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Prepared for

STATOIL

GEOCHEMICAL EVALUATION OF THE STATOIL 30/2-2 WELL OFFSHORE NORWAY

TEXT

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GEOCHEMICAL EVALUATION OF

THE STATOIL 30/2-2 WELL

OFFSHORE NORWAY

GEOCHEMICAL EVALUATION OF THE STATOIL 30/2-2 WELL, OFFSHORE NORWAY

SUMMARY

The section between 1000 metres and 4170 metres has been evaluated.

Apart from interbeds at 1100-1550± metres the Tertiary (Utsira Member) and Cretaceous mudstones are poor gas prone source rocks. Minor hydrocarbon generation commences at 3000± metres and significant generation at 3500± metres.

Very good brownish black shaly mudstones predominate in the Draupne (at 3775-3825 metres) and are mature (oil window) on structure. The strong shows of wet gas - condensate and minor light oil within this interval are partially due to hydrocarbons from the host sediments and part migrated from their down dip equivalents.

Shaly mudstones within the Upper Jurassic Sandstone and Tarbert members (3830-3950± metres) are good, mature and gas-prone source rocks. The shows of migrated hydrocarbons in this interval resemble those in the Draupne. Their source is believed to be the shaly mudstones in this interval or possibly the underlying coals and carbonaceous shales.

Per unit volume the beds of coal, shale and carbonaceous shale in the Ness - Drake members (i.e. below 3950± metres) represent an excellent gas source and are mature on structure. The strong shows of wet gas - condensate are primarily due to generation within these rich source facies. Traces of oil are also suspected but their interpretation is hindered by contamination.

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INTRODUCTION

This report presents a geochemical evaluation of the 30/2-2 well drilled by Statoil in the Norwegian Sea.

The study was designed to evaluate the section in terms of richness, maturity and potential for oil or gas. Additional tests were performed to characterise the shows of migrated hydrocarbons.

This project was authorised by Ms. E.M. Carlsen, Statoil, Stavanger, who also specified the analytical format.

A. ANALYTICAL

A total of one hundred and sixty five (165) canned ditch cuttings samples and twenty (20) core samples were received and assigned the Geochem job number 1124.

Serious contamination was not observed during the sample washing process.

The samples were analysed in accordance with telexed instructions (5.7.85, 9.7.85 and 19.7.85) under contract T-6192 No. 12. Light hydrocarbons, organic carbon and pyrolysis analyses were used to screen the samples and follow-up analyses were based upon the screen results. A total of ninety seven light hydrocarbons analyses, one hundred and sixty two organic carbon determinations, one hundred and eighteen Rockeval pyrolysis analyses, twenty three C_{15+} extractions with chromatography, twenty three C_{15+} saturates analyses, twenty three C_{15+} aromatics analyses, eighteen quantified pyrolysis-GC analyses, thirty one vitrinite reflectance determinations, thirty five visual kerogen analyses, fifteen 8 ion mass fragmentograms and forty five carbon isotopes analyses (fractions) were performed in this study.

The data are listed in tables 1 t0 14 and presented graphically in figures 1 to 17.

A brief description of the analytical methods employed is included in the back of this report.

B. GENERAL INFORMATION

Ten (10) copies of this report, and the kerogen slides, have been forwarded to Ms. E.M. Carlsen, Statoil, Stavanger.

A copy of the data has been retained by Geochem for future consultation with authorised Statoil personnel.

Unused sample material and vitrinite reflectance blocks will be returned in accordance with the clients instructions.

The results of this study are proprietary to Statoil.

RESULTS AND DISCUSSION

Each of the relevant parameters are first discussed separately and then collectively in the "Conclusions".

Well logs were not available for this study but a summary of the formation tops was provided by the client.

A. ZONATION

This zonation is based upon a consideration of the formation tops and variations in the geochemical data. A total of six (6) zones are identified.

Zone A (1000-1950± metres) approximately corresponds to the Utsira Formation. The sediments are mainly olive grey mudstones and shaly mudstones with greenish grey interbeds and, at 1200-1300± metres beds of sandstone.

C_1-C_4 hydrocarbon abundances drop from 1330ppm to 60ppm (at 1500± metres) and then improve to 6125ppm in the deepest sample. These gases vary widely in wetness (1.2-46.9% C_{2+} hydrocarbons) particularly in the leaner samples where loss of methane is suspected. Isobutane to normal butane ratios are low (less than 0.71). The heavier C_5-C_7 hydrocarbons increase in richness from 49ppm to 1281ppm in the deepest sample.

Zone B^1 (1950-2940± metres) includes the Balder Formation (1963-2208 metres) and sediments of Cretaceous (undivided) age. Down to 2430± metres greenish grey shales and shaly mudstones predominate whereas the underlying mudstones are darker coloured (medium dark grey to dark greenish grey). Minor moderate brown mudstones and limestones are also present

Gas abundances vary widely from 950ppm up to 41116ppm but commonly exceed 10000ppm. Gas wetness values of 65.4-93.3% and low (less than 0.40) butane ratios suggest out of place migrated hydrocarbons. Gasoline range hydrocarbons are also abundant 4031-48391ppm and like the gases peak at 2525-2540± metres.

Zone B^2 lies between 2940± metres and 3775 metres. Lithologically, this interval is similar to Zone B^1, consisting of medium grey to dark greenish grey shaly mudstones plus darker coloured (medium dark grey) mudstones and minor limestones below 3500± metres.

Apart from a kick at 3500± metres the gaseous hydrocarbons above 3660± metres are leaner 986-4885ppm than those in Zone B^1 and have variable 8.7-90.8 gas wetness values. The gasoline fraction is richest at 3495-3535± metres (17183-34738ppm) but is generally less than 4484ppm. Butane ratios of less than 0.68 suggest further traces of out of place hydrocarbons.

Below 3660± metres the gases and gasolines are somewhat richer (2813-26514ppm and 1438-33082ppm respectively) but,more significantly, are very wet (67.8-88.6% C_{2+} hydrocarbons) and have very low (0.25-0.39) butane ratios. An upward diffusion of hydrocarbons from shows in the Jurassic is suspected.

Zone C 3775-3830± metres is equivalent to the Draupne Formation (picked at 3776-3825 metres). Sample quality is poor (abundant LCM) in this interval. The sediments are dominantly brownish black shaly mudstones with beds of limestone at 3775-3790± metres.

These sediments are rich (14562-16257ppm) in very wet gas (88.8-90.4%) and gasolines (30353-33894ppm). Isobutane to normal butane ratios are low (0.30-0.45) and indicate shows of migrated hydrocarbons.

Zone D (3830-3950± metres) corresponds to the Upper Jurassic Sandstone Member (3825-3935± metres) and the underlying Tarbert Member (down to 3955 metres). The sediments, however, appear to be dominantly brownish black shaly mudstones although LCM (cement and metal) is abundant in most of the samples. Beds of sandstone are present in the Tarbert.

This zone is also rich in C_1-C_4 (27369-40687ppm) and C_5-C_7 (23216-45893ppm) hydrocarbons. Gas wetness values of 80.8-89.7% and low (less than 0.39) butane ratios suggest that out of place migrated hydrocarbons are present here too.

Zone E extending from 3950 metres down to the deepest sample at 4170 metres, includes sediments from the Ness (3955-4018 metres), Early Etive, Etive (4098-4135 metres) and Drake Members. Interbedded brownish black shales (carbonaceous), coals and minor sands are present above approximately 4050± metres. The underlying sediments consist of sandstones with interbeds of greyish black carbonaceous shale.

C_1-C_4 gas abundances at 14198-45748ppm are comparable to those in Zone D although the gases are somewhat drier, containing 53.7-77.6% C_{2+} hydrocarbons. Butane ratios (0.28-0.64) are generally less than 0.5. Gasoline range hydrocarbons drop from 16975ppm to 3274-8734ppm at 3965-4070± metres and then improve to 7199-15300ppm in the basal 100± metres.

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.

Olive grey mudstones of above average richness (1.29-1.53% organic carbon) containing a mixture of woody, herbaceous and algal kerogen are present at 1100-1650± metres. With these exceptions the Utsira mudstones are poor to fair (less than 0.73% organic carbon) source rocks.

Zones B^1 and B^2 are characterised by a monotonous sequence of below average richness (0.27-0.99% organic carbon) shales and shaly mudstones. Their organic matter is also relatively uniform; chiefly consisting of wood and inertinite, with minimal herbaceous, algal and amorphous kerogen.

The Draupne shaly mudstones at 3776-3875 metres have good (4.50-5.50% organic carbon) contents of a mixed amorphous, algal, woody and inertinitic assemblage. Brownish black shaly mudstones within the Upper Jurassic Sandstone and Tarbert Members also have good (2.10-5.17%) organic carbon contents but their organic matter contains mainly woody and inertinitic or algal and woody kerogen. Differentiation between the various organic matter types was, however, difficult in many of these samples.

Carbonaceous shales and coals within Zone E have organic carbon contents of 13.2-47.8% and 47.5-81.8%, respectively; the interbedded medium dark grey shales have values of 0.69-3.36%. Apart from the carbonaceous shales/mudstones at 3990-4090± metres - containing a mixture of amorphous, woody, algal and herbaceous debris - the organic matter in the Zone E sediments chiefly consists of wood or woody and inertinitic kerogen.

C. LEVEL OF THERMAL MATURATION

Thermal maturation levels have been evaluated by the visual kerogen (spore colour) and vitrinite reflectance methods.

Spore colour based maturation indices increase from 2- at 2300± metres to 2 at 3000± metres, reach 2 to 2+ at 3500± metres and 2+ at 3750± metres. A range of spore colours, due in part to reworking, was observed in the sediments below 3750± metres. Within the analysed section there appears to be a minimal increase in maturity below this depth.

When plotted, the vitrinite reflectance values form two trends. The near vertical trend at 1.0-1.2% Ro down to 3800± metres is due to reworked material. the less mature trend increases from 0.3% Ro at the top of the section to 0.45% Ro at 2350± metres, 0.53% Ro at 2950± metres and 0.72% Ro at 3500± metres. A maximum value of 0.95-1.01% Ro was obtained for the coaly facies in Zone E.

Maturation indices of 2-, 2 and 2 to 2+ normally correlate with mean vitrinite reflectances of 0.45%, 0.53% and 0.72% Ro respectively. The agreement between the two maturation methods in this well is clearly very good. Rockeval Tmax values, with one or two anomolous exceptions, support these trends in a semi quantative manner.

Herbaceous, amorphous and algal kerogen becomes marginally mature at 0.45% Ro (2-), starts to generate significant hydrocarbons at 0.53% Ro (2) and enters the oil window at 0.72% Ro (2 to 2+). The corresponding values for woody organic matter are 0.53% Ro (2), 0.72% Ro (2 to 2+) and 0.90-1.00% Ro (2+) respectively. Down to 3000± metres the (mainly woody and inertinitic) organic matter is, therefore, totally immature. Minor generation of gas and associated light liquids has been initiated at 3000-3500± metres and significant generation starts below 3500± metres in the Cretaceous (Zone B^2). The nature of the organic matter changes in the Draupne (3776-3825 metres) and these sediments are within the maturation oil window. Organic matter reverts to mainly woody material in the coals and shales of Zone E but with the increased maturation level at this depth they too are optimally mature.

D. SOURCE RICHNESS

The abundance of light hydrocarbons is used as a preliminary guide to source richness. Within the analysed well section the gases are commonly very wet, clearly enhanced by out of place migrated species and, therefore, unrelated to source richness.

Organic carbon values suggest that the Zone A mudstones may be good potential source rocks whereas the shales in Zone B^1 and B^2 are generally fair. These ratings will be optimistic since the organic matter is largely woody in character. The Draupne mudstones have very good organic carbon contents whereas the mudstones in the Upper Jurassic sandstones and Tarbert have a good rather than very good rating (due to their woody organic matter). Within the Ness - Drake Members (below 3950± metres) the coals and carbonaceous shales are clearly rich, and the interbedded medium dark grey shales fair to good, source rocks.

High hydrocarbons to total extract ratios indicate that the indigenous C_{15+} hydrocarbons are enhanced by non-indigenous species. Their abundance is, therefore, unrelated to source richness.

Pyrolysate yields of 2.06-2.83mg/g indicate that the mudstones at 1100-1550± metres in the Utsira have a fair hydrocarbon potential. With these exceptions the mudstones and shales down to 3775± metres are uniformly poor source rocks. The dominant brownish black mudstones in the Draupne generated 7.55-9.61mg/g pyrolysate and are evidentally very good to rich whereas the underlying mudstones (down to 3950± metres) are good with fair interbeds (2.82-4.69mg/g pyrolysate). Within the Ness and Etive Members are rich beds of coal and carbonaceous shale/mudstone which yielded up to 167.3mg/g pyrolysate. Interbedded with the coals are brownish black and medium dark grey shales of variable (0.67-7.74mg/g pyrolysate) richness. In general they are, per unit volume, good source rocks.

The nature of potential hydrocarbon products (gas, condensate or oil) is apparent from the pyrolysis-GC analyses. These "pyrograms" show that the mudstones at 1100-1550± metres have a potential for gas and condensate but the basal Tertiary and Cretaceous sediments are generally gas prone. An extended range of hydrocarbons in the pyrolysis-GC traces from the Draupne suggest a potential for gas and condensate or light oil. Pyrograms from the underlying

Jurassic mudstones, shales and coals, however, indicate a primary potential for gas, with limited volumes of light liquids.

To summarise:-

- fair mudstones at 1100-1550± metres have a potential for gas - condensate.
- the basal Tertiary and the Cretaceous sediments are generally poor gas prone source rocks.
- the Draupne mudstones at 3775-3825± metres have an excellent potential for gas - condensate and associated light oil.
- shaly mudstones in the Upper Jurassic Sandstone and Tarbert Members are good source rocks for gas and minor light liquids.
- interbeds of coal and carbonaceous shale, within the Ness - Etive are generally rich source rocks for gas plus traces of condensate. The shales (medium dark grey and brownish black) in this interval also have a good potential for gas and associated liquids.

E. MIGRATED HYDROCARBONS

Potential reservoir facies are represented by beds of sandstone at 1200-1350± metres and from 3940± metres down to TD. Limestones are present at 2315-2330± metres, at 3495-3570± metres and at 3670-3745± metres.

Strong shows of wet gas and gasolines, suggesting migrated hydrocarbons are almost continuous between 1950± metres and 2930± metres. Further scattered shows, with a kick at 3495-3535± metres were detected in the lower part of the Cretaceous above 3700± metres. An increase in light hydrocarbon abundance and of gas wetness below this depth is due to a suspected diffusion halo of hydrocarbons from shows in the Jurassic (see below). C_{15+} hydrocarbons extracted from the mudstones at 2045-2870± metre interval, although they have high (52.8-79.94%) hydrocarbon to total extract ratios are a mixture of medium gravity crude oil and drilling introduced contamination (diesel type at 2520-2540± metres). The migrated hydrocarbons in this interval, therefore, are dominantly of wet gas and condensate, with weak shows of associated crude oil. Further intermittent shows (weak) of crude oil plus wet gas are present down to the base of the Cretaceous.

