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A MATURATION AND SOURCE ROCK STUDY OF THE SECTION 1,800 TO 4,898 METRES OF THE CONOCO NORWAY 24/9-1 WELL, NORWEGIAN NORTH SEA

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INTRODUCTION

A maturation and source rock study has been carried out using canned wet ditch cuttings and sidewall cores from the section 1,800 to 4,898 metres of the Conoco Norway 24/9-1 well, drilled in the Norwegian North Sea.

Evaluation of maturity has been based on analyses of light hydrocarbon, spore colouration, vitrinite reflectivity and maximum palaeotemperature determinations. Analysis for organic carbon was carried out on all the samples received and the analyses were used in the selection of samples for source rock analyses.

All of the canned samples were analysed for headspace gas, (C_1 to C_4 gases). In some cases it was found that the gases had escaped from the cans during transport. Subsequently the samples were washed in cold water to remove drilling mud and, after drying and description, were found to be of good quality for geochemical analysis except for those in the turbo-drilled interval between 2,873 and 3,709 metres. Over this interval some difficulty has been experienced in vitrinite reflectivity analysis, though this is mainly attributable to the lack of organic particles available for measurements in the Upper Cretaceous sediments. The lithologies of the samples suggest that the age of the samples is from Tertiary to Upper Jurassic.

II

RESULTS AND INTERPRETATION

A. MATURITY EVALUATION

Four principal maturation parameters have been used in this study and their results are discussed below:

1. Light Hydrocarbon Analysis (Tables 1 and 2, Figures 1, 2 and 3)

(i) Headspace Gas (Table 1 and Figure 1)

From figure 1 it may be seen that particular trends are present both in the quantity and in the composition of the headspace gases over various intervals throughout the section.

Within the interval 1,800 to 2,760 metres the proportion of wet gas, (ethane, propane and butanes), varies generally between 40% and 80% and the concentration of headspace gas ranges from 2.2 to 10,256 ppm. Most of the samples in this interval have gas concentrations of greater than 1,000 ppm and the highest contents, exceeding 5,000 ppm, are found between 1,800 and 2,000 metres.

Between 2,760 and 4,080 metres the concentrations of C_1 to C_4 gases decrease to a lower level and rarely exceed 2,000 ppm. The amount of wet gas is low, methane accounting for over 80% of the headspace gas in most samples.

Below 4,080 metres and to the base of the section the total headspace gas concentrations are considerably higher, though vary greatly between consecutive samples. Over half the samples give gas concentrations higher than 5,000 ppm and between 4,500 and 4,620 metres concentrations exceed 35,000 ppm. The methane content decreases from about 80% at the top of this interval to 40%, or less, towards the base of the section.

Although the compositions of the gases suggest that the analysed section is mature throughout, that is below 1,800 metres, it would be expected that at shallow depths of 1,800-2,200 metres, the gases would be arising from only transitionally mature sediments. However in some cases, high concentrations

of 7-10,000 ppm are encountered in which wet gases make up a substantial proportion. The possibility of a fault or reservoir rock must therefore be anticipated within the section 1,830-2,010 metres.

(ii) Gaseous Hydrocarbons (Table 2 and Figure 2)

Within a section maturity can be determined by measuring the proportion of methane relative to the other C_2 to C_4 hydrocarbons (ethane to n-butane). In immature sediments only methane of biogenic origin is found, but with increasing maturity, the other hydrocarbons in this range are generated.

The abundance of C_1 to C_4 hydrocarbons varies from 4 to 65 ppb, within the interval 1,860 to 2,730 metres and the methane content is widely varying from less than 10% to around 80%. Between 2,880 and 4,230 metres the adsorbed gas content is very low, 5 to 25 ppb, and some loss of C_1 to C_4 gas is suspected. Methane contents are mainly above 70% in this interval. Within the interval 4,320 to 4,898 metres gas contents are higher at 43 to 673 ppb and the methane content is greatly reduced, wet gases representing over 85% of the total headspace gas.

Like the headspace gases the adsorbed gases show anomalous distributions of concentrations. In the section between 2,040 and 2,250 metres amounts of gas present are indicative of transitional maturity although the richness in wet gases is more suggestive of advanced maturity. It is suggested that either reworked organic matter is present or some contamination by migrant gases.

(iii) Gasoline Range Hydrocarbons (Table 2 and Figure 3)

During gasoline analysis, maturity is generally indicated when all the constituent C_5 to C_7 hydrocarbons are present, and when the difference in percentage abundance between any two of the components is not greater than one order of magnitude. Immature sediments exhibit some components in very high percentage abundance while others are not present in measurable quantities and the total amount of gasolines is often low and usually less

than 100 ppb.

