$ | 3.99 | 3.11 | 3.11 | 3.55 | 4.14 | 3.47 | 5.00 |
| $nC_{27}$ | 4.16 | 4.19 | 2.88 | 3.74 | 5.75 | 3.75 | 5.69 |
| $nC_{28}$ | 3.12 | 2.16 | 2.19 | 2.43 | 3.22 | 2.56 | 2.84 |
| $nC_{29}$ | 2.78 | 3.59 | 2.08 | 3.18 | 4.60 | 3.02 | 3.14 |
| $nC_{30}$ | 1.82 | 1.80 | 1.04 | 2.15 | 2.07 | 1.83 | 1.37 |
| $nC_{31}$ | 1.56 | 2.16 | 1.04 | 2.99 | 0.69 | 1.55 | 1.18 |
| $nC_{32}$ | 0.95 | 1.32 | 0.58 | 2.06 | 0.46 | 0.91 | 0.49 |
| $nC_{33}$ | 0.87 | 1.44 | 0.69 | 1.87 | 0.46 | 0.82 | 0.39 |
| $nC_{34}$ | 0.52 | 0.96 | 0.46 | 1.22 | 0.23 | 0.37 | 0.20 |
| $nC_{35}$ | 0.26 | 0.60 | 0.23 | 0.47 | 0.23 | 0.27 | 0.10 |
| PARAFFIN | 33.31 | 24.32 | 27.03 | 31.08 | 22.74 | 28.04 | 24.10 |
| ISOPRENOID | 3.24 | 2.91 | 3.09 | 4.19 | 2.62 | 4.13 | 4.80 |
| NAPHTHENE | 63.45 | 72.76 | 69.88 | 64.73 | 74.64 | 67.83 | 71.11 |
| CPI INDEX A | 1.02 | 1.12 | 1.03 | 1.14 | 1.27 | 1.11 | 1.32 |
| CPI INDEX B | 1.15 | 1.49 | 1.16 | 1.29 | 1.53 | 1.27 | 1.48 |
| PRISTANE/PHYTANE | 1.20 | 1.22 | 0.74 | 1.32 | 1.04 | 1.09 | 0.99 |
| PRISTANE/$nC_{17}$ | 0.58 | 0.61 | 0.48 | 0.71 | 0.63 | 0.76 | 1.05 |

TABLE 9

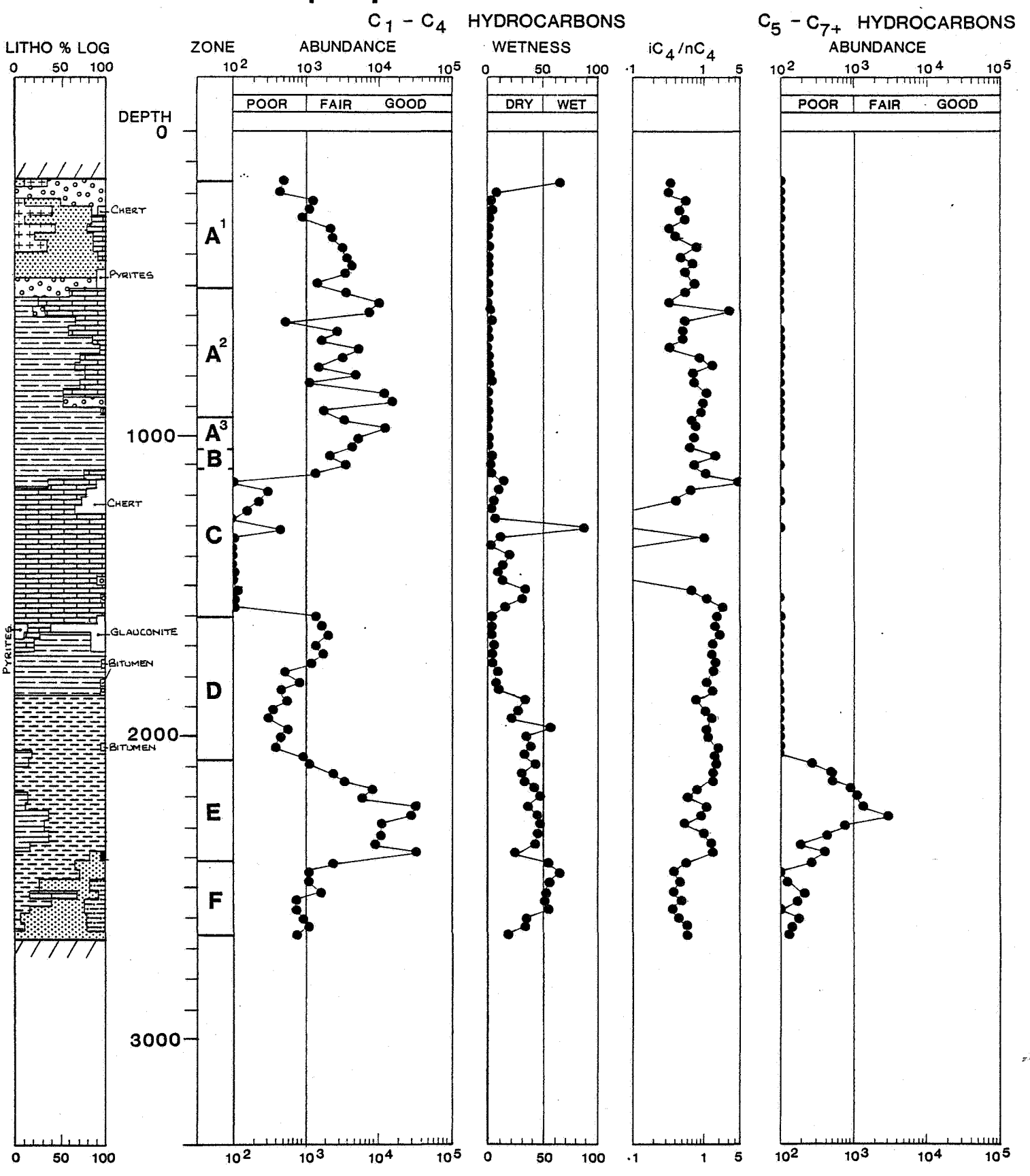
COMPOSITION (NORMALISED %) OF $C_{15+}$ PARAFFIN – NAPHTHENE HYDROCARBONS

| GEOCHEM SAMPLE NUMBER | -070A | -071B | -074 | -076 | -078 | -080 | -083 |
|---|---|---|---|---|---|---|---|
| DEPTH | 2220-2250m | 2250-2280m | 2340-2370m | 2400-2430m | 2460-2490m | 2520-2550m | 2610-2640m |
| SAMPLE TYPE | | | | | | | |
| $nC_{15}$ | 1.10 | 9.48 | 7.94 | 5.99 | 9.85 | 5.54 | 4.03 |
| $nC_{16}$ | 4.88 | 10.02 | 8.12 | 7.09 | 10.17 | 10.06 | 7.29 |
| $nC_{17}$ | 8.46 | 9.48 | 8.00 | 7.57 | 9.11 | 10.16 | 8.23 |
| $nC_{18}$ | 11.13 | 8.41 | 7.70 | 8.51 | 8.69 | 11.36 | 10.72 |
| $nC_{19}$ | 9.48 | 7.87 | 6.54 | 7.64 | 6.99 | 7.94 | 7.20 |
| $nC_{20}$ | 8.74 | 7.00 | 6.84 | 7.33 | 8.90 | 6.46 | 8.15 |
| $nC_{21}$ | 7.64 | 5.82 | 5.99 | 6.46 | 4.87 | 6.46 | 6.60 |
| $nC_{22}$ | 6.16 | 5.28 | 5.56 | 5.59 | 4.56 | 5.82 | 6.17 |
| $nC_{23}$ | 7.36 | 6.25 | 6.35 | 7.33 | 5.19 | 6.83 | 6.17 |
| $nC_{24}$ | 5.34 | 4.63 | 5.25 | 5.28 | 4.24 | 5.08 | 5.23 |
| $nC_{25}$ | 6.07 | 4.63 | 5.86 | 7.17 | 5.30 | 5.82 | 5.06 |
| $nC_{26}$ | 5.61 | 5.60 | 4.28 | 4.96 | 4.03 | 3.97 | 4.80 |
| $nC_{27}$ | 5.06 | 2.59 | 4.64 | 5.59 | 5.19 | 4.16 | 3.86 |
| $nC_{28}$ | 3.22 | 3.13 | 3.48 | 3.31 | 2.33 | 1.94 | 3.17 |
| $nC_{29}$ | 3.96 | 3.02 | 3.79 | 4.33 | 4.56 | 2.68 | 3.77 |
| $nC_{30}$ | 1.93 | 2.37 | 2.08 | 1.89 | 1.48 | 1.11 | 2.32 |
| $nC_{31}$ | 1.66 | 1.72 | 2.44 | 1.50 | 1.91 | 1.39 | 1.97 |
| $nC_{32}$ | 0.83 | 1.40 | 1.95 | 0.87 | 0.74 | 1.39 | 1.63 |
| $nC_{33}$ | 0.64 | 0.65 | 1.34 | 0.87 | 1.06 | 0.65 | 1.63 |
| $nC_{34}$ | 0.55 | 0.43 | 1.16 | 0.47 | 0.64 | 0.65 | 1.20 |
| $nC_{35}$ | 0.18 | 0.22 | 0.67 | 0.24 | 0.21 | 0.55 | 0.77 |
| PARAFFIN | 20.70 | 32.19 | 40.21 | 31.24 | 28.58 | 26.71 | 27.15 |
| ISOPRENOID | 4.11 | 8.08 | 4.62 | 5.51 | 3.57 | 4.64 | 2.65 |
| NAPHTHENE | 75.19 | 59.73 | 55.17 | 63.24 | 67.85 | 68.66 | 70.20 |
| CPI INDEX A | 1.15 | 0.95 | 1.14 | 1.27 | 1.15 | 1.24 | 1.01 |
| CPI INDEX B | 1.24 | 0.86 | 1.26 | 1.44 | 1.69 | 1.42 | 1.09 |
| PRISTANE/PHYTANE | 1.00 | 1.10 | 1.51 | 1.20 | 1.27 | 1.16 | 1.07 |
| PRISTANE/$nC_{17}$ | 1.17 | 1.39 | 0.86 | 1.27 | 0.77 | 0.92 | 0.61 |

FIGURE 1

# $C_1 - C_7$ HYDROCARBONS

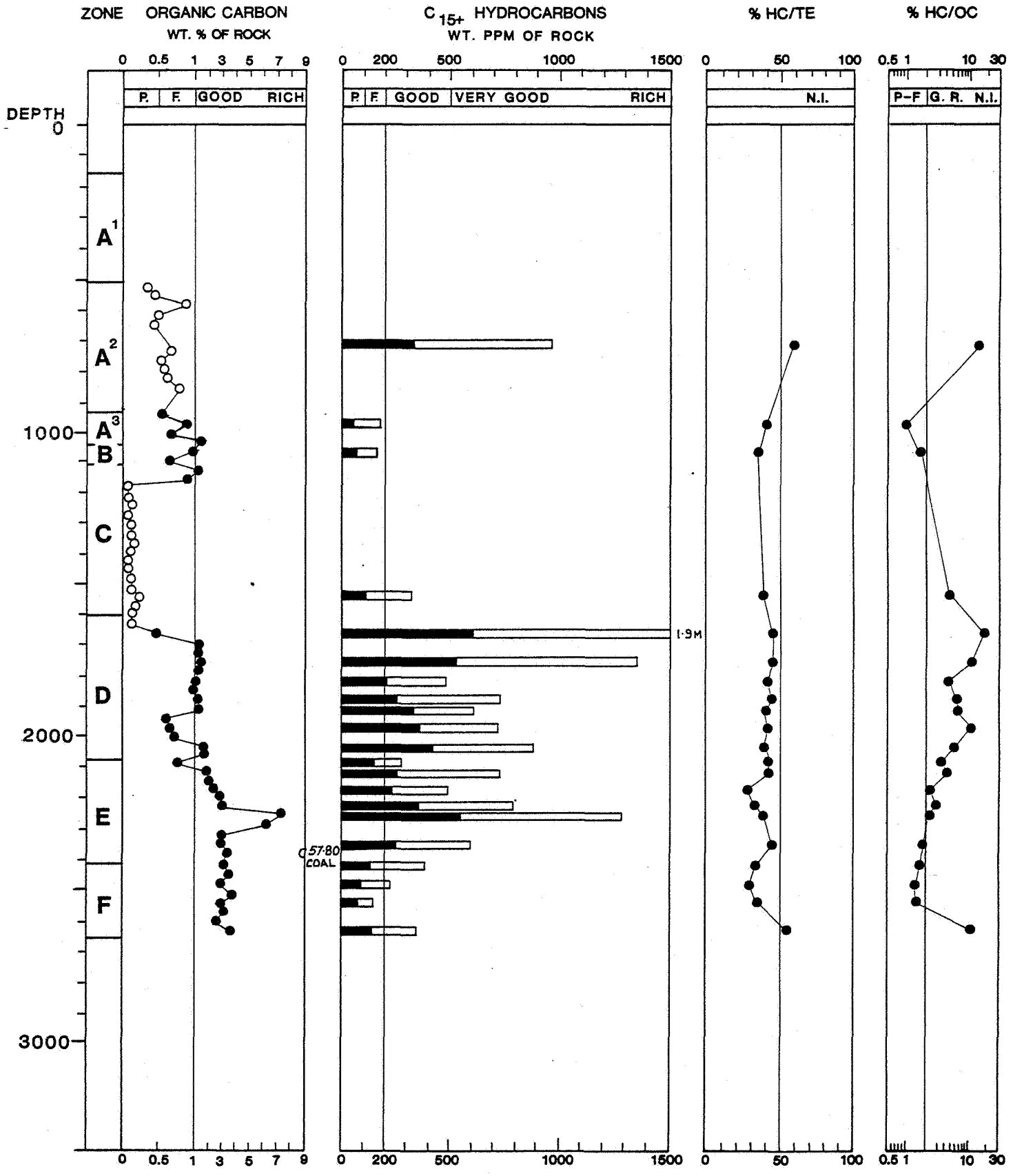
WELL 8/3-2




LIMESTONE
DOLOMITE
SHALE
MUDSTONE/ CLAYSTONE
COAL
SILTSTONE
SANDSTONE
EVAPORITE
IGNEOUS
L.C.M.