The Draupne is characterised by very strong shows of wet gas and associated light oil. A marked front end bias to the paraffin-naphthene fraction chromatograms however suggests that the liquids extracted from the cuttings samples are contaminated by hydrocarbons from the mud-system. This effect is more apparent in the extracts from the Upper Jurassic Sandstone and Tarbert Members. The C_1-C_7 and C_{15+} hydrocarbon data, nonetheless, confirm that strong shows of wet gas - condensate extend down to at least 3950± metres; making the interbedded sandstones highly prospective.

Although there is abundant wet gas below 3950± metres the gasolines particularly at 3965-4070± metres, are weaker than hitherto. Heavy hydrocarbons extracted from sediments of the Ness - Drake Members are a mixture of indigenous (the coaly facies are rich source rocks, and nearing peak maturity), drilling contaminant (see paraffin-naphthene traces from cuttings samples) and migrated hydrocarbons. Allowing for these various contributions the shows of migrated crude oil (light - medium gravity) are at best fair below 3950± metres; the primary product being wet gas and condensate.

To summarise:-

- strong shows of wet gas - condensate and traces of medium gravity crude oil were detected in the mudstones at 1950-2930± metres.
- weaker shows of similar hydrocarbons occur intermittently down to the base of the Cretaceous at 3775± metres.
- very strong shows of wet gas and associated light crude oil are present in the Draupne (3776-3825 metres) and extend down to 3950± metres in the Upper Jurassic Sandstone Member.
- strong shows, mainly of wet gas, persist down to total depth. Interpretation of the heavy hydrocarbon data from this interval is complicated by contamination and indigenous species. Weak shows of medium gravity oil are, however, believed to be present below 3950± metres.

F. OIL TO SOURCE ROCK CORRELATION

A selection of the sediments representing potential source rocks, or associated with shows of migrated hydrocarbons, were solvent extracted and their C_{15+} hydrocarbons compared by means of carbon isotope ratios and mass fragmentograms. From Section E of this study it will be apparent that the source rock extracts are enhanced by migrated hydrocarbons although this effect will not be too serious in the richer Jurassic sediments.

Carbon isotope ratios of the C_{15+} total extracts and hydrocarbons are influenced by the depositional environment of their source rocks. Hydrocarbons from the shows at 1950-2930± metres are isotopically lighter (more negative) than the deeper shows and correlate with the hydrocarbons extracted from the rich Draupne mudstones. Hydrocarbons extracted from the underlying shales/mudstones and coaly facies form a single diffuse group when plotted. Their saturated and aromatic hydrocarbons have ratios (-26.6 to -27.2^{o}/oo and -25.1 to 26.6^{o}/oo respectively) which are approximately 1^{o}/oo heavier (more positive) than those associated with the sandstone cores examined in the correlation study (Geochem, September 1985). It would appear, therefore, that the shales/mudstones in the Upper Jurassic Sandstone Member or the coals/ carbonaceous shales in the Ness - Etive memebers are the source of the shows in the sands at 3959-4102± metres.

More detailed correlations are possible using mass fragmentograms of the triterpanes and steranes. High noise levels and elevated baselines in several of the traces, however, confirm that the biomarkers are sparse in may of these samples. This effect is largely due to the nature of the hydrocarbons; which have a tendency to gas - condensate or light oil.

Shows of condensate represented by the samples at 2405-2420± metres and 2855-2870± metres have good abundances of the C_{31+} hopanes and the moretanes at m/z 191 whereas the steranes (at m/z 217, 218) have strong C_{28} and C_{29} components. The latter fragmentograms correlate with those from the Draupne and Upper Jurassic shales/mudstones.

Biomarkers are sparse in the sediments between 3790± metres and 3980± metres. At m/z 191 the fragmentograms show an abundance of C_{27} tris norhopane, a good C_{28} bis norhopane peak and a strong unknown peak (X). C_{31+} hopanes and the moretanes however are relatively sparse. The corresponding sterane fragmentograms (at m/z 217, 218) loosely correlate the hydrocarbons from the 3790-3980± metre interval although those extracted from the shales/coals below 3900± metres have a higher C_{29} component.

Strong C_{29} sterane peaks were also observed in the m/z 217 mass fragmentograms at 3991-4017± metres. The moretanes (m/z 191) in these extracts are minimal although peak X is again prominent. With the exception of the latter these traces suggest a correlation with the fluids extracted from the reservoir sands.

Below 4020± metres the C_{29} tris norhopanes, C_{29} norhopanes and the moretanes are relatively abundant. There is also a good distribution of the C_{31+} hopanes on the m/z 191 fragmentograms. At m/z 217, however, there is an increase in the relative amounts of the C_{27} steranes below 4060± metres.

Mass fragmentograms of the phenanthrenes and dibenzothiophenes show slight variations, particularly in the more highly substituted members, but generally confirm the relationships indicated by the steranes and triterpanes.

Summarising:-

- carbon isotopes correlate the shows of condensate at 1950-2930± metres with the Draupne mudstones. Mass fragmentograms support the conclusion but extend the relationship to the shales of the Upper Jurassic Sandstone Member.

- hydrocarbons extracted from the Middle Jurassic shales and from the underlying coals and carbonaceous shale sequences display no clear cut division in the distribution of steranes and triterpanes. These fragmentograms do approximately correlate, with those obtained from the fluids in the sands from the 3939-4102± metre interval.

- carbon isotope ratios do, however, show a correlation between the reservoired hydrocarbons and those associated with the shales/coals in the Ness - Etive (possibly the Upper Jurassic shales at 3830-3950± metres too).

G. CONCLUSIONS

Six zones, generally coinciding with the principal stratigraphic divisions are recognised between 1000 metres and 4170 metres in 30/2-2.

Zone A (1000-1950± metres) is composed of olive grey and light olive grey mudstones from the Utsira Formation. At 1100-1650± metres the mudstones have good (1.29-1.53%) organic carbon contents. They are immature but potentially fair source rocks for gas and minor associated liquids. The remaining mudstones are poor and gas prone.

Zone B lies between 1950± metres and 2940± metres. Medium olive grey shales within the Balder Formation (down to 2208 metres) contain significant interbedded moderate brown mudstones. The underlying Cretaceous sediments are a sequence of greenish grey to dark greenish grey shales and shaly mudstones, with minor limestones at 2315-2360± metres. Organic carbon contents are below average (0.27-0.99%) in the dominant mudstones/shales. Their largely woody and inertinitic organic matter is immature and has a negligible potential for gas. Zone B^1 is, therefore, a poor immature gas source.

Zone B^2, 2940± metres to 3775± metres, covers the lower part of the Cretaceous and like Zone B^1 is chiefly composed of medium grey to dark greenish grey shaly mudstones. Medium dark grey mudstones and minor limestones are also present below 3500± metres. Organic carbon contents of 0.33-0.88% increase slightly with depth but the wood and inertinite in these sediments results in a poor hydrocarbon potential. Above 3000± metres the sediments are totally immature, minor hydrocarbon generation has been initiated at 3000-3500± metres and significant gas generation commences below this depth. The Zone B^2 shales and mudstones are nonetheless poor source rocks for gas.

Zone C (3775-3830± metres) approximately corresponds to the Draupne Formation. The predominant brownish black shaly mudstones have very good (4.50-5.50% organic carbon) contents of a mixed amorphous, algal, woody and inertinitic organic assemblage. These sediments are within the "oil window" on structure and are realising their excellent potential for gas - condensate and associated light oil.

Zone D (3830-3950± metres) includes the Upper Jurassic Sandstone (3825-3835±

metres) and Tarbert members. Although sample quality is poor in this interval the sediments appear to be largely brownish black shaly mudstone with beds of limestone at 3775-3790± metres. The mudstones are not quite as rich (2.10-5.17% organic carbon) as those in Zone C and contain a poorer quality (woody and inertinitic or woody and algal) type of organic matter. They are, nonetheless, mature on-structure and represent a good source for gas and minor associated liquids.

Zone E (3950-4170 metres) covers the Ness (3955-4018 metres), Early Etive, Etive (4098-4135 metres) and Drake members of the Middle and Lower Jurassic. This interval is lithologically varied containing interbedded coals, carbonaceous shales and sands above 4050± metres. The overlie a sequence of greyish black carbonaceous shales and sands. Per unit volume the coals and carbonaceous shales are a rich, and mature, source for gas. Associated sandstones reservoirs should be highly prospective.

Strong shows of wet gas, condensate and traces of a medium gravity crude oil were detected in the mudstones at 1950-2930± metres. Further, weaker, shows of the same type of hydrocarbons extend down to the base of the Cretaceous at 3775 metres.

Very strong shows of wet - condensate and light crude oil occur in the Draupne mudstones. They are partially due to generation from the host sediments (which are mature) but migration from their down dip lateral equivalents is also suspected. Shows within the Upper Jurassic Sandstone and Tarbert members (3830-3950± metres) are of similar hydrocarbons but their source is believed to be the host shales or the underlying coaly facies.

Shows within the Ness - Drake members (below 3950± metres) although strong are of somewhat drier gas than that in Zone D. This is most probably due to gases generated from the coals and carbonaceous shales within this interval. Drilling contaminants and traces of indigenous hydrocarbons have complicated the interpretation of the heavy hydrocarbon data from this zone. Significant traces of oil are, nonetheless, suspected below 3950± metres but the primary product is undoubtedley wet gas; with associated light liquids. Their source is almost certain to be the rich coals and carbonaceous shales within the Ness - Drake members.

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)
1124-001	1000-050m	A 60% Glauconitic claystone, sandy in part, blocky, poorly consolidated, non-calc., light greenish grey	5GY8/1	0.73
		B 40% LCM - cement		
1124-003	1100-150m	A 65% Mudstone, sl. silty, sub-platy to platy, mod. soft, non-calc., sig. cavings, olive grey	5Y4/1	1.50
		B 35% Mudstone, silty in part, blocky, mod. soft, non-calc., sig. cavings, light olive grey Minor sandstone	5Y6/1	1.52
1124-005	1200-250m	A 80% Mudstone, sl. silty, sub-platy to platy. mod. soft, non-calc., sig. cavings, olive grey to medium olive grey	5Y4/1-5Y5/1	1.48
		B 10% Mudstone, as 1124-003B, abundant cavings	5Y6/1	
		C 10% Sand, glauconitic, coarse grained, sub-rounded to sub-angular, mod. to well sorted, white Minor sandstone	N9	
1124-007	1300-350m	A 70% Sand, as 1124-005C	N9	
		B 30% Mudstone, as 1124-005A, sig. cavings	5Y4/1-5Y5/1	1.52,1.50
1124-009	1400-450m	A 98% Mudstone, as 1124-005A, sig. cavings Minor sandstone	5Y4/1-5Y5/1	1.29
1124-011	1500-550m	A 98% Mudstone, as 1124-005A, sig. cavings	5Y4/1-5Y5/1	1.53
1124-013	1600-650m	A 98% Mudstone, as 1124-005A, sig. cavings	5Y4/1-5Y5/1	1.49
1124-015	1700-750m	A 80% Shaly mudstone, subfissile to sub-platy, mod. hard, non-calc., sig. cavings, greenish grey	5GY6/1	0.33
		B 20% Mudstone, sl. silty, sub-platy, mod. soft, non-calc., sig. cavings, olive grey	5Y4/1	1.48,1.44
1124-017	1800-850m	A 98% Shale, fissile to platy, mod. hard, non-calc., sig. cavings, medium greenish grey to greenish grey Minor sandstone	5GY5/1-5GY6/1	0.25
1124-019	1900-950m	A 75% Shale, as 1124-017A, sig. cavings	5GY5/1-5GY6/1	0.44
		B 20% Shaly mudstone, subfissile to sub-platy, mod. hard, non-calc., sig. cavings, moderate brown	5YR3/4	0.12
		C 5% Dolomite, sub-platy, hard, greyish orange	10YR7/4	

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)
1124-020	1950-2000m	A 85%	Shale, fissile to platy, mod. hard, non-calc., sig. cavings, medium greenish grey to greenish grey	5GY5/1-5GY6/1	0.43
		B 15%	Shaly mudstone, subfissile to sub-platy, mod. hard, non-calc., sig. cavings, moderate brown Minor dolomite	5YR3/4	0.11
1124-021	2000-015m	A 85%	Shaly mudstone, silty in part, subfissile to sub-platy, mod. soft, non-calc., medium greenish grey to greenish grey	5GY5/1-5GY6/1	0.61,0.62
		B 15%	Shaly mudstone, as 1124-020B, sig. cavings	5YR3/4	0.12
1124-024	2015-030m	A 75%	Shale, sl. silty, fissile to platy, mod. hard, non-calc., sig. cavings, medium greenish grey to greenish grey	5GY6/1-5GY5/1	0.44
		B 25%	Shaly mudstone, as 1124-020B, sig. cavings	5YR3/4	0.14
1124-027	2090-105m	A 80%	Shale, as 1124-024A, sig. cavings	5GY6/1-5GY5/1	0.38
		B 20%	Shaly mudstone, as 1124-020B, sig. cavings	5YR3/4	0.11,0.13
1124-031	2150-165m	A 90%	Shale, as 1124-024A, sig. cavings	5GY6/1-5GY5/1	0.27
		B 10%	Shaly mudstone, as 1124-020B, sig. cavings Minor dolomite	5YR3/4	0.12
1124-034	2195-210m	A 90%	Shale, fissile to platy, mod. hard, non-calc., sig. cavings, medium greenish grey to greenish grey	5GY5/1-5GY6/1	0.31
		B 10%	Shaly mudstone, as 1124-020B, abundant cavings Minor dolomite	5YR3/4	0.17
1124-036	2225-240m	A 95%	Shale, as 1124-034A, sig. cavings	5GY5/1-5GY6/1	0.45
		B 5%	Shaly mudstone, as 1124-020B, abundant cavings	5YR3/4	0.14,0.16
1124-038	2255-270m	A 95%	Shale, as 1124-034A, sig. cavings	5GY5/1-5GY6/1	0.42
		B 5%	Shaly mudstone, as 1124-020B, dominant cavings Minor sandstone	5YR3/4	
1124-040	2255-300m	A 98%	Shale, as 1124-034A, sig. cavings Minor shaly mudstone, sandstone	5GY5/1-5GY6/1	0.47
1124-042	2315-330m	A 90%	Shale, as 1124-034A, sig. cavings	5GY5/1-5GY6/1	0.55
		B 10%	Limestone, arg., sub-platy, mod. soft, yellow F., milky cut, yellowish grey Minor pyrite, shaly mudstone	5Y7/2	

Abbreviations = **ar**enaceous, **arg**illaceous, **calc**areous, **C**ut, **dol**omitic, **F**luorescence, **foram**inifera, **foss**iliferous
Lost Circulation Material, **mod**erately, **occ**asionally, **sl**ightly, **v**ery

