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GEOCHEMICAL SERVICE REPORT

Prepared for
NORSK HYDRO A.S.

GEOCHEMICAL EVALUATION OF NORSK HYDRO'S 30/7-3 WELL, NORWEGIAN NORTH SEA

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GEOCHEMICAL EVALUATION OF NORSK HYDRO'S 30/7-3 WELL, NORWEGIAN NORTH SEA

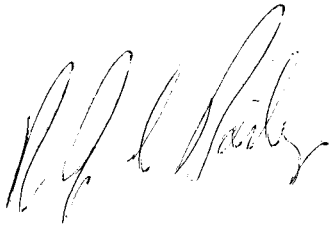
SUMMARY

Six (6) geochemical zones are recognised in the section between 1820 metres and 4040 metres in Norsk Hydro's 30/7-3.

Zones A (1820-2100± metres) and B (2100-2600± metres) are potentially fair source rocks for oil and gas. On structure however, Zone A and the upper two hundred metres of Zone B are immature and of no exploration interest. The remainder of Zone B is generating minor volumes of young oil or condensate.

The rest of the section has a primary potential for gas and associated oil. Zones C (2600-3675± metres) and D (3675-3875± metres) have fair and poor potentials respectively, but are immature; Zones E (3875-4025± metres) and F (4025-4040± metres) are marginally mature and are potentially fair to good and fair sources respectively.

Young oils, probably derived from the lateral equivalents of the encompassing shales, are present at 2050-2370± metres in the stringers of siltstone and sandstone, and in the limestones at 3675-3820± metres. The only significant shows are at 2170± metres and 3750± metres. Traces of oil might have invaded the shales at 2925-3075± metres and the limestones (?) and shales at 4015-4035± metres.



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INTRODUCTION

This report presents the results of a geochemical study of the section between 1820 metres and 4040 metres in Norsk Hydro's 30/7-3 Well, drilled in the Norwegian sector of the North Sea.

The study was designed to evaluate the hydrocarbon potential of the source rocks and to detect and characterise migrated crude oil within the reservoir lithologies.

This study was authorised by Mr J P Hopkinson, Norsk Hydro A.S.

A. ANALYTICAL

A total of fifty-eight (58) canned samples were received from the interval 1820 metres to 4040 metres in 30/7-3. A sampling interval of 50 metres was generally employed down to 3800± metres and a ten metre interval below this depth. The can from 3820 metres was found to be empty, whilst the identification was difficult to decipher (rust) on the cans from 2220 metres and 2380 metres. On the basis of the analytical data, it is believed that the latter could be from 3380 metres. These samples were assigned the Geochem job number 119 and sequential sample numbers from -001 to -058.

In washing the samples, a strong smell of diesel was noted at 2520-2900 metres and at 3800 metres. The mud contained 1-4% diesel below 2500± metres (Mr A Saeboe, personal communication).

The samples were screened with the light hydrocarbon (C_1-C_7) and organic carbon analyses. Samples for further analysis were selected on the basis of the screen results. A total of fifty seven light hydrocarbon analyses, one hundred and one organic carbon analyses, sixteen detailed gasoline range analyses, twenty-two extractions with chromatography, twenty-two paraffin-naphthene analyses and twenty visual kerogen analyses were performed.

The data are presented in tables 1 through 7 and graphically in figures 1 through 5. A brief description of the analytical techniques employed in this study is included in the back of the report.

B. GENERAL INFORMATION

Fifteen (15) copies of this report have been forwarded to Mr J P Hopkinson, Norsk Hydro A.S., Oslo. A copy of the data has been retained by Geochem for future consultation with authorised Norsk Hydro personnel.

The glass kerogen slides are included with the reports. Unused washed and bagged sample material will be handled as directed.

The results and interpretations related to this study are regarded as highly confidential and are proprietary to Norsk Hydro A.S.

RESULTS AND INTERPRETATION

This interpretation is concerned with the section between 1820 metres and 4040 metres in Norsk Hydro's 30/7-3 Well. The parameters relevant to the geochemical evaluation of the section will be discussed individually and then synthesised under "Conclusions".

A. ORGANIC GEOCHEMICAL ZONATION

This zonation is based upon the light hydrocarbon (C_1-C_7) data. Six (6) zones are recognised.

Zone A — 1820 metres to 2100± metres, consists of olive grey to medium dark greenish grey shales accompanied by minor silt below 1900± metres.

The abundances of the C_1-C_4 gaseous hydrocarbons tend to fall around 1900 ppm down to 2000± metres but then increase to over 8000 ppm by the bottom of the Zone. These gases are very dry (% C_{2+} in total C_1-C_4) above 2000± metres and, although wetter, are still classified as dry below this depth. The heavier C_5-C_7 hydrocarbons are relatively sparse, increasing with depth from 40 ppm to over 300 ppm.

Zone B — extends from 2100± metres down to 2600± metres. Limestones are developed below 2550± metres but otherwise, this interval is also shaley. Several shale lithologies are present but those which are olive grey and medium grey in colour are dominant. Minor sands are present between 2100± metres and 2370± metres.

Fluorescence was observed in the sandstone at 2170 metres.

Gas abundances average approximately 7500 ppm above 2200± metres but then, with the exception of the richer samples at 2300-2370± metres, run at about 2000 ppm. These gases are significantly wetter than in Zone A, increasing from 36% wet at the top of the Zone to the range 51-64% wet below 2200± metres. This increased wetness is parallelled by the C_5-C_7 abundances. Above 2370± metres, these hydrocarbons range from 1693 ppm up to 4046 ppm and are thus about an order of magnitude more abundant than in Zone A. Only one sample from below 2970± metres exceeds one thousand parts per million but the values are still significantly higher than those of Zone A. The sample from 2380 metres is leaner and drier than the others of Zone B (see Introduction).

The sand-containing samples above 2370± metres are relatively enriched in both the C_1-C_4 gases and in the oil-like gasoline (C_5-C_7) hydrocarbons.

Zone C covers the interval from 2600± metres to 3675± metres. The uppermost sample contains a significant proportion of limestone. With this exception, this entire Zone is composed of medium dark grey to medium grey shales. No fluorescence was observed in the limestone.

Geochemically, Zone C is drier and leaner in the C_5-C_7 hydrocarbons than the sediments above and below. The interval from 2975± metres to 3125± metres contains 7985-12268 ppm of the C_1-C_4 gases. Within the rest of the Zone, the gases vary from 428 ppm up to 2664 ppm but are generally less than 1500 ppm. The gases are however, dry down to 3350± metres (only one sample over 18% wet) and only marginally wet (21-34%) below this depth. Only one sample (3050 metres) contains more than 1165 ppm of the C_5-C_7 hydrocarbons and most of them fall below 720 ppm.

Zone D 3675± metres to 3875± metres. The sample from 3880 metres consists of cement and lost circulation material and hence, the base of this Zone could be ten± metres deeper. There is a significant limestone development at 3725-3805± metres and limestones are present less abundantly from the top of the Zone down to 3820± metres. Medium grey shales constitute most of each sample above 3725± metres and are totally dominant below the limestones. However, the presence of cement in the samples below 3805± metres throws some doubt upon their quality.

Fluorescence was observed in the limestone at 3750 metres.

Geochemically, the sample from 3700 metres is transitional between Zone C and the rest of Zone D. The underlying sample (3750 metres) is both rich (11633 ppm C_1-C_4, 18990 ppm C_5-C_7) and wet (80%) whilst the rest of the section above 3820± metres is also wet (60-61%) and has fairly good abundances (3100-4000 ppm) of the oil-like C_5-C_7 fraction but less than 1000 ppm of the gaseous hydrocarbons. Below 3820± metres, similar C_5-C_7 abundances (2668-5571 ppm) prevail but the gases, although more abundant (decreasing with depth from 2640 ppm to 930 ppm) are only marginally wet.

Zone E lies between 3875± metres and 4025± metres. The sample from 3880 metres consists of cement and lost circulation material and cement is present down to 3920± metres. Otherwise, the samples consist of medium dark grey to medium grey shales (with significant proportions of limestone at 3885-3920± metres) above 3920± metres, underlain by tuffs with minor shale, the proportion of shale tending to increase towards the bottom of the Zone.

No fluorescence was observed in the limestones.

Geochemically, Zone E is rather varied. It is distinguished from Zone D by increased gas dryness and lower C_5-C_7 abundances. Above 4005± metres, the samples contain between 562 ppm and 3586 ppm of the C_1-C_4 gases, but only exceed 2000 ppm below 3965± metres. At the base of the Zone, values increase to 5600-6000 ppm. These gases are commonly dry (17-30%) above 3985± metres but then become marginally wet and, by the bottom of the Zone are wet. In contrast with the overlying sediments, less than 550 ppm of the heavier C_5-C_7 fraction are present, the only exception being the top forty-five metres of the tuffaceous interval.

Zone F extends from 4025± metres to the deepest sample at 4040 metres and consists of dark grey to medium dark grey shales.

The gases are slightly more abundant (6600-7700 ppm) than in Zone E and are wet, although not very wet. However, the C_5-C_7 fraction is an order of magnitude more abundant (2700-7000 ppm).

In summary:

- Zone A is characterised by fair, increasing to fair to good by the bottom of the Zone, contents of dry gas. Gas wetness improves below 2000± metres. The C_5-C_7 hydrocarbons increase with depth but are relatively sparse
- Zone B has fair contents of wet gas. C_5-C_7 abundances are fair above 2370± metres and poor to fair below this depth. Minor sands are present above 2370± metres. The best gas values are at the top of the Zone.
- the shales of Zone C have poor to fair or fair contents of gas which is dry above 3350± metres and marginally wet below this depth. The interval at 2975-3125± metres however, has good abundances of dry gas.

- within Zone D, limestones are present down to 3820± metres. The sample from 3750 metres is particularly rich and wet, but all of the limestone-containing samples are wet, although with only fair C5-C7 contents. Below this depth, hydrocarbon contents are fair but the gases are only marginally wet.
- the shales and tuffs of Zone E have poor to fair contents of dry gas. There is an improvement as the proportion of shale increases towards the bottom of the tuffaceous interval and below 4005± metres, the sediments have fair contents of marginally wet to wet gas.
- Zone F has fair values of wet gas and fair C5-C7 abundances (particularly at 4030 metres).
- fluorescence is present in the sand at 2170 metres and in the limestone at 3750 metres.
- the only really rich samples are at 3100 metres and 3750 metres; the latter is also the only very wet sample
- these lithologic descriptions refer to the samples as received.

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 per cent organic carbon and this is the standard to which these samples will be compared.

Organic matter type influences not only the hydrocarbon richness of the sediments but also the character of the hydrocarbon product (oil,gas) and the response of the organic matter to thermal maturation. Oil proneness decreases in the order amorphous-herbaceous-stem-woody. Wood is largely gas prone whilst coaly material has a strictly limited potential for hydrocarbons.

The shales of Zones A through C are of relatively constant richness, falling within the general ranges 0.30-0.79%, 0.27-0.71% and 0.40-0.70% organic carbon respectively. Most of the samples throughout this interval contain in excess of 0.45% organic carbon. The chief exceptions to the general ranges quoted above are the minor brownish grey shales at 2100-2200± metres with 0.12-0.23% organic carbon and the medium light grey shales at 2450-2600± metres (0.17-0.20% organic carbon) and 3125-3275± metres (0.08-0.31% organic carbon). All of these shales are of below-average organic richness and would be generally rated as "fair" although the minor dark olive grey shale at 2320 metres has a good content of 1.27% organic carbon.

This homogeneity is not, however, reflected in the type of organic matter present within the sediments. Herbaceous material tends to be dominant in Zones A and B, but is accompanied by significant proportions of amorphous, woody and stem kerogens. Particularly

within Zone A, amorphous kerogen is being developed from the herbaceous debris and, in some intervals, is the dominant form. In contrast, Zone C is characterised by coaly, or coaly or woody material. Herbaceous debris varies from a minor to a significant role while amorphous kerogen is absent.

Zone D is leaner than the overlying sediments. Only three of the analysed samples exceeding 0.51% organic carbon (general range 0.30-0.51%). It is rated as poor. The organic matter within this interval resembles that of Zone C.

The uppermost twenty metres and the bottom ten metres of Zone E contain less than one half of one per cent organic carbon. However, in general, the shales and tuffaceous shales of this interval are of below-average to average richness, the shales containing 0.71-1.05% organic carbon (1.37% at 3980 feet) and the tuffaceous shales, above 3985± metres, 0.66-1.18% organic carbon (2.03% at 3950 metres). The ranges of values for both sediment types are comparable. Within Zone F, the shales are of similar richness (0.50-0.71% organic carbon) to those of Zone C.

Coaly, or coaly and woody, organic matter is very dominant throughout Zones E and F. Herbaceous debris is only a minor constituent whilst amorphous kerogen is absent.

In summary:

- Zones A and B have poor to fair or fair contents of organic matter which contains a high proportion of herbaceous, amorphous and stem kerogens with a good potential for generating oil and gas.
- Zone C is of comparable richness and Zone D is poor. In both cases, the organic matter is dominantly coaly and woody in type with a primary potential for gas with associated liquid hydrocarbons.
- Zone E is the richest interval in this section. It is still of only fair richness but contains interbeds of good richness. The organic matter is coaly and woody in type.
- Zone F has poor to fair or fair contents of coaly-woody organic matter
- relatively oxidising conditions apparently prevailed at the seawater-sediment interface during the deposition of the sediments from Zone F up to the base of Zone B.
- some of the samples contain <u>minor</u> coal. This presumably occurs as thin insignificant interbeds.

C. LEVEL OF THERMAL MATURATION

Thermal maturation indices increase from 1+ to 2- at the top of the section to 2- at 2300± metres, reaching 2 at 3850± metres and 2 to 2+ at 3950± metres.