$iC_4$ - ISOBUTANE
$nC_4$ - NORMAL BUTANE
ABUNDANCE - VOLUME PPM OF ROCK
WETNESS - % $C_2$-$C_4$ IN $C_1$-$C_4$

FIGURE 2 **RICHNESS** WELL 8/3-2

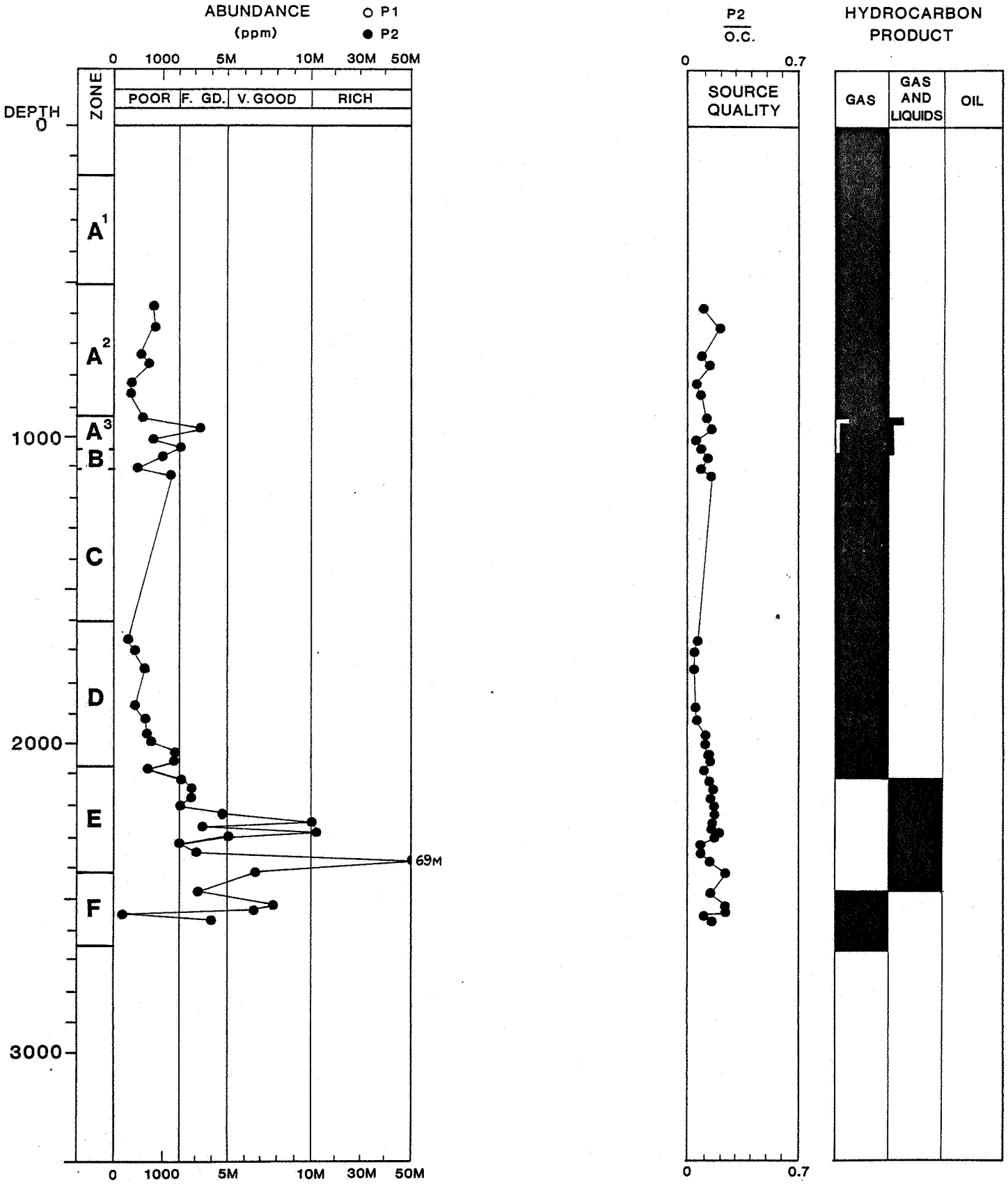



● SHALE
○ OTHER LITHOLOGIES

P – N – PARAFFIN – NAPHTHENES
AROM – AROMATICS
HC – $C_{15+}$ HYDROCARBONS
OC – ORGANIC CARBON
TE – TOTAL $C_{15+}$ EXTRACT

P – POOR
F – FAIR
G – GOOD
R – RICH
N.I. – NON-INDIGENOUS HYDROCARBONS

FIGURE 3 **PYROLYSIS** WELL 8/3-2



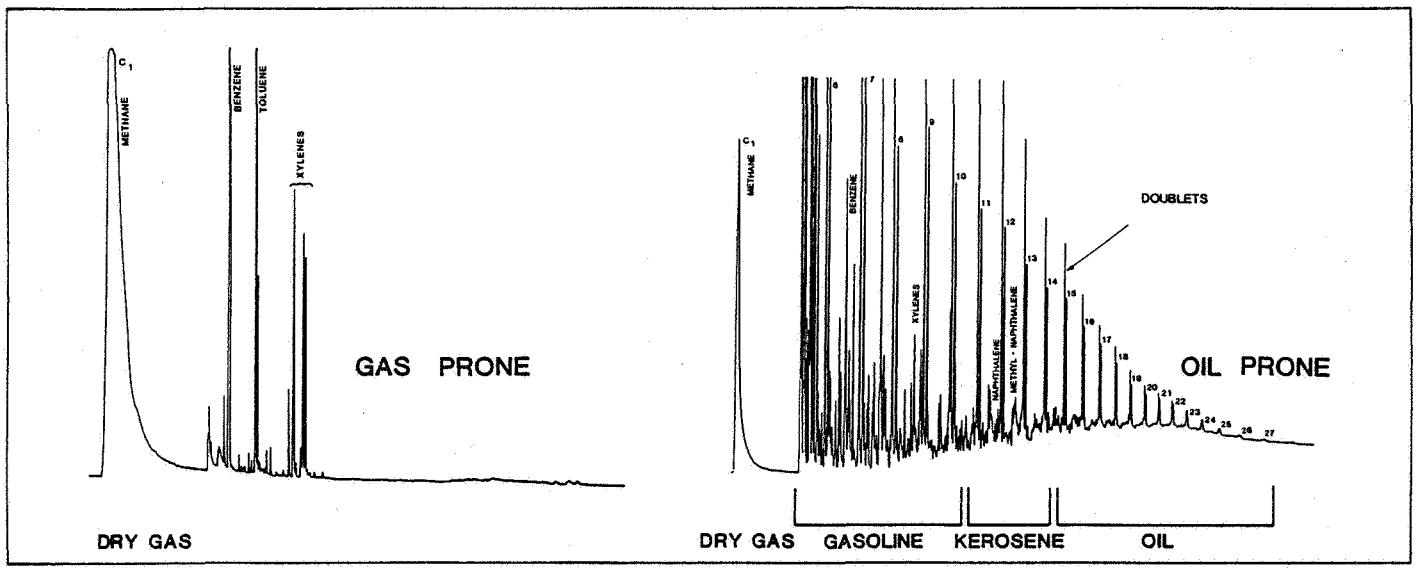

P1 — THERMAL BITUMEN

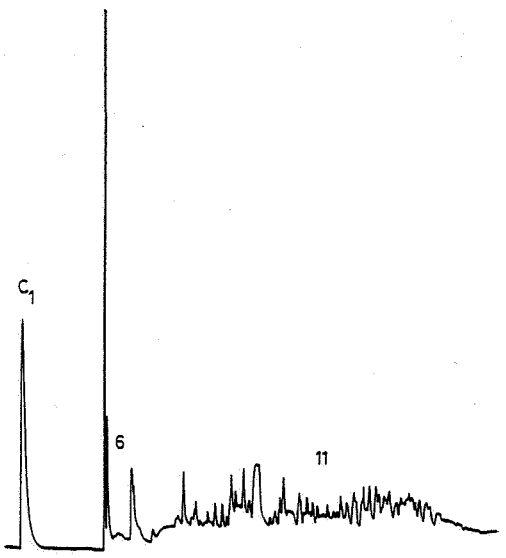
P2 — PYROLYSATE

O.C. — ORGANIC CARBON

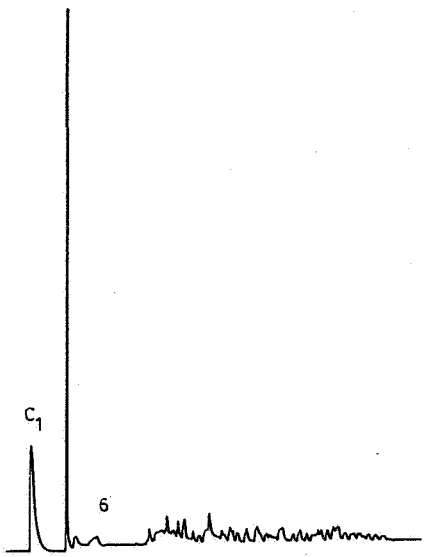
NON-INDIG. — NON-INDIGENOUS HYDROCARBONS (SHOWS OR CONTAMINATION)

FIGURE 4a **PYROLYSIS GC** WELL 8/3-2

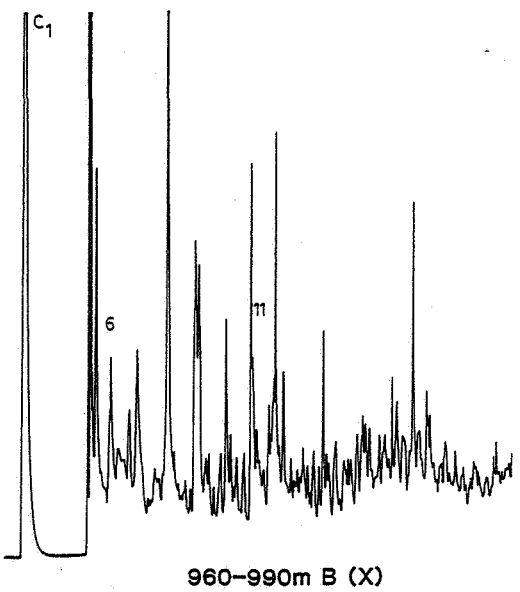


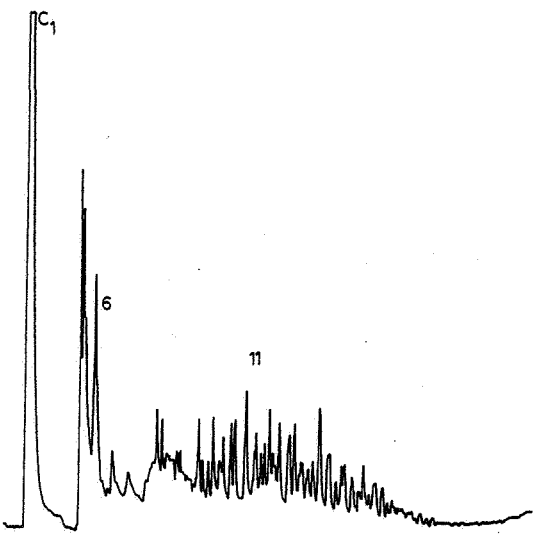

570-600m A (X)




810-840m B (X)



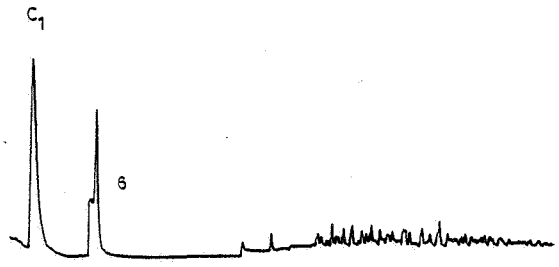

960-990m B (X)