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)
1124-044	2345-360m	A 98%	Shale, fissile to platy, mod. hard, non-calc., sig. cavings, medium greenish grey to greenish grey Minor limestone	5GY5/1- 5GY6/1	0.51,0.48
1124-046	2375-390m	A 65%	Shale, as 1124-044A, sig. cavings	5GY5/1- 5GY6/1	0.59
		B 35%	LCM - cement Minor pyrite, limestone		
1124-048	2405-420m	A 98%	Shaly mudstone, sl. silty, subfissile to sub-platy, mod. soft, non to sl. calc., sig. cavings, dark greenish grey to medium greenish grey Minor limestone	5GY4/1- 5GY5/1	0.74
1124-050	2435-450m	A 98%	Shaly mudstone, as 1124-048A, sig. cavings	5GY4/1- 5GY5/1	0.71
1124-052	2465-480m	A 98%	Shaly mudstone, as 1124-048A, sig. cavings	5GY4/1- 5GY5/1	0.59
1124-054	2495-520m	A 80%	Shaly mudstone, as 1124-048A, sig. cavings	5GY4/1- 5GY5/1	0.65
		B 20%	Mudstone, sub-platy to blocky, mod. soft, highly calc.,moderate brown Minor LCM - cement	5YR3/4	0.24,0.24
1124-056	2525-540m	A 70%	Shaly mudstone, as 1124-048A, sig. cavings	5GY4/1- 5GY5/1	0.65
		B 15%	Mudstone, as 1124-054B, sig. cavings	5YR3/4	0.38
		C 15%	LCM - cement(?)		
1124-058	2555-570m	A 98%	Shaly mudstone, as 1124-048A, sig. cavings Minor LCM - cement	5GY4/1- 5GY5/1	0.68
1124-060	2585-600m	A 98%	Shaly mudstone, as 1124-048A, sig. cavings	5GY4/1- 5GY5/1	0.60
1124-062	2615-630m	A 98%	Shale, fissile to platy, mod. hard, non to sl. calc., sig. cavings, dark greenish grey to medium greenish grey	5GY4/1- 5GY5/1	0.55,0.52
1124-064	2645-660m	A 98%	Shale, as 1124-062A, sig. cavings	5GY4/1- 5GY5/1	0.56
1124-066	2675-690m	A 90%	Shale, as 1124-062A, sig. cavings	5GY4/1- 5GY5/1	0.59
		B 10%	LCM - cement		
1124-068	2705-720m	A 98%	Shale, as 1124-062A, sig. cavings	5GY4/1- 5GY5/1	0.54
1124-070	2735-750m	A 98%	Shale, fissile to sub-platy, mod. hard, non to sl. calc., dark greenish grey to medium greenish grey Minor LCM - cement	5GY4/1- 5GY5/1	0.60

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)
1124-072	2765-780m	A 98%	Shale, fissile to sub-platy, mod. hard, non to sl. calc., dark sig. cavings, greenish grey to medium greenish grey	5GY4/1-5GY5/1	0.60
1124-074	2795-810m	A 98%	Shale, as 1124-072A, sig. cavings	5GY4/1-5GY5/1	0.61,0.58
1124-076	2825-840m	A 98%	Shale, as 1124-072A, sig. cavings Minor red shaly mudstone	5GY4/1-5GY5/1	0.71
1124-078	2855-870m	A 98%	Shaly mudstone, subfissile to sub-platy, mod. hard, non to sl. calc., sig. cavings, dark greenish grey to medium greenish grey	5GY4/1-5GY5/1	0.99
1124-080	2885-900m	A 98%	Shaly mudstone, as 1124-078A, sig. cavings	5GY4/1-5GY5/1	0.89
1124-082	2915-930m	A 98%	Shaly mudstone, as 1124-078A, sig. cavings	5GY4/1-5GY5/1	0.85
1124-084	2945-940m	A 98%	Shaly mudstone, as 1124-078A, sig. cavings	5GY4/1-5GY5/1	0.73,0.73
1124-086	2975-990m	A 98%	Shaly mudstone, as 1124-078A, sig. cavings	5GY4/1-5GY5/1	0.60
1124-088	3020-035m	A 98%	Shaly mudstone, as 1124-078A, sig. cavings Minor shaly mudstone	5GY4/1-5GY5/1	0.62
1124-090	3050-065m	A 98%	Shaly mudstone, sub-fissile to sub-platy, mod. hard, non to sl. calc., sig. cavings, medium grey to medium greenish grey	N5-5GY5/1	0.62
1124-092	3080-095m	A 98%	Shaly mudstone, as 1124-090A, sig. cavings	N5-5GY5/1	0.62
1124-094	3110-125m	A 98%	Shale, fissile to platy, mod. hard, non calc., dark greenish grey to medium greenish grey	5GY4/1-5GY5/1	0.59
1124-096	3140-155m	A 98%	Shaly mudstone, subfissile to sub-platy, mod. hard, non-calc., medium dark grey to v. dark greenish grey Minor red shaly mudstone	N4-5GY3/1	0.57,0.58
1124-098	3170-185m	A 98%	Shaly mudstone, as 1124-096A, sig. cavings Minor other shaly mudstone	N4-5GY3/1	0.62
1124-100	3200-215m	A 80%	Shaly mudstone, as 1124-096A, sig. cavings	N4-5GY3/1	0.68
		B 20%	Shaly mudstone, sub-fissile to platy, mod. hard, non-calc., sig. cavings, medium grey to medium greenish grey	N5-5GY4/1	0.51

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)
1124-102	3230-245m	A 98%	Shaly mudstone, sub-fissile to platy, mod. hard, non-calc., sig. cavings, medium grey to medium greenish grey	N5-5GY4/1	0.62
1124-104	3260-275m	A 65%	Shaly mudstone, as 1124-102B, sig. cavings	N5-5GY4/1	0.35
		B 35%	Mudstone, blocky, mod. soft, sl. calc., light bluish grey	5B7/1	0.35
1124-106	3290-305m	A 98%	Shaly mudstone, as 1124-102B, sig. cavings Minor limestone	N5-5GY4/1	0.81
1124-108	3320-335m	A 98%	Shaly mudstone, subfissile to sub-platy, mod. hard, non to sl. calc., sig. cavings, medium dark grey to dark greenish grey	N4-5GY4/1	0.63
1124-110	3350-365m	A 98%	Shaly mudstone, as 1124-108A, sig. cavings Minor LCM - cement	N4-5GY4/1	0.65
1124-112	3380-390m	A 98%	Shaly mudstone, as 1124-108A, sig. cavings	N4-5GY4/1	0.64
1124-114	3405-420m	A 98%	Mudstone, sub-platy, mod. hard, mod. calc., sig. cavings, medium grey	N5	0.61,0.61
1124-116	3435-450m	A 98%	Shaly mudstone, subfissile to sub-platy, mod. hard, non to sl. calc., medium dark grey to dark greenish grey Minor red shaly mudstone	N4-5GY4/1	0.61
1124-118	3465-480m	A 98%	Shaly mudstone, as 1124-116A, sig. cavings Minor mudstone	N4-5GY4/1	0.41
1124-120	3495-570m	A 90%	Shaly mudstone, as 1124-116A, sig. cavings	N4-5GY4/1	0.33
		B 10%	Limestone, platy, mod. hard, sig. cavings, pale yellow F., milky cut, yellowish grey Minor mudstone	5Y8/1	
1124-122	3520-535m	A 90%	Shaly mudstone, as 1124-116A, sig. cavings	N4-5GY4/1	0.39
		B 10%	Mudstone, blocky, mod. soft, mod. calc., v. light grey	N8	
1124-124	3550-565m	A 95%	Shaly mudstone, as 1124-116A, sig. cavings	N4-5GY4/1	0.33,0.34
		B 5%	Mudstone, as 1124-122B, sig. cavings	N8	
1124-126	3580-595m	A 95%	Shaly mudstone, as 1124-116A, sig. cavings	N4-5GY4/1	0.41
		B 5%	Mudstone, as 1124-122B, sig. cavings	N8	
1124-128	3610-625m	A 98%	Shaly mudstone, as 1124-116A, sig. cavings Minor mudstone	N4-5GY4/1	0.47

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)
1124-130	3640-655m	A 98%	Shaly mudstone, subfissile(?), mod. hard, sl. calc., sig. cavings, dark grey to medium dark grey	N3-4	0.65
1124-132	3670-685m	A 90%	Shaly mudstone, subfissile to platy, mod. hard, non to sl. calc., sig. cavings, medium dark grey to medium grey	N4-5	0.68
		B 10%	Limestone, arg., blocky, mod. soft, sig. cavings, v. light grey to light grey	N8-7	
1124-134	3700-715m	A 60%	Limestone, as 1124-132B, sig. cavings	N8-7	0.20
		B 40%	Shaly mudstone, as 1124-132A, sig. to abundant cavings	N4-5	0.88,0.90
1124-135	3715-730m	A 70%	Shaly mudstone, as 1124-132A, sig. to abundant cavings	N4-5	0.85
		B 30%	Limestone, as 1124-132B, sig. cavings	N8-7	0.26
1124-136	3730-745m	A 60%	Shaly mudstone, subfissile to platy, mod. hard, non to sl. calc., sig. cavings, medium dark grey to dark greenish grey	N4-5GY4/1	0.88
		B 40%	Limestone, arg., occ. sandy, blocky, mod. soft, sig. cavings, milky cut, light grey to v. light grey Minor sandstone	N7-8	0.34,0.34
1124-137	3745-760m	A 98%	Shaly mudstone, subfissile to sub-platy, mod. hard, non to sl. calc., dark greenish grey Minor limestone	5GY4/1	0.61
1124-138	3760-775m	A 98%	Shaly mudstone, as 1124-137A, sig. cavings Minor limestone	5GY4/1	0.86
1124-139	3775-790m	A 70%	Shaly mudstone, occ. silty, platy to blocky, mod. hard, non-calc., brownish black	5YR2/1	4.50
		B 30%	Limestone, arg., blocky, mod. soft, light grey to v. light grey Minor green shale	N7-8	0.27
1124-140	3790-802m	A 98%	Shaly mudstone, as 1124-139A, sig. cavings Minor limestone	5YR2/1	4.69
1124-141	3800-815m	A 80%	LCM - cement		
		B 20%	Shaly mudstone, as 1124-139A, sig. cavings	5YR2/1	5.69,5.21
1124-142	3815-830m	A 70%	Shaly mudstone, as 1124-139A, sig. cavings	5YR2/1	4.72
		B 30%	LCM - cement		
1124-143	3830-845m	A 90%	Shaly mudstone, as 1124-139A, sig. cavings	5YR2/1	5.17
		B 10%	LCM - cement		

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)
1124-144	3845-860m	A 65% Shaly mudstone, silty in part, platy to blocky, mod. hard, micaceous in part, non-calc., sig. cavings, brownish black	5YR2/1	4.49
		B 25% LCM - cement		
		C 10% LCM - metal		
		Minor marl		
1124-145	3860-875m	A 70% Shaly mudstone, as 1124-144A, sig. cavings	5YR2/1	3.44
		B 15% LCM - metal		
		C 15% LCM - metal		
1124-146	3875-890m	A 90% Shaly mudstone, as 1124-144A, sig. cavings	5YR2/1	2.22,2.26
		B 10% LCM - metal		
		Minor cement		
1124-147A	3890-905m	A 95% Shaly mudstone, as 1124-144A, sig. cavings	5YR2/1	2.10
		B 5% LCM - cement		
		Minor LCM - metal		
1124-148	3905-920m	A 95% Shaly mudstone, as 1124-144A, sig. cavings	5YR2/1	3.11
		B 5% LCM - cement		
		Minor plastic		
1124-149	3920-935m	A 95% Shaly mudstone, as 1124-144A, sig. cavings	5YR2/1	2.96
		B 5% LCM - cement		
		Minor shale, sandstone		
1124-150	3935-950m	A 60% Sandstone, dominantly unconsolidated, fine grained, sub-rounded, fairly well sorted, milky cut, yellowish grey	5Y7/2	
		B 40% Shale, fissile to subfissile, mod. hard, non-calc., sig. cavings, brownish black	5YR2/1	2.81
1124-151 CORE	3965.70m	A 98% Mudstone, poorly laminated, mod. hard, non-calc., micaceous, brownish black	5YR2/1	2.67
1124-152	3950-965m	A 55% Shale, as 1124-150B, sig. cavings	5YR2/1	3.05,2.96
		B 45% Sandstone, as 1124-150A, milky cut	5Y7/2	
1124-153 CORE #3	3961.70m	A 98% Carbonaceous mudstone, with coal interbeds, subfissile, mod. hard, non-calc., brownish black	5YR2/1	13.20
1124-154 CORE #4	3970.30m	A 98% Coal, brittle, soft, concoidal, fracture, vitreous lustre, black	N1	77.80
1124-155	3965-980m	A 65% Shale, as 1124-150B, sig. cavings	5YR2/1	4.23
		B 35% Sandstone, as 1124-150A, milky cut	5Y7/2	
		Minor LCM - cement		
1124-156 CORE #4	3976.17m	A 98% Coal, brittle, soft, vitreous with dull layers, pyritic lenses, black	N1	81.80

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)
1124-157 CORE	3976.46m	A 98% Carbonaceous shale, coal lenses and laminations, subfissile, mod. soft, non-calc., black	N1	42.50,43.40
1124-158 CORE #4	3977.22m	A 98% Carbonaceous shale, as 1124-157A	N1	47.8
1124-159 CORE #4	3979.05m	A 98% Shale, subfissile, mod. hard, non-calc., medium dark grey	N4	1.73
1124-160 CORE #5	3979.29m	A 98% Coal, with carbonaceous shale interbeds, layered, soft to medium soft, non-calc., black	N1	47.50
1124-161 CORE	3984.80m	A 98% Coal, as 1124-160A	N1	48.50
1124-162	3980-995m	A 80% Shale, silty in part, subfissile to platy, mod. hard, non-calc., sig. cavings, black to greyish black	N1-2	3.05
		B 20% LCM - cement		
		Minor coal, sand		
1124-163 CORE	3990.31m	A 98% Shale, carbonaceous fragments on laminations, fissile, mod. hard, non-calc., medium dark grey	N4	2.97,2.77
1124-164 CORE	3991.67m	A 98% Shale, as 1124-163A	N4	4.20
1124-165 CORE	3995.63m	A 98% Shale, fissile, mod. hard, non-calc., medium dark grey	N4	1.20
1124-166	3995-4010m	A 70% Shale, as 1124-165A, sig. cavings	N4	3.02
		B 30% Sandstone, fine grained, fairly well sorted, milky cut, white	N9	
		Minor coal		
1124-167 CORE	4017.40m	A 98% Carbonaceous mudstone with coal veins, subfissile, mod. hard, non-calc., black to greyish black	N1-2	14.30
1124-168	4010-025m	A 50% Carbonaceous mudstone, as 1124-167A, sig. cavings	N1-2	4.04,3.98
		B 30% Sandstone, as 1124-166B, sig. cavings, milky cut	N9	
		C 20% Shale, as 1124-165A, sig. cavings	N4	0.52
1124-169 CORE	4030.79m	A 98% Shale, carbonaceous fragments, subfissile, mod. hard, non-calc., medium dark grey/greyish black	N4/N2	1.24
1124-170	4025-040m	A 65% Carbonaceous mudstone, as 1124-167A, sig. cavings	N1-2	5.45
		B 25% Shale, as 1124-165A, sig. cavings	N4	1.27
		C 10% Sandstone, as 1124-166B, sig. cavings, milky cut	N9	
		Minor coal		