The section above 2300± metres is immature. Between 2300± metres and 3850± metres the herbaceous, amorphous±stem kerogens are marginally mature and have started to generate minor volumes of liquid hydrocarbons. However in Zones C and D coaly and woody material which is still immature, is very dominant and only relatively minor proportions of herbaceous kerogen are present. Thus for practical purposes, Zones C and D must be considered immature with a potential for only minor gas and liquids - the latter probably being condensate in type.

Below Zone D herbaceous and amorphous kerogen are mature (although not maximally mature). They are however sparse and the coaly and woody debris which constitutes most of the organic matter is only marginally mature. Thus, again, gas and associated condensate or young oil-type liquids would be anticipated.

The trends in light hydrocarbon compositions and the configurations of the C_{15+} paraffin-naphthene chromatograms (allowing for non-source hydrocarbons, see Section E) are compatible with this interpretation.

The oil window within which organic matter realises its maximum potential for oil, is not penetrated in this well but probably lies above 4500± metres.

D. HYDROCARBON SOURCE RICHNESS

Preliminary assessments of present and potential hydrocarbon source richness can be obtained from the light hydrocarbon and organic carbon abundances respectively. Definitive evaluations are based upon the C_{15+} hydrocarbon contents.

The light hydrocarbon data suggests that Zones A and B are fair sources. Zone C is poor to fair or fair with the exception of the interval at 2975-3125+ metres which is good. Zone D and Zone E above 3965± metres are both rated as poor to fair whilst the rest of the section is a fair source.

Organic carbon contents give comparable ratings: Zones A through C, poor to fair or fair; Zone D poor; Zone E, fair with occasional good intervals; Zone F, fair but not as good as Zone E. Due to the character of the organic matter, these are the best ratings that can be applied to Zones C through F.

Definitive evaluations involve the C_{15+} hydrocarbons. In almost all of the samples from this well, the source-related hydrocarbons are supplemented by hydrocarbons introduced during

drilling and/or by migrated hydrocarbons (see Section E). Thus the "good" source ratings which would commonly be derived from the measured hydrocarbon abundances are anomalous, the true ratings being lower. Allowing for the non-source hydrocarbons it is suggested that a fair rating should be applied to the entire section. It is noted that the shale samples from 2270 metres, 2470 metres, 4020 metres and 4030 metres are, even with the non-indigenous hydrocarbons, only rated as fair whilst that from 2720 metres is poor.

Combining these different lines of reasoning in order to take advantage of the greater coverage provided by the C_1-C_7 and organic carbon data, the following source ratings are obtained:

- Zones A and B, potentially fair source rocks for oil and gas
- Zones C and D, poor to fair or fair source rocks for gas and associated oil
- Zone E consists of interbedded fair and fair to good or good source rocks with a potential for gas and associated oil
- Zone F is fair
- no rich source rocks were detected in this study. In particular, the richer source rocks are not oil prone.

E. NON INDIGENOUS HYDROCARBONS

Potential reservoir facies are represented by the sand stringers between 2100± metres and 2370± metres (± the minor siltstones present for two hundred metres above this) and the limestones at 2550-2650± metres, 3675-3820± metres (particularly 3725-3805± metres) and 3885-3920± metres(?).

Fluorescence was observed in the sandstone at 2170 metres and in the limestone at 3750 metres.

The light hydrocarbon (C_1-C_7) data suggest the possibility of migrated oil within the sand stringers of Zone B and perhaps, as traces, within the overlying siltstones of Zone A. Oil is indicated in the limestone at 3750 metres and, less abundantly in the other limestones over the interval 3675-3820± metres.. Cuttings gas wetness suggests oil in the Zone B sand stringers and extending up to 2050± metres and within the limestones over the interval 3725-3820± metres. In addition, there are reasonable wetness values at 2450-2550± metres (minor sands?) and at 4015-4035± metres.

C_{15+} hydrocarbon abundances are commonly higher than would be anticipated in view of the amount and type of organic matter which these sediments contain; hydrocarbons constitute a high

(although not excessively high) proportion of the total extract for sediments at these levels of thermal maturation - except in the shales of Zone B and some of the Zone C shales; paraffin-naphthene to aromatic ratios are very high above 2250± metres, at 2850-3150± metres and 3650-3930± metres. All of these data suggest non-source hydrocarbons. The C_{15+} paraffin-napthene hydrocarbons indicate contamination by diesel in most of the samples below 2300± metres, although diesel contributes most of the sample hydrocarbons only at 3980 feet. A second, and more important, contaminant causes the hump in the background envelope which peaks at approximately nC_{23}. This is a naphthenic drilling contaminant resembling pipe dope. In combination, these contaminant hydrocarbons constitute a high proportion of the total in most of the samples selected for analysis.

In addition to the contamination introduced during drilling, other non-source hydrocarbons are present: these are migrated crude oil hydrocarbons. A heavy (approximately 25° API) crude oil is present in the sand stringers of Zone B and in the overlying siltstones of Zone A. This crude, which is most abundant in the sandstone at 2170± metres, was derived from a parent source rock rich in land plant derived organic matter and is rather waxy. The source of this crude is probably only marginally mature. Traces of a similar oil, but rather less waxy, and derived from a somewhat more mature source rock, are apparently present at 2925-3075± metres although reservoir lithologies are not represented in the samples submitted for analysis. The limestones of Zone D, particularly at 3750 metres, contain a similar oil although only traces are present below 3820± metres. This oil was also derived from a parent source rock rich in land plant derived organic matter, which is mature but not very mature. It, too, is heavy.

The light hydrocarbon data suggest the possibility of traces of oil below 4015± metres - presumably in thin limestone stringers. C_{15+} hydrocarbon abundances are relatively low but even so, include diesel-derived hydrocarbons. Hence, only traces of crude oil could be involved.

The character of the source (high proportion of herbaceous± stem debris, not very mature) is confirmed by the gasoline range (C_4-C_7) data.

F. CONCLUSIONS

Six (6) geochemical Zones are recognised in the section between 1820 metres and 4040 metres in Norsk Hydro's 30/7-3.

Zones A (1820-2100± metres) and B (2100-2600± metres) consist dominantly of shales with poor to fair or fair contents (0.27-0.79% organic carbon) of organic matter in which the dominant constituent is herbaceous debris. Significant proportions of

amorphous, woody and stem kerogens are also present. Particularly within Zone A, the herbaceous material is passing to amorphous kerogen which, in some horizons, is the dominant form. Zones A and B are potentially fair source rocks for oil and gas able, in a mature state, to yield significant but not major volumes of hydrocarbons to associated reservoirs. On structure however, Zone A and the upper two hundred metres of Zone B are immature and of no exploration interest. In the rest of Zone B, the amorphous, herbaceous±stem kerogens are marginally mature and have started to generate minor volumes of liquid hydrocarbons - young condensate or young oil in character.

Zone C (2600-3675± metres) is of similar richness but its organic matter is dominantly coaly or coaly and woody; herbaceous debris constitutes a minor to significant proportion of the total and amorphous kerogen is absent. In this well, only the relatively minor herbaceous material is even marginally mature, the coaly and woody material and hence, for practical purposes this interval, being immature. Thus, although Zone C has a poor to fair or fair potential for gas with associated liquid hydrocarbons, it is unable to realise this potential on structure.

Zone D (3675-3875(?)± metres) contains a similar type of organic matter to Zone C but organic carbon values seldom exceed 0.5%. This interval is immature but, even if mature, would be only a poor source rock.

Coaly, or coaly and woody, organic matter are also the dominant forms in Zones E (3875(?)-4025± metres) and F (4025-4040± metres). They are marginally mature; the minor herbaceous kerogen is mature. The upper twenty metres and the lowermost ten metres of Zone E are lean, but the shales and tuffaceous shales within the rest of Zone have fair or fair to good organic contents - with occasional "good" intervals - whilst Zone F has fair organic contents. In this well, both Zones E and F are poor to fair sources for gas with associated young oil or condensate. In a more mature state, Zone E would rate as fair to good (with good intervals) and Zone F as fair.

There are no rich intervals and, in particular,no richly amorphous oil-prone intervals, within this well. The intervals with the best potential are Zones A and B (character of the organic matter) and Zone E (organic richness). They are not sufficiently mature on-structure to realise their full potential which is for significant, but not major, oil and gas (Zones A and B) or gas with associated oil (Zone E). Off-structure, their down-dip lateral equivalents could be sufficiently mature to realise this potential.

The sand stringers within Zone B (2100-2370± metres) and the overlying (2050-2100± metres) Zone A silt stringers contain a

heavy, relatively waxy oil. The best show is at 2170± metres This crude was derived from a parent source rock with a high proportion of herbaceous-stem-woody organic matter which is only marginally mature. The off-structure Zone A and B shales would be compatible with these source requirements.

A second oil type is present within the limestones of Zone D (although only traces are present below 3820± metres; the best show is at 3750± metres) and possibly at 2925-3075± metres, although potential reservoirs do not appear to be associated with this second interval. This crude is also a young oil but is less waxy than the other and was derived from a somewhat more mature parent source rock which also contains a high proportion of land plant derived organic matter.

Both oils were probably derived from the lateral equivalents of the associated shales. Although they occur over relatively thick intervals, it must be emphasised that the only significant shows are at 2170± metres and at 3750± metres. This would be expected from the fact that rich mature oil source horizons are not present in this well.

Minor traces of crude have apparently invaded the limestones(?) and shales at 4015-4035± metres. It is clear that at best, only minor volumes could be involved: the C_1- C_7 data are not typically oil-like; the C_{15+} hydrocarbons, although not particularly abundant, reflect contamination and not crude oil.

Oxidising conditions apparently prevailed at the seawater-sediment interface during Zone C through Zone F times.

TABLE 1A

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	$\frac{iC_4}{nC_4}$
119-001	1820m	1584	38	8.4	2.0	2.4	1635	51	3.1%	16.9	0.83
119-002	1870m	849	29	10.8	2.8	3.1	895	46	5.1%	23	0.90
119-003	1920m	1723	63	26	5.8	5.5	1823	100	5.5%	29	1.05
119-004	1970m	1730	88	39	9.6	7.9	1874	144	7.7%	41	1.21
119-005	2020m	3268	265	108	41	31	3713	445	12.0%	76	1.32
119-006	2070m	6403	1179	321	75	65	8043	1640	20.4%	150	1.15
119-007	2120m	4424	1438	275	169	212	6519	2094	32.1%	408	0.80
119-008	2170m	4217	1334	643	264	417	6875	2658	38.7%	1659	0.63
119-009	2220m	796	499	329	112	117	1853	1057	57.0%	817	0.96
119-010	2270m	827	513	332	109	113	1894	1067	56.3%	617	0.96
119-011	2320m	1440	866	430	123	120	2979	1539	51.7%	613	1.02
119-012	2350m	960	719	453	145	140	2417	1457	60.3%	781	1.04
119-013	2380m	349	34	17.4	2.4	2.0	405	56	13.8%	8.5	1.20
119-014	2420m	480	217	237	51	60	1045	565	54.1%	240	0.85
119-015	2470m	696	383	283	67	80	1509	813	53.9%	283	0.84
119-016	2520m	720	399	298	70	82	1569	849	54.1%	179	0.85
119-017	2570m	311	143	125	30	43	652	341	52.3%	248	0.70
119-018	2670m	284	7.6	6.4	1.6	6.9	306	22	7.3%	26	0.23
119-019	2720m	434	14.8	12.8	2.7	12.5	477	43	9.0%	77	0.21
119-020	2800m	213	44	35	3.2	20	315	102	32.4%	42	0.16
119-021	2850m	869	51	30	2.8	19.1	972	103	10.6%	156	0.15
119-022	2900m	1301	99	59	4.7	32	1496	195	13.0%	225	0.15

TABLE 1A

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	$\frac{iC_4}{nC_4}$
119-023	2950m	1405	109	58	6.4	29	1607	202	12.6%	77	0.22
119-024	3010m	6751	499	105	17.9	41	7414	663	8.9%	403	0.44
119-025	3050m	7755	741	212	41	86	8836	1080	12.2%	1563	0.48
119-026	3100m	10832	785	142	23	39	11821	989	8.4%	866	0.59
119-027	3150m	592	30	9.9	2.2	6.0	640	48	7.5%	106	0.37
119-028	3203m	1147	54	12.1	1.8	5.2	1220	73	6.0%	107	0.35
119-029	3250m	364	29	6.0	0.5	1.8	401	37	9.3%	60	0.28
119-030	3300m	729	64	16.5	1.2	3.0	814	85	10.4%	81	0.40
119-031	3450m	468	41	24	4.2	6.4	568	100	17.5%	63	0.66
119-032	3500m	303	33	37	9.9	12.2	395	92	23.3%	111	0.81
119-033	3550m	1401	196	63	8.7	7.1	1676	275	16.4%	31	1.22
119-034	3600m	496	102	33	4.3	3.0	638	142	22.3%	9.6	1.43
119-035	3650m	649	69	16.3	1.0	1.4	737	88	11.9%	6.2	0.71
119-036	3700m	687	163	53	4.2	4.3	911	224	24.6%	15.5	0.98
119-037	3750m	1577	1152	1189	240	325	4483	2906	64.8%	2521	0.74
119-038	3800m	193	60	59	14.7	10.8	337	144	42.9%	87	1.36
119-039	3810m	208	53	73	16.2	17.0	367	159	43.3%	229	0.95
119-040	3820m	NO SAMPLE									
119-041	3830m	1519	402	184	36	25	2166	647	29.9%	415	1.44
119-042	3840m	917	176	93	29	16.9	1232	315	25.6%	358	1.71
119-043	3850m	921	147	77	24	14.2	1183	262	22.1%	257	1.69
119-044	3870m	329	66	40	10.3	7.3	433	124	28.5%	86	1.41