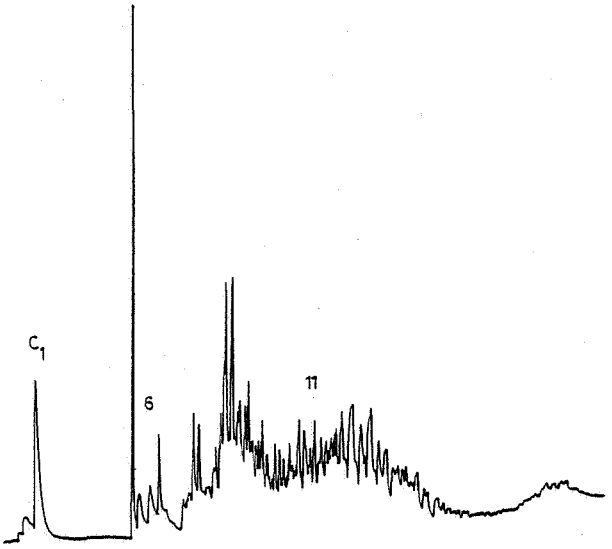

1020-1050m B

(X) EXTRACTED SAMPLE

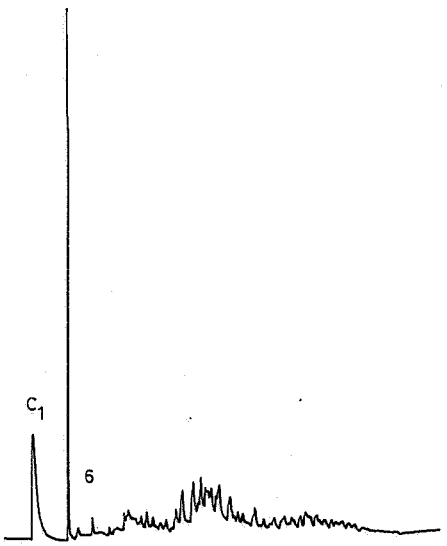
FIGURE 4b **PYROLYSIS GC** WELL 8/3-2



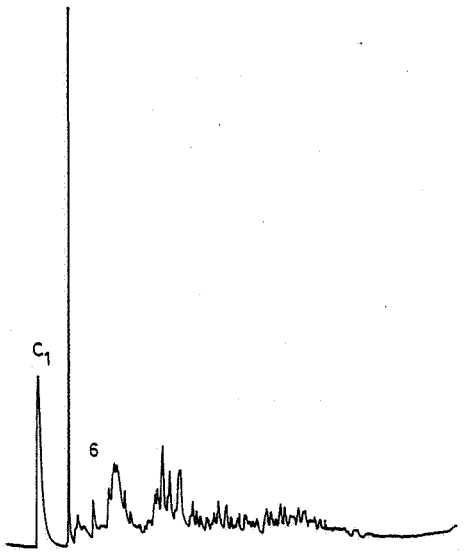

1050–1080m A



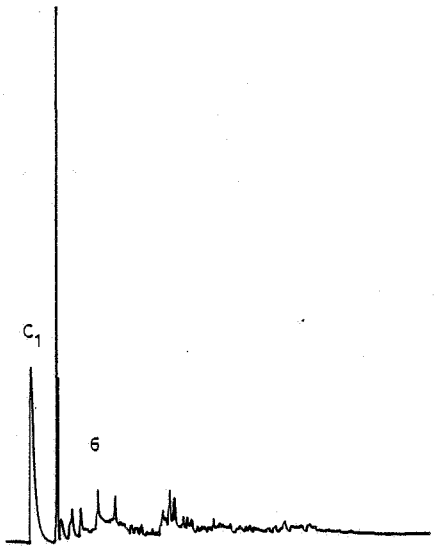

1110–1140m A (X)



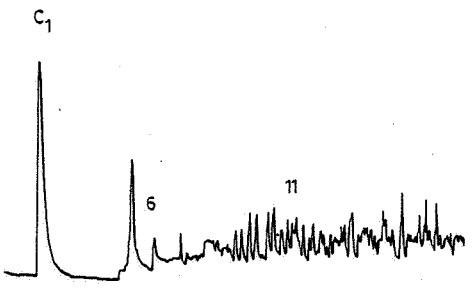

1650–1680m A (X)




1680–1710m A (X)



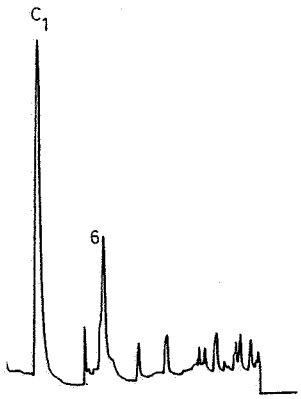

1740–1770m A (X)



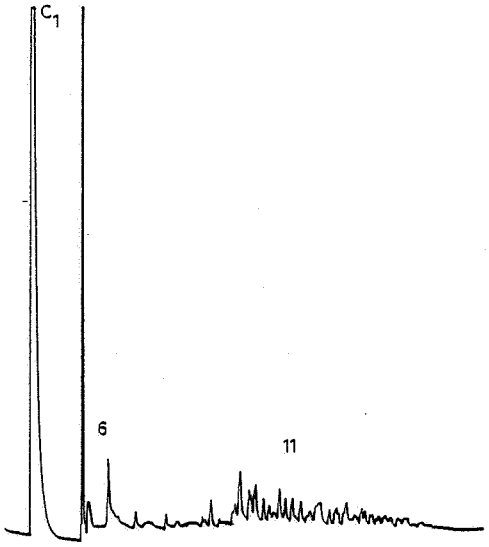

1800–1830m A

(X) EXTRACTED SAMPLE

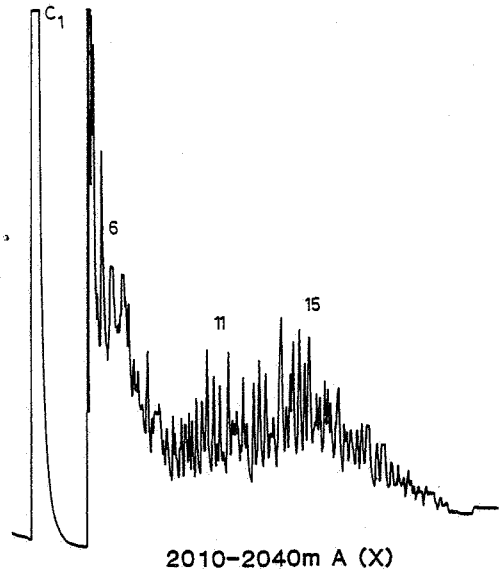
FIGURE 4c **PYROLYSIS GC** WELL 8/3-2



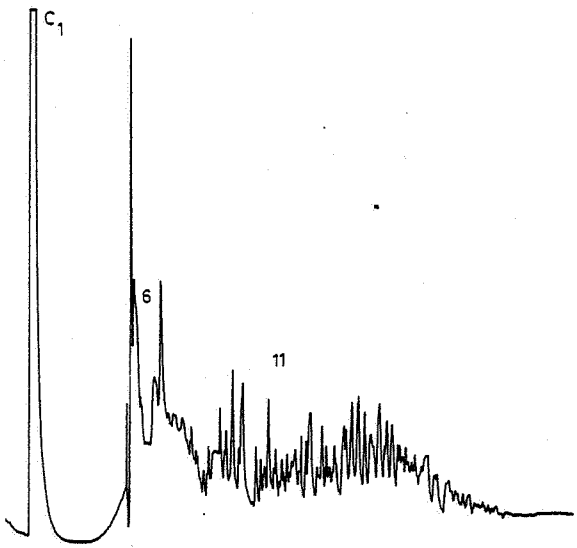

1860-1890m A



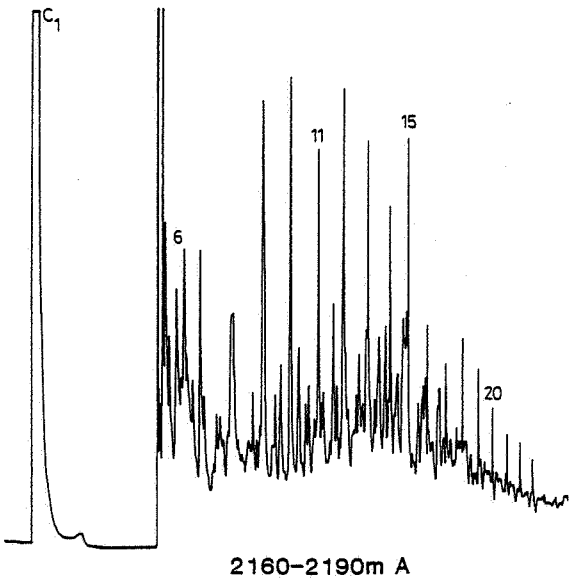

1950-1980m A (X)



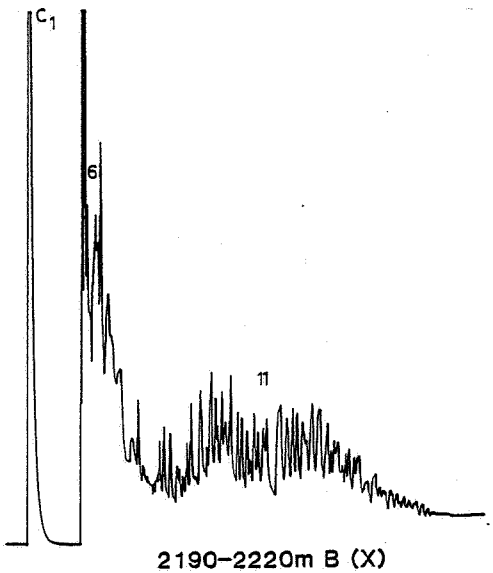

2010-2040m A (X)




2100-2130m A (X)



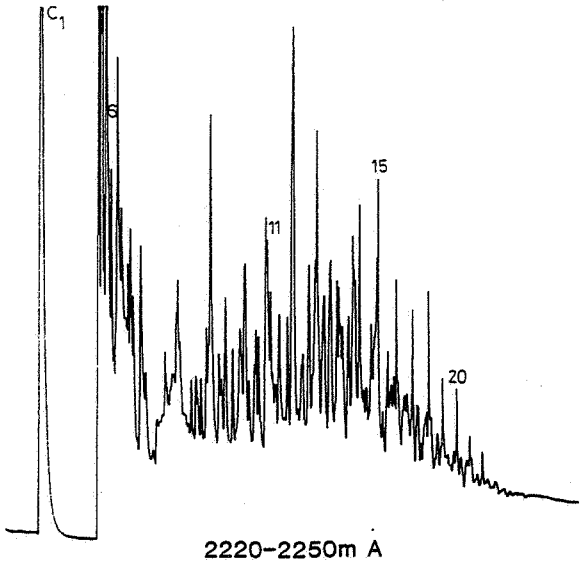

2160-2190m A



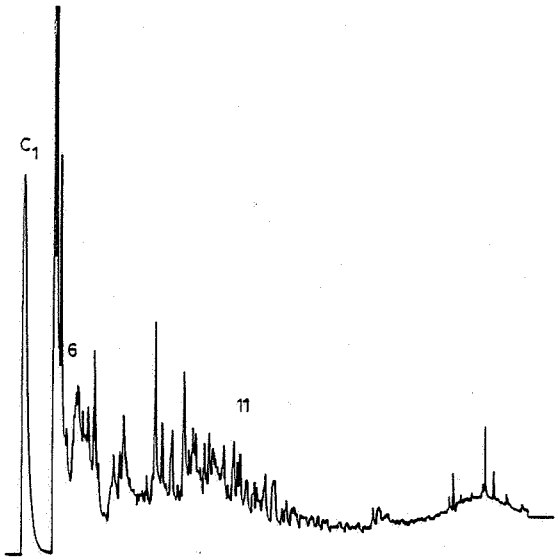

2190-2220m B (X)