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)
1124-171	4040-055m	A 50%	Carbonaceous mudstone with coal veins, subfissile, mod. hard, non-calc., sig. cavings, black to greyish black	N1-2	5.34
		B 40%	Shale, occ. coal lenses, subfissile, mod. hard, non-calc., micaceous, medium dark grey	N4	1.28,1.26
		C 10%	Sandstone, fine grained, fairly well sorted, milky cut, sig. cavings, white	N9	
1124-172 CORE	4048.95m	A 98%	Carbonaceous mudstone with coal interbed, fissile to subfissile, mod. hard, non-calc., black to greyish black	N1-2	35.4
1124-173 CORE	4049.39m	A 98%	Carbonaceous mudstone, as 1124-172A	N1-2	46.60
1124-174 CORE	4051.35m	A 98%	Shale, subfissile, laminated, mod. hard, non-calc., micaceous, medium dark grey	N4	0.94,0.94
1124-175 CORE	4051.49m	A 98%	Shale, carbonaceous fragments, mod. hard, non-calc., medium dark grey	N4	2.09
1124-176	4055-070m	A 60%	Sandstone, partially unconsolidated, fine grained, fairly well sorted, milky cut, white to yellowish grey	N9-5Y7/2	
		B 25%	Carbonaceous shale, as 1124-172A, sig. cavings	N1-2	9.36
		C 15%	Shale, as 1124-174A, sig. cavings	N4	1.01
1124-177	4070-085m	A 80%	Sandstone, as 1124-176A, milky cut	N9-5Y7/2	
		B 20%	Carbonaceous shale, as 1124-172A, sig. cavings Minor shale	N1-2	4.56
1124-178	4085-100m	A 70%	Sandstone, as 1124-176A, milky cut	N9-5Y7/2	
		B 30%	Carbonaceous shale, as 1124-172A, sig. cavings Minor shale	N1-2	3.55
1124-179 CORE	4096.47m	A 98%	Shale, silty lenses, disturbed bedding, micaceous, fissile, mod. hard, non-calc., dark grey	N3	2.09,2.10
1124-180 CORE	4097.79m	A 98%	Silty shale with poorly sorted sandstone lenses, fissile, mod. hard, non-calc., dark grey to medium dark grey	N3-4	1.40
1124-181	4100-115m	A 90%	Sand, fine to medium grained, sub-angular, fairly well sorted, white	N9	
		B 10%	Carbonaceous shale, as 1124-172A, sig. to abundant cavings Minor shale	N1-2	2.42

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)
1124-182	4115-130m	A 90%	Sand, fine to medium grained, sub-angular, fairly well sorted, white	N9	
		B 10%	Carbonaceous mudstone with coal interbed, fissile to subfissile, mod. hard, non-calc., sig. cavings, black to greyish black	N1-2	3.08
			Minor shale		
1124-183	4130-145m	A 50%	Sand, as 1124-182A	N9	
		B 40%	Carbonaceous shale, sl. silty, micaceous, subfissile to platy, mod. hard, non-calc., abundant cavings, black to greyish black	N1-2	
		C 10%	Shale, silty, micaceous, platy, mod. hard, non-calc., medium dark grey	N4	0.69,0.68
1124-184	4145-160m	A 65%	LCM - lignite		
		B 35%	Shale, as 1124-183C, sig. cavings	N4	1.54
1124-185	4160-172m	A 70%	Shale, as 1124-183C, sig. cavings	N4	1.08
		B 30%	Sand, as 1125-182A	N9	
			Minor carbonaceous shale, sandstone		

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	$\frac{iC_4}{nC_4}$
1124-001	1000-1050	643	56	33	2	4	738	95	12.9	14	0.46
1124-003	1100-1150	1214	5	3	0	1	1222	8	0.7	19	0.52
1124-005	1200-1250	331	3	2	0	2	339	8	2.3	28	0.07
1124-007	1300-1350	162	1	1	0	0	163	1	0.9	5	0.00
1124-009	1400-1450	12	5	3	0	1	21	10	44.9	24	0.30
1124-011	1500-1550	9	3	1	0	1	14	5	37.6	18	0.46
1124-013	1600-1650	8	2	1	0	1	12	4	31.5	14	0.24
1124-015	1700-1750	1066	12	14	0	2	1094	28	2.6	41	0.21
1124-017	1800-1850	481	33	57	26	31	627	147	23.4	70	0.84
1124-019	1900-1950	3162	780	960	292	456	5650	2488	44.0	644	0.64
1124-020	1950-2000	262	202	507	206	431	1608	1345	83.7	1525	0.48
1124-021	2000-2015	3542	1306	2187	737	1683	9455	5913	62.5	2567	0.44
1124-024	2045-2060	2892	1237	2544	1327	3290	11290	8398	74.4	6349	0.40
1124-027	2090-2105	2206	727	1382	480	1165	5959	3753	63.0	1992	0.41
1124-031	2150-2165	2052	514	1194	427	1278	5465	3413	62.5	3789	0.33
1124-034	2195-2210	1352	309	655	231	695	3242	1890	58.3	1740	0.33
1124-036	2225-2240	2013	1213	2499	2199	4089	12013	10001	83.2	10196	0.54
1124-038	2255-2270	1306	469	2310	1098	3480	8663	7357	84.9	10987	0.32
1124-040	2285-2300	433	186	1363	768	2370	5120	4687	91.5	6414	0.32
1124-042	2315-2330	923	392	1512	1393	2696	6915	5992	86.6	6728	0.52
1124-044	2345-2360	1331	403	1329	592	1802	5456	4125	75.6	4294	0.33
1124-046	2375-2390	687	479	1692	752	2364	5974	5287	88.5	4391	0.32
1124-048	2405-2420	794	627	3222	1552	4892	11087	10293	92.8	9719	0.32
1124-050	2435-2450	1121	534	1594	603	1810	5662	4541	80.2	2825	0.33
1124-052	2465-2480	44	25	118	54	173	414	370	89.3	491	0.31
1124-054	2495-2510	1756	1157	2204	2014	3721	10852	9095	83.8	8512	0.54
1124-056	2525-2540	2513	2207	3883	3523	6129	18255	15742	86.2	13965	0.57
1124-058	2555-2570	1345	775	1624	1413	2643	7800	6455	82.8	6161	0.53
1124-060	2585-2600	1462	654	1500	892	2229	6737	5275	78.3	4510	0.40
1124-062	2615-2630	2645	917	2688	1020	2888	10158	7514	74.0	5545	0.35

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	$\frac{iC_4}{nC_4}$
1124-064	2645-2660	1233	425	1240	628	1594	5121	3888	75.9	2914	0.39
1124-066	2675-2690	2929	751	2295	901	2464	9340	6411	68.6	5053	0.37
1124-068	2705-2720	265	80	232	128	308	1014	748	73.8	1321	0.41
1124-070	2735-2750	1432	390	885	393	880	3980	2548	64.0	1510	0.45
1124-072	2765-2780	5	1	4	2	6	17	13	73.0	163	0.27
1124-074	2795-2810	647	219	630	227	505	2229	1582	71.0	589	0.45
1124-076	2825-2840	970	625	1283	892	1953	5724	4754	83.1	3197	0.46
1124-078	2855-2870	1271	632	1682	681	1815	6081	4810	79.1	3080	0.38
1124-080	2885-2900	1374	600	1533	605	1599	5710	4336	75.9	2726	0.38
1124-082	2915-2930	511	318	915	524	1209	3478	2967	85.3	2049	0.43
1124-084	2945-2960	13	10	42	22	55	142	129	90.8	333	0.40
1124-086	2975-2990	477	213	532	184	324	1730	1252	72.4	514	0.57
1124-088	3020-3035	595	275	476	124	201	1670	1075	64.4	213	0.62
1124-090	3050-3065	212	120	157	37	50	575	363	63.2	129	0.73
1124-092	3080-3095	217	109	179	52	61	618	401	64.9	67	0.85
1124-094	3110-3125	11	7	26	10	19	73	62	84.9	45	0.51
1124-096	3140-3155	568	194	570	210	490	2032	1464	72.0	619	0.43
1124-098	3170-3185	132	9	19	7	14	180	49	27.0	54	0.47
1124-100	3200-3215	916	176	303	100	221	1716	799	46.6	429	0.45
1124-102	3230-3245	19	12	29	9	17	85	66	77.8	72	0.52
1124-104	3260-3275	151	198	301	66	84	800	649	81.1	138	0.79
1124-106	3290-3305	214	168	222	50	53	707	493	69.8	104	0.94
1124-108	3320-3335	14	27	49	11	14	115	101	87.5	70	0.84
1124-110	3350-3365	995	712	976	194	241	3118	2123	68.1	334	0.80
1124-112	3380-3390	527	433	613	106	121	1801	1273	70.7	390	0.88
1124-114	3405-3420	1430	231	396	80	99	2236	806	36.0	225	0.81
1124-116	3435-3450	559	406	802	167	334	2268	1709	75.4	727	0.50
1124-118	3465-3480	691	274	475	133	390	1965	1273	64.8	1586	0.34
1124-120	3495-3510	1411	1133	1424	1016	2272	7256	5845	80.6	5153	0.45
1124-122	3520-3535	1769	798	961	266	794	4588	2819	61.4	3050	0.34

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	$\frac{iC_4}{nC_4}$
1124-124	3550-3565	338	133	164	47	143	824	486	59.0	952	0.33
1124-126	3580-3595	349	73	114	35	97	668	319	47.8	638	0.36
1124-128	3610-3625	431	72	73	16	46	638	207	32.4	318	0.34
1124-130	3640-3655	119	7	12	3	9	149	30	20.3	160	0.36
1124-132	3670-3685	427	348	499	89	163	1525	1098	72.0	308	0.55
1124-134	3700-3715	949	1295	2579	643	1490	6957	6008	86.4	2230	0.43
1124-135	3715-3730	2275	1056	1889	1302	2865	9386	7111	75.8	4502	0.45
1124-136	3730-3745	850	165	1073	609	2283	4981	4130	82.9	10256	0.27
1124-137	3745-3760	635	618	1400	345	1063	4062	3427	84.4	1604	0.32
1124-138	3760-3775	1075	963	1406	953	2122	6519	5444	83.5	4372	0.45
1124-139	3775-3790	2948	2539	3310	2442	4841	16079	13131	81.7	9240	0.50
1124-140	3790-3802	2605	2102	2703	2134	3932	13476	10871	80.7	7427	0.54
1124-141	3800-3815	1998	2124	3076	1396	4207	12802	10804	84.4	6077	0.33
1124-142	3815-3830	2959	2436	3058	2351	4432	15237	12277	80.6	7719	0.53
1124-143	3830-3845	2540	2155	2754	1251	3550	12250	9710	79.3	3983	0.35
1124-144	3845-3860	1928	1487	1939	1494	2874	9722	7794	80.2	5415	0.52
1124-145	3860-3875	3089	2182	3182	960	3031	12443	9354	75.2	5176	0.32
1124-146	3875-3890	1917	1705	2492	1347	3631	11092	9175	82.7	6230	0.37
1124-147	3890-3905	2539	2660	3921	2725	5966	17810	15271	85.7	12792	0.46
1124-148 .	3905-3920	1906	1213	1572	573	1840	7104	5198	73.2	2498	0.31
1124-149	3920-3935	1969	1598	1887	1425	2628	9506	7537	79.3	4217	0.54
1124-150	3935-3950	3279	2272	2688	1740	3589	13569	10290	75.8	5866	0.48
1124-152	3950-3965	3490	2299	2469	588	1494	10341	6851	66.2	2743	0.39
1124-155	3965-3980	3664	1666	466	53	117	5966	2302	38.6	502	0.46
1124-162	3980-3995	6945	4034	3404	809	1887	17081	10135	59.3	1814	0.43
1124-166	3995-4010	4718	2681	2255	678	1303	11636	6917	59.5	1600	0.52
1124-168	4010-4025	5475	3070	2367	327	599	11838	6363	53.8	891	0.55
1124-170	4025-4040	3433	1725	671	94	167	6090	2657	43.6	350	0.56
1124-171	4040-4055	11607	7384	6223	986	2448	28647	17040	59.5	4576	0.40
1124-176	4055-4070	8335	4021	2761	417	518	16052	7717	48.1	1691	0.81

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	$\frac{iC_4}{nC_4}$
1124-177	4070-4085	13472	7960	4329	748	1065	27573	14101	51.1	5345	0.70
1124-178	4085-4100	2956	1791	1488	301	526	7062	4106	58.1	1084	0.57
1124-181	4100-4115	5112	3864	3684	489	1383	14531	9419	64.8	2081	0.35
1124-182	4115-4130	2782	1805	1776	303	838	7504	4722	62.9	1196	0.36
1124-183	4130-4145	6955	4833	4877	1017	2716	20399	13444	65.9	3707	0.37
1124-184	4145-4160	2169	1519	1551	242	618	6100	3930	64.4	1249	0.39
1124-185	4160-4172	4216	3159	3381	749	1547	13052	8836	67.7	3616	0.48

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	iC_4 / nC_4
1124-001	1000-1050	134	14	10	1	3	162	28	17.0	59	0.24
1124-003	1100-1150	101	4	2	0	0	108	7	6.6	46	0.33
1124-005	1200-1250	89	9	4	0	1	104	14	13.9	45	0.41
1124-007	1300-1350	141	9	4	0	3	157	16	10.0	44	0.00
1124-009	1400-1450	29	12	6	2	5	54	25	45.5	77	0.37
1124-011	1500-1550	25	11	5	1	5	46	21	45.8	79	0.15
1124-013	1600-1650	40	8	5	1	5	58	18	31.8	65	0.21
1124-015	1700-1750	332	11	16	2	8	369	37	9.9	99	0.27
1124-017	1800-1850	75	16	23	11	21	146	71	48.6	167	0.52
1124-019	1900-1950	90	34	102	71	178	475	385	81.1	637	0.40
1124-020	1950-2000	215	186	769	444	1283	2896	2681	92.6	4545	0.35
1124-021	2000-2015	193	119	471	412	1495	2690	2498	92.8	5269	0.28
1124-024	2045-2060	618	289	1023	829	2983	5742	5124	89.2	26480	0.28
1124-027	2090-2105	342	119	334	169	666	1631	1289	79.0	4962	0.25
1124-031	2150-2165	194	86	204	138	596	1218	1024	84.1	7495	0.23
1124-034	2195-2210	266	131	283	147	657	1484	1218	82.1	10001	0.22
1124-036	2225-2240	189	145	1255	1004	3842	6434	6245	97.1	23364	0.26
1124-038	2255-2270	70	47	119	89	437	762	692	90.8	10342	0.20
1124-040	2285-2300	238	117	437	364	1496	2652	2414	91.0	19428	0.24
1124-042	2315-2330	185	77	765	744	3067	4837	4652	96.2	35797	0.24
1124-044	2345-2360	383	191	834	684	2874	4965	4582	92.3	25044	0.24
1124-046	2375-2390	127	90	763	618	2515	4113	3986	96.9	18357	0.25
1124-048	2405-2420	200	186	488	444	2075	3393	3193	94.1	22943	0.21
1124-050	2435-2450	114	99	416	196	936	1761	1648	93.5	9879	0.21
1124-052	2465-2480	159	94	435	189	763	1640	1481	90.3	3750	0.25
1124-054	2495-2510	201	162	884	547	2464	4258	4057	95.3	21068	0.22
1124-056	2525-2540	248	432	5247	5429	11505	22862	22613	98.9	34426	0.47
1124-058	2555-2570	235	160	1079	659	2780	4913	4678	95.2	19409	0.24
1124-060	2585-2600	462	226	962	684	2606	4941	4479	90.7	18772	0.26
1124-062	2615-2630	138	86	341	225	963	1753	1615	92.1	14720	0.23