TABLE 1A

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	$\frac{iC_4}{nC_4}$
119-045	3880m	1157	108	53	7.8	11.4	1337	180	13.5%	30	0.68
119-046	3890m	297	57	27	3.8	3.0	388	91	23.4%	8.3	1.27
119-047	3900m	302	55	24	3.7	2.9	388	86	22.1%	22	1.27
119-048	3940m	912	167	48	3.6	17.4	1148	236	20.5%	603	0.21
119-049	3950m	498	165	67	7.1	28	765	267	34.9%	795	0.25
119-050	3960m	1008	192	56	3.8	4.6	1264	256	20.3%	38	0.82
119-051	3970m	1358	222	54	3.5	10.6	1648	290	17.6%	311	0.33
119-052	3980m	913	272	61	3.5	10.9	1260	347	27.6%	341	0.32
119-053	3990m	523	257	30	1.8	6.1	818	295	36.0%	135	0.29
119-054	4000m	985	417	84	3.2	15.3	1504	519	34.5%	472	0.21
119-055	4010m	2493	739	147	10.2	16.4	3406	912	26.8%	282	0.62
119-056	4020m	2671	1660	300	10.7	10.9	4653	1982	42.6%	23	0.98
119-057	4030m	2141	1552	1150	260	316	5419	3278	60.5%	1243	0.82
119-058	4040m	3090	1743	698	93	76	5700	2610	45.8%	368	1.22

TABLE 1B

CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS IN CUTTINGS 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	$\frac{iC_4}{nC_4}$
119-001	1820m	132	29	16.6	6.8	8.8	193	61	31.7%	23	0.77
119-002	1870m	58	7.2	5.4	3.9	4.6	79	21	26.7%	57	0.85
119-003	1920m	107	8.6	6.7	2.0	4.0	128	21	16.6%	91	0.50
119-004	1970m	64	8.9	11.3	5.3	6.7	96	32	33.5%	118	0.79
119-005	2020m	214	20	25	14.5	17.5	291	77	26.5%	35	0.83
119-006	2070m	134	92	111	42	62	441	307	69.6%	163	0.68
119-007	2120m	171	149	220	63	144	747	576	77.1%	1289	0.44
119-008	2170m	159	104	176	110	249	798	639	80.1%	2387	0.44
119-009	2220m	67	42	65	33	72	279	212	76.0%	1112	0.46
119-010	2270m	53	36	59	32	75	255	202	79.2%	1076	0.43
119-011	2320m	122	145	237	98	169	771	649	84.2%	2057	0.58
119-012	2350m	82	55	119	76	151	483	401	83.0%	1678	0.50
119-013	2380m	153	36	34	9.0	11.9	244	91	37.2%	262	0.76
119-014	2420m	76	23	45	19.4	37	200	124	62.2%	253	0.52
119-015	2470m	108	46	124	54	123	455	347	76.3%	904	0.44
119-016	2520m	70	36	91	31	70	268	198	73.9%	695	0.44
119-017	2570m	81	15.5	20	6.7	27	150	69	46.1%	644	0.25
119-018	2670m	85	8.2	7.1	4.1	16.9	121	36	29.7%	442	0.24
119-019	2720m	117	14.7	14.0	4.5	24	174	57	32.9%	114	0.19
119-020	2800m	73	15.9	20	3.9	21	134	61	45.4%	135	0.18
119-021	2850m	242	28	27	4.8	35	337	95	28.1%	851	0.14
119-022	2900m	102	14.7	13.6	2.0	12.7	145	43	29.6%	147	0.16

TABLE 1B

CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS IN CUTTINGS 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	$\frac{iC_4}{nC_4}$
119-023	2950m	93	39	37	5.2	37	211	118	56.0%	470	0.14
119-024	3010m	437	72	35	6.2	21	571	134	23.5%	226	0.29
119-025	3050m	147	49	36	9.6	31	273	126	46.0%	435	0.31
119-026	3100m	346	64	23	3.2	11.2	447	101	22.7%	298	0.29
119-027	3150m	265	20	21	7.9	24	338	73	21.6%	606	0.33
119-028	3203m	210	23	11.6	2.8	10.8	258	48	18.7%	305	0.26
119-029	3250m	129	18.5	9.8	1.1	3.5	162	33	20.3%	225	0.31
119-030	3300m	132	23	10.6	0.7	3.4	169	38	22.3%	227	0.21
119-031	3450m	169	31	36	12.9	15.6	264	95	36.2%	263	0.83
119-032	3500m	139	26	52	22	33	272	133	48.9%	914	0.66
119-033	3550m	382	488	71	29	17.7	988	606	61.3%	553	1.64
119-034	3600m	172	96	48	5.4	5.2	327	155	47.3%	200	1.04
119-035	3650m	239	114	98	25	52	528	289	54.7%	123	0.48
119-036	3700m	224	173	128	33	52	610	386	63.3%	400	0.63
119-037	3750m	802	1190	2664	941	1553	7150	6348	88.8%	16470	0.60
119-038	3800m	188	124	183	65	86	646	458	70.9%	3939	0.75
119-039	3810m	132	92	143	54	65	486	354	72.8%	2889	0.83
119-040	3820m	NO SAMPLE									
119-041	3830m	180	117	100	29	48	474	294	62.0%	2489	0.60
119-042	3840m	573	247	232	89	89	1230	657	53.4%	5213	1.00
119-043	3850m	353	143	142	71	63	772	419	54.3%	4305	1.13
119-044	3870m	224	89	84	38	43	478	254	53.1%	2582	0.88

TABLE 1B

CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS IN CUTTINGS 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	$\frac{iC_4}{nC_4}$
119-045	3880m	92	27	21	11.3	15.4	167	75	44.7%	427	0.73
119-046	3890m	235	47	30	7.3	7.3	327	92	28.0%	260	1.00
119-047	3900m	105	29	19.7	6.6	13.7	174	69	39.6%	506	0.48
119-048	3940m	286	35	16.0	5.8	17.6	360	74	20.7%	607	0.33
119-049	3950m	427	58	35	5.3	17.0	542	115	21.3%	558	0.31
119-050	3960m	599	61	27	6.7	19.5	713	114	16.0%	1142	0.34
119-051	3970m	1275	169	62	4.6	12.4	1523	248	16.3%	135	0.37
119-052	3980m	1974	242	89	6.2	14.6	2326	352	15.1%	17.4	0.42
119-053	3990m	265	84	23	1.6	3.6	377	112	29.8%	16.0	0.44
119-054	4000m	603	271	93	5.9	8.9	982	379	38.6%	57	0.66
119-055	4010m	1036	757	376	19.6	46	2235	1199	53.6%	240	0.43
119-056	4020m	214	590	381	16.9	48	1250	1036	82.9%	142	0.35
119-057	4030m	244	216	412	74	244	1190	946	79.5%	5691	0.30
119-058	4040m	970	383	447	41	124	1965	995	50.6%	2323	0.33

TABLE 1C

TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS (1A + 1B)

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	$\frac{iC_4}{nC_4}$
119-001	1820m	1716	67	25	8.8	11.2	1828	112	6.1%	40	0.79
119-002	1870m	907	36	16.2	6.7	7.7	974	67	6.9%	80	0.87
119-003	1920m	1830	72	33	7.8	9.5	1952	122	6.3%	120	0.82
119-004	1970m	1794	97	50	14.9	14.6	1970	176	8.9%	159	1.02
119-005	2020m	3482	285	133	55	48	4003	521	13.0%	111	1.14
119-006	2070m	6537	1271	432	117	127	8484	1947	22.9%	313	0.92
119-007	2120m	4596	1586	495	232	356	7265	2669	36.7%	1697	0.65
119-008	2170m	4376	1438	819	374	666	7673	3297	42.9%	4046	0.56
119-009	2220m	863	541	394	145	189	2132	1269	59.5%	1929	0.77
119-010	2270m	880	549	391	141	188	2149	1269	59.0%	1693	0.75
119-011	2320m	1562	1011	667	221	289	3750	2188	58.3%	2670	0.76
119-012	2350m	1042	774	572	221	291	2900	1858	64.1%	2459	0.76
119-013	2380m	502	70	51	11.4	13.9	648	146	22.6%	270	0.82
119-014	2420m	556	240	282	70	97	1245	689	55.3%	536	0.72
119-015	2470m	804	429	407	121	203	1964	1160	59.1%	1187	0.60
119-016	2520m	790	435	389	101	152	1867	1077	57.7%	874	0.66
119-017	2570m	392	158	145	37	71	803	411	51.3%	892	0.52
119-018	2670m	369	15.8	13.5	5.7	24	428	59	13.8%	468	0.24
119-019	2720m	551	29	27	7.2	36	650	99	15.2%	191	0.20
119-020	2800m	286	60	55	7.1	41	449	163	36.3%	177	0.17
119-021	2850m	1111	79	57	7.6	54	1309	198	15.1%	1007	0.14
119-022	2900m	1403	114	73	6.7	45	1642	239	14.5%	372	0.15

TABLE 1C

TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS (1A + 1B)

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	$\frac{iC_4}{nC_4}$
119-023	2950m	1498	148	95	11.6	66	1819	321	17.6%	547	0.18
119-024	3010m	7188	571	140	24	62	7985	797	10.0%	629	0.39
119-025	3050m	7902	790	248	51	117	9108	1206	13.2%	1998	0.43
119-026	3100m	11178	849	165	26	50	12268	1090	8.9%	1164	0.52
119-027	3150m	857	50	31	10.1	30	978	121	12.4%	712	0.34
119-028	3203m	1357	77	24	4.6	16.0	1479	122	8.2%	412	0.29
119-029	3250m	493	47	15.8	1.6	5.3	563	70	12.4%	285	0.30
119-030	3300m	861	87	27	1.9	6.4	983	122	12.4%	308	0.30
119-031	3450m	637	72	60	17.1	22	808	171	21.2%	326	0.78
119-032	3500m	442	59	89	32	45	667	225	33.7%	1025	0.71
119-033	3550m	1783	684	134	38	25	2664	881	33.1%	584	1.52
119-034	3600m	668	198	81	9.7	8.2	965	297	30.8%	210	1.18
119-035	3650m	888	183	114	26	53	1264	376	29.7%	129	0.49
119-036	3700m	911	336	181	37	56	1521	610	40.1%	415	0.66
119-037	3750m	2379	2342	3853	1181	1878	11633	9254	79.5%	18990	0.63
119-038	3800m	381	184	242	80	97	984	603	61.3%	4026	0.82
119-039	3810m	340	145	216	70	82	853	513	60.1%	3118	0.85
119-040	3820m	NO SAMPLE									
119-041	3830m	1699	519	284	65	73	2640	941	35.6%	2904	0.89
119-042	3840m	1490	423	325	118	106	2462	972	39.5%	5571	1.11
119-043	3850m	1274	290	219	95	77	1925	651	33.8%	4562	1.23
119-044	3870m	553	155	124	48	50	930	377	40.5%	2668	0.96

TABLE 1C

TOTAL CONCENTRATION (VOL. PPM OF ROCK) OF C_1 - C_7 HYDROCARBONS (1A + 1B)

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	$\frac{iC_4}{nC_4}$
119-045	3880m	1249	135	74	19.1	27	1504	255	16.9%	457	0.70
119-046	3890m	532	104	57	11.1	10.3	714	182	25.5%	268	1.08
119-047	3900m	407	84	44	10.3	16.6	562	155	27.6%	528	0.62
119-048	3940m	1198	202	64	9.4	35	1508	310	20.6%	1210	0.27
119-049	3950m	925	223	102	12.4	45	1307	382	29.2%	1353	0.27
119-050	3960m	1607	253	83	10.5	24	1977	370	18.7%	1180	0.44
119-051	3970m	2633	391	116	8.1	23	3171	538	17.0%	446	0.35
119-052	3980m	2887	514	150	9.7	25	3586	699	19.5%	358	0.39
119-053	3990m	788	341	53	3.4	9.7	1195	407	34.1%	151	0.35
119-054	4000m	1588	688	177	9.1	24	2486	898	36.1%	529	0.38
119-055	4010m	3529	1496	523	30	62	5640	2111	37.4%	522	0.48
119-056	4020m	2885	2250	681	28	59	5931	3046	51.3%	165	0.47
119-057	4030m	2385	1768	1562	334	560	6609	4224	63.9%	6934	0.60
119-058	4040m	4060	2126	1145	134	200	7665	3605	47.0%	2691	0.67

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-001	1820m	A 98% Shale, fissile to blocky, non calcareous, olive grey Significant cavings Minor cement	5Y4/1	0.64
119-002	1870m	A 98% Shale, as 119-001A Cavings Minor cement	5Y4/1	0.46
119-003	1920m	A 95% Shale, fissile, non calcareous, olive grey to dark greenish grey	5Y4/1-5G5/1	0.55
		B 5% Siltstone, blocky, non calcareous, no fluorescence, olive grey Significant cavings	5Y4/1	
119-004	1970m	A 95% Shale, fissile, non calcareous, significant cavings, medium dark greenish grey	5G5/1	0.37
		B 5% Siltstone, as 119-003B Cavings, no fluorescence	5Y4/1	
		Minor shale, light bluish grey	5B7/1	
		Minor cement		
119-005	2020m	A 98% Shale, as 119-004A Abundant cavings Minor siltstone and cement	5G5/1	0.30,0.30
119-006	2070m	A 98% Shale, as 119-004A, Abundant cavings Minor cement and siltstone, Cavings	5G5/1	0.79
		Minor shale, moderate brown	5YR3/4	
119-007	2120m	A 80% Shale, fissile to blocky, non calcareous, medium grey to olive grey	N5-5Y4/1	0.67
		B 15% Shale, fissile to blocky, non calcareous, brownish grey	5YR4/1	0.23
		C 5% Sandstone, blocky, non calcareous, no fluorescence, light olive grey Significant shale cavings	5Y6/1	