(X) EXTRACTED SAMPLE

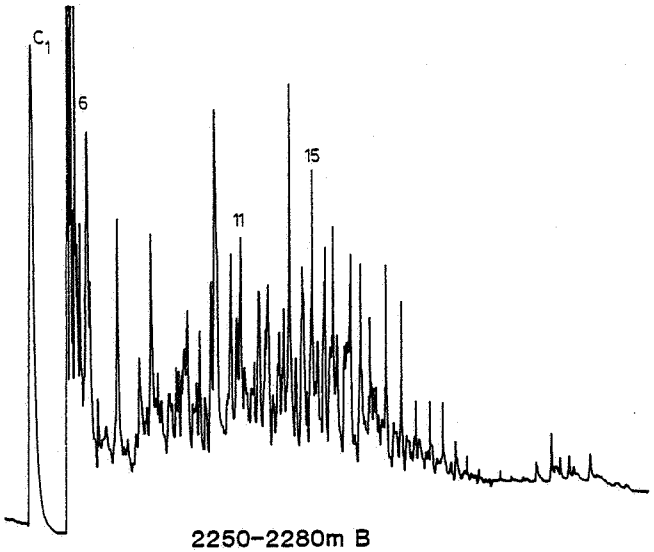
FIGURE 4d **PYROLYSIS GC** WELL 8/3-2



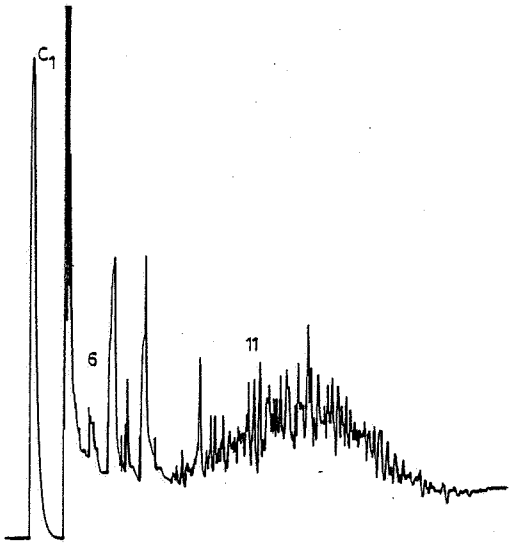

2220-2250m A



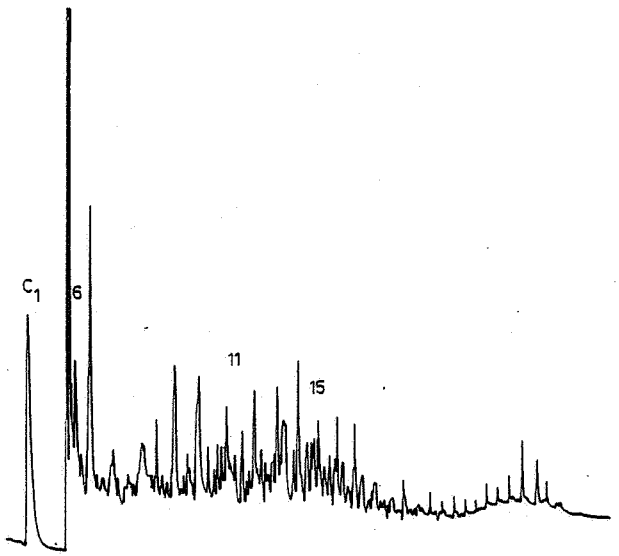

2220-2250m A (X)



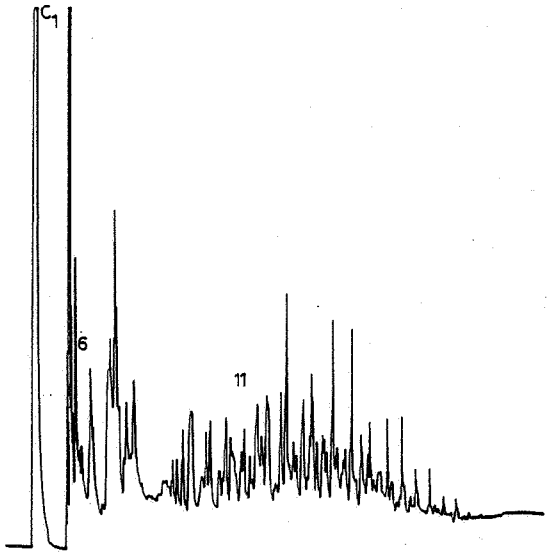

2250-2280m B




2250-2280m B (X)



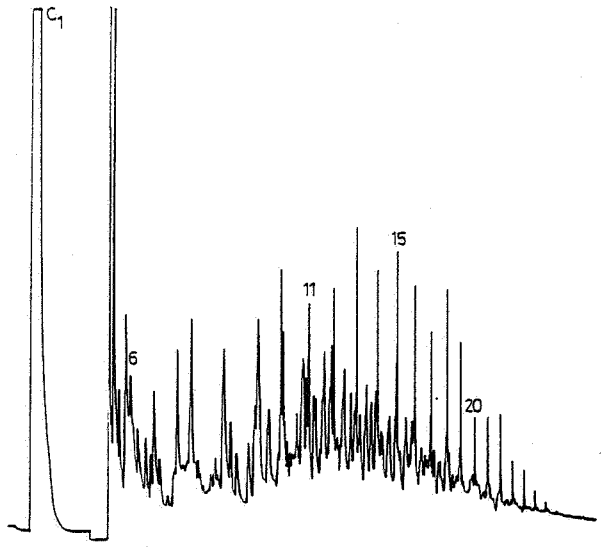

2280-2310m A



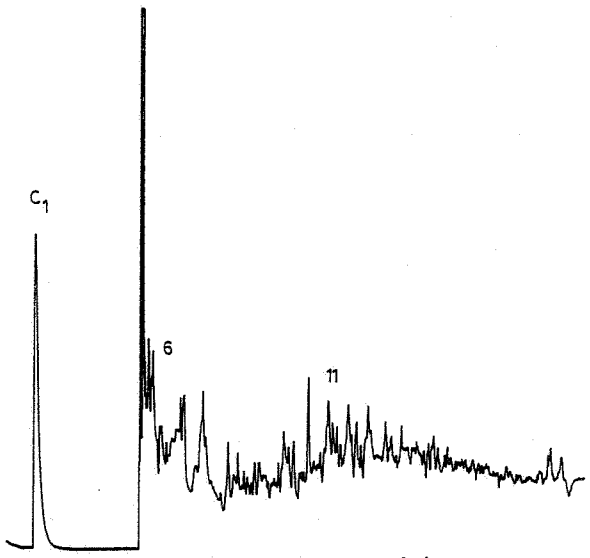

2310-2340m B

(X) EXTRACTED SAMPLE

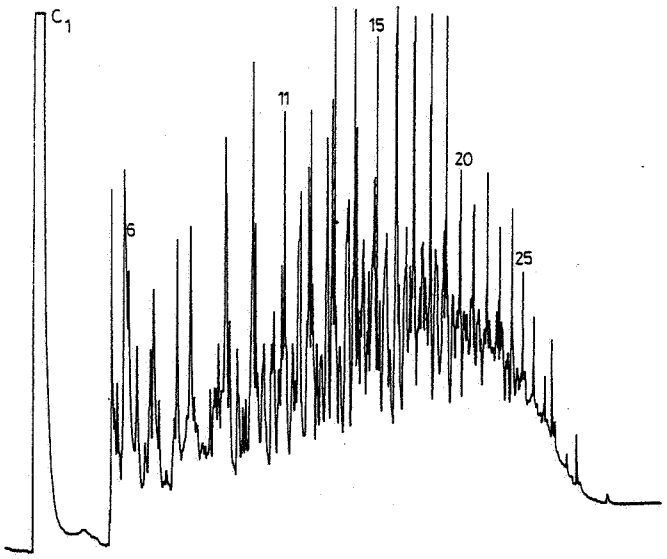
FIGURE 4e **PYROLYSIS GC** WELL 8/3-2



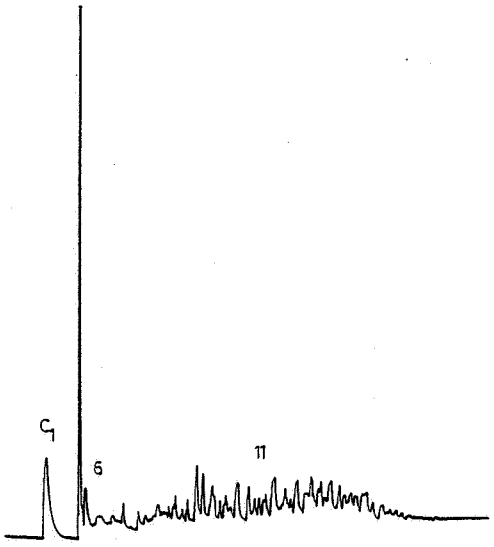

2340-2370m A



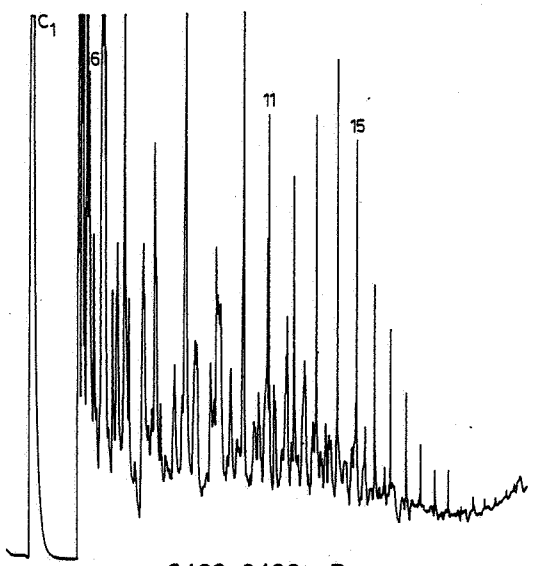

2340-2370m A (X)



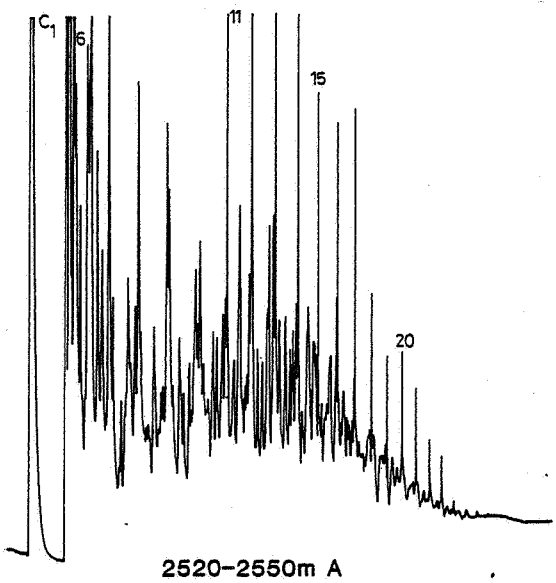

2400-2430m A




2400-2430m A (X)