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	$\frac{iC_4}{nC_4}$
1124-064	2645-2660	191	108	319	151	649	1418	1227	86.5	7260	0.23
1124-066	2675-2690	130	61	229	196	809	1426	1295	90.8	10870	0.24
1124-068	2705-2720	135	55	130	102	410	833	698	83.7	5211	0.25
1124-070	2735-2750	128	43	111	43	201	527	399	75.7	2520	0.22
1124-072	2765-2780	91	56	175	117	493	933	841	90.2	6924	0.24
1124-074	2795-2810	157	111	466	205	874	1814	1656	91.3	3687	0.23
1124-076	2825-2840	141	152	837	673	2695	4498	4357	96.9	15778	0.25
1124-078	2855-2870	131	169	1040	662	2543	4546	4415	97.1	11978	0.26
1124-080	2885-2900	329	342	1894	1400	5192	9158	8828	96.4	23249	0.27
1124-082	2915-2930	117	126	921	805	2773	4742	4626	97.5	16639	0.29
1124-084	2945-2960	91	68	242	112	483	998	906	90.8	2991	0.23
1124-086	2975-2990	57	44	231	90	339	761	705	92.6	1223	0.27
1124-088	3020-3035	123	136	476	156	404	1295	1172	90.5	2031	0.39
1124-090	3050-3065	100	170	678	161	438	1547	1447	93.5	827	0.37
1124-092	3080-3095	79	53	121	29	85	368	288	78.4	214	0.34
1124-094	3110-3125	119	74	256	58	197	705	586	83.1	772	0.29
1124-096	3140-3155	1116	133	317	124	464	2154	1038	48.2	1696	0.27
1124-098	3170-3185	1164	92	102	22	104	1484	320	21.6	297	0.21
1124-100	3200-3215	2351	189	95	16	101	2753	401	14.6	565	0.16
1124-102	3230-3245	425	147	452	124	432	1581	1156	73.1	1319	0.29
1124-104	3260-3275	95	117	300	60	163	734	640	87.1	287	0.37
1124-106	3290-3305	129	166	308	41	101	744	615	82.7	251	0.41
1124-108	3320-3335	234	330	755	123	238	1680	1446	86.1	825	0.52
1124-110	3350-3365	172	249	725	167	454	1767	1595	90.3	1874	0.37
1124-112	3380-3390	338	133	370	75	147	1062	724	68.2	1210	0.51
1124-114	3405-3420	1467	89	242	43	88	1930	463	24.0	708	0.49
1124-116	3435-3450	267	103	252	54	186	862	595	69.0	943	0.29
1124-118	3465-3480	1195	173	144	46	212	1770	575	32.5	2183	0.22
1124-120	3495-3510	2526	799	1978	1406	5640	12348	9822	79.5	29585	0.25
1124-122	3520-3535	1545	322	303	290	733	3193	1648	51.6	14133	0.40

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	$\frac{iC_4}{nC_4}$
1124-124	3550-3565	1181	138	76	21	94	1509	328	21.7	3532	0.22
1124-126	3580-3595	982	87	47	12	54	1183	200	16.9	1670	0.22
1124-128	3610-3625	1350	107	43	6	33	1539	189	12.3	1204	0.19
1124-130	3640-3655	2985	131	65	15	55	3251	266	8.2	1190	0.27
1124-132	3670-3685	478	167	349	65	229	1288	810	62.9	1130	0.28
1124-134	3700-3715	158	134	561	259	918	2030	1872	92.2	6816	0.28
1124-135	3715-3730	1487	461	3902	2482	8797	17128	15642	91.3	28581	0.28
1124-136	3730-3745	427	140	715	319	1497	3099	2672	86.2	9168	0.21
1124-137	3745-3760	472	503	1783	605	2306	5670	5198	91.7	6481	0.26
1124-138	3760-3775	281	353	1397	452	2224	4707	4426	94.0	12241	0.20
1124-139	3775-3790	1624	3603	6751	4163	11417	27558	25934	94.1	23390	0.36
1124-140	3790-3802	2311	3938	7007	4988	11995	30239	27928	92.4	26467	0.42
1124-141	3800-3815	1535	3043	6140	3039	10355	24112	22577	93.6	26272	0.29
1124-142	3815-3830	1831	3945	6822	3874	11008	27481	25650	93.3	22633	0.35
1124-143	3830-3845	3072	4209	6720	3703	10733	28437	25365	89.2	19233	0.35
1124-144	3845-3860	1959	2885	6025	3542	10911	25322	23363	92.3	29230	0.32
1124-145	3860-3875	1394	1549	5119	2207	9155	19425	18031	92.8	27401	0.24
1124-146	3875-3890	913	756	4296	1887	8424	16277	15364	94.4	27966	0.22
1124-147	3890-3905	2327	1142	4840	2562	9617	20488	18161	88.6	33100	0.27
1124-148	3905-3920	2926	2466	5392	2101	8654	21538	18612	86.4	28853	0.24
1124-149	3920-3935	1870	3274	5799	2864	9674	23480	21610	92.0	23675	0.30
1124-150	3935-3950	4605	3307	5905	3600	10163	27580	22975	83.3	36678	0.35
1124-152	3950-3965	5934	5222	5897	1815	5458	24327	18393	75.6	14233	0.33
1124-155	3965-3980	7457	5898	5528	1041	3121	23045	15588	67.6	7287	0.33
1124-162	3980-3995	6881	5577	5738	1370	3682	23248	16367	70.4	3111	0.37
1124-166	3995-4010	6010	4749	4645	1069	3188	19661	13651	69.4	6339	0.34
1124-168	4010-4025	5668	3870	2103	291	868	12799	7131	55.7	2383	0.34
1124-170	4025-4040	7480	5421	4105	495	1366	18867	11387	60.4	3362	0.36
1124-171	4040-4055	5163	4478	4430	767	2262	17101	11938	69.8	4157	0.34
1124-176	4055-4070	9361	6335	4548	704	1241	22190	12829	57.8	4837	0.57

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	$\frac{iC_4}{nC_4}$
1124-177	4070-4085	1966	1846	1058	226	522	5618	3652	65.0	5235	0.43
1124-178	4085-4100	4237	3633	4030	1313	3310	16524	12286	74.4	11014	0.40
1124-181	4100-4115	2996	3711	5578	1966	7408	21659	18663	86.2	15424	0.27
1124-182	4115-4130	1923	1309	1808	418	1389	6848	4925	71.9	6003	0.30
1124-183	4130-4145	1691	3187	4763	1469	4958	16068	14377	89.5	11593	0.30
1124-184	4145-4160	1082	1451	2653	714	2199	8098	7017	86.6	6585	0.32
1124-185	4160-4172	605	973	1792	576	1721	5667	5062	89.3	8487	0.33

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	iC_4 / nC_4
1124-001	1000-1050	777	70	43	3	8	900	123	13.7	72	0.36
1124-003	1100-1150	1314	9	5	0	1	1330	15	1.2	65	0.43
1124-005	1200-1250	421	12	6	1	3	443	22	5.0	73	0.17
1124-007	1300-1350	303	10	4	0	3	320	17	5.4	49	0.00
1124-009	1400-1450	41	17	10	2	5	75	34	45.3	101	0.36
1124-011	1500-1550	34	14	6	1	6	60	26	43.8	97	0.18
1124-013	1600-1650	48	10	6	1	6	70	22	31.8	79	0.21
1124-015	1700-1750	1398	22	30	3	10	1463	65	4.4	141	0.26
1124-017	1800-1850	556	49	80	37	52	773	218	28.1	238	0.71
1124-019	1900-1950	3252	814	1062	363	634	6125	2873	46.9	1281	0.57
1124-020	1950-2000	477	388	1275	649	1714	4503	4026	89.4	6071	0.38
1124-021	2000-2015	3735	1425	2658	1149	3178	12146	8411	69.2	7836	0.36
1124-024	2045-2060	3510	1526	3568	2156	6273	17032	13522	79.4	32829	0.34
1124-027	2090-2105	2548	846	1716	649	1831	7590	5042	66.4	6954	0.35
1124-031	2150-2165	2245	600	1398	566	1874	6683	4437	66.4	11284	0.30
1124-034	2195-2210	1618	440	938	378	1351	4726	3108	65.8	11742	0.28
1124-036	2225-2240	2201	1358	3754	3203	7931	18447	16246	88.1	33560	0.40
1124-038	2255-2270	1376	516	2428	1187	3917	9425	8049	85.4	21328	0.30
1124-040	2285-2300	671	302	1800	1132	3866	7772	7101	91.4	25842	0.29
1124-042	2315-2330	1108	468	2276	2136	5763	11752	10644	90.6	42524	0.37
1124-044	2345-2360	1714	593	2162	1276	4676	10422	8707	83.6	29338	0.27
1124-046	2375-2390	814	569	2455	1370	4879	10088	9273	91.9	22748	0.28
1124-048	2405-2420	994	813	3711	1995	6968	14480	13486	93.1	32662	0.29
1124-050	2435-2450	1234	633	2011	799	2746	7423	6189	83.4	12704	0.29
1124-052	2465-2480	203	119	553	243	935	2054	1851	90.1	4241	0.26
1124-054	2495-2510	1957	1320	3088	2561	6184	15110	13153	87.0	29580	0.41
1124-056	2525-2540	2761	2639	9130	8952	17634	41116	38355	93.3	48391	0.51
1124-058	2555-2570	1580	936	2703	2072	5422	12713	11133	87.6	25570	0.38
1124-060	2585-2600	1924	880	2462	1576	4835	11678	9754	83.5	23282	0.33
1124-062	2615-2630	2783	1004	3029	1245	3851	11911	9129	76.6	20264	0.32

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	$\frac{iC_4}{nC_4}$
1124-064	2645-2660	1424	533	1559	779	2243	6538	5114	78.2	10175	0.35
1124-066	2675-2690	3060	812	2524	1097	3273	10766	7706	71.6	15923	0.34
1124-068	2705-2720	401	135	363	230	718	1847	1446	78.3	6532	0.32
1124-070	2735-2750	1560	434	996	436	1081	4507	2947	65.4	4031	0.40
1124-072	2765-2780	96	57	179	119	500	950	854	89.9	7087	0.24
1124-074	2795-2810	804	330	1096	432	1380	4043	3238	80.1	4275	0.31
1124-076	2825-2840	1111	777	2120	1565	4649	10222	9111	89.1	18975	0.34
1124-078	2855-2870	1402	801	2722	1344	4358	10627	9225	86.8	15058	0.31
1124-080	2885-2900	1703	942	3427	2005	6791	14868	13165	88.5	25976	0.30
1124-082	2915-2930	628	444	1837	1330	3982	8220	7592	92.4	18689	0.33
1124-084	2945-2960	104	78	284	134	539	1140	1036	90.8	3323	0.25
1124-086	2975-2990	534	257	763	274	663	2491	1957	78.6	1737	0.41
1124-088	3020-3035	718	411	952	279	605	2965	2247	75.8	2244	0.46
1124-090	3050-3065	312	290	835	198	488	2123	1811	85.3	956	0.41
1124-092	3080-3095	296	162	299	81	147	986	689	69.9	281	0.55
1124-094	3110-3125	130	82	282	68	216	778	648	83.3	817	0.31
1124-096	3140-3155	1684	328	887	334	953	4186	2502	59.8	2315	0.35
1124-098	3170-3185	1295	101	121	29	119	1664	369	22.2	350	0.24
1124-100	3200-3215	3268	365	398	116	322	4468	1201	26.9	994	0.36
1124-102	3230-3245	444	159	481	133	449	1666	1222	73.3	1391	0.30
1124-104	3260-3275	246	315	601	126	246	1534	1288	84.0	425	0.51
1124-106	3290-3305	342	334	530	91	154	1451	1108	76.4	355	0.59
1124-108	3320-3335	248	357	804	134	251	1795	1546	86.2	894	0.53
1124-110	3350-3365	1167	961	1701	361	695	4885	3718	76.1	2207	0.52
1124-112	3380-3390	865	566	983	181	267	2863	1998	69.8	1601	0.68
1124-114	3405-3420	2898	320	638	123	187	4166	1269	30.5	933	0.66
1124-116	3435-3450	826	509	1055	220	520	3130	2304	73.6	1670	0.42
1124-118	3465-3480	1887	447	619	179	603	3735	1848	49.5	3769	0.30
1124-120	3495-3510	3936	1932	3402	2422	7911	19603	15667	79.9	34738	0.31
1124-122	3520-3535	3314	1121	1264	556	1527	7781	4467	57.4	17183	0.36

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	$\frac{iC_4}{nC_4}$
1124-124	3550-3565	1518	271	239	68	237	2333	815	34.9	4484	0.29
1124-126	3580-3595	1332	160	161	47	151	1851	519	28.1	2308	0.31
1124-128	3610-3625	1781	178	116	22	80	2177	395	18.2	1522	0.27
1124-130	3640-3655	3104	138	77	18	63	3400	296	8.7	1350	0.28
1124-132	3670-3685	905	515	848	153	392	2813	1908	67.8	1438	0.39
1124-134	3700-3715	1107	1430	3141	902	2408	8987	7880	87.7	9047	0.37
1124-135	3715-3730	3762	1516	5791	3784	11661	26514	22753	85.8	33082	0.32
1124-136	3730-3745	1278	305	1788	929	3781	8079	6802	84.2	19424	0.25
1124-137	3745-3760	1107	1122	3184	950	3370	9732	8625	88.6	8085	0.28
1124-138	3760-3775	1356	1317	2802	1405	4347	11226	9870	87.9	16613	0.32
1124-139	3775-3790	4572	6142	10062	6604	16257	43637	39065	89.5	32630	0.41
1124-140	3790-3802	4916	6040	9710	7122	15926	43714	38799	88.8	33894	0.45
1124-141	3800-3815	3533	5168	9216	4435	14562	36914	33381	90.4	32348	0.30
1124-142	3815-3830	4791	6382	9880	6225	15440	42718	37927	88.8	30353	0.40
1124-143	3830-3845	5611	6364	9473	4955	14283	40687	35075	86.2	23216	0.35
1124-144	3845-3860	3887	4372	7965	5036	13785	35045	31157	88.9	34645	0.37
1124-145	3860-3875	4483	3731	8301	3167	12185	31868	27385	85.9	32577	0.26
1124-146	3875-3890	2830	2462	6788	3234	12055	27369	24539	89.7	34196	0.27
1124-147	3890-3905	4866	3802	8761	5287	15583	38298	33432	87.3	45893	0.34
1124-148	3905-3920	4832	3679	6964	2674	10494	28642	23811	83.1	31351	0.25
1124-149	3920-3935	3839	4872	7685	4289	12302	32986	29147	88.4	27893	0.35
1124-150	3935-3950	7884	5579	8593	5340	13752	41149	33265	80.8	42543	0.39
1124-152	3950-3965	9424	7522	8367	2403	6952	34668	25243	72.8	16975	0.35
1124-155	3965-3980	11120	7564	5994	1095	3237	29011	17890	61.7	7789	0.34
1124-162	3980-3995	13826	9611	9142	2180	5570	40328	26502	65.7	4925	0.39
1124-166	3995-4010	10728	7430	6900	1747	4491	31297	20568	65.7	7939	0.39
1124-168	4010-4025	11142	6940	4469	618	1467	24637	13495	54.8	3274	0.42
1124-170	4025-4040	10913	7146	4776	588	1533	24957	14044	56.3	3711	0.38
1124-171	4040-4055	16770	11862	10653	1753	4710	45748	28978	63.3	8734	0.37
1124-176	4055-4070	17696	10356	7310	1121	1759	38242	20546	53.7	6528	0.64