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-008	2170m	A 60% Shale, fissile, non calcareous, significant cavings, medium dark greenish grey	5G5/1	0.51,0.53
		B 20% Shale, fissile to blocky, medium grey to olive grey	N5-5Y4/1	0.12
		C 10% Quartzite, blocky, non calcareous, blue fluorescence, light grey	N7	
		D 10% Silty shale, fissile to blocky, non calcareous, speckled, medium dark greenish grey	5G5/1	0.35
119-009	2220m	A 70% Shale, fissile to blocky, non calcareous, medium grey to olive grey	N5-5Y4/1	0.35
		B 30% Shale, fissile, non calcareous, dark olive grey	5Y3/1	0.61,0.61
		Minor quartz grains, lost circulation (walnut)		
		Minor siltstone and quartzite		
119-010	2270m	A 98% Shale, fissile, non calcareous, olive grey to medium dark greenish grey	5Y4/1-5G5/1	0.59
		Minor cement and sandstone		
		Minor walnut shell and quartz grains		
		Minor shale, brownish grey	5YR4/1	
119-011	2320m	A 70% Shale, fissile to blocky, non calcareous, medium grey to olive grey	N5-5Y4/1	0.62
		B 20% Shale, as 119-009B cavings	5Y3/1	1.27
		C 5% Cement, non calcareous		
		D 5% Sandstone, blocky, non calcareous, no fluorescence, light olive grey	5Y6/1	
		Minor Quartz grains		
		Minor shale,brownish grey	5YR4/1	
119-012	2350m	A 80% Shale, fissile to blocky non calcareous, cavings, medium dark greenish grey	5G5/1	0.39,0.36
		B 10% Shale, fissile to blocky, non calcareous, cavings, medium bluish grey	5B5/1	

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH		GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-012	2350m	C 10%	Fine Quartz grains, subrounded, opaque Minor lost circulation (walnut shell) Minor coal, abundant cavings Minor cement, Minor shale	5YR4/1 brownish grey	
119-013	2380m	A 98%	Shale, fissile to blocky, non calcareous, cavings medium grey Minor cement	N5	0.53
119-014	2420m	A 45%	Shale, fissile to blocky, non calcareous, cavings, dark greenish grey	5GY4/1	0.59
		B 40%	Shale, as 119-013A,cavings	N5	0.27,0.27
		C 10%	Cement, non calcareous		
		D 5%	Shale, fissile, non calcareous, brownish grey, cavings Minor quartz grains	5YR4/1	
119-015	2470m	A 50%	Shale, fissile to blocky, non calcareous, cavings, dark bluish grey	5B4/1	0.52
		B 40%	Shale, fissile to blocky, non calcareous, medium light grey to medium bluish grey	N6-5B6/1	0.20
		C 5%	Shale, as 119-014D	5YR4/1	
		D 5%	Shale, fissile to blocky, non calcareous, dark greenish grey Minor cement, Minor quartzite	5GY4/1	
119-016	2520m	A 60%	Shale, fissile to blocky, non calcareous, medium grey	N5	0.67
		B 40%	Shale, fissile to blocky non calcareous, medium light grey Very abundant cavings Minor quartzite	N6	0.17,0.18
119-017	2570m	A 60%	Limestone, blocky, no fluorescence, white to pinkish grey	N9-5YR8/1	0.02
		B 40%	Shale, fissile to blocky, non calcareous, cavings, greyish black to dark grey Cavings	N2-N3	0.71

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-018	2670m	A 80% Shale, fissile to blocky slightly calcareous, medium grey	N5	0.44
		B 20% Limestone, blocky, no fluorescence, pinkish grey	5YR8/1	
		Minor shale cavings		
119-019	2720m	A 98% Shale, fissile, non calcareous, medium bluish grey	5B4/1	0.44
		Minor limestone		
		Lost circulation (walnut shell)		
119-020	2800m	A 98% Shale, fissile to blocky, non calcareous, medium dark grey, cavings	N4	0.55
		Minor limestone		
119-021	2850m	A 98% Shale, as 119-018A Significant cavings	N5	0.51
		Minor shale, brownish grey	5YR4/1	
		Minor limestone		
119-022	2900m	A 98% Shale, as 119-020A Cavings	N4	0.45
		Minor shale, brownish grey	5YR4/1	
		Minor limestone. Minor walnut shell		
119-023	2950m	A 98% Shale, as 119-018A Significant cavings	N5	0.49
		Minor shale, greyish red	5R4/2	
119-024	3010m	A 98% Shale, fissile to blocky, non calcareous, significant cavings, medium grey	N5	0.51,0.51
		Minor limestone		
119-025	3050m	A 98% Shale, as 119-020A Significant cavings	N4	0.63
		Minor limestone		
119-026	3100m	A 98% Shale, fissile to blocky, slightly calcareous, significant cavings, medium dark grey	N4	0.55
		Minor limestone		
		Poor sample		

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-027	3150m	A 85% Shale, fissile to blocky non calcareous, medium dark grey, cavings	N4	0.70
		B 15% Shale, fissile to blocky, very calcareous, medium grey to medium light grey Minor limestone	N5-N6	0.23,0.23
119-028	3203m	A 90% Shale, fissile to blocky, slightly calcareous, significant cavings, medium dark grey	N4	0.08
		B 10% Shale, as 119-027B	N5-N6	0.10
119-029	3250m	A 98% Shale, fissile to blocky slightly calcareous, significant cavings, medium dark grey	N4	0.31
		Minor coal, vitreous		
		Minor shale, brownish grey	5YR4/1	
119-030	3300m	A 98% Shale, fissile to blocky, non calcareous, significant cavings, medium grey	N5	0.50,0.50
		Minor shale, as 119-029A	N4	
		Minor coal		
119-031	3450m	A 98% Shale, fissile to blocky, slightly calcareous, significant cavings, medium dark grey	N4	0.59
		Minor coal		
119-032	3500m	A 98% Shale, fissile to blocky calcareous, cavings, medium grey	N5	0.70
		Limestone		
119-033	3550m	A 99% Shale, as 119-032A	N5	0.55
		Cavings		
119-034	3600m	A 98% Shale, fissile to blocky, slightly calcareous, cavings medium dark grey to medium grey	N4-N5	0.40
		Minor limestone		
119-035	3650m	A 80% Shale, as 119-032A cavings	N5	0.41,0.41
		B 10% Shale, fissile, non calcareous, medium bluish grey	5B5/1	0.45
		C 10% Shale, fissile, non calcareous, greyish brown	5YR3/2	0.24
		Minor limestone		

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-036	3700m	A 75% Shale, fissile to blocky, non calcareous, cavings, medium dark grey	N4	0.48
		B 10% Shale, fissile to blocky calcareous, cavings, medium grey	N5	0.20,0.21
		C 10% Limestone, blocky, no fluorescence, pale yellowish brown	10YR6/2	
		D 5% Shale, fissile, non calcareous, greyish brown Minor limestone	5YR3/2	
119-037	3750m	A 50% Shale, fissile to blocky, slightly calcareous, cavings, medium dark grey to medium grey	N4-N5	0.82
		B 50% Limestone, blocky; blue fluorescence, light olive grey	5Y6/1	1.05
		Minor shale, medium dark grey	N4	
119-038	3800m	A 70% Limestone, blocky, no fluorescence, moderate yellowish brown	10YR5/4	0.74
		B 30% Shale, fissile to blocky calcareous, medium grey to medium light grey Significant metal turnings	N5-N6	0.51
119-039	3810m	A 80% Cement, calcareous		
		B 10% Limestone, blocky, no fluorescence, moderate yellowish brown	10YR5/4	
		C 10% Shale, as 119-038B Metal turnings	N5-N6	0.48
119-040	3820m	NO SAMPLE		
119-041	3830m	A 97% Shale, fissile, calcareous cavings, medium grey to medium light grey Minor cement, Minor turnings	N5-N6	0.39
119-042	3840m	A 70% Shale, as 119-041A	N5-N6	0.30
		B 20% Cement, calcareous		
		C 10% Limestone, blocky, no fluorescence, light olive grey	5Y6/1	

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-043	3850m	A 90% Shale, fissile, calcareous, cavings, medium grey to medium light grey, iron staining	N5-N6	0.41
		B 10% Cement, calcareous Minor limestone		
119-044	3870m	A 50% Shale, fissile, calcareous medium grey	N5	0.48
		B 30% Cement, calcareous		
		C 20% Shale, fissile, non calcareous, medium dark grey	N4	0.70
		Minor limestone		
119-045	3880m	A 98% Lost circulation; cement, paint and vermiculite Very minor shale		
119-046	3890m	A 70% Shale, fissile to blocky, calcareous, medium dark grey to medium grey	N4-N5	0.46
		B 30% Limestone, blocky, no fluorescence, light olive grey	5Y6/1	
		Minor cement		
119-047	3900m	A 60% Shale, as 119-046A, minor cavings	N4-N5	0.61
		B 30% Limestone, as 119-046B	5Y6/1	
		C 10% Cement, calcareous Minor coal and minor quartz grains		
119-048	3940m	A 90% Volcanic tuff, non calcareous, olive grey	5Y4/1	0.97,0.96
		B 10% Shale, fissile, non calcareous, medium dark grey	N4	0.78
		Cement cavings		
119-049	3950m	A 90% Volcanic tuff, as 119-048A	5Y4/1	2.03
		B 10% Shale, as 119-048B	N4	0.71
		Minor coal, minor cement		
119-050	3960m	A 80% Volcanic tuff, as 119-048A	5Y4/1	0.74,0.74
		B 20% Shale, fissile to blocky, slightly calcareous, medium dark grey to medium grey	N4-N5	0.82
		Cement cavings		

TABLE 2
ORGANIC CARBON RESULTS AND GROSS LITHOLOGIC DESCRIPTIONS

GEOCHEM SAMPLE NUMBER	DEPTH	GROSS LITHOLOGIC DESCRIPTION	G S A Colour Code	TOTAL ORGANIC CARBON (% of Rock)
119-051	3970m	A 70% Volcanic tuff, non calcareous, dark olive grey	5Y5/1	1.18
		B 30% Shale, fissile, non calcareous, medium dark grey	N4	1.02
119-052	3980m	A 80% Volcanic tuff, as 119-051A	5Y5/1	0.66,0.67
		B 20% Shale, as 119-051B Minor cement cavings	N4	1.37
119-053	3990m	A 70% Volcanic tuff, as 119-051A	5Y5/1	0.37
		B 30% Shale, as 119-051B Cement cavings	N4	0.70
119-054	4000m	A 50% Shale, thinly fissile, non calcareous, dark grey to medium dark grey	N3-N4	1.05
		B 50% Volcanic tuff, blocky, medium dark grey Cement cavings Minor shale	N4	0.44
119-055	4010m	A 60% Shale, as 119-054A	N3-N4	0.94
		B 40% Volcanic tuff, as 119-054B Cement cavings	N4	0.47
119-056	4020m	A 97% Shale, thinly fissile, non calcareous, cavings, dark grey to medium dark grey Minor limestone Minor tuffs	N3-N4	0.28
119-057	4030m	A 98% Shale, as 119-056A, cavings Minor iron staining Minor coal Minor bitumen	N3-N4	0.50
119-058	4040m	A 95% Shale, thinly fissile, non calcareous, cavings, dark grey	N3	0.71
		B 5% Limestone, blocky, no fluorescence, white Minor quartz grains Very minor coal	N9	

N.B. Volcanic tuffs 3940-4010 metres = tuffaceous shale

TABLE 3
DETAILED GASOLINE RANGE ($C_4 - C_7$) ANALYSIS

GEOCHEM SAMPLE NUMBER	007	008	016	017	021	025	027	032
DEPTH	2120m	2170m	2520m	2570m	2850m	3050m	3150m	3500m
NORMALISED COMPOSITION								
isobutane	12.75	4.31	5.10	8.18	1.28	4.89	2.55	2.29
n - butane (nB)	15.58	10.57	15.07	16.80	12.84	19.20	7.36	11.57
isopentane	13.88	7.98	8.37	11.37	3.72	8.03	15.51	6.68
n - pentane (nP)	17.71	10.05	14.43	18.09	23.22	34.22	24.30	17.27
2,2 - dimethylB	0.57	1.20	0.21	0.43	0.74	0.35	0.25	0.23
cyclopentane (CP)	2.76	2.22	2.00	1.03	0.73	0.52	6.43	1.47
2,3 - dimethylB	1.13	1.33	0.51	0.34	0.39	0.35	1.08	0.57
2 - methylP	2.69	4.92	3.35	4.31	4.35	4.89	7.36	3.84
3 - methylP	1.56	2.62	2.02	2.41	2.78	2.44	4.47	2.00
n - hexane (nH)	4.53	5.69	5.89	6.28	17.67	6.63	7.31	7.87
methylCP (MCP)	7.86	9.18	4.68	3.61	1.83	3.84	8.69	3.43
2,2 - dimethylP	0.14	0.39	0.30	0.26	0.42	1.39	5.15	0.31
benzene	12.89	13.31	16.91	7.75	10.49	3.84	5.50	18.38
2,4 - dimethylP	0.07	0.04	0.20	0.17	0.11	0.35	0.15	0.10
2,2,3 - trimethylB	1.13	8.87	8.15	4.74	0.88	1.05	0.34	8.79
cyclohexane (CH)	0.85	1.77	1.44	1.55	3.47	1.40	0.93	2.65
3,3 - dimethylP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1 - dimethylCP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 - methylH	0.35	0.72	0.78	1.46	2.58	1.05	0.54	1.59
2,3 - dimethylP	0.28	0.98	0.55	0.43	0.25	0.17	0.15	0.16
1,c,3 - dimethylCP	–	–	–	–	–	–	–	–
3 - methylH	0.21	0.81	0.53	0.26	0.21	0.15	0.10	0.15
1,t,3 - dimethylCP	–	–	–	–	–	–	–	–
1,t,2 - dimethylCP	0.64	1.72	1.34	0.86	0.30	0.70	0.39	0.59
3 - ethylP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
n - heptane	0.50	0.69	1.56	3.70	6.84	1.05	0.34	4.62
1,c,2 - dimethylCP	0.07	0.13	0.20	0.17	0.09	0.35	0.05	0.10
methylCH (MCH)	1.77	10.11	5.33	5.08	4.15	2.44	0.88	4.53
toluene	0.14	0.39	0.40	0.69	0.18	0.69	0.15	0.35
ABUNDANCE (ppm)	650	1410	872	350	488	300	390	892
MCP/benzene	0.61	0.69	0.28	0.47	0.17	1.00	1.58	0.19
MCP/MCH	4.44	0.91	0.88	0.71	0.44	1.57	9.87	0.76
CH/MCP	0.11	0.91	0.31	0.43	0.29	0.36	0.11	0.77
iP/nP	0.78	0.79	0.58	0.63	0.16	0.23	0.64	0.39
%n - PARAFFINS	38.32	27.00	36.95	44.87	60.57	61.10	39.31	41.33
% ISOPARAFFINS	34.50	34.19	30.09	34.38	17.72	25.13	37.67	26.73
% NAPHTHENES	13.96	21.65	15.00	12.31	10.58	9.26	17.38	12.78
% AROMATICS	13.03	13.70	17.31	8.44	10.67	4.53	5.65	18.73