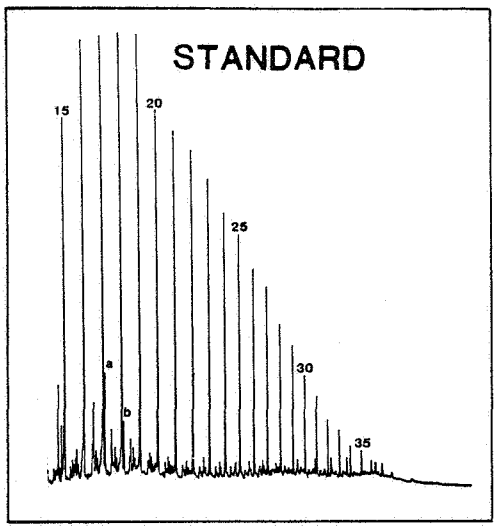

2460-2490m B

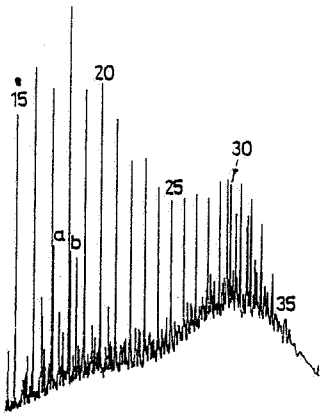



2520-2550m A

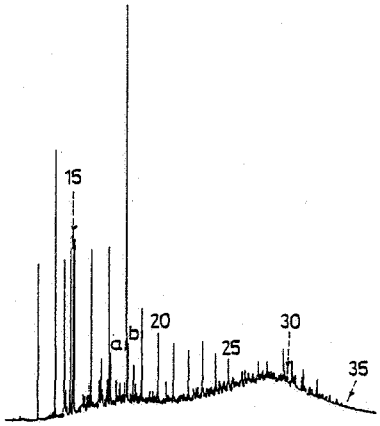
(X) EXTRACTED SAMPLE

# FIGURE 5a $C_{15+}$ PARAFFIN-NAPHTHENES WELL 8/3-2

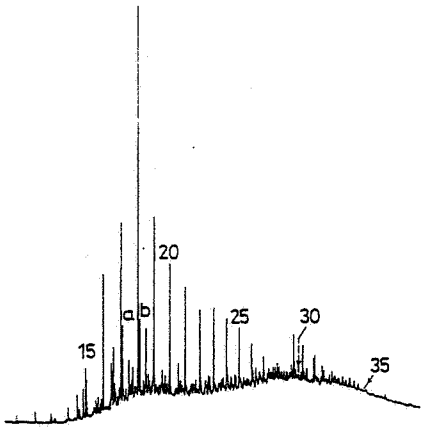


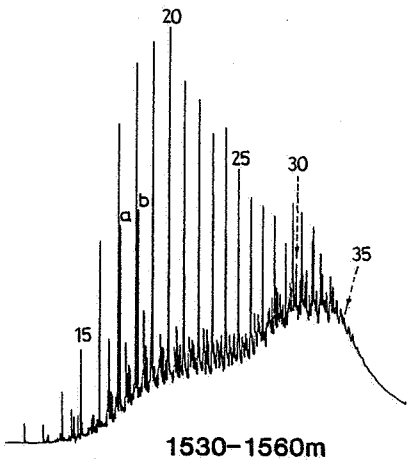

690–720m



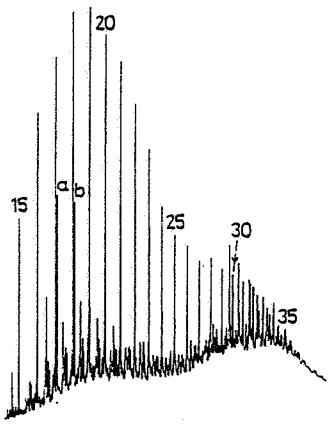

960–990m



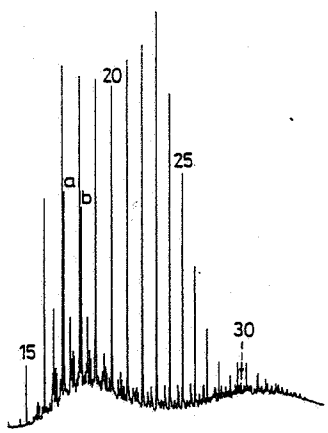

1050–1080m



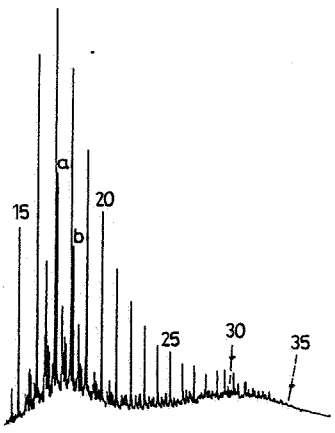

1530–1560m



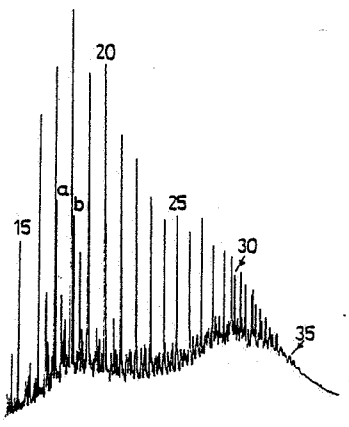

1650–1680m




1740–1770m A




1800–1830m A

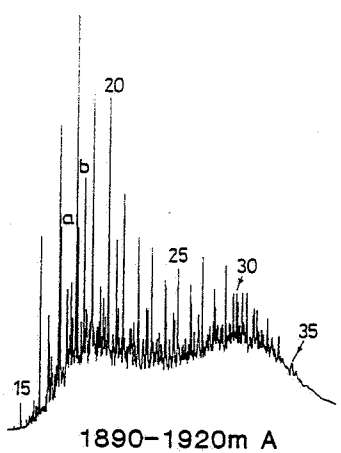



1860–1890m A

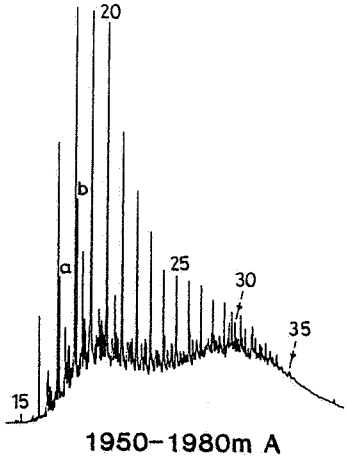
a – PRISTANE
b – PHYTANE

CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 – $nC_{20}$)

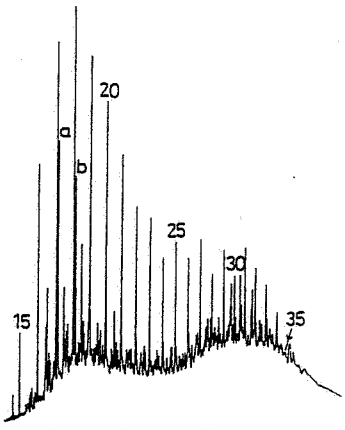
FIGURE 5b $C_{15+}$ PARAFFIN - NAPHTHENES WELL 8/3-2



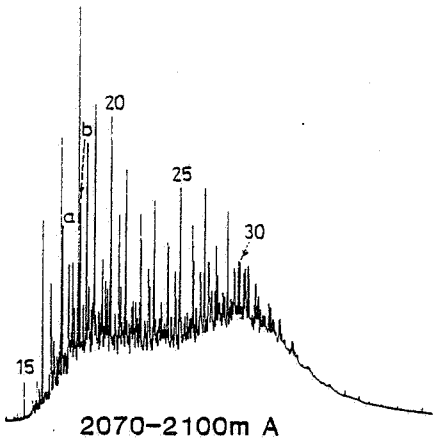
1890–1920m A



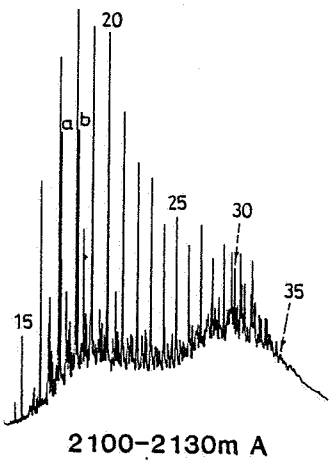
1950–1980m A



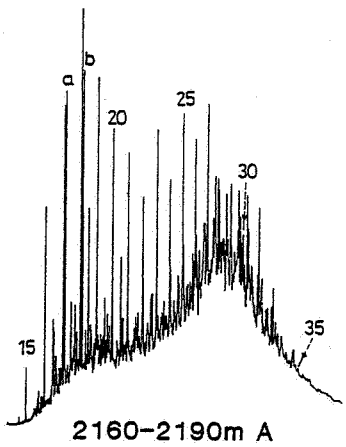
2010–2040m A



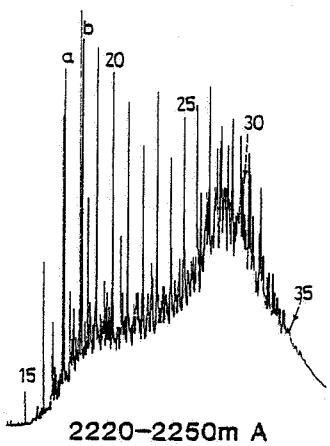
2070–2100m A



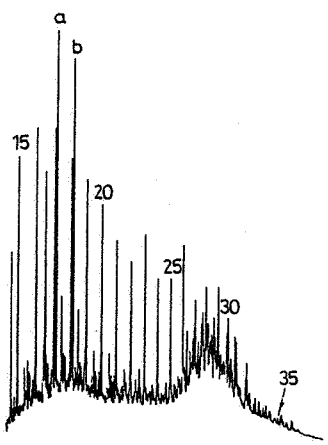
2100–2130m A



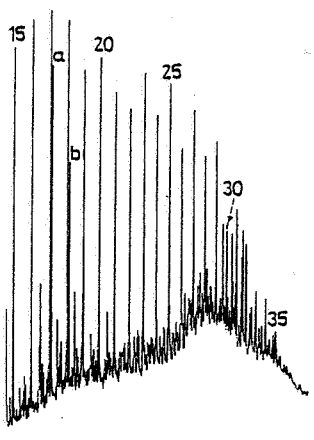
2160–2190m A



2220–2250m A



2250–2280m B

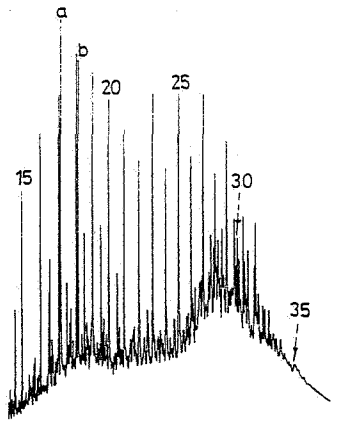


2340–2370m

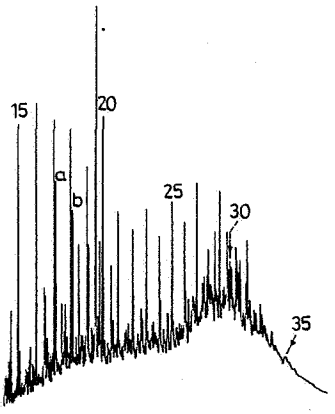
**a** – PRISTANE
**b** – PHYTANE

CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 – $nC_{20}$)

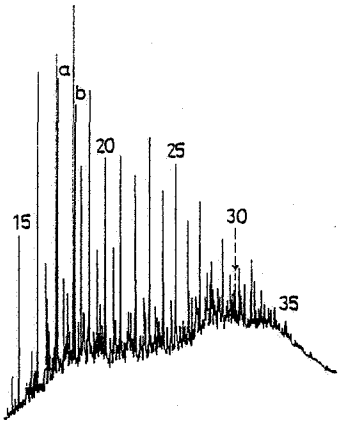
FIGURE 5c $C_{15+}$ PARAFFIN - NAPHTHENES WELL 8/3-2



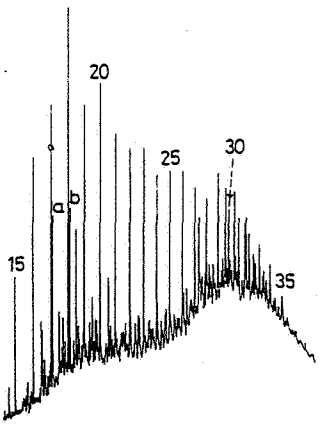

2400-2430m




2460-2490m




2520-2550m

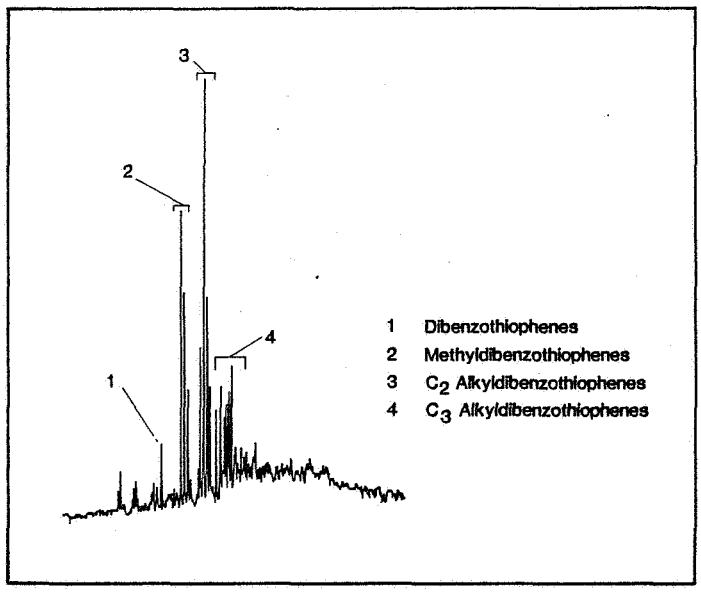


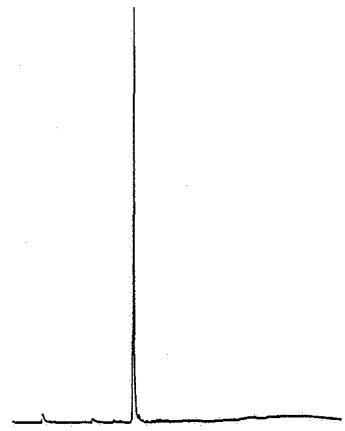

2610-2640m

a - PRISTANE
b - PHYTANE

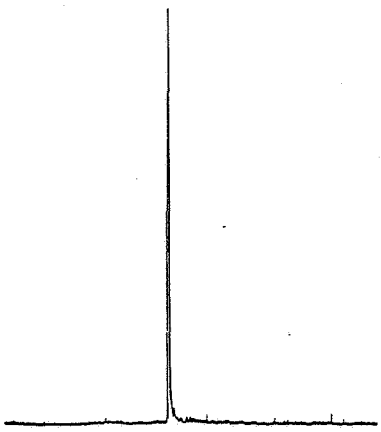
CARBON NUMBERS OF NORMAL PARAFFINS INDICATED (20 - $nC_{20}$)