Within the interval 1,860 to 2,250 metres fair quantities of gasoline range hydrocarbons have been found and vary from 46 to 1,153 ppb. The full complement of gasoline components is not present and the pattern is similar to that experienced in sediments containing oil-prone types of organic matter at an early stage of maturation. Very low quantities of gasolines and erratic distributions of the components characterise the interval 2,280 to 3,810 metres suggesting that oil-sourcing organic matter is sparse though not necessarily immature. The short interval 3,960 to 4,260 metres displays low quantities of gasolines but with some components occasionally absent. However the general distribution and percentage abundance of the components present is of an oil-like nature and the sediments, though rather lean, appear mature for oil generation to take place. From 4,320 to 4,898 metres concentrations of gasolines are quite high though not exceptional, ranging from 290 to 5,510 ppb. All the major component gasolines are present but cyclopentane and benzene have only been detected in small quantities. This interval appears to be quite mature for the generation of liquid hydrocarbons.

Headspace gas and absorbed gaseous hydrocarbon data suggest that the analysed interval from 1,830 metres is in the early stages of maturity for the generation of hydrocarbons. Below about 2,700 metres and down to approximately 4,000 metres the sediments continue to mature though they are very lean in organic matter; hence the very low concentrations of gases and gasolines recorded. Below 4,000 metres high contents of headspace gas and gasolines are measured indicating mature oil-prone types of organic matter to be present.

2. Spore Colouration Analysis (Table 3 and 4 and Figure 4)

An effect of maturation processes on sporopollenin is to increase the visible colour density from pale yellow, through orange and brown to black. The determinative procedures of Staplin (1969) have been largely followed in this analysis, except that a ten-point scale of colour indices has been utilised rather than the five-point scale adopted by Staplin.

Within the interval 1,800 to 2,160 metres spore colour indices of about 3 suggestive of sediments transitional from immature to mature are found. Inertinite and sapropel are the dominant kerogen components with minor amounts of vitrinite. In the interval 2,310 to 2,790 metres, spore colours average 3 to 3.5, again indicative of transitional immature to mature sediments. Inertinite is the dominant kerogen with generally minor amounts of sapropel; sapropel is more abundant at 2,610 metres.

Below 2,790 metres spore colour indices indicate mature sediments, with values of 3.5 at 2,880 metres, 3.5-4 at 3,180 metres, 4 at 3,600 metres, 4-4.5 at 3,780 metres, 4.5 at 4,080 metres, 5 at 4,470 metres and 5-5.5 at 4,860 metres.

Within the section from 1,800 to 3,930 metres a wide range in spore colour indices from 2 to 4.5 was noted. Within this interval the kerogen was found to consist mainly of inertinite with subordinate amounts of vitrinite and sapropel, although sapropel is more abundant at 4,860 metres.

A line representing change in value of index with depth has been drawn to pass through the average values and indicates that oil prone source rocks become mature between 2,500 and 3,000 metres depth at index levels of 3 to 3.5 and, at Total Depth, the zone in which oil-prone organic matter is most productive is being reached.

3. Vitrinite Reflectivity Analysis (Table 4 and Figure 5)

Measurement of vitrinite reflectivity was carried out on a total of twenty-six samples using both polished mounted rock chips and kerogen concentrates. The quantities of vitrinite seen were very low in the majority of samples, and seven samples contained insufficient organic particles for any measurements to be made. Homogeneous tabular particles of vitrinite allowed reliable results to be obtained on samples between 1,980 and 2,460 metres and at 4,830 metres at which depths it was possible to measure sufficient numbers of particles, and well defined reflectivity distributions were obtained.

Between 1,980 and 2,610 metres vitrinite reflectivities show a slight increase, (figure 5), and range from 0.31% to 0.36%. From 2,610 to 4,080 metres no readily distinguishable vitrinite particles were seen, the samples either being devoid of any fragments of organic material or containing small quantities of inertinite. Below 4,080 metres vitrinite particles of widely variable, and lower than expected reflectivity, were measured; vitrinite grains have reflectivities of about 0.44% at this depth. Again, in much of this deepest interval inertinite is dominant and vitrinite rare. At a depth of 4,530 metres reflectivity values of 0.55% were obtained from thin vitrinite laminae while at 4,830 metres vitrinite stringers were identified with an average reflectivity of 0.65%. Much of the low reflecting material below 4,080 metres may be resinite.

The rate of increase of reflectivity is low through most of the section, but changes markedly to a higher value below 4,000 metres. There is the possibility of a discontinuity at approximately 2,250 metres depth which is more likely to be a fault than an unconformity.

When the samples were observed in incident blue light small quantities of spores fluorescing pale yellow and yellow were noted between 1,980 to 2,900 metres, but, from 2,800 to 3,900 metres either dull yellow ?exinitic fluorescence or no organic fluorescence was seen. Between depths of 3,960 and 4,530 metres golden-yellow and yellow-orange fluorescing spores were present but only in the sample from 4,350 metres was exinite plentiful. Samples from 4,620, 4,740 and 4,830 metres contained abundant orange and orange-brown fluorescing spores and resin.

The data suggest that an early stage of maturity for oil generation is present between about 2,100 and 2,600 metres where vitrinite reflectivity values of about 0.35% have been measured. Oil-prone types of organic matter are mature for hydrocarbon generation below 4,000 metres and gas generation from humic organic matter seems likely below about 4,500 metres, (reflectivity 0.5%), though the lack of useful data above 4,000 metres and its sparcity below limit the reliability of this interpretation.