TABLE 3

DETAILED GASOLINE RANGE ($C_4 - C_7$) ANALYSIS

GEOCHEM SAMPLE NUMBER	035	037	038	042	043	050	057	058
DEPTH	3650m	3750m	3800m	3840m	3850m	3960m	4030m	4040m
NORMALISED COMPOSITION								
isobutane	3.08	4.01	1.96	2.86	2.19	2.73	3.47	4.34
n - butane (nB)	12.21	9.02	3.35	8.96	3.49	7.72	11.80	12.77
isopentane	3.66	9.73	6.42	6.24	4.67	6.99	7.69	9.89
n - pentane (nP)	21.39	11.12	6.68	10.85	7.00	10.09	10.45	11.94
2,2 - dimethylB	0.27	0.71	1.30	0.91	1.05	0.58	0.73	1.12
cyclopentane (CP)	2.35	0.54	0.50	0.25	0.39	1.30	0.40	0.41
2,3 - dimethylB	0.27	1.15	1.69	1.45	1.50	0.30	0.95	1.24
2- methylP	4.88	6.33	8.90	7.34	8.42	2.15	6.15	7.28
3- methylP	2.40	3.55	4.34	3.88	4.28	1.40	3.69	4.05
n - hexane (nH)	10.04	9.15	11.40	10.03	12.01	4.96	8.59	9.96
methylCP (MCP)	3.89	2.79	3.14	2.67	3.00	3.26	3.36	3.40
2,2 - dimethylP	0.23	0 60	1.54	1.12	1.57	1.17	0.84	0.77
benzene	12.75	13.30	8.24	7.94	6.15	35.65	7.38	5.92
2,4 - dimethylP	0.10	0.10	0.30	0.10	1.14	0.51	0.27	0.10
2,2,3 - trimethylB	8.50	1.76	1.50	1.36	1.43	13.00	3.51	0.99
cyclohexane (CH)	1.81	4.15	7.75	6.41	8.20	1.49	4.42	4.75
3,3 - dimethylP	0.01	0.01	0.01	0.01	0.32	0.01	0.01	0.01
1,1 - dimethylCP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2 - methylH	1.49	3.02	5.48	5.44	5.86	1.01	3.22	3.26
2,3 - dimethylP	0.18	0.66	0.77	0.40	0.64	0.43	0.76	0.62
1,c,3 - dimethylCP	–	–	–	–	–	–	–	–
3 - methylH	0.14	0.73	0.60	0.53	0.61	0.49	0.63	0.55
1,t,3 - dimethylCP	–	–	–	–	–	–	–	–
1,t,2 - dimethylCP	0.36	1.60	1.39	0.85	1.34	1.04	1.31	1.14
3 - ethylP	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
n - heptane	6.10	6.80	11.17	7.95	11.79	3.59	6.21	5.52
1,c,2 - dimethylCP	0.14	0.35	0.38	0.69	0.30	0.20	0.22	0.39
methylCH (MCH)	2.94	8.40	10.50	8.77	11.08	4.61	9.99	8.76
toluene	0.95	0.52	1.17	1.33	1.20	5.39	3.23	0.94
ABUNDANCE (ppm)	260	9664	3187	3322	3136	1131	3994	2008
MCP/benzene	0.30	0.21	0.38	0.34	0.49	0.13	0.45	0.57
MCP/MCH	1.32	0.33	0.30	0.30	0.27	0.71	0.34	0.39
CH/MCP	0.46	1.49	2.47	2.40	2.73	0.46	1.31	1.40
iP/nP	0.17	0.88	0.96	0.57	0.67	0.69	0.74	0.83
%n - PARAFFINS	49.74	36.09	32.60	37.79	34.29	26.36	37.05	40.19
%iPARAFFINS	25.22	32.37	34.82	31.65	33.69	30.78	31.93	34.23
% NAPHTHENES	11.50	17.84	23.67	19.65	24.33	11.92	19.71	18.86
% AROMATICS	13.70	13.83	9.41	9.27	7.35	31.04	10.61	6.86

TABLE 4A

WEIGHT (GRAMMES) OF nC_{5+} EXTRACTS AND CHROMATOGRAPHIC FRACTIONS

GEOCHEM SAMPLE NUMBER	INTERVAL	ROCK EXTRACTED	TOTAL EXTRACT OBTAINED	TOTAL EXTRACT		nC_5 SOLUBLE FRACTION				
				Preciptd. Asphaltenes	nC_5 soluble	Paraffin – Naphthenes	Aromatics	Eluted NSO's	Non-eluted NSO's	Sulphur
119-003	1920m	21.0851	0.0203	0.0102	0.0101	0.0063	0.0019	0.0017	0.0002	–
119-006	2070m	23.0264	0.0231	0.0144	0.0087	0.0053	0.0020	0.0014	–	–
119-008C	2170m	1.6379	0.0165	0.0080	0.0085	0.0060	0.0016	0.0009	–	–
119-010	2270m	33.4356	0.0109	0.0285	0.0050	0.0033	0.0026	–	–	–
119-012	2350m	28.5584	0.0310	0.0182	0.0128	0.0065	0.0037	0.0026	–	–
119-015	2470m	35.2933	0.0214	0.0140	0.0074	0.0032	0.0025	0.0017	–	–
119-017A	2570m	13.0459	0.0176	0.0104	0.0072	0.0033	0.0018	0.0021	–	–
119-019	2720m	64.2282	0.0227	0.0150	0.0077	0.0021	0.0030	0.0024	0.0002	–
119-023	2950m	28.7717	0.0260	0.0108	0.0152	0.0104	0.0025	0.0023	–	–
119-025	3050m	33.0064	0.0281	0.0132	0.0149	0.0103	0.0027	0.0018	–	–
119-029	3250m	12.5025	0.0297	0.0183	0.0114	0.0061	0.0027	0.0026	–	–
119-033	3550m	56.4275	0.0455	0.0209	0.0246	0.0052	0.0026	0.0027	–	–
119-036	3700m	21.8621	0.0241	0.0130	0.0111	0.0071	0.0015	0.0025	–	–
119-037B	3750m	0.7945	0.0210	0.0110	0.0100	0.0072	0.0011	0.0017	–	–
119-039B	3810m	1.5400	0.0271	0.0098	0.0173	0.0032	0.0005	0.0013	–	–
119-042A	3840m	9.8007	0.0222	0.0125	0.0097	0.0071	0.0009	0.0017	–	–
119-042C	3850m	3.1899	0.0260	0.0127	0.0133	0.0098	0.0016	0.0019	–	–
119-047A	3900m	7.9862	0.0210	0.0138	0.0072	0.0046	0.0009	0.0017	–	–
119-049	3950m	84.7945	0.1097	0.0312	0.0785	0.0360	0.0184	0.0241	–	–
119-052	3980m	61.1942	0.0379	0.0160	0.0219	0.0126	0.0042	0.0051	–	–
119-056	4020m	100.4410	0.0328	0.0145	0.0183	0.0102	0.0059	0.0022	–	–
119-057	4030m	80.2470	0.0491	0.0196	0.0295	0.0120	0.0068	0.0107	–	–

TABLE 4B

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

GEOCHEM SAMPLE NUMBER	INTERVAL	TOTAL EXTRACT	HYDROCARBONS			NON HYDROCARBONS				
			Paraffin – Naphthenes	Aromatics	TOTAL	Preciptd. Asphaltenes	Eluted NSO's	Non-eluted NSO's	Sulphur	TOTAL
119-003	1920m	963	299	90	389	484	81	9	–	574
119-006	2070m	1003	230	87	317	625	61	–	–	686
119-008C	2170m	10074	3663	977	4640	4884	549	–	–	5433
119-010	2270m	1178	150	97	247	852	79	–	–	931
119-012	2350m	1085	228	130	358	637	91	–	–	728
119-015	2470m	606	91	71	162	396	48	–	–	444
119-017A	2570m	1349	251	141	392	797	161	–	–	958
119-019	2720m	353	33	47	80	234	37	3	–	274
119-023	2950m	904	363	88	451	375	79	–	–	454
119-025	3050m	851	312	82	394	400	54	–	–	454
119-029	3250m	2376	488	216	704	1464	208	–	–	1672
119-033	3550m	806	216	108	324	370	112	–	–	482
119-036	3700m	1102	325	69	394	595	114	–	–	709
119-037B	3750m	26431	9062	1384	10446	13845	2140	–	–	15986
119-039B	3810m	17598	7208	1104	8312	6364	2922	–	–	9286
119-042A	3840m	2265	724	92	816	1275	173	–	–	1448
119-042C	3850m	8150	3072	502	3574	3981	596	–	–	4577
119-047A	3900m	2630	576	113	689	1728	213	–	–	1941
119-049	3950m	1294	424	217	641	368	285	–	–	653
119-052	3980m	619	207	69	276	261	83	–	–	344
119-056	4020m	327	102	58	160	145	22	–	–	167
119-057	4030m	612	149	85	234	244	133	–	–	377

TABLE 4C

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

GEOCHEM SAMPLE NUMBER	INTERVAL	HYDROCARBONS			NON HYDROCARBONS					
		Paraffin – Naphthenes	Aromatics	P – N / AROM	Preciptd. Asphaltenes	Eluted NSO's	Non eluted NSO's	Sulphur	ASPH / NSO	HC / NON HC
119-003	1920m	31.05	9.35	3.32	50.26	8.41	0.93	–	5.98	0.68
119-006	2070m	22.93	8.67	2.64	62.31	6.08	–		10.25	0.46
119-008C	2170m	36.36	9.70	3.75	48.49	5.45	–	–	8.90	0.85
119-010	2270m	12.73	8.23	1.55	72.33	6.71	–	–	10.78	0.27
119-012	2350m	20.99	11.97	1.75	58.66	8.38	–	–	7.00	0.49
119-015	2470m	15.02	11.72	1.28	65.35	7.92	–	–	8.25	0.36
119-017A	2570m	18.59	10.44	1.78	59.04	11.93	–	–	4.95	0.41
119-019	2720m	9.32	13.28	0.70	66.10	10.45	0.85	–	6.32	0.29
119-023	2950m	40.11	9.72	4.13	41.44	8.73	–	–	4.75	0.99
119-025	3050m	36.79	9.67	3.80	47.17	6.37	–	–	7.41	0.87
119-029	3250m	20.54	9.09	2.26	61.62	8.75	–	–	7.04	0.42
119-033	3550m	26.80	13.40	2.00	45.91	13.90	–	–	3.30	0.67
119-036	3700m	29.46	6.26	4.71	53.94	10.34	–	–	5.22	0.56
119-037B	3750m	34.28	5.24	6.55	52.38	8.10	–	–	6.47	0.65
119-039B	3810m	40.96	6.27	6.53	36.16	16.60	–	–	2.18	0.89
119-042A	3840m	31.98	4.06	7.87	56.32	7.64	–	–	7.37	0.56
119-042C	3850m	37.69	6.16	6.12	48.84	7.31	–	–	6.67	0.78
119-047A	3900m	21.90	4.30	5.10	65.70	8.10	–	–	8.11	0.35
119-049	3950m	32.77	16.77	1.95	28.44	22.02	–	–	1.29	0.98
119-052	3980m	33.39	11.13	3.00	42.10	13.39	–	–	3.14	0.80
119-056	4020m	31.19	17.74	1.76	44.34	6.73	–	–	6.59	0.96
119-057	4030m	24.39	13.91	1.75	39.93	21.77	–	–	1.83	0.62

TABLE 5

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

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC CARBON	HYDROCARBONS / TOTAL EXTRACT	HYDROCARBONS / ORGANIC CARBON	TOTAL EXTRACT / ORGANIC CARBON
119-003	1920m	0.66	40.39	5.89	14.59
119-006	2070m	0.84	31.61	26.42	83.58
119-008C	2170m	0.12	46.06	386.67	839.50
119-010	2270m	0.75	20.97	3.29	15.71
119-012	2350m	0.91	32.99	3.93	11.92
119-015	2470m	0.75	26.73	2.16	8.08
119-017A	2570m	0.09	29.06	43.56	149.89
119-019	2720m	0.88	22.66	0.91	4.01
119-023	2950m	0.52	49.89	8.67	17.38
119-025	3050m	0.78	46.30	5.05	10.91
119-029	3250m	1.94	29.63	3.63	12.25
119-033	3550m	1.03	40.20	3.15	7.83
119-036	3700m	0.50	35.75	7.88	22.04
119-037B	3750m	-	39.52	-	-
119-039B	3810m	-	47.23	-	-
119-042A	3840m	0.33	36.03	24.73	68.64
119-042C	3850m	0.33	43.85	108.30	246.97
119-047A	3900m	0.42	26.20	13.25	50.58
119-049	3950m	2.33	49.54	2.75	5.55
119-052	3980m	0.89	44.59	3.10	6.96
119-056	4020m	0.68	48.93	2.35	4.81
119-057	4030m	1.37	38.24	1.71	4.47

TABLE 6

VISUAL KEROGEN DATA

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION				THERMAL MATURATION INDEX
		TYPES	REMARKS	PARTICLE SIZE	PRESERV-ATION	
119-003	1920m	H;W-C;S-Am	reworked material present. Minor caved material. Almost 2-	F-M	F-G	1+ to 2-
119-006	2070m	Am*;H-S-W;C	* H passing to Am. Some H at 1+ to 2-	F-M	G	2-
119-010	2270m	H;Am-S-W;C	almost 2-	M	F-G	1+ to 2-
119-012A	2350m	H;Am-W;S-C	abundant pollen	M	G	2-
119-015	2470m	W;H;S-Am-C		M	G	2-
119-019	2720m	C-W;H;S		M	F	2-
119-023	2950m	C;W;H		F-M	F	2-
119-025	3050m	C-W;H;S		M	F-G	2- to 2
119-029	3250m	C-W;-;H	almost 2	F-M	F	2- to 2
119-033	3550m	W-C;H;Al-S	marine algae	F-M	F-G	2- to 2
119-036A	3700m	C-W;-;H	almost 2	M	F	2- to 2
119-042A	3840m	C-W;H;-	almost 2	F-M	F-G	2- to 2
119-047A	3900m	C;W;H	reworked material at 3-	F-M	P-F	2
119-049A	3950m	W;C-Am*;H-S	* finely comminuted, unrecognisable	F-M	F-G	2
119-049B	3950m	C-W;-;H	almost 2 to 2+	F-M	P-F	2
119-051A	3970m		sparse coaly organic matter, no meaningful determination possible	F		
119-052A	3980m	C;W;H		F-C	P-F	2 to 2+
119-052B	4020m	C-W;-;H	reworked material present	F-M	P-F	2 to 2+

Algal, Amorphous, Coaly, Herbaceous, Stem, Woody.