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	$\frac{iC_4}{nC_4}$
1124-177	4070-4085	15438	9806	5387	973	1587	33191	17753	53.5	10581	0.61
1124-178	4085-4100	7194	5424	5518	1614	3836	23586	16392	69.5	12098	0.42
1124-181	4100-4115	8108	7575	9262	2455	8791	36190	28082	77.6	17505	0.28
1124-182	4115-4130	4705	3114	3584	721	2227	14352	9647	67.2	7199	0.32
1124-183	4130-4145	8646	8020	9640	2486	7674	36467	27821	76.3	15300	0.32
1124-184	4145-4160	3251	2970	4204	956	2817	14198	10947	77.1	7834	0.34
1124-185	4160-4172	4821	4132	5173	1325	3268	18719	13899	74.2	12103	0.41

TABLE 3
KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION	
		TYPES 40%; 10-40%; 10%	REMARKS	RE-WORKED (%)	PARTICLE SIZE	PRESERV-ATION	INDEX	1 – 10 SCALE
1124-003A	1100-1150m	-;W-H-Al-Am;I		-	F-C	F-G	1+	
1124-009A	1400-1450m	W;H-Al;I-Am		10	F-C	F-G	1+	
1124-011A	1500-1550m	W;H-Al;Am-I	differentiation difficult	10	F-M/C	F-G	1+/1+ to 2-	
1124-013A	1600-1650m	W;Al-H;Am-I		10	F-C	F-G	1+/1+ to 2-	
1124-019A	1900-1950m	-;Al-W-H;I-Am		10	F-M/C	P-F	1+ to 2- max	
1124-027A	2090-2105m	-;W-Al-H-I;Am		25	F-M/C	F	1+ to 2-	
1124-038A	2255-2270m	W-I;H;Al-Am	dominant H marginally mature, good H at 2 close to 2-	60	F-M/C	F-G	1+ to 2-/2-(?)	
1124-042A	2315-2330m	W-I;H;Al-Am	H at 2- to 2 and 2	70	F-M	G	2-	
1124-048A	2405-2420m	W-I;-;H-Al-Am	H at 2- to 2 and 2	75	F-M/C	G	2- max(?)	
1124-056A	2525-2540m	W-I;-;H-Al	dominant H at 2- to 2 and 2, trace of	85	M	G	2-	
1124-066A	2675-2690m	W-I;-;H-Al-Am	frequent H at 2- to 2 and 2, minor material at 1+ to 2-	70	F-M	G	2-	
1124-078A	2855-2870m	W;I-H-Al;Am	H at 2- to 2 and 2	65	M	F-G	2-	
1124-086A	2975-2990m	W-I;-;H-Al	H at 2	75	M	G	2+ to 2	
1124-090A	3050-3065m	W-I;-;H-Al	H at 2- to 2	85	M	G	2(?)	
1124-098A	3170-3185m	W-I;-;H-Al-Am	contamination	85	F-M	P-F	2	
1124-106A	3290-3305m	W-I;-;H-Al	caving	75	F-M	G	2	
1124-114A	3405-3420m	W;I;H-Al	H at 2 to 2+ and 2+	75	F-M	G	2	
1124-122A	3520-3535m	W-I;-;Al-H	contamination, H at 2	90	M	F	2 to 2+ max	
1124-130A	3640-3655m	W;I;Al-H-Am	dark, degraded, amorphous-like material believed to be contamination	80	F-M	F	2 to 2+(?)	

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

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

Dominant, Major, Significant, Minor

TABLE 3

KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION	
		TYPES 40%; 10-40%; 10%	REMARKS	RE-WORKED (%)	PARTICLE SIZE	PRESERV-ATION	INDEX	1 – 10 SCALE
1124-136A	3730-3745m	W-I;-;H-Am-Al		60	F-C	F-G	2 to 2+	
1124-139A	3775-3790m	-;Am**-Al**-I-W;H	**includes Al passing to Am	35	M	F	2+	
1124-141B	3800-3815m	-;W-I-Am**-Al;H	differentiation extremely difficult **not prime quality, includes incompletely developed material	-	F-C	P-F	2+(?)	
1124-145A	3860-3875m	W-I;H;Al-Am		-	F-M	G	2+	
1124-147A	3890-3905m	Al;W-I;Am-H	differentiation difficult, sapropelisation	-	F-M	F-G	2+	
1124-151A	3956.70m CORE	W;H-I;-		-	M-C	G	2+ max	
1124-153A	3961.70m CORE#3	-;Am**-W-Al**-I;H	differentiation difficult	-	F-C	F-G	2+ max	
1124-160A	3979.29m CORE#5	W;H;Am-I		-	F-C	F-G	2+(?)	
1124-164A	3991.67m CORE	W;H;I-Am-Al		-	M-C	F-G	2+ to 3-	
1124-167A	4017.40m	W;I-H**-Al**-Am**;-	**includes material passing to amorphous differentiation difficult	-	F-VC	F-G	2+	
1124-170A	4025-4040m	-;W-Am**-Al**-H**-I;-	differentiation difficult **as 167A	-	F-VC	F	3-	
1124-172A	4048.95m CORE	Am**-W;H**-Al**;I	differentiation difficult **as 167A	-	F-C	G	2+	
1124-176B	4055-4070m	W-Am**;-;I-H-Al	H at 3- to 3 and 3 **not prime quality or typically oil-prone	-	F-M	F	3-(?)	
1124-179A	4096.47,52m CORE	W-I;-;H-Am		-	M-C	G	2+ to 3-	

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

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

Dominant, Major, Significant, Minor

TABLE 3

KEROGEN TYPE AND MATURATION

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION					THERMAL MATURATION	
		TYPES 40%; 10-40%; 10%	REMARKS	RE-WORKED (%)	PARTICLE SIZE	PRESERV-ATION	INDEX	1 – 10 SCALE
1124-183B	4130-4145m	W;I-H-Am;Al		-	M	F-G	2+ to 3-	
1124-185A	4160-4172m	W;I-H;Am-Al	H at 3- through 3	-	F-M	F-G	2+ to 3-	

Algal, Amorphous, Herbaceous, Inertinite, Resin, Wood

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

Dominant, Major, Significant, Minor

TABLE 4

VITRINITE REFLECTANCE DATA

GEOCHEM SAMPLE NUMBER	DEPTH	SAMPLE TYPE	AVERAGE REFLECTIVITY Ro (%), (NUMBER OF PARTICLES)			REMARKS
			1	2	3	
1124-003A	1100-150m	WR	0.31(12)	-	-	
1124-005A	1200-250m	WR	0.32(4)	-	-	
1124-009A	1400-450m	WR	0.31(3)	0.75(3)	-	
1124-011A	1500-550m	WR	0.35(3)	-	-	
1124-013A	1600-650m	WR	0.35(2)	-	-	
1124-019A	1900-950m	WR	NO DETERMINATIONS POSSIBLE			
1124-021A	2000-015m	WR	0.78(4)	-	-	
1124-027A	2090-105m	WR	1.24(2)	-	-	
1124-038A	2255-270m	WR	0.34(1)	0.86(7)	-	
1124-042A	2315-330m	WR	1.02(13)	-	-	
1124-048A	2405-420m	WR	0.43(8)	1.00(11)	-	
1124-056A	2525-540m	WR	0.44(6)	1.04(11)	-	
1124-066A	2675-690m	WR	0.44(2)	1.05(20)	-	
1124-078A	2855-870m	WR	0.48(4)	1.02(19)	-	
1124-086A	2975-990m	WR	1.08(20)	-	-	
1124-090A	3050-065m	WR	1.13(23)	-	-	
1124-098A	3170-185m	WR	1.15(3)	-	-	
1124-106A	3290-305m	WR	0.58(4)	1.27(20)	-	
1124-114A	3405-420m	WR	0.63(3)	1.16(13)	-	
1124-122A	3520-535m	WR	1.21(4)	-	-	
1124-130A	3640-655m	WR	1.22(2)	-	-	
1124-136A	3730-745m	WR	0.59(3)	0.74(7)	1.18(12)	
1124-139A	3775-790m	KC	0.93(13)	-	-	
1124-145A	3860-875m	KC	0.95(30)	-	-	
1124-151A CORE	3956.70m	KC	1.00(30)	-	-	
1124-154A CORE #4	3970.30m	WR	0.93(40)	-	-	
1124-160A CORE #5	3979.29m	KC	0.97(40)	-	-	
1124-167A CORE	4017.40m	KC	1.04(30)	-	-	
1124-172A CORE	4048.95m	KC	1.05(40)	-	-	
1124-179A CORE	4096.47m	KC	1.05(30)	-	-	
1124-185A	4160-172m	KC	1.08(30)	-	-	

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	Preciptd. Asphaltenes	Eluted NSO's	Non-eluted NSO's	Sulphur
1124-024	2045-2060	968	519	153	672	117	145	31	3
1124-036	2225-2240	546	224	65	288	166	70	19	2
1124-048	2405-2420	1317	833	164	997	107	159	38	16
1124-056	2525-2540	2386	1760	148	1907	308	130	33	7
1124-078	2855-2870	2199	1260	455	1715	174	255	40	16
1124-106	3290-3305	237	110	37	147	42	37	5	5
1124-120	3495-3510	397	230	51	281	72	43	1	1
1124-137A	3745-3760	997	641	152	792	66	111	20	8
1124-140	3790-3802	3691	1916	1248	3165	178	288	44	16
1124-143A	3830-3845	4332	2575	1025	3600	286	332	78	36
1124-145A	3860-3875	4242	2591	864	3455	278	443	50	16
1124-151A	3956.70	1238	599	270	869	226	95	26	22
1124-153A	3961.70	3221	1720	722	2442	290	390	90	9
1124-155A	3965-3980	829	519	189	708	44	57	7	12
1124-160A	3979.29	2986	415	893	1309	1371	194	50	63
1124-164A	3991.67	763	377	165	542	117	61	16	27
1124-167A	4017.40	991	257	342	598	272	87	25	9
1124-170A	4025-4040	2152	1347	453	1800	151	147	46	8
1124-175A	4051.49	455	288	82	370	27	50	8	0
1124-177	4070-4085	589	312	144	456	55	52	15	12
1124-179A	4096.47	261	114	58	172	50	27	8	4
1124-183B	4130-4145	2989	1427	513	1940	171	657	185	36
1124-185A	4160-4172	1761	896	334	1230	308	170	41	11

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
1124-024	2045-2060	53.59	15.85	12.05	14.99	3.22	0.30
1124-036	2225-2240	40.94	11.86	30.41	12.87	3.51	0.41
1124-048	2405-2420	63.23	12.45	8.15	12.07	2.90	1.20
1124-056	2525-2540	73.75	6.18	12.92	5.46	1.37	0.31
1124-078	2855-2870	57.31	20.67	7.91	11.58	1.80	0.73
1124-106	3290-3305	46.37	15.84	17.66	15.84	2.31	1.98
1124-120	3495-3510	57.88	12.80	18.16	10.72	0.22	0.22
1124-137A	3745-3760	64.23	15.21	6.60	11.17	2.02	0.78
1124-140	3790-3802	51.92	33.82	4.83	7.81	1.18	0.44
1124-143A	3830-3845	59.43	23.66	6.61	7.66	1.81	0.83
1124-145A	3860-3875	61.09	20.36	6.56	10.43	1.18	0.37
1124-151A	3956.70	48.43	21.79	18.25	7.69	2.11	1.74
1124-153A	3961.70	53.39	22.43	9.00	12.11	2.78	0.29
1124-155A	3965-3980	62.63	22.85	5.36	6.88	0.81	1.48
1124-160A	3979.29	13.91	29.91	45.92	6.48	1.67	2.11
1124-164A	3991.67	49.37	21.66	15.33	8.02	2.08	3.53
1124-167A	4017.40	25.90	34.48	27.42	8.75	2.57	0.88
1124-170A	4025-4040	62.61	21.04	7.04	6.82	2.13	0.36
1124-175A	4051.49	63.20	18.06	5.89	10.99	1.86	0.00
1124-177	4070-4085	52.97	24.40	9.27	8.84	2.54	1.99
1124-179A	4096.47	43.63	22.27	19.20	10.45	3.07	1.38
1124-183B	4130-4145	47.74	17.17	5.71	21.99	6.17	1.22
1124-185A	4160-4172	50.91	18.97	17.51	9.66	2.33	0.63

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
1124-024	2045-2060	0.53	69.43	12.68	18.26	3.38
1124-036	2225-2240	0.61	52.81	4.73	8.95	3.45
1124-048	2405-2420	0.67	75.69	14.88	19.66	5.08
1124-056	2525-2540	0.42	79.94	45.42	56.81	11.93
1124-078	2855-2870	0.96	77.98	17.86	22.90	2.77
1124-106	3290-3305	0.58	62.21	2.54	4.08	2.93
1124-120	3495-3510	0.45	70.68	6.24	8.82	4.52
1124-137A	3745-3760	0.63	79.44	12.57	15.83	4.22
1124-140	3790-3802	4.26	85.74	7.43	8.66	1.53
1124-143A	3830-3845	5.08	83.10	7.09	8.53	2.51
1124-145A	3860-3875	2.93	81.46	11.79	14.48	3.00
1124-151A	3956.70	2.97	70.22	2.93	4.17	2.22
1124-153A	3961.70	7.81	75.82	3.13	4.12	2.38
124-155A	3965-3980	2.94	85.48	2.41	2.82	2.74
1124-160A	3979.29	35.90	43.82	0.36	0.83	0.47
1124-164A	3991.67	3.29	71.03	1.65	2.32	2.28
1124-167A	4017.40	16.70	60.38	0.36	0.59	0.75
1124-170A	4025-4040	4.48	83.65	4.02	4.80	2.98
1124-175A	4051.49	1.89	81.26	1.96	2.41	3.50
1124-177	4070-4085	1.40	77.36	3.26	4.21	2.17
1124-179A	4096.47	1.40	65.90	1.23	1.87	1.96
1124-183B	4130-4145	2.95	64.91	6.58	10.13	2.78
1124-185A	4160-4172	2.45	69.88	5.02	7.19	2.68