FIGURE 6a **SULPHUR CHROMATOGRAMS** WELL 8/3-2

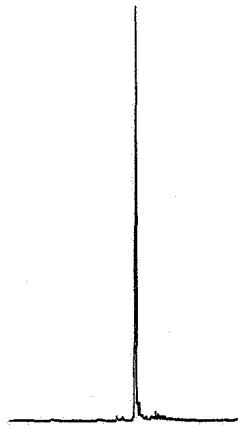


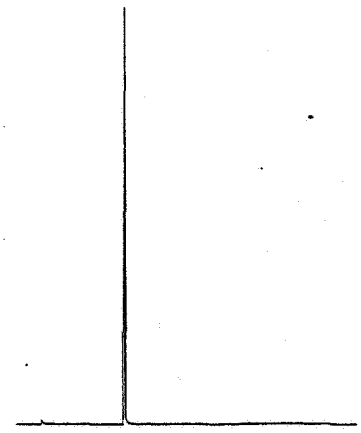
690–720m



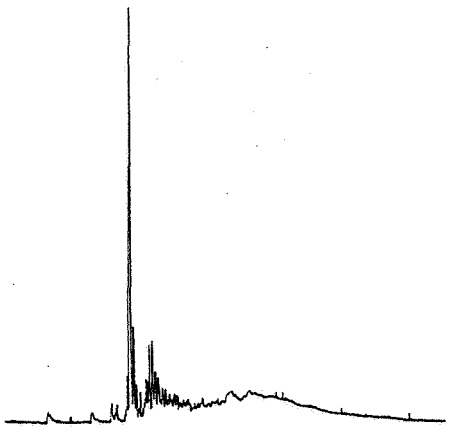
1740–1770m A



1800–1830m A

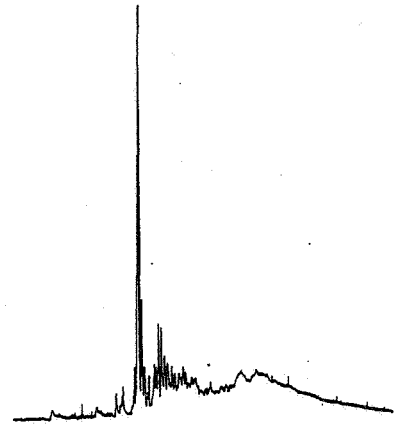


1860–1890m A



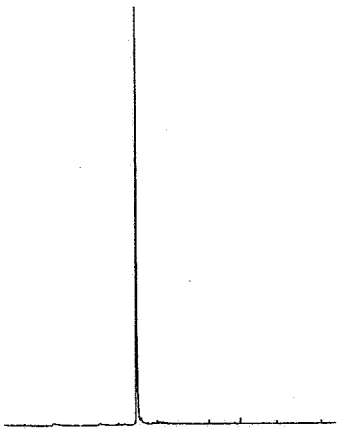
1890–1920m A

1950–1980m A

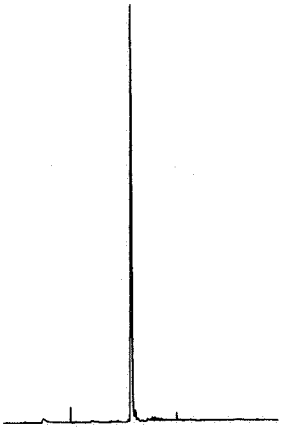


2010–2040m A

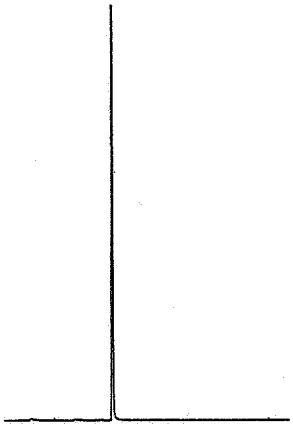
FIGURE 6b **SULPHUR CHROMATOGRAMS** WELL 8/3-2



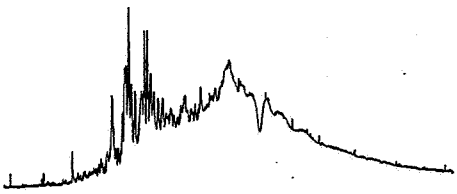
2070-2100m A



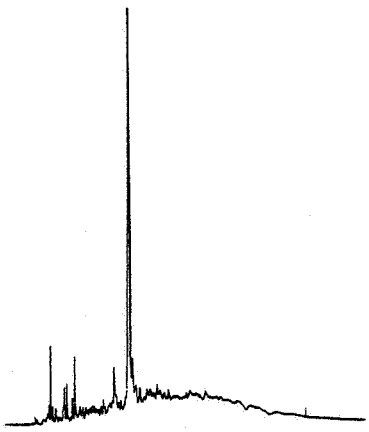
2100-2130m A



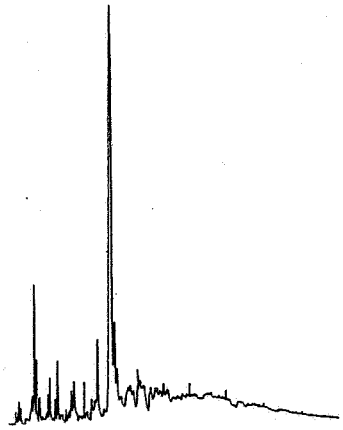
2160-2190m A



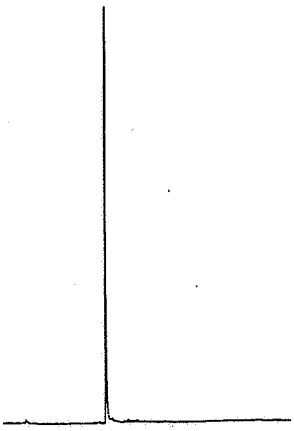
2220-2250m A



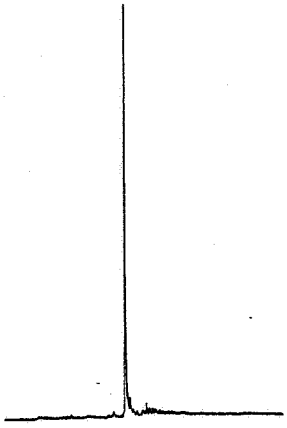
2250-2280m B



2400-2430m



2460-2490m



2520-2550m

2610-2640m

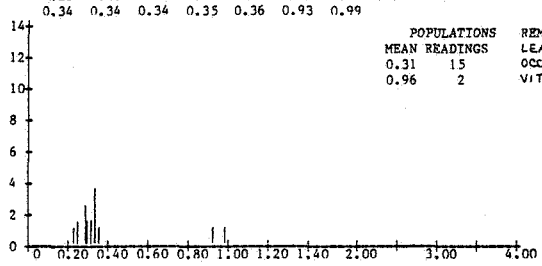
# FIGURE 7a VITRINITE REFLECTANCE WELL 8/3-2

SAMPLE 714-015A DEPTH 570-600 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.23 0.25 0.25 0.29 0.29 0.29 0.30 0.31 0.32 0.32
0.34 0.34 0.34 0.35 0.36 0.93 0.99

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.31 | 15 |
| 0.96 | 2 |

REMARKS: LEAN. OCCASIONAL SMALL VITRINITE PARTICLES.

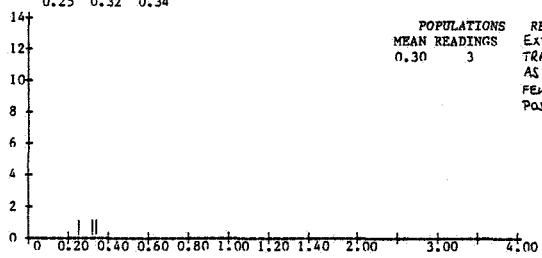



SAMPLE 714-020B DEPTH 720-750 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.25 0.32 0.34

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.30 | 3 |

REMARKS: EXTREMELY LEAN. TRACE OF VITRINITE AS TINY SCRAPS - FEW MEASUREMENTS POSSIBLE.

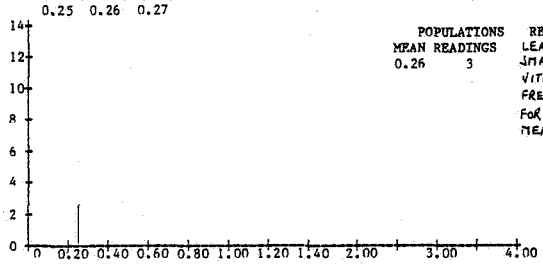



SAMPLE 714-023B DEPTH 810-840 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.25 0.26 0.27

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.26 | 3 |

REMARKS: LEAN. SMALL SCATTERED VITRINITE PARTICLES FREQUENTLY UNSUITABLE FOR REFLECTANCE MEASUREMENT.

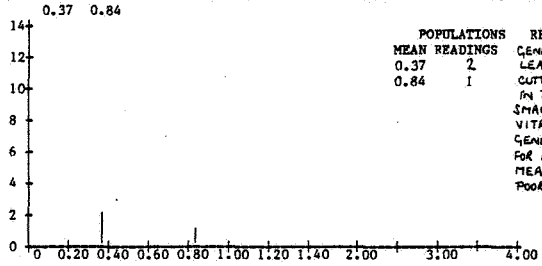



SAMPLE 714-028B DEPTH 960-990 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.37 0.84

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.37 | 2 |
| 0.84 | 1 |

REMARKS: GENERALLY EXTREMELY LEAN. OCCASIONAL CUTTINGS FAIRLY RICH IN BITUMEN STAINING. SMALL SCATTERED VITRINITE PARTICLES GENERALLY UNSUITABLE FOR REFLECTANCE MEASUREMENT. POOR SAMPLE.

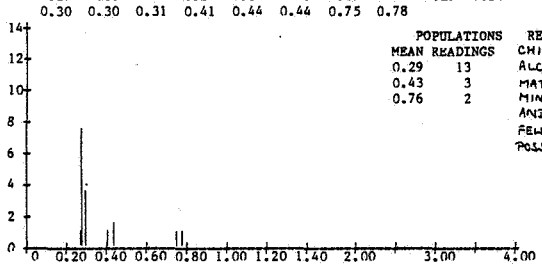



SAMPLE 714-030B DEPTH 1020-1050 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.27 0.28 0.28 0.28 0.28 0.29 0.29 0.29 0.29 0.30
0.30 0.30 0.31 0.41 0.44 0.44 0.75 0.78

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.29 | 13 |
| 0.43 | 3 |
| 0.76 | 2 |

REMARKS: CHIEFLY DEGRADED ALGAL(?)/AMORPHOUS MATERIAL. MINOR VITRINITE AND INERTINITE. FEW MEASUREMENTS POSSIBLE.

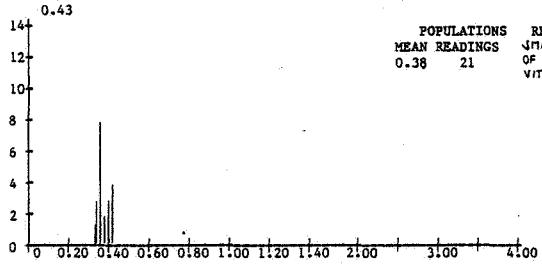



SAMPLE 714-031A DEPTH 1050-1080 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.33 0.34 0.35 0.35 0.36 0.36 0.37 0.37 0.37 0.37
0.37 0.37 0.38 0.39 0.40 0.40 0.41 0.42 0.42 0.43
0.43

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.38 | 21 |

REMARKS: SMALL PARTICLES OF FRESH (IMMATURE) VITRINITE.

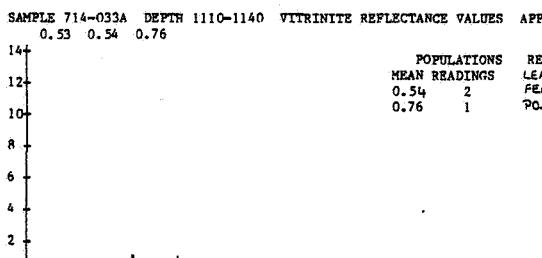



SAMPLE 714-033A DEPTH 1110-1140 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.53 0.54 0.76

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.54 | 2 |
| 0.76 | 1 |

REMARKS: LEAN. FEW MEASUREMENTS POSSIBLE.