TABLE 6

VISUAL KEROGEN DATA

GEOCHEM SAMPLE NUMBER	DEPTH	ORGANIC MATTER DESCRIPTION				THERMAL MATURATION INDEX
		TYPES	REMARKS	PARTICLE SIZE	PRESERV-ATION	
119-056	4020m	C-W;-;H	reworked material present	F-M	P-F	2 to 2+
119-057	4030m	C;W;H	reworked material present	F-M	P-F	2

Algal, Amorphous, Coaly, Herbaceous, Stem, Woody.

TABLE 7

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

GEOCHEM SAMPLE NUMBER	003	006	008C	010	012	015	017A	019	023	025
DEPTH	1920m	2070m	2170m	2270m	2350m	2470m	2570m	2720m	2950m	3050m
SAMPLE TYPE										
nC_{15}	8.3	12.8	7.0	13.1	15.6	16.4	20.3	17.9	11.7	11.6
nC_{16}	7.4	11.4	6.0	14.7	14.0	16.7	19.9	17.4	10.8	10.6
nC_{17}	5.8	9.0	5.3	12.1	10.7	14.6	14.5	14.4	9.2	8.6
nC_{18}	3.3	4.6	2.7	6.3	6.7	7.5	8.2	8.0	7.3	7.3
nC_{19}	1.5	2.2	1.6	3.6	4.1	4.0	4.0	4.9	6.2	6.2
[illegible]	1.3	1.8	1.3	2.2	4.4	3.6	3.5	4.2	6.1	6.0
nC_{21}	0.8	1.0	0.8	1.6	3.2	2.6	2.3	3.5	5.1	5.2
nC_{22}	1.3	1.4	1.6	2.2	3.6	3.0	4.0	4.0	5.4	5.3
nC_{23}	2.3	1.7	1.9	2.1	3.8	3.6	3.5	3.3	5.1	5.0
nC_{24}	4.4	3.1	4.1	2.7	4.2	3.0	3.0	2.4	4.7	4.7
nC_{25}	7.3	5.0	6.9	3.9	4.5	3.2	2.6	2.4	4.5	4.5
nC_{26}	9.4	7.0	9.9	5.2	5.3	2.9	2.6	2.6	4.1	4.4
nC_{27}	9.8	7.7	10.5	5.7	5.2	3.5	2.3	3.0	4.0	4.0
nC_{28}	9.3	7.0	10.2	4.8	4.0	2.5	1.9	2.3	3.5	3.7
nC_{29}	8.5	7.4	9.1	5.9	3.8	3.7	2.3	3.5	3.5	3.6
nC_{30}	6.4	5.5	7.4	3.8	2.5	2.3	1.6	1.9	2.8	2.8
nC_{31}	5.3	4.8	5.7	4.7	2.3	2.9	1.9	2.3	2.3	2.4
[illegible]	3.3	3.0	3.7	2.1	0.9	1.3	0.7	0.7	1.6	1.5
nC_{33}	2.5	2.1	2.2	2.1	0.8	1.7	0.7	1.0	1.2	1.3
nC_{34}	1.2	0.8	1.3	0.7	0.2	0.5	0.2	0.3	0.6	0.7
nC_{35}	0.6	0.5	0.8	0.5	0.1	0.3	–	–	0.5	0.4
PARAFFIN	17.8	17.3	21.0	10.4	14.7	12.5	8.5	11.2	23.8	20.5
ISOPRENOID	0.6	1.2	0.4	0.9	1.5	1.1	0.6	1.4	2.1	1.8
NAPHTHENE	81.6	81.5	78.6	88.7	83.8	86.4	90.9	87.4	74.1	77.7
CPI INDEX A	1.03	1.00	0.99	0.99	0.97	1.08	0.88	1.00	0.99	0.98
CPI INDEX B	1.07	1.11	1.03	1.25	1.12	1.36	1.17	1.36	1.07	1.05
PRISTANE/PHYTANE	1.38	2.00	1.36	2.22	1.53	1.77	1.23	1.06	1.76	1.83
PRISTANE/nC_{17}	0.32	0.49	0.22	0.52	0.58	0.40	0.26	0.43	0.61	0.67

TABLE 7

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

GEOCHEM SAMPLE NUMBER	029	033	036	037B	039B	042A	042C	047A	049	052
DEPTH	3250m	3550m	3700m	3750m	3810m	3840m	3840m	3900m	3950m	3980m
SAMPLE TYPE										
nC_{15}	17.4	13.7	17.1	10.8	16.5	14.5	8.3	16.9	20.6	21.5
nC_{16}	16.1	14.8	14.7	10.8	16.1	14.6	8.0	15.3	17.8	18.7
nC_{17}	13.3	13.4	12.1	9.6	13.5	12.9	7.0	11.7	14.1	16.5
nC_{18}	8.9	10.1	7.6	5.6	7.4	8.5	4.8	6.4	11.6	12.4
nC_{19}	5.4	7.9	4.7	4.0	4.2	5.2	4.3	3.3	8.6	8.9
[illegible]	4.6	6.7	4.1	4.3	4.5	4.2	5.3	3.0	7.0	7.2
nC_{21}	3.3	5.3	2.9	4.2	3.5	2.8	5.1	1.8	5.1	4.7
nC_{22}	3.5	4.8	2.8	4.9	4.4	2.5	6.4	1.6	3.8	3.3
nC_{23}	3.5	3.9	2.9	4.8	4.2	2.4	5.9	1.6	3.0	2.2
nC_{24}	2.8	3.3	3.1	4.7	3.7	2.7	5.7	1.8	1.9	1.2
nC_{25}	3.0	3.3	3.9	4.7	3.5	3.6	5.6	2.5	1.6	0.8
nC_{26}	3.0	3.0	4.3	4.9	3.3	4.7	5.7	3.6	1.0	0.6
nC_{27}	3.1	2.6	4.5	5.0	3.5	4.7	5.6	3.6	1.3	0.5
nC_{28}	2.6	1.9	4.0	4.6	3.2	4.4	5.1	3.3	0.5	0.2
nC_{29}	3.3	2.3	3.8	4.7	3.3	3.8	5.1	2.5	1.3	0.5
nC_{30}	2.2	1.6	2.8	3.5	2.0	3.1	4.0	1.9	0.2	0.2
nC_{31}	2.0	1.2	2.3	3.4	1.6	2.4	3.5	1.5	0.5	0.3
[illegible]	0.9	0.5	1.1	2.1	0.7	1.3	2.1	0.6	0.2	0.1
nC_{33}	0.7	–	0.7	1.6	0.5	1.1	1.3	0.3	0.2	0.1
nC_{34}	0.2	–	0.4	0.9	0.1	0.5	1.0	–	–	–
nC_{35}	–	–	0.2	0.6	0.1	0.2	0.5	–	–	–
PARAFFIN	12.4	17.9	18.9	18.9	14.2	16.3	19.9	18.0	14.5	18.2
ISOPRENOID	1.2	2.1	1.5	1.0	1.0	1.5	0.9	1.0	2.1	2.7
NAPHTHENE	86.4	80.0	79.6	80.1	84.8	82.2	79.2	81.0	83.4	79.1
CPI INDEX A	1.01	1.01	1.00	0.99	0.97	0.95	0.97	0.94	1.17	1.11
CPI INDEX B	1.20	1.15	1.11	1.10	1.14	1.02	1.07	1.01	1.89	1.43
PRISTANE/PHYTANE	1.43	1.57	1.57	1.42	1.27	1.38	1.14	1.53	1.57	1.42
PRISTANE/nC_{17}	0.42	0.55	0.41	0.33	0.29	0.40	0.36	0.29	0.62	0.52

TABLE 7

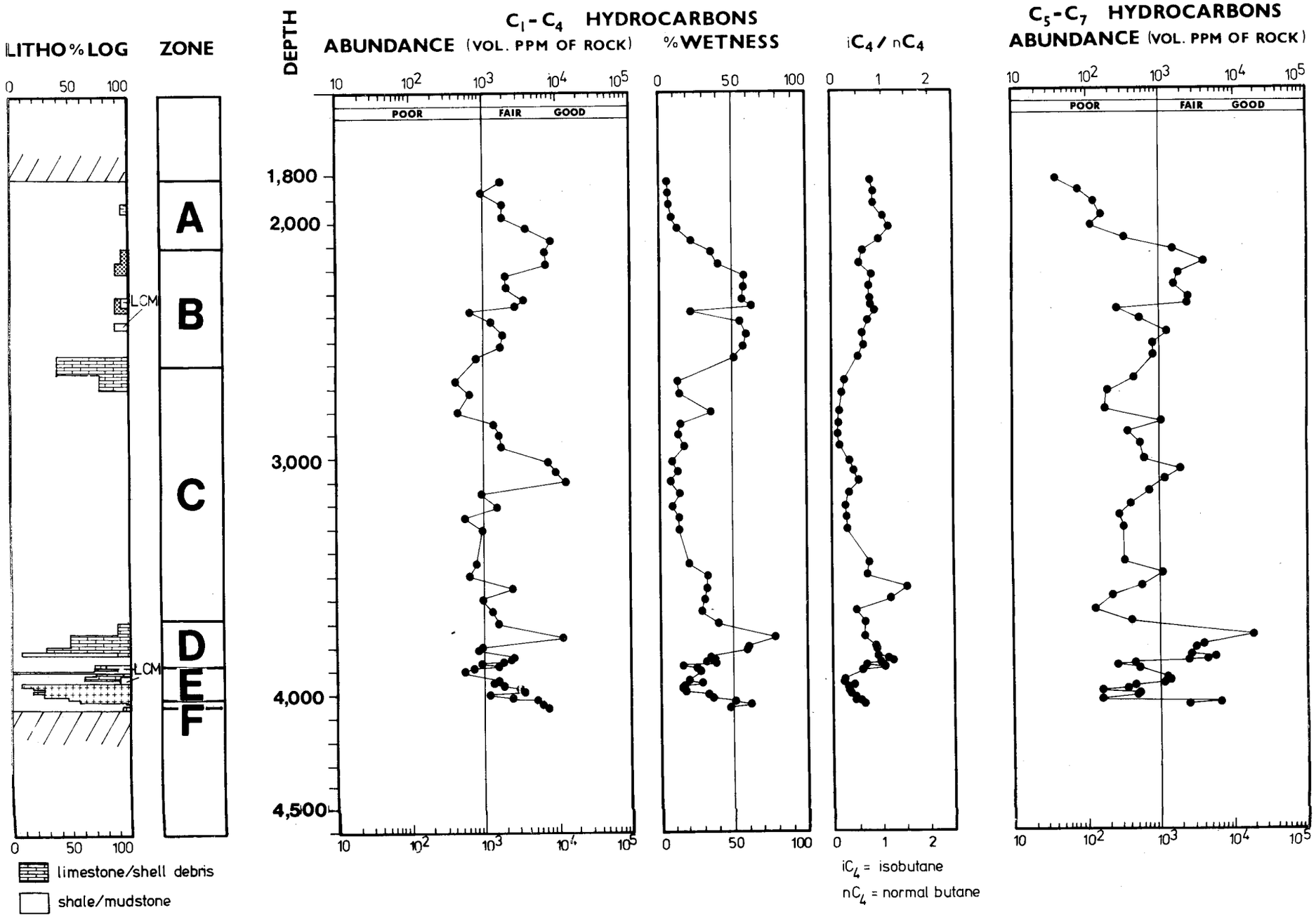
COMPOSITION (NORMALISED %) OF C_{15+} PARAFFIN – NAPHTHENE HYDROCARBONS

GEOCHEM SAMPLE NUMBER	056	057
DEPTH	4020m	4030m
SAMPLE TYPE		
nC_{15}	17.9	17.9
nC_{16}	18.3	16.7
nC_{17}	16.9	14.5
nC_{18}	10.7	10.5
nC_{19}	6.7	7.9
[illegible]	5.3	5.9
nC_{21}	3.7	4.1
nC_{22}	3.5	3.7
nC_{23}	3.2	2.7
nC_{24}	2.3	2.2
nC_{25}	1.9	2.1
nC_{26}	1.4	2.1
nC_{27}	1.2	1.9
nC_{28}	0.9	1.8
nC_{29}	1.2	2.1
nC_{30}	1.2	1.3
nC_{31}	1.4	1.1
nC_{32}	0.7	0.6
nC_{33}	0.7	0.4
nC_{34}	0.5	0.3
nC_{35}	0.5	0.1
PARAFFIN	9.8	15.5
ISOPRENOID	1.0	1.7
NAPHTHENE	89.2	82.8
CPI INDEX A	1.02	0.94
CPI INDEX B	1.17	1.11
PRISTANE/PHYTANE	1.44	1.50
PRISTANE/nC_{17}	0.36	0.46