TABLE 7

ROCKEVAL PYROLYSIS DATA

GEOCHEM SAMPLE NUMBER	DEPTH	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	Production INDEX	Hydrogen INDEX	Oxygen INDEX	Tmax (%C)
1124-001A	1000-1050	0.07	0.52	1.79	0.12	71.2	245.2	418
1124-003A	1100-1150	0.17	2.80	1.23	0.06	186.7	82.0	418
1124-005A	1200-1250	0.12	2.83	1.43	0.04	191.2	96.6	423
1124-007B	1300-1350	0.15	2.31	1.28	0.06	176.3	97.7	426
1124-009A	1400-1450	0.16	1.83	1.18	0.08	141.9	91.5	427
1124-011A	1500-1550	0.12	2.06	1.28	0.06	134.6	83.7	425
1124-013A	1600-1650	0.11	1.86	1.45	0.06	124.8	97.3	428
1124-015B	1700-1750	0.13	1.27	1.38	0.09	87.0	94.5	427
1124-017A	1800-1850	0.07	0.09	0.59	0.44	36.0	236.0	406
1124-019A	1900-1950	0.09	0.21	0.74	0.30	47.7	168.2	425
1124-021A	2000-2015	0.20	0.35	1.15	0.36	57.4	188.5	428
1124-024A	2045-2060	0.10	0.29	1.05	0.26	65.9	238.6	421
1124-027A	2090-2105	0.08	0.18	0.85	0.31	47.4	223.7	423
1124-031A	2150-2165	0.11	0.16	1.27	0.41	59.3	470.4	394
1124-034A	2195-2210	0.06	0.10	0.63	0.38	32.3	203.2	410
1124-036A	2225-2240	0.09	0.17	1.07	0.35	37.8	237.8	420
1124-038A	2255-2270	0.14	0.19	1.27	0.42	45.2	302.4	421
1124-040A	2285-2300	0.13	0.19	1.25	0.41	40.4	266.0	421
1124-042A	2315-2330	0.10	0.29	0.97	0.26	52.7	176.4	386
1124-044A	2345-2360	0.12	0.17	0.71	0.41	34.7	144.9	427
1124-046A	2375-2390	0.11	0.28	0.65	0.28	47.5	110.2	426
1124-048A	2405-2420	0.18	0.55	0.78	0.25	74.3	105.4	425
1124-050A	2435-2450	0.17	0.43	1.18	0.28	60.6	166.2	423
1124-052A	2465-2480	0.10	0.19	1.13	0.34	32.2	191.5	406
1124-054A	2495-2510	0.13	0.33	0.85	0.28	50.8	130.8	371
1124-056A	2525-2540	1.73	1.05	1.13	0.62	161.5	173.8	313
1124-058A	2555-2570	0.38	0.73	0.81	0.34	107.4	119.1	376
1124-060A	2585-2600	0.18	0.55	1.11	0.25	91.7	185.0	434
1124-062A	2615-2630	0.13	0.34	0.80	0.28	64.2	150.9	430
1124-064A	2645-2660	0.11	0.24	0.73	0.31	42.9	130.4	427
1124-066A	2675-2690	0.15	0.34	0.46	0.31	57.6	78.0	428
1124-068A	2705-2720	0.13	0.27	0.49	0.32	47.4	86.0	425
1124-070A	2735-2750	0.14	0.24	0.78	0.37	40.0	130.0	431
1124-072A	2765-2780	0.11	0.32	0.47	0.26	53.3	78.3	428
1124-074A	2795-2810	0.09	0.28	0.45	0.24	47.5	76.3	430
1124-076A	2825-2840	0.15	0.48	0.34	0.24	67.6	47.9	434
1124-078A	2855-2870	0.24	0.82	0.47	0.23	82.8	47.5	436
1124-080A	2885-2900	0.19	0.69	0.59	0.22	77.5	66.3	434
1124-082A	2915-2930	0.20	0.71	0.41	0.22	83.5	48.2	432
1124-084A	2945-2960	0.13	0.42	0.65	0.24	57.5	89.0	434
1124-086A	2975-2990	0.09	0.17	0.98	0.35	28.3	163.3	432
1124-088A	3020-3035	0.11	0.26	0.48	0.30	41.9	77.4	433
1124-090A	3050-3065	0.11	0.24	0.67	0.31	38.7	108.1	432
1124-092A	3080-3095	0.08	0.23	0.84	0.26	37.1	135.5	432
1124-094A	3110-3125	0.11	0.30	0.35	0.27	50.8	59.3	429
1124-096A	3140-3155	0.05	0.08	0.45	0.38	14.0	78.9	431
1124-098A	3170-3185	0.08	0.03	0.38	0.73	4.8	61.3	335
1124-100A	3200-3215	0.08	0.03	0.43	0.73	4.4	63.2	274
1124-102A	3230-3245	0.08	0.23	0.92	0.26	37.1	148.4	432
1124-104A	3260-3275	0.09	0.21	0.80	0.30	30.4	115.9	439

TABLE 7

ROCKEVAL PYROLYSIS DATA

GEOCHEM SAMPLE NUMBER	DEPTH	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	Production INDEX	Hydrogen INDEX	Oxygen INDEX	Tmax (%C)
1124-106A	3290-3305	0.12	0.35	0.56	0.26	43.2	69.1	436
1124-108A	3320-3335	0.07	0.22	0.46	0.24	34.9	73.0	437
1124-110A	3350-3365	0.09	0.27	0.38	0.25	41.5	58.5	437
1124-112A	3380-3390	0.10	0.19	0.98	0.34	29.7	153.1	436
1124-114A	3405-3420	0.10	0.27	0.83	0.27	44.3	136.1	433
1124-116A	3435-3450	0.16	0.26	0.59	0.38	42.6	96.7	434
1124-118A	3465-3480	0.08	0.11	0.39	0.42	26.8	95.1	442
1124-120A	3495-3510	0.09	0.12	0.84	0.43	36.4	254.5	452
1124-122A	3520-3535	0.09	0.02	0.63	0.82	5.1	161.5	457
1124-124A	3550-3565	0.07	0.05	0.70	0.58	15.2	212.1	389
1124-126A	3580-3595	0.07	0.06	0.77	0.54	14.6	187.8	323
1124-128A	3610-3625	0.08	0.04	0.43	0.67	8.5	91.5	274
1124-130A	3640-3655	0.07	0.05	0.48	0.58	7.7	73.8	333
1124-132A	3670-3685	0.08	0.25	0.56	0.24	36.8	82.4	442
1124-134B	3700-3715	0.09	0.41	0.40	0.18	46.1	44.9	445
1124-135A	3715-3730	0.10	0.45	0.75	0.18	52.9	88.2	440
1124-136A	3730-3745	0.16	0.43	0.82	0.27	48.9	93.2	439
1124-136B	3730-3745	0.02	0.07	1.20	0.22	20.6	352.9	422
1124-137A	3745-3760	0.09	0.25	0.56	0.26	41.0	91.8	443
1124-138A	3760-3775	0.15	0.62	0.49	0.19	72.1	57.0	444
1124-139A	3775-3790	1.81	7.81	0.90	0.19	173.6	20.0	447
1124-140A	3790-3802	2.69	7.55	1.13	0.26	161.0	24.1	444
1124-141B	3800-3815	2.41	9.61	2.25	0.20	176.3	41.3	450
1124-142A	3815-3830	3.23	7.56	1.33	0.30	160.2	28.2	449
1124-143A	3830-3845	2.26	4.69	1.64	0.33	90.7	31.7	453
1124-144A	3845-3860	1.75	4.35	1.29	0.29	96.9	28.7	453
1124-145A	3860-3875	1.04	3.49	1.10	0.23	101.5	32.0	455
1124-146A	3875-3890	1.26	3.80	0.95	0.25	169.6	42.4	449
1124-147A	3890-3905	0.94	2.82	0.91	0.25	134.3	43.3	450
1124-148A	3905-3920	1.48	4.38	1.00	0.25	140.8	32.2	449
1124-149A	3920-3935	1.17	4.05	0.88	0.22	136.8	29.7	451
1124-150B	3935-3950	1.34	4.65	0.68	0.22	165.5	24.2	452
1124-152A	3950-3965	1.57	5.20	0.62	0.23	173.3	20.7	451
1124-151A	3956.70	0.55	2.50	0.57	0.18	93.6	21.3	460
1124-153A	3961.70	2.50	22.50	2.06	0.10	170.5	15.6	464
1124-155A	3965-3980	2.11	7.74	1.13	0.21	183.0	26.7	451
1124-154A	3970.30	8.43	167.30	5.30	0.05	215.0	6.8	458
1124-156A	3976.17	11.80	159.18	5.00	0.07	194.6	6.1	460
1124-157A	3976.46	4.35	80.61	2.90	0.05	189.2	6.8	462
1124-158A	3977.22	5.00	87.08	3.80	0.05	174.9	7.6	463
1124-159A	3979.05	0.18	1.25	0.37	0.13	72.3	21.4	464
1124-160A	3979.29	3.55	124.37	3.55	0.03	261.8	7.5	457
1124-162A	3980-3995	1.29	4.60	0.50	0.22	150.8	16.4	449
1124-161A	3984.80	5.15	124.61	4.07	0.04	256.9	8.4	457
1124-163A	3990.31	0.43	1.86	0.47	0.19	67.1	17.0	468
1124-164A	3991.67	0.88	5.70	0.44	0.13	135.7	10.5	465
1124-166A	3995-4010	1.11	3.91	0.49	0.22	129.5	16.2	455
1124-165A	3995.63	0.10	0.70	0.34	0.13	58.3	28.3	462
1124-168A	4010-4025	1.48	6.58	0.62	0.18	164.1	15.5	451
1124-167A	4017.40	1.73	15.45	2.14	0.10	108.0	15.0	471

TABLE 7

ROCKEVAL PYROLYSIS DATA

GEOCHEM SAMPLE NUMBER	DEPTH	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	Production INDEX	Hydrogen INDEX	Oxygen INDEX	Tmax (%C)
1124-170A	4025-4040	2.01	8.50	0.65	0.19	156.0	11.9	457
1124-170B	4025-4040	0.24	0.92	0.52	0.21	72.4	40.9	460
1124-169A	4030.79	0.13	1.11	0.38	0.10	89.5	30.6	462
1124-171A	4040-4055	1.71	6.05	0.68	0.22	72.5	8.2	459
1124-171B	4040-4055	0.33	1.07	0.34	0.24	84.9	27.0	459
1124-172A	4048.95	3.82	63.57	2.27	0.06	179.6	6.4	464
1124-173A	4049.39	2.67	74.82	3.30	0.03	160.6	7.1	467
1124-174A	4051.35	0.12	0.73	0.63	0.14	77.7	67.0	449
1124-175A	4051.49	0.61	3.07	1.08	0.17	146.9	51.7	461
1124-176B	4055-4070	2.60	13.04	0.88	0.17	139.3	9.4	461
1124-177B	4070-4085	1.46	6.85	0.44	0.18	150.2	9.6	461
1124-178B	4085-4100	1.39	5.12	0.54	0.21	144.2	15.2	457
1124-179A	4096.47	0.31	1.28	0.39	0.19	61.2	18.7	466
1124-180A	4097.79	0.16	0.70	0.58	0.19	50.0	41.4	466
1124-182B	4115-4130	1.26	3.73	0.41	0.25	121.1	13.3	456
1124-183B	4130-4145	2.02	5.69	0.48	0.26	169.3	14.3	451
1124-184B	4145-4160	0.55	1.31	0.71	0.30	85.1	46.1	452
1124-185A	4160-4172	0.39	0.67	0.62	0.37	62.0	57.4	450

TABLE 8

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

GEOCHEM SAMPLE NUMBER	-024	-036	-048	-056	-078	-106	-120
DEPTH	2045-2060m	2225-2240m	2405-2420m	2525-2540m	2855-2870m	3290-3305m	3495-3510m
SAMPLE TYPE							
nC_{15}	7.48	2.08	6.42	19.96	4.01	4.37	5.70
nC_{16}	8.86	5.43	9.64	19.64	5.53	8.22	8.12
nC_{17}	9.11	7.00	9.54	18.70	7.01	10.33	9.14
nC_{18}	8.41	7.84	8.55	11.53	7.53	9.91	9.08
nC_{19}	7.77	8.28	9.00	8.67	8.20	9.06	9.84
nC_{20}	6.72	6.92	6.41	5.36	7.45	6.50	9.04
nC_{21}	6.41	6.14	5.96	3.31	6.28	5.23	6.84
nC_{22}	6.96	6.24	5.39	2.51	7.15	5.46	7.03
nC_{23}	5.34	6.13	4.25	2.03	6.84	4.76	5.97
nC_{24}	5.40	6.95	4.46	1.82	5.95	5.12	5.56
nC_{25}	4.82	6.26	3.96	1.54	6.13	4.78	4.75
nC_{26}	4.17	4.42	2.83	1.11	5.22	4.37	3.66
nC_{27}	3.50	4.60	3.13	0.74	3.97	4.11	2.69
nC_{28}	2.97	5.09	3.35	0.71	3.61	4.97	2.32
nC_{29}	3.15	4.75	4.00	0.55	3.69	3.04	2.14
nC_{30}	2.17	2.59	2.86	0.32	2.46	1.93	1.67
nC_{31}	1.82	2.26	2.33	0.32	2.24	1.96	1.60
nC_{32}	1.23	2.00	1.13	0.25	2.05	1.62	1.15
nC_{33}	1.37	1.94	2.01	0.26	1.77	1.50	1.35
nC_{34}	1.37	1.32	2.35	0.26	1.64	1.89	1.32
nC_{35}	0.94	1.78	2.44	0.22	1.26	0.83	1.03
PARAFFIN	19.31	20.07	21.18	24.17	24.09	19.40	20.97
ISOPRENOID	1.90	2.54	1.69	3.89	2.28	1.91	2.08
NAPHTHENE	78.79	77.39	77.13	71.95	73.63	78.69	76.95
CPI INDEX A	0.95	0.98	0.99	0.97	0.98	0.91	0.95
CPI INDEX B	1.08	1.10	1.16	1.06	1.07	0.96	1.06
PRISTANE/PHYTANE	1.74	0.53	1.57	2.37	1.47	1.46	1.34
PRISTANE/nC_{17}	0.69	0.62	0.51	0.61	0.80	0.57	0.62

TABLE 8

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

GEOCHEM SAMPLE NUMBER	-137A	-140	-143A	-145A	-151A	-153A	-155A
DEPTH	3745-3760m	3790-3802m	3830-3845m	3860-3875m	3956.70m CORE	3961.70m CORE #3	3965-3980m
SAMPLE TYPE							
nC_{15}	8.57	10.20	11.33	13.40	6.28	7.61	10.54
nC_{16}	10.14	10.03	10.11	13.79	6.94	7.16	11.19
nC_{17}	10.33	9.50	9.48	12.28	7.10	7.47	10.97
nC_{18}	9.71	8.90	8.55	9.18	6.94	7.15	10.05
nC_{19}	6.63	8.96	8.86	8.78	7.56	7.56	9.29
nC_{20}	7.12	7.65	6.84	5.53	6.86	7.13	7.45
nC_{21}	5.65	6.42	5.80	4.76	6.97	6.43	6.22
nC_{22}	5.43	5.89	5.45	4.47	7.17	6.13	6.13
nC_{23}	4.74	4.51	5.74	4.68	7.08	6.76	5.90
nC_{24}	4.48	5.53	4.84	3.58	6.93	6.48	4.18
nC_{25}	4.91	2.89	4.47	3.28	6.63	6.04	4.18
nC_{26}	4.47	3.05	4.27	2.32	5.24	4.99	3.95
nC_{27}	2.90	2.85	3.21	1.99	4.76	4.32	3.05
nC_{28}	2.78	1.96	2.56	3.82	3.43	3.41	1.79
nC_{29}	1.92	1.85	2.12	1.61	3.04	2.91	1.49
nC_{30}	1.47	1.29	1.51	1.17	1.95	2.07	1.17
nC_{31}	1.23	0.97	1.25	1.04	1.67	1.55	1.02
nC_{32}	1.08	0.86	0.88	0.81	0.94	1.15	0.74
nC_{33}	1.23	1.18	1.13	1.67	1.16	1.51	1.02
nC_{34}	1.22	3.01	0.99	1.11	0.811	1.56	0.90
nC_{35}	0.99	2.49	0.58	0.73	0.58	0.61	0.69
PARAFFIN	14.24	16.54	20.16	22.82	43.23	37.83	18.96
ISOPRENOID	2.01	1.76	2.12	1.80	2.40	1.88	1.75
NAPHTHENE	83.75	81.70	77.72	75.37	54.37	60.29	79.29
CPI INDEX A	0.95	0.88	1.01	0.98	1.04	1.04	1.05
CPI INDEX B	0.97	0.96	1.02	0.85	1.16	1.07	1.07
PRISTANE/PHYTANE	1.81	1.71	2.19	2.48	3.09	3.24	2.05
PRISTANE/nC_{17}	0.88	0.71	0.76	0.46	0.59	0.51	0.56