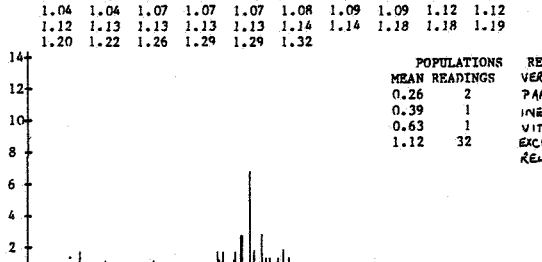



SAMPLE 714-052A DEPTH 1680-1710 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.26 0.27 0.39 0.63 0.95 0.95 0.96 0.98 0.99 1.03
1.04 1.04 1.07 1.07 1.07 1.08 1.09 1.09 1.12 1.12
1.12 1.13 1.13 1.13 1.13 1.14 1.14 1.18 1.18 1.19
1.20 1.22 1.26 1.29 1.29 1.32

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.26 | 2 |
| 0.39 | 1 |
| 0.63 | 1 |
| 1.12 | 32 |

REMARKS: VERY DOMINANTLY PARTICLES OF INERTINITE AND VITRINITE - ALMOST EXCLUSIVELY REWORKED

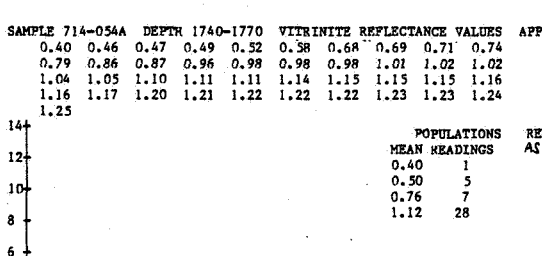



SAMPLE 714-054A DEPTH 1740-1770 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.40 0.46 0.47 0.49 0.52 0.58 0.68 0.69 0.71 0.74
0.79 0.86 0.87 0.96 0.98 0.98 0.98 1.01 1.02 1.02
1.04 1.05 1.10 1.11 1.11 1.14 1.15 1.15 1.15 1.16
1.16 1.17 1.20 1.21 1.22 1.22 1.22 1.23 1.23 1.24
1.25

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.40 | 1 |
| 0.50 | 5 |
| 0.76 | 7 |
| 1.12 | 28 |

REMARKS: AS 714-052A

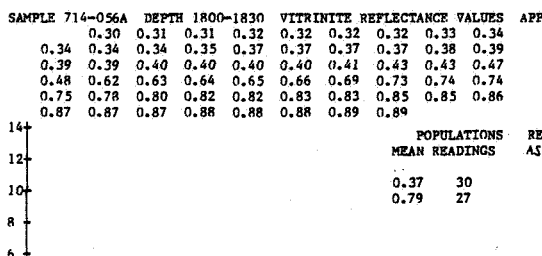



SAMPLE 714-056A DEPTH 1800-1830 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.30 0.31 0.31 0.32 0.32 0.32 0.32 0.33 0.34
0.34 0.34 0.34 0.35 0.37 0.37 0.37 0.37 0.38 0.39
0.39 0.39 0.40 0.40 0.40 0.40 0.41 0.43 0.43 0.47
0.48 0.62 0.63 0.64 0.65 0.66 0.69 0.73 0.74 0.74
0.75 0.78 0.80 0.82 0.82 0.83 0.83 0.85 0.85 0.86
0.87 0.87 0.87 0.88 0.88 0.88 0.89 0.89

| POPULATIONS MEAN READINGS | |
|---|---|
| 0.37 | 30 |
| 0.79 | 27 |

REMARKS: AS 714-052A



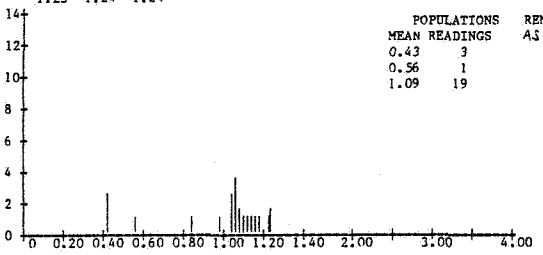
# FIGURE 7b VITRINITE REFLECTANCE WELL 8/3-2

SAMPLE 714-058A DEPTH 1860-1890 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.42 0.43 0.43 0.56 0.84 0.98 1.04 1.04 1.04 1.06
1.07 1.07 1.07 1.08 1.09 1.10 1.12 1.14 1.16 1.18
1.23 1.24 1.24

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.43 | 3 |
| 0.56 | 1 |
| 1.09 | 19 |

REMARKS: AS 714-052A

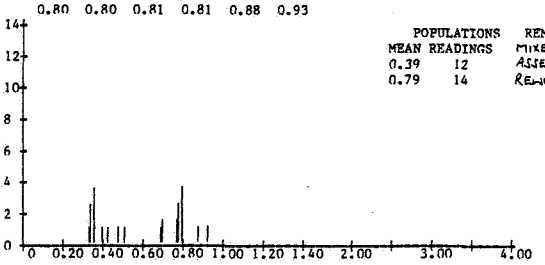



SAMPLE 714-063A DEPTH 2010-2040 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.33 0.34 0.34 0.35 0.36 0.37 0.37 0.37 0.40 0.43
0.48 0.51 0.69 0.70 0.71 0.77 0.77 0.78 0.78 0.79
0.80 0.80 0.81 0.81 0.88 0.93

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.39 | 12 |
| 0.79 | 14 |

REMARKS: MIXED ORGANIC ASSEMBLAGE. REWORKING APPARENT.

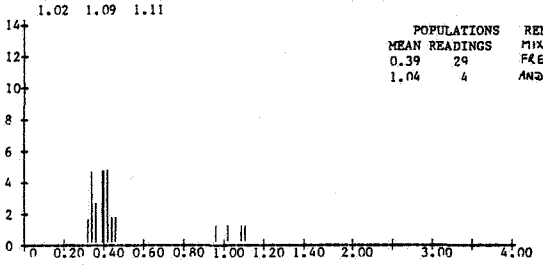



SAMPLE 714-066A DEPTH 2100-2130 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.32 0.33 0.34 0.34 0.34 0.35 0.35 0.36 0.37 0.37
0.39 0.39 0.39 0.39 0.39 0.40 0.40 0.40 0.41 0.41
0.42 0.42 0.42 0.42 0.43 0.44 0.45 0.46 0.47 0.96
1.02 1.09 1.11

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.39 | 29 |
| 1.04 | 4 |

REMARKS: MIXED ASSEMBLAGE. FREQUENT INERTINITE AND VITRINITE.

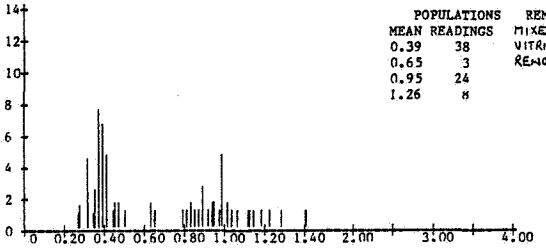



SAMPLE 714-068A DEPTH 2160-2190 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.27 0.28 0.28 0.32 0.33 0.33 0.33 0.33 0.35 0.36
0.37 0.37 0.38 0.38 0.38 0.39 0.39 0.39 0.39 0.39
0.40 0.40 0.40 0.40 0.41 0.41 0.41 0.42 0.43 0.43
0.43 0.43 0.45 0.46 0.46 0.48 0.49 0.51 0.64 0.65
0.66 0.80 0.82 0.84 0.84 0.86 0.88 0.90 0.91 0.91
0.93 0.95 0.95 0.96 0.97 0.99 1.00 1.00 1.00 1.01
1.01 1.03 1.03 1.05 1.08 1.13 1.14 1.16 1.20 1.24
1.30 1.45 1.46

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.39 | 38 |
| 0.65 | 3 |
| 0.95 | 24 |
| 1.26 | 8 |

REMARKS: MIXED ASSEMBLAGE. VITRINITE FREQUENTLY REWORKED.

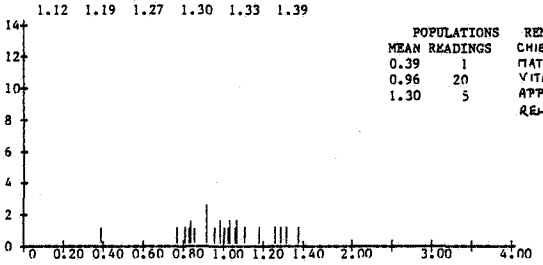



SAMPLE 714-070A DEPTH 2230-2280 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.39 0.77 0.81 0.83 0.84 0.85 0.86 0.92 0.93 0.93
0.96 0.99 0.99 1.01 1.03 1.04 1.04 1.07 1.08 1.09
1.12 1.19 1.27 1.30 1.33 1.39

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.39 | 1 |
| 0.96 | 20 |
| 1.30 | 5 |

REMARKS: CHIEFLY AMORPHOUS MATERIAL. MINOR VITRINITE - APPARENTLY DOMINANTLY REWORKED.

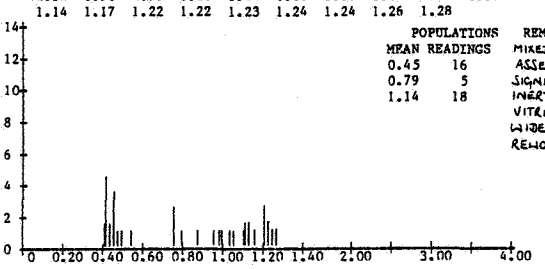



SAMPLE 714-072A DEPTH 2280-2310 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.41 0.41 0.42 0.42 0.43 0.43 0.43 0.44 0.45 0.46
0.46 0.47 0.47 0.48 0.50 0.55 0.76 0.76 0.76 0.80
0.88 0.96 0.99 1.00 1.04 1.06 1.11 1.12 1.13 1.14
1.14 1.17 1.22 1.22 1.23 1.24 1.24 1.26 1.28

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.45 | 16 |
| 0.79 | 5 |
| 1.14 | 18 |

REMARKS: MIXED ORGANIC ASSEMBLAGE. SIGNIFICANT INERTINITE AND VITRINITE - WIDESPREAD REWORKING.

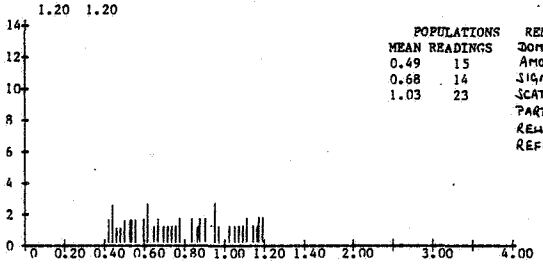



SAMPLE 714-073B DEPTH 2310-2340 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.42 0.43 0.44 0.45 0.45 0.46 0.48 0.50 0.51 0.53
0.53 0.54 0.55 0.56 0.56 0.60 0.61 0.62 0.62 0.63
0.65 0.67 0.67 0.70 0.72 0.74 0.76 0.78 0.78 0.84
0.85 0.87 0.88 0.89 0.91 0.91 0.96 0.96 0.97 0.98
1.03 1.06 1.08 1.10 1.12 1.12 1.15 1.17 1.18 1.19
1.20 1.20

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.49 | 15 |
| 0.68 | 14 |
| 1.03 | 23 |

REMARKS: DOMINANTLY AMORPHOUS/ALGAL. SIGNIFICANT INERTINITE. SCATTERED VITRINITE PARTICLES, LARGELY REWORKED, OF VARIABLE REFLECTANCE.

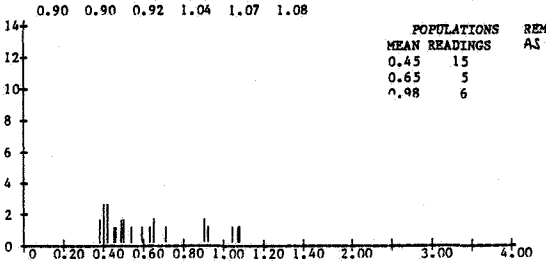



SAMPLE 714-074A DEPTH 2340-2370 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.38 0.38 0.40 0.41 0.41 0.42 0.42 0.43 0.45 0.46
0.49 0.49 0.50 0.51 0.54 0.59 0.63 0.65 0.65 0.71
0.90 0.90 0.92 1.04 1.07 1.08

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.45 | 15 |
| 0.65 | 5 |
| 0.98 | 6 |

REMARKS: AS 714-072A

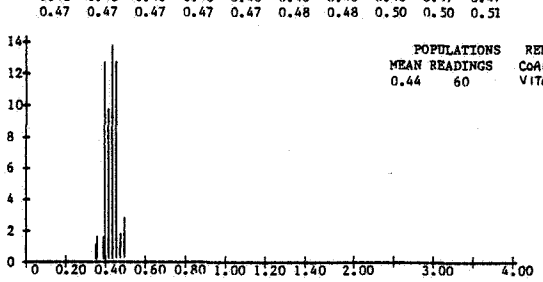



SAMPLE 714-075C DEPTH 2370-2400 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.35 0.36 0.37 0.39 0.39 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 0.42 0.42
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 0.44 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 0.47 0.47
0.47 0.47 0.47 0.47 0.47 0.48 0.48 0.50 0.50 0.51

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.44 | 60 |

REMARKS: COAL. VITRINITE DOMINANT.