FIGURE 1

C_1-C_7 HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

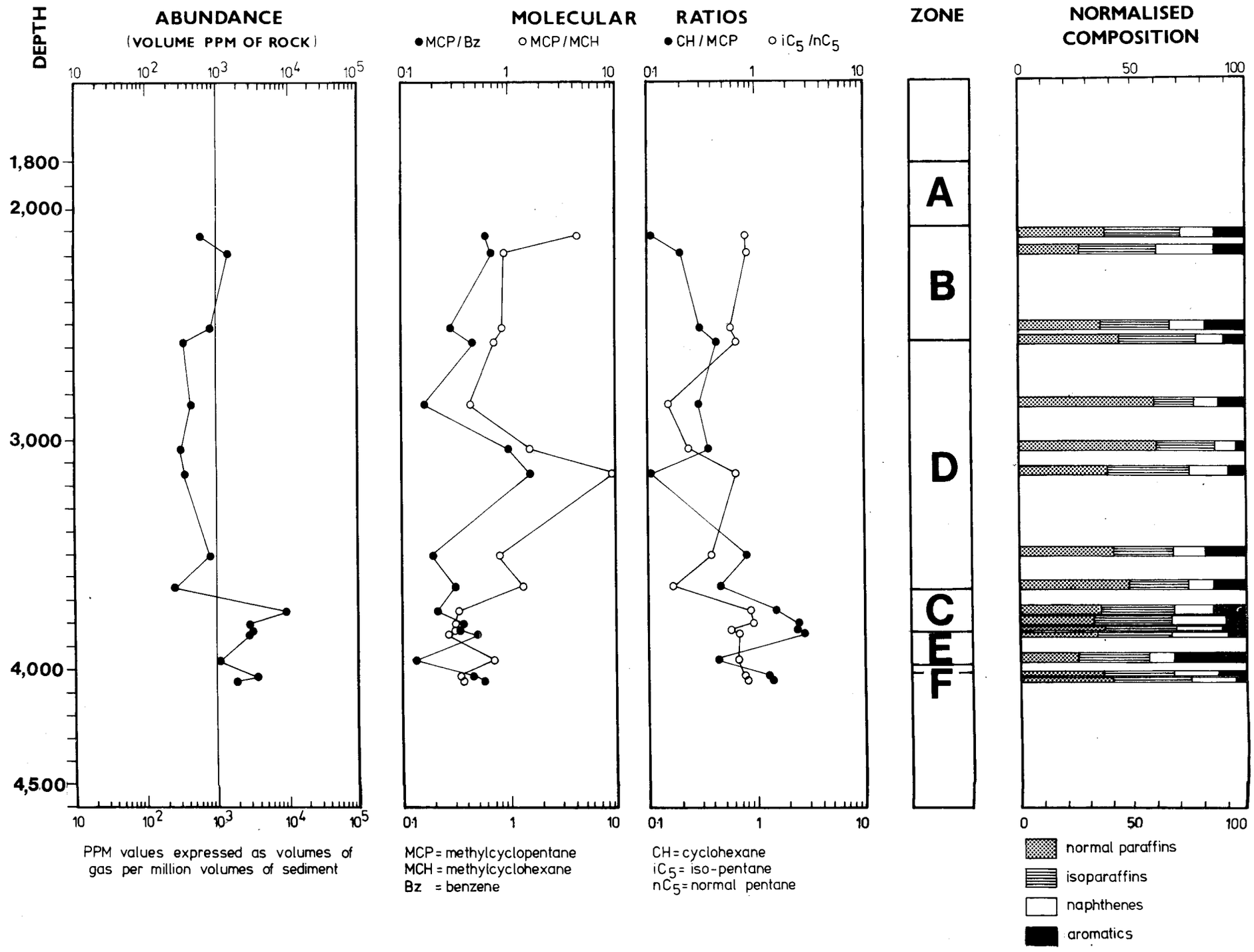


PPM VALUES EXPRESSED AS VOLUMES OF GAS PER MILLION VOLUMES OF SEDIMENT

FIGURE 2

C_4-C_7 HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA



PPM values expressed as volumes of gas per million volumes of sediment

MCP = methylcyclopentane
MCH = methylcyclohexane
Bz = benzene

CH = cyclohexane
iC_5 = iso-pentane
nC_5 = normal pentane

FIGURE 3

C_{15+} HYDROCARBONS — RICHNESS

PRESENTATION OF ANALYTICAL DATA

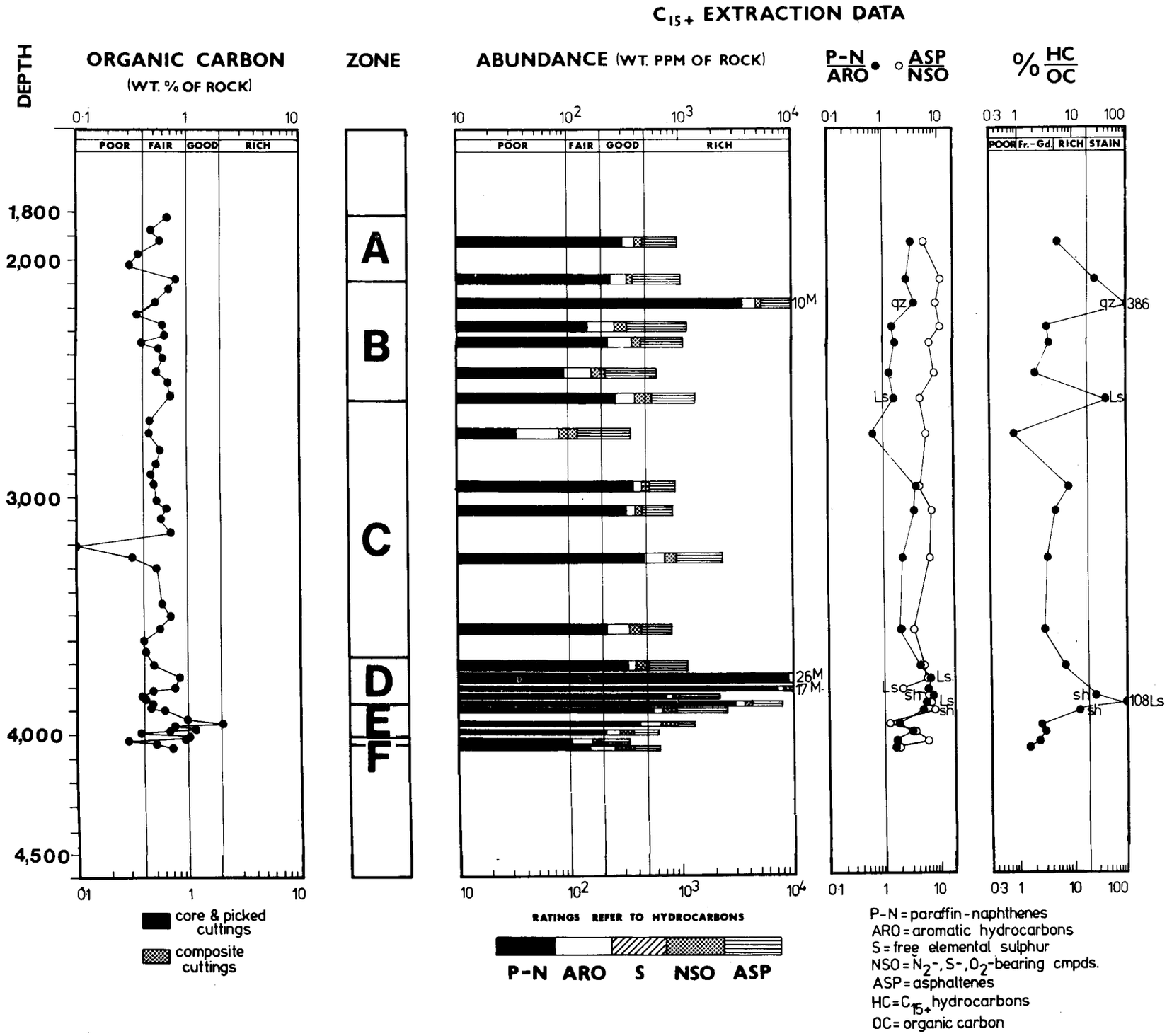


FIGURE 4a

C_{15+} PARAFFIN — NAPHTHENE HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