TABLE 8

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

GEOCHEM SAMPLE NUMBER	-160A	-164A	-167A	-170A	-175A	-177	-179A
DEPTH	3979.29m CORE #5	3991.67m CORE	4017.40m CORE	4025-4040m	4051.49m CORE	4070-4085m	4096.47m CORE
SAMPLE TYPE							
nC_{15}	15.85	8.99	8.44	11.06	4.79	6.98	6.05
nC_{16}	12.53	9.80	9.45	10.87	6.71	9.77	8.06
nC_{17}	9.02	9.92	9.04	11.42	7.87	11.49	8.67
nC_{18}	8.20	9.90	9.83	8.86	8.39	11.54	9.29
nC_{19}	8.17	9.55	9.93	8.68	8.64	11.43	9.01
nC_{20}	6.24	7.77	8.35	6.54	8.49	8.30	7.57
nC_{21}	5.25	7.34	7.67	5.97	8.01	6.36	6.73
nC_{22}	4.85	6.65	6.87	5.11	7.73	5.92	6.38
nC_{23}	4.08	5.93	6.08	5.88	7.39	3.98	6.26
nC_{24}	4.85	5.37	5.76	5.67	6.54	4.33	5.52
nC_{25}	3.92	4.72	4.53	4.55	6.15	3.63	4.84
nC_{26}	3.83	3.22	3.41	3.17	4.55	3.47	4.03
nC_{27}	2.44	2.82	2.69	2.46	4.10	2.14	3.64
nC_{28}	2.49	2.06	1.83	2.37	2.77	4.41	3.05
nC_{29}	1.60	1.74	1.51	1.62	2.34	1.50	3.18
nC_{30}	1.48	1.14	1.09	1.18	1.44	1.07	2.08
nC_{31}	0.88	0.91	0.83	1.00	1.24	0.89	1.66
nC_{32}	0.74	0.61	0.47	0.91	0.81	0.64	1.32
nC_{33}	1.64	0.73	1.14	1.11	0.82	0.82	0.89
nC_{34}	1.62	0.50	0.91	0.98	0.71	0.71	1.13
nC_{35}	0.31	0.33	0.18	0.61	0.54	0.62	0.65
PARAFFIN	12.35	39.97	33.08	18.52	48.93	17.37	31.11
ISOPRENOID	0.87	2.16	2.03	1.64	1.18	2.06	1.47
NAPHTHENE	86.78	57.86	64.89	79.84	49.88	80.58	67.42
CPI INDEX A	0.89	1.05	1.02	1.04	1.06	0.81	1.02
CPI INDEX B	0.87	1.16	1.10	1.02	1.17	0.73	1.09
PRISTANE/PHYTANE	2.22	3.15	2.97	3.15	2.44	1.65	2.41
PRISTANE/nC_{17}	0.54	0.41	0.51	0.59	0.22	0.64	0.38

TABLE 8

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

GEOCHEM SAMPLE NUMBER	-183B	-185A
DEPTH	4130-4145m	4160-4172m
SAMPLE TYPE		
nC_{15}	11.65	12.39
nC_{16}	11.00	12.17
nC_{17}	9.20	10.05
nC_{18}	9.11	9.42
nC_{19}	8.86	8.68
nC_{20}	6.70	7.49
nC_{21}	5.89	5.20
nC_{22}	6.08	5.22
nC_{23}	5.41	4.18
nC_{24}	4.49	4.91
nC_{25}	3.92	3.90
nC_{26}	3.41	2.68
nC_{27}	3.26	2.62
nC_{28}	2.59	2.48
nC_{29}	2.06	1.88
nC_{30}	1.66	1.44
nC_{31}	1.22	1.15
nC_{32}	0.87	0.73
nC_{33}	1.02	1.21
nC_{34}	0.96	1.30
nC_{35}	0.64	0.92
PARAFFIN	16.28	18.28
ISOPRENOID	1.25	1.31
NAPHTHENE	82.47	80.41
CPI INDEX A	1.00	0.91
CPI INDEX B	1.04	1.07
PRISTANE/PHYTANE	1.62	1.97
PRISTANE/nC_{17}	0.52	0.48

TABLE 9

COMPOSITION (NORMALISED %) OF C_{15+} AROMATIC HYDROCARBONS

- DIBENZOTHIOPHENE SERIES

GEOCHEM SAMPLE NUMBER	DEPTH	DIBENZOTHIOPHENE (M/Z 184)	METHYL DIBENZOTHIOPHENE (M/Z 198)	DIMETHYL DIBENZOTHIOPHENE (M/Z 212)
1124-048	2405-420m	25.1	42.4	32.5
1124-078	2855-870m	30.1	43.2	26.7
1124-140	3790-802m	9.4	38.9	51.7
1124-143A	3830-845m	10.3	40.0	49.7
1124-145A	3860-875m	18.6	47.4	34.0
1124-151A CORE	3956.70m	13.2	42.9	43.8
1124-153A CORE #3	3961.70m	20.5	44.5	35.0
1124-155A	3965-980m	7.0	36.5	56.5
1124-164A CORE	3991.67m	18.8	45.7	35.5
11240167A CORE	4017.40m	19.1	44.9	36.0
1124-170A	4025-040m	12.0	41.7	46.3
1124-175A CORE	4051.49m	22.2	45.0	32.8
1124-177	4070-085m	14.2	38.7	47.1
1124-183B	4130-145m	22.2	39.1	38.8
1124-185A	4160-172m	15.1	39.8	45.1

TABLE 10

COMPOSITION (NORMALISED %) OF C_{15+} AROMATIC HYDROCARBONS

-PHENANTHRENE SERIES

GEOCHEM SAMPLE NUMBER	DEPTH	PHENANTHRENE (M/Z 178)	METHYL PHENANTHRENE (M/Z 192)	DIMETHYL PHENANTHRENE (M/Z 206)	TRIMETHYL PHENANTHRENE (M/Z 220)
1124-048	2405-420m	27.7	40.5	22.6	9.2
1124-078	2855-870m	33.9	41.0	17.5	7.6
1124-140	3790-802m	15.9	41.1	30.4	12.6
1124-143A	3830-845m	19.5	39.0	29.0	12.5
1124-145A	3860-875m	24.2	48.4	21.9	5.5
1124-151A CORE	3956.70m	14.3	43.7	30.8	11.2
1124-153A CORE #3	3961.70m	33.1	41.0	20.5	5.4
1124-155A	3965-980m	1.0	38.0	34.9	18.1
1124-164A CORE	3991.67m	18.1	42.4	28.5	11.0
1124-167A CORE	4017.40m	12.0	41.5	33.6	12.9
1124-170A	4025-040m	11.8	39.1	33.0	16.1
1124-175A CORE	4051.49m	24.1	41.9	25.4	8.6
1124-177	4070-085m	12.1	39.4	32.7	15.8
1124-183B	4130-145m	25.9	39.5	25.7	8.9
1124-185A	4160-172m	14.3	40.1	31.3	14.3

TABLE 11

METHYL PHENANTHRENE INDEX

GEOCHEM SAMPLE NUMBER	DEPTH	% AREA	% HEIGHT
1124-024	2045-060m	0.54	0.59
1124-036	2225-240m	0.53	0.56
1124-048	2405-420m	0.54	0.51
1124-056	2525-540m	0.48	0.46
1124-078	2855-870m	0.54	0.56
1124-106	3290-305m	0.60	0.60
1124-120	2395-510m	0.69	0.71
1124-137A	3745-760m	0.60	0.62
1124-140	3790-802m	0.61	0.62
1124-143A	3830-845m	0.62	0.67
1124-145A	3860-875m	0.65	0.71
1124-151A CORE	3956.70m	0.78	0.83
1124-153A CORE #3	3961.70m	0.80	0.83
1124-155A	3965-980m	0.65	0.67
1124-160A CORE #5	3979.29m	0.82	0.85
1124-164A CORE	3991.67m	0.82	0.87
1124-167A CORE	4017.40m	0.85	0.92
1124-170	4025-040m	0.72	0.81
1124-175A CORE	4051.49m	0.95	0.99
1124-177	4070-085m	0.77	0.81
1124-179A CORE	4096.47m	0.93	0.93
1124-183B	4130-145m	0.69	0.72
1124-185A	4160-172m	0.70	0.76

TABLE 12

MOLECULAR MATURATION PARAMETERS

GEOCHEM SAMPLE NO.	DEPTH	STERANES M/Z 217 (259)			TERPANES M/Z 191				
		C_{29} 20S (αα) / C_{29} 20R (αα)	C_{29} 20R (ββ) / C_{29} 20R (αα)	C_{27} (20S) Diasteranes / C_{27} (20R) Diasteranes	Tm / Ts	C_{30} Moretane / C_{30} Hopane	C_{29} normoretane / C_{29} norhopane + C_{29} normoretane	Bisnorhopane (C_{28}) / Tm + Bisnorhopane + C_{29} norhopane	C_{31} (20S) / C_{31} (20S) + C_{31} (20R) x 100
1124-048	2405-420m	0.67	1.04	1.63	1.13	0.19	0.21	0.13	55%
1124-078	2855-870m	0.88	1.34	1.71	1.77	0.17	0.20	0.08	59%
1124-140	3790-802m	1.34	2.17	1.38	0.51	0.15	0.10	0.24	-
1124-143	3830-845m	1.20	2.20	1.73	0.68	0.12	0.03	0.22	50%
1124-145	3860-875m	1.37	3.12	1.71	0.67	0.12	0.10	0.25	57%
1124-151A	3956.70m	0.76	1.88	1.81	1.54	0.16	0.12	0.25	48%
1124-153 CORE #3	3961.70m	0.84	1.76	1.67	1.04	0.15	0.13	0.23	59%
1124-155	3965-980m	0.94	1.81	1.73	0.81	0.14	0.14	0.16	58%
1124-164 CORE	3991.67m	0.64	1.48	1.68	0.74	0.15	0.08	0.24	56%
1124-167 CORE	4017.40m	1.12	1.64	1.84	1.40	0.15	0.29	0.23	59%
1124-170	4025-040m	0.58	0.81	1.59	1.10	0.21	0.18	0.09	55%
1124-175 CORE	4051.49m	0.51	1.15	2.02	1.37	0.15	0.15	0.08	56%
1124-177	4070-085m	0.74	1.19	1.57	1.10	0.14	0.15	0.07	57%
1124-183B	4130-145m	0.73	1.60	1.51	0.77	0.13	0.11	0.16	56%
1124-185A	4160-172m	0.95	1.52	1.70	0.83	0.13	0.14	0.16	56%

TABLE 13

GOGI INDEX

GEOCHEM SAMPLE NUMBER	DEPTH	C_1	C_2-C_5	C_6-C_{14}	C_{15+}
1124-003A	1100-150m	13.62	20.71	57.34	8.33
1124-007B	1300-350m	14.66	28.90	56.44	0
1124-048A	2405-420m	23.16	39.50	37.34	0
1124-078A	2855-870m	27.14	28.57	43.78	0.51
1124-106A	3290-305m	26.99	36.15	36.86	0
1124-139A	3775-790m	14.16	19.41	52.82	13.61
1124-141B	3800-815m	19.70	20.47	50.20	9.63
1124-143A	3830-845m	23.57	16.78	46.58	13.06
1124-145A	3860-875m	28.60	22.99	43.00	5.41
1124-151A CORE	3956.70m	44.06	22.00	32.36	1.57
1124-153A CORE #3	3961.70m	36.66	12.08	37.80	13.46
1124-154A CORE #4	3970.30m	38.13	14.17	34.97	12.73
1124-160A CORE #5	3979.29m	38.88	13.67	30.36	17.09
1124-164A CORE	3991.67m	35.22	17.16	43.96	3.65
1124-167A CORE	4017.40m	8.75	17.45	45.51	27.99
1124-172A CORE	4048.95m	42.52	14.59	36.87	6.03
1124-175A CORE	4051.49m	28.42	26.38	40.63	4.58
1124-179A	4096.47m	46.30	23.01	30.24	0.44

TABLE 14

CARBON ISOTOPE RESULTS

$^{o}/oo$ PDB

GEOCHEM SAMPLE NUMBER	DEPTH	PARAFFIN-NAPHTHENE	AROMATICS	TOTAL EXTRACT
1124-048	2405-420m	-28.90	-28.20	-28.55
1124-078A	2855-870m	-29.04	-27.99	-28.52
1124-140	3790-802m	-29.26	-27.85	-28.50
1124-143A	3830-845m	-27.11	-25.55	-26.31
1124-145A	3860-875m	-27.20	-25.87	-26.53
1124-151A CORE	3956.70m	-27.03	-24.99	-25.67
1124-153A CORE #3	3961.70m	-26.93	-25.08	-25.49
1124-155A	3965-980m	-27.50	-26.41	-26.93
1124-164A CORE	3991.67m	-26.77	-25.15	-25.77
1124-167A CORE	4017.40m	-26.56	-25.11	-25.22
1124-170A	4025-040m	-27.15	-25.47	-26.77
1124-175A CORE	4051.49m	-30.49	-25.88	-29.23
1124-177	4070-085m	-27.70	-26.57	-27.03
1124-183B	4130-145m	-27.64	-26.35	-27.04
1124-185A	4160-172m	-27.76	-26.35	-27.07

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

The analysis involves the gas chromatographic separation of the individual 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) <u>ORGANIC CARBON ANLYSIS</u>

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) <u>MINI-PYROLYSIS</u>

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) <u>DETAILED C_4-C_7 HYDROCARBON ANALYSIS</u>

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 present 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) <u>KEROGEN TYPE AND MATURATION</u>

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 <u>directly</u> 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 the 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 oranic 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, 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 rocks 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 than1) 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:

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

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

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 pyrolysate. PYROLYSIS also provides the above together with the temperature of peak pyrolysate evolution. The capillary chromatograms of the pyrolysate obtained by PYROLYSIS-GC are reproduced in the report. The Mini-Pyrolysis analysis is recommended as a screening technique.

L) <u>CORRELATION STUDY ANALYSES</u>

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_{4+} 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 determining the reservoir history of a crude and of evaluating whether adjacent traps will or will not be prospective for oil. In carbonate sections, where organic matter is sometimes sparse, this technique is also used to evaluate thermal maturation levels.

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

N) CRUDE OIL ANALYSIS

N-1) API GRAVITY

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

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

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

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

N-5) FRACTIONAL DISTILLATION

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