SAMPLE 714-076A DEPTH 2400-2430 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

0.35 0.39 0.41 0.42 0.42 0.45 0.49 0.49 0.49 0.64
0.69 0.97 1.11 1.18 1.40

| POPULATIONS MEAN | READINGS |
|---|---|
| 0.43 | 9 |
| 0.66 | 2 |
| 1.09 | 3 |
| 1.40 | 1 |

REMARKS: AS 714-072A

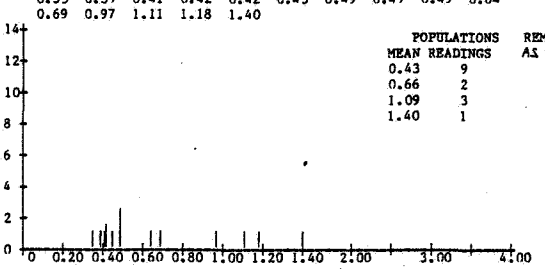
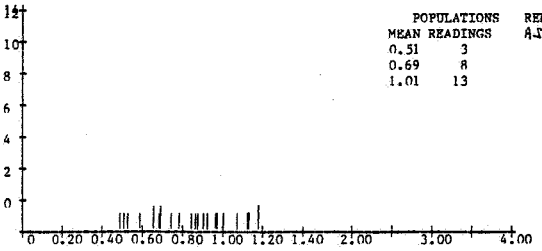


FIGURE 7c **VITRINITE REFLECTANCE** WELL 8/3-2

SAMPLE 714-078B DEPTH 2460-2490 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

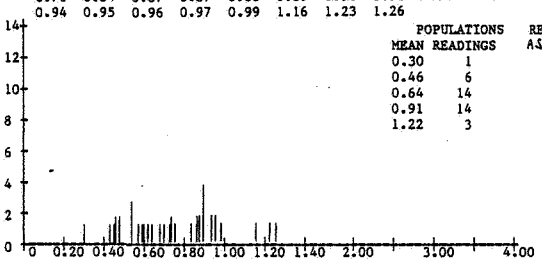
| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.49 | 0.51 | 0.53 | 0.59 | 0.66 | 0.67 | 0.69 | 0.70 | 0.71 | 0.75 |
| 0.79 | 0.85 | 0.87 | 0.88 | 0.91 | 0.93 | 0.97 | 0.98 | 1.01 | 1.08 |
| 1.13 | 1.14 | 1.19 | 1.19 | | | | | | |




| POPULATIONS MEAN | READINGS | REMARKS |
|---|---|---|
| 0.51 | 3 | AS 714-072A |
| 0.69 | 8 | |
| 1.01 | 13 | |

SAMPLE 714-080A DEPTH 2520-2550 VITRINITE REFLECTANCE VALUES APPEARANCE IN UV

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 0.30 | 0.43 | 0.45 | 0.46 | 0.46 | 0.48 | 0.49 | 0.54 | 0.55 | 0.55 |
| 0.57 | 0.59 | 0.60 | 0.62 | 0.64 | 0.68 | 0.70 | 0.73 | 0.74 | 0.74 |
| 0.76 | 0.84 | 0.87 | 0.87 | 0.88 | 0.89 | 0.90 | 0.91 | 0.91 | 0.91 |
| 0.94 | 0.95 | 0.96 | 0.97 | 0.99 | 1.16 | 1.23 | 1.26 | | |




| POPULATIONS MEAN | READINGS | REMARKS |
|---|---|---|
| 0.30 | 1 | AS 714-073B |
| 0.46 | 6 | |
| 0.64 | 14 | |
| 0.91 | 14 | |
| 1.22 | 3 | |

# FIGURE 8 ORGANIC FACIES & MATURITY WELL 8/3-2

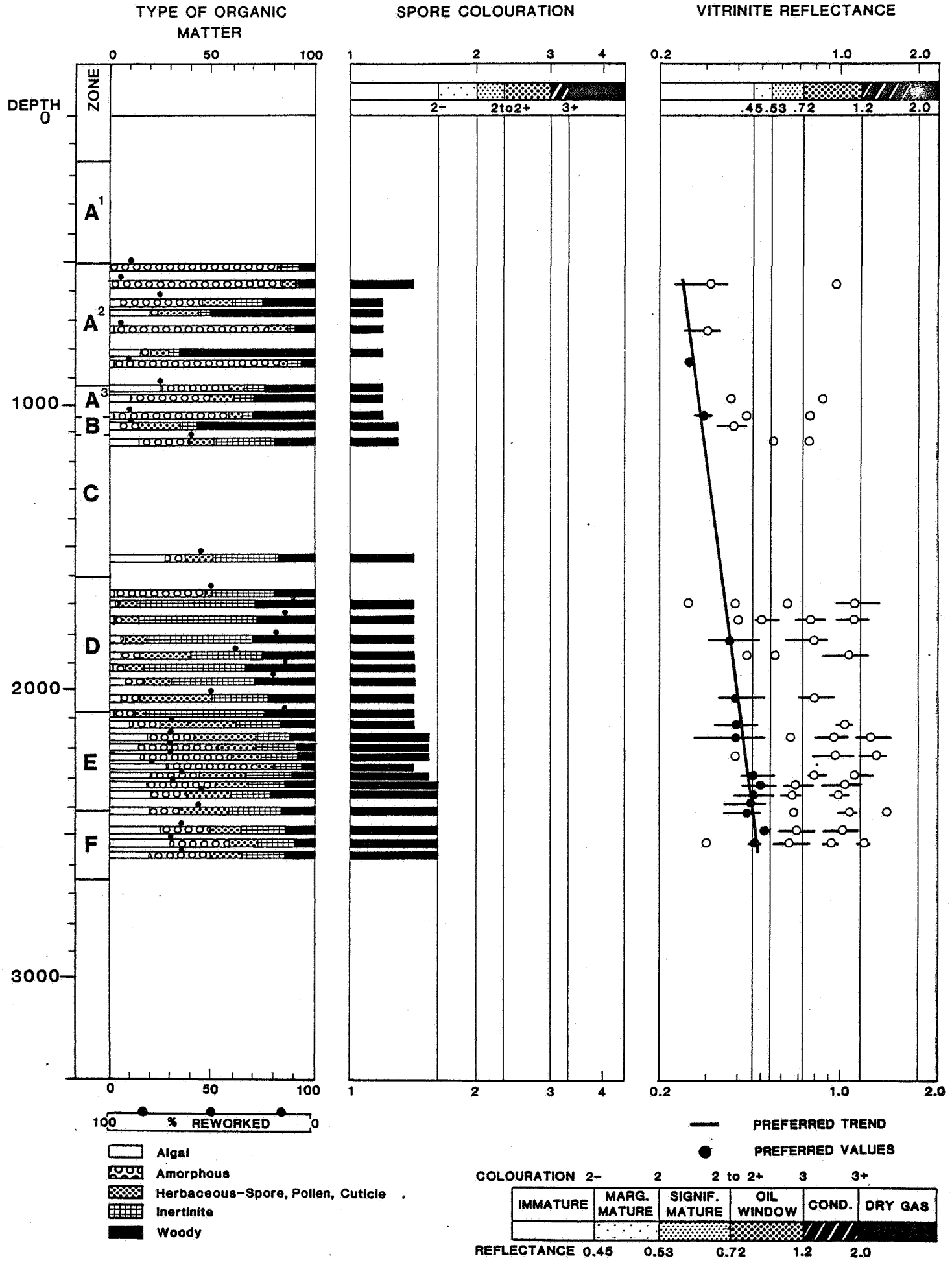
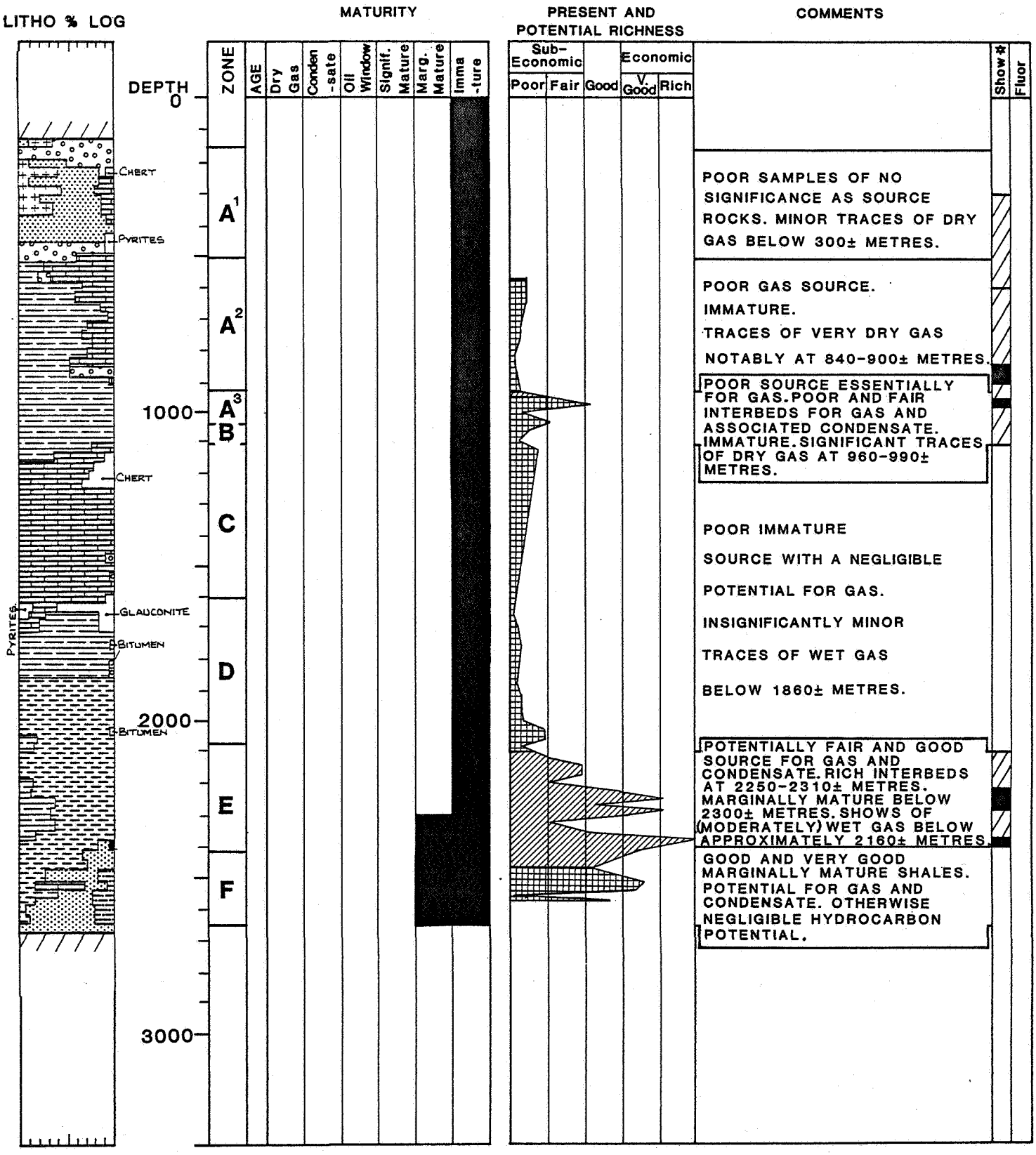


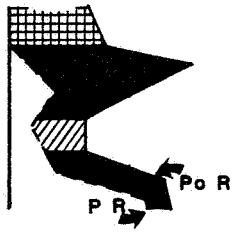
FIGURE 9

# RATING

WELL 8/3-2




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 $C_1$-$C_7$ analysis and should be canned (or at least wet) for the $C_4$-$C_7$ analysis. The other analyses can be run on both canned and bagged samples.

## A) $C_1$-$C_7$ LIGHT HYDROCARBON ANALYSIS

The abundance and composition of the $C_1$-$C_7$ 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 betwwen 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 $C_1$-$C_4$ gaseous hydrocarbons (methane, ethane, propane, isobutane and normal butane) and a partial resolution of the $C_5$-$C_7$ gasoline-range hydrocarbons (for their complete resolution see Section E). The ppm abundance of the five gases and of the total $C_5$-$C_7$ 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 $C_1$-$C_7$ 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, $C_1$-$C_7$, $C_4$-$C_7$, pyrolysis and $C_{15+}$ 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 $C_1$-$C_7$ 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 diagramatically 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 $C_4$-$C_7$ HYDROCARBON ANALYSIS

The abundance and composition of the $C_4$-$C_7$ 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 $C_{15+}$ 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 $C_{15+}$ 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 (± 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 conjection 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) $C_{15+}$ 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 diagramatically.

J) GC ANALYSIS OF $C_{15+}$ PARAFFIN-NAPHTHENE HYDROCARBONS

The gas chromatographic configurations of the heavy $C_{15+}$ 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 $nC_{35}$. 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 (± strong pristane peaks) are characteristic of immature land plant organic matter whilst even preferences (± 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:

$$C.P.I_A = \frac{\frac{C_{21} + C_{23} + C_{25} + C_{27}}{C_{20} + C_{22} + C_{24} + C_{26}} + \frac{C_{21} + C_{23} + C_{25} + C_{27}}{C_{22} + C_{24} + C_{26} + C_{28}}}{2}$$

$$C.P.I_B = \frac{\frac{C_{25} + C_{27} + C_{29} + C_{31}}{C_{24} + C_{26} + C_{28} + C_{30}} + \frac{C_{25} + C_{27} + C_{29} + C_{31}}{C_{26} + C_{28} + C_{30} + C_{32}}}{2}$$

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.$I_A$ and C.P.$I_B$; pristane to phytane ratio; pristane to $nC_{17}$ 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 $C_{15+}$ 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 $C_1$ (methane) out towards $C_{35}$ 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 pyrolsate. 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 $C_4$-$C_7$ 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 $C_{15+}$ paraffin-naphthenes. See section J. The branched±normal paraffin distributions are used to "fingerprint" the samples.
- capillary chromatograms of whole oils and of the $C_{8+}$ fraction of source rocks.
- capillary gas chromatography of $C_{15+}$ 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 determing 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.