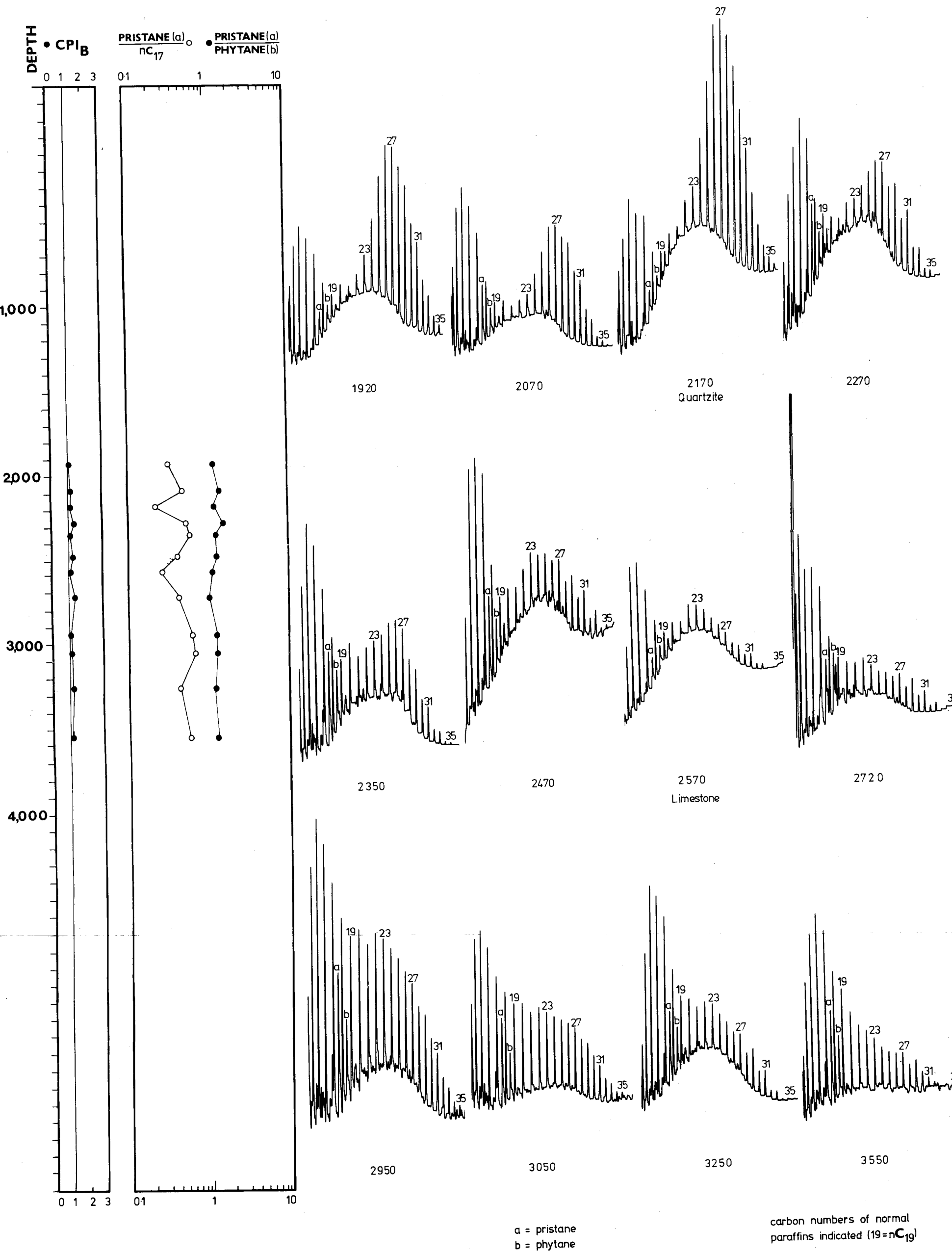


FIGURE 4b

C_{15+} PARAFFIN — NAPHTHENE HYDROCARBONS

PRESENTATION OF ANALYTICAL DATA

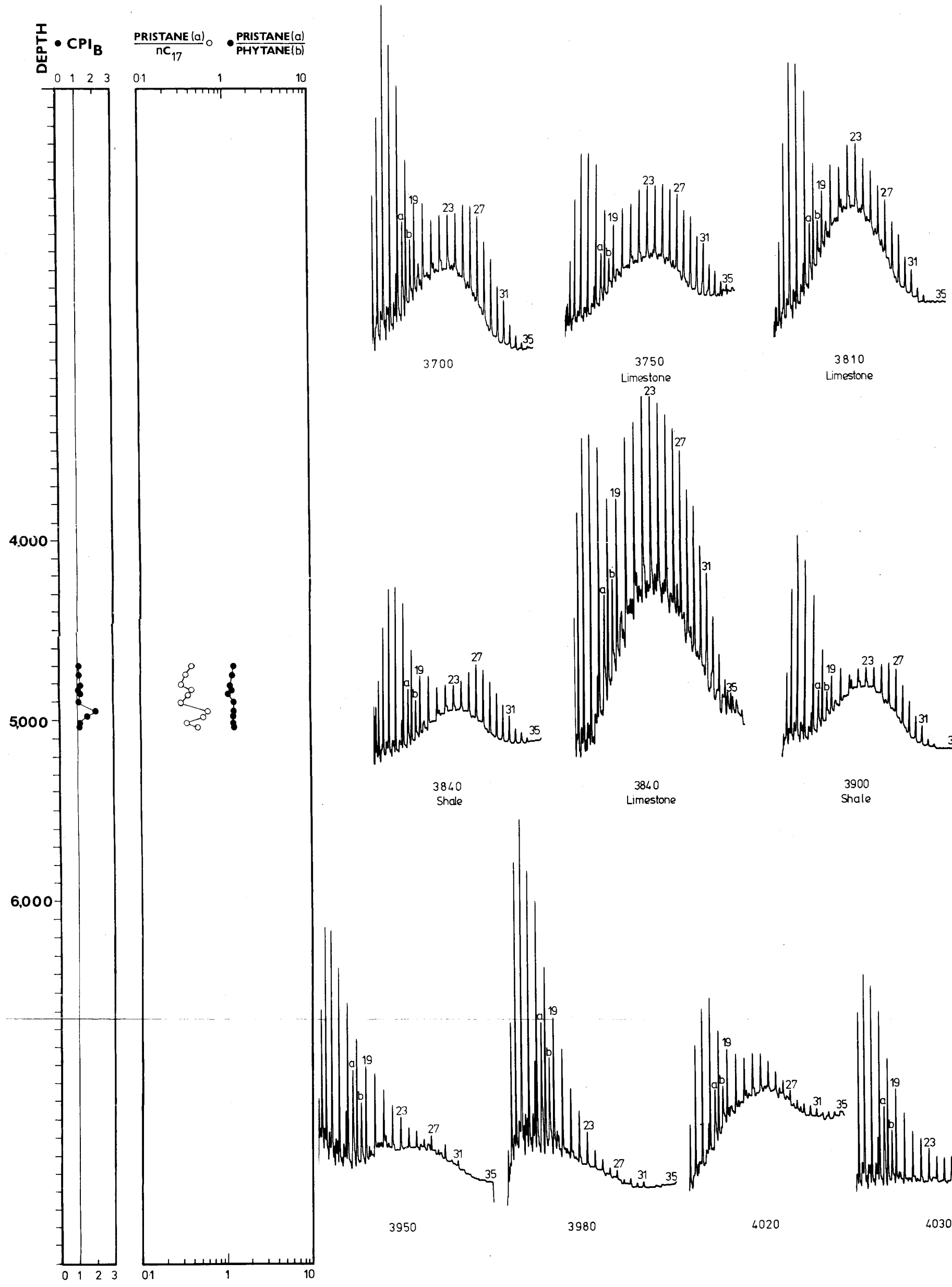
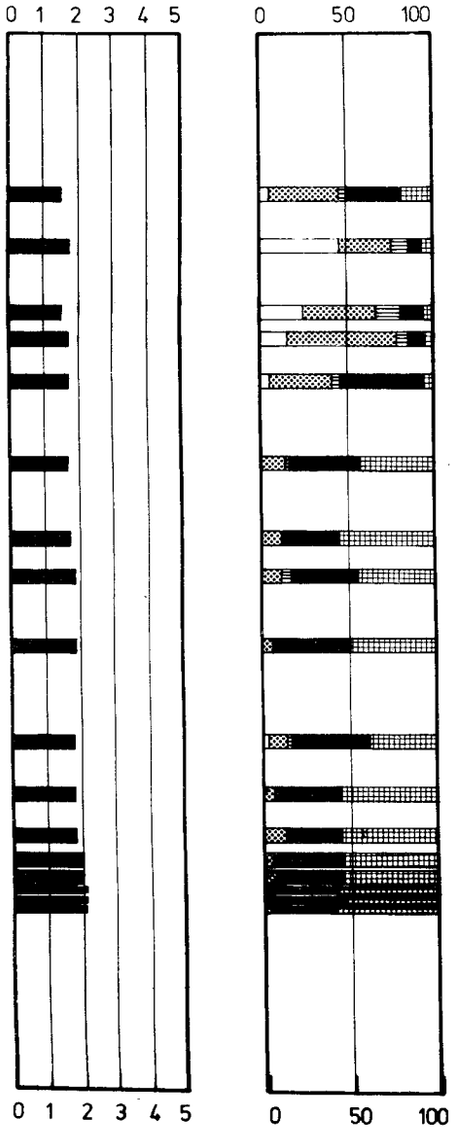


FIGURE 5

INTERPRETATION DIAGRAM

SOURCE TYPE

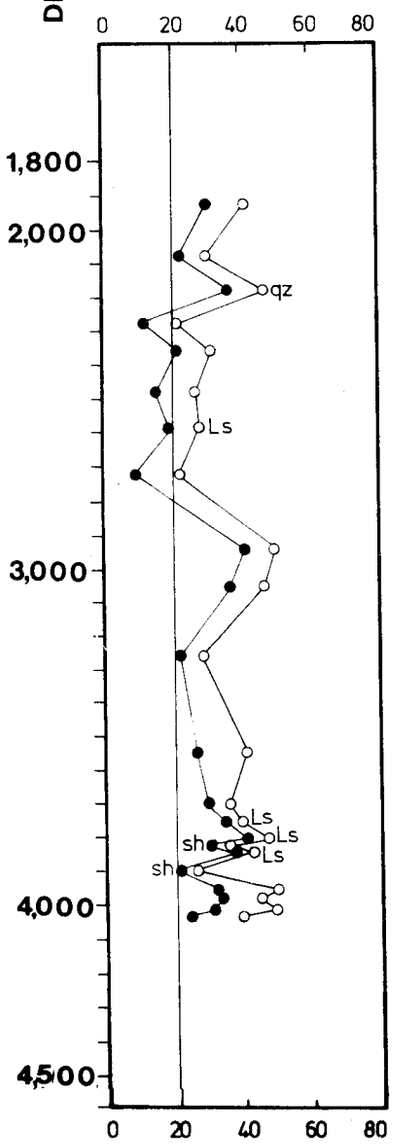
VISUAL KEROGEN



Al = algal
Am = amorphous
H = herbaceous-spore, pollen, cuticle
C = black fusain-related material (C/H hi)
S = stem
W = woody

MATURATION

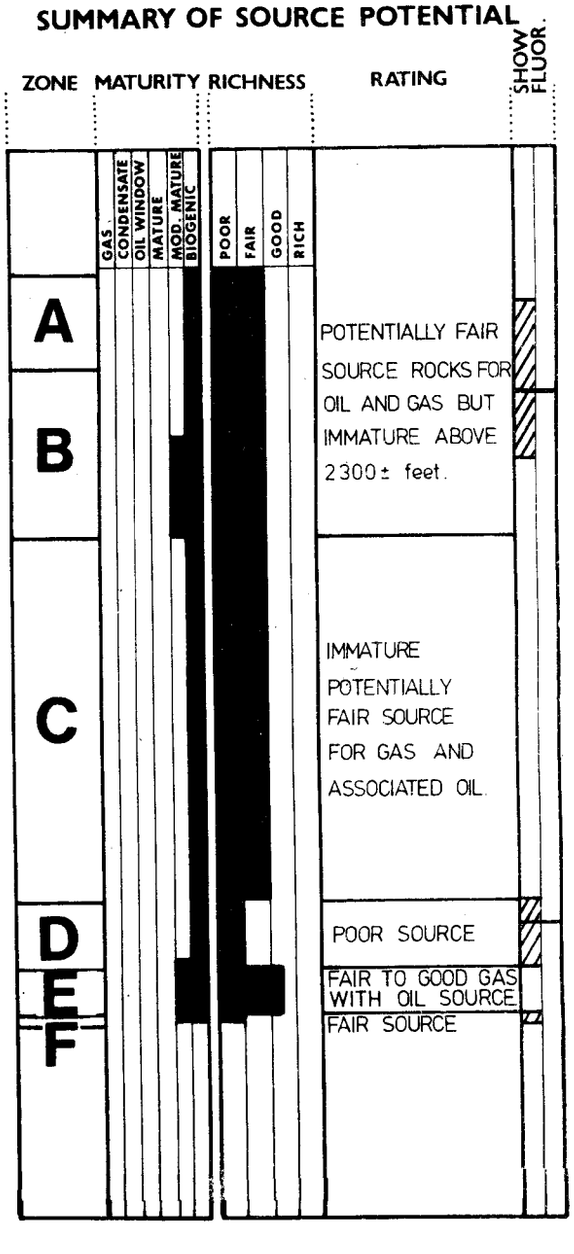
C_{15+} FRACTION



P–N = paraffin-napthenes
TE = total extract
HC = hydrocarbons

RATING

SUMMARY OF SOURCE POTENTIAL



INTERPRETATION BASED UPON BOTH THIS DIAGRAM & THE PREVIOUS FIGURES

"SHOW" BASED UPON GEOCHEMICAL DATA

○ Core
● Cutting

BRIEF DESCRIPTION OF THE ANALYSES PERFORMED BY GEOCHEM

"Screen Analyses" are described in sections A and C, "Sample Preparation" in section B and "Follow-up Analyses" in sections C through G. 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 sealed wet in a plastic bag) for the C_4 - C_7 analysis. The other analyses can also be used on outcrop 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 type, source quality, thermal maturity and the possible presence of migrated hydrocarbons. As this analysis not only provides a lot of information but is also economical, it 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 D). The p.p.m. abundance of the five gases and of the total C_5 - C_7 hydrocarbons are calculated from their electronically integrated peak areas (<u>not</u> 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.

The remaining samples (also washed) are dried and packaged in labelled plastic bags for return to the client. Any hand picked sample remaining after analysis is also returned together with the extracted rock material.

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

C) ORGANIC CARBON ANALYSIS

The organic carbon content of a rock is a measure of its total organic richness. Combined with the visual kerogen, C_1 - C_7, C_4 - C_7 and C_{15+} analyses, the organic carbon content is used to evaluate the hydrocarbon source quality of the sediment. Not only is this analysis an integral part of a total evaluation, but 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, standard 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) DETAILED C_4 - C_7 HYDROCARBON ANALYSIS

The abundance and composition of the C_4 - C_7 gasoline-range hydrocarbons in sediments reflects their source quality, level of thermal maturation and organic facies. In addition, the data also reveal the presence of migrated hydrocarbons and can be used for crude oil-parent source rock correlation studies.

This powerful analysis, performed upon hand picked lithologies, is employed as a follow-up to confirm the potential of samples which have been selected using the initial screen analysis. It is used in conjunction with the organic carbon, visual kerogen and C_{15+} analyses.

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

Tabulation of the composition and p.p.m. abundance of the total gasoline-range fraction is achieved by comparison with a standard. In the report, the data are also presented graphically.

E) C_{15+} EXTRACTION, DEASPHALTENING AND CHROMATOGRAPHIC SEPARATION

Sections "A" and "D" dealt with analyses covering the light end of the hydrocarbon spectrum. This section is concerned with the solvent extractable organic material in the rock with more than fourteen carbon atoms in the molecule (ie. the heavy end). The amount and composition of this fraction indicates source quality, source type, the level of thermal maturation and the possible presence of migrated hydrocarbons. The individual parts into which the total fraction is split, can be submitted for further analyses (carbon isotopes, gas chromatography, high mass spectroscopy) which are primarily designed to correlate crude oils to their parent source rocks (but also see section "F").

These results are integrated with those derived from the visual kerogen, organic carbon and C_4 - C_7 analyses.

The techniques involved in this analysis have been designed to give very reproducible results. Hand picked samples are ground and then solvent extracted in a soxhlet apparatus with benzene-methanol (the solvent system can be adapted to client's specifications). The total extract obtained is then separated by column chromatography into the following fractions: paraffin-naphthene hydrocarbons, aromatic hydrocarbons, eluted NSO's (nitrogen-, sulphur-, and oxygen- containing non-hydrocarbons), non-eluted NSO's and precipitated asphaltenes. Note that the non-hydrocarbons are split into three fractions instead of being reported as a gross value.

For convenience and thoroughness, these data are reported in three formats: the weights of the fractions, their p.p.m. abundance and the percentage composition of the total extract. The data are also presented diagramatically.

Upon completion of the study, the extracts and extracted rock are both returned to the client.

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

The molecular composition of the heavy C_{15+} paraffin-naphthene hydrocarbons reflects source quality, source type, the degree of thermal maturation and the presence of migrated hydrocarbons.

This analysis provides a useful cross-correlation with the visual kerogen, C_{15+} chromatography and light hydrocarbon (C_1 - C_7, C_4 - C_7) analyses.

The paraffin-naphthene hydrocarbons obtained by column chromatography are introduced into the gas chromatograph using a solid rod injection system to ensure that all of the sample, including the heaviest ends, is analysed. Excellent resolution of the individual normal paraffins and of the significant isoprenoids and other isoparaffins is achieved.

The normal paraffin carbon preference indices (C.P.I.) are calculated using the following formulae:

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

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

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

G) VISUAL KEROGEN ANALYSIS

Kerogen is the insoluble organic matter in rocks. Visual examination of the kerogen gives a direct measure of the level of thermal maturation and organic facies and indicates the source quality of the sediment. Source quality is confirmed using the analyses discussed above.

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

Kerogen is separated from the inorganic rock matrix by methods which avoid oxidation of the organic matter. It is then mounted on a glass slide and examined under a high power microscope.

This examination gives the following data: the types (amorphous, algal, herbaceous etc.) and proportions of the organic matter present, the colour and hence level of thermal maturation of the organic matter and the state of preservation of the organic matter.

Our reports include colour transparencies of the kerogen. Upon completion of the study, the glass slides are sent to the client.