4. Maximum Palaeotemperature Analysis (Table 4 and Figure 6)

Maximum palaeotemperature analysis was carried out on a total of fifty-seven samples six of which gave inconsistent values for the measured parameters. The maximum palaeotemperatures plotted against depth, (figure 6), show a fairly uniform increase in values. A gradient has been drawn as a band rather than a single line as this was felt more appropriate in view of the range of values from samples of closely spaced depths. Maximum palaeotemperature values for samples with results following the general trend increase from 218°F at 1,860 metres to 345°F at 4,805 metres depth. There is a hiatus in the results at depths of about 3,300 and 4,000 metres.

The palaeotemperature values are rather higher than would be expected throughout the analysed section when compared with the results of the other methods and the predominance of inertinite in the organic matter is a probable cause.

5. Comparison of Maturation Indices

Though light hydrocarbon analyses suggest that the analysed section is transitionally mature at 1,800 metres, certain features of quantity and concentrations of components suggest that migrant hydrocarbons may be present in the section between 1,800 and 2,250 metres.

Spore colouration indicates that the sediments become mature for the sourcing of oil between 2,500 and 3,000 metres although the data is not precise. Vitrinite reflectivities are fairly consistent with the spore colours measured for the Lower Tertiary and Mesozoic sediments. Reflectivity values approaching 0.4% at 2,500 metres indicate that the sediments are just mature for oil generation, though a probable discontinuity in vitrinite reflectivities suggests the possibility of a fault at 2,250 metres.

Between 3,000 and 4,000 metres only spore colour analysis has given continuous data and together with the other maturation data obtained suggests a very gradual increase in maturity down this interval.

It seems likely that below about 3,860 metres where geochemical parameters indicate a distinct change in the type of organic matter included in the sediments, a zone mature for significant medium to light oil generation is present and continues to Total Depth where hydrocarbon generation would be expected to reach its peak. Appreciable quantities of gas are likely to be generated from humic, gas-prone types of organic matter below about 4,500 metres.

It is noted that maximum palaeotemperatures are not consistent with the other maturation parameters throughout the section.

B. SOURCE ROCK EVALUATION (Table 5 and Figures 8, 9 and 10)

All the samples of cuttings and sidewall cores were screened for organic carbon content, a total of ninety samples, before full source rock analysis. On reviewing the results, a total of fifty-seven samples were selected for source rock analysis. The results are discussed in four parts in view of the geochemical results, lithologies and the probable changes in stratigraphic ages which they suggest.

1. Interval 1,800 to 2,250 metres (Samples 1 to 11)

This interval consists of light to medium grey and olive-grey shales often silty. These shales have organic carbon contents in the range 0.55% to 1.55% which are below average to average for argillaceous lithologies. The extractability of the samples in organic solvents is highly variable from 0.5% to a maximum of 19% though most samples have extractabilities of less than 7%. Hydrocarbon abundances are poor to fair ranging from less than 20 ppm to 190 ppm, four samples having hydrocarbon concentrations of more than 100 ppm.

On considering the probable hydrocarbon product from these sediments, figure 8, it is seen that gas or gas-and-some-oil are most likely though sample 5, 1,980-2,010 metres, indicates the presence of an oil-prone horizon. On reviewing the richness of the shales they are seen to have a poor to fair potential as hydrocarbon source rocks (figure 9). In view of the probable marginal state of maturity reached by these sediments, the major hydrocarbon generation zone has not yet been reached. Off structure, this interval may have significant hydrocarbon source potential, and some of the extract may in small part be migrant hydrocarbons.

2. Interval 2,280 to 2,820 metres (Samples 12 to 25)

This interval comprises green-grey and grey shales as identified in sidewall core samples and shales and kaolin-quartz mixtures in the cuttings the latter probably being break-down products of the sand encountered in this interval. Organic carbon contents are mainly below average ranging from 0.13% to 0.68% with one exception, a grey shale from 2,541 metres with an organic

carbon content of 1.30%. The extractability of the organic matter in this interval is variable, from 3.8% to 22.3%, but generally higher than in the preceding interval. Hydrocarbon abundances are low throughout and range from less than 20 ppm to 80 ppm.

The suggested hydrocarbon product from all the analysed horizons is gas (figure 8). In view of the leanness of the samples in organic carbon, (a content of at least 2% organic carbon being considered necessary for a good gas source), and the low state of maturity it is thought that this interval has no significant hydrocarbon source potential.

3. Interval 2,844.5 to 3,870 metres (Samples 26 to 52)

Ditch cuttings samples from this interval were identified as mixed lithologies of grey shales and mudstones with traces of limestone and sand. The sidewall core samples, of good quality through the interval, comprised grey calcareous shales. Organic carbon contents are low in all samples ranging from 0.13% to 0.60%. The sidewall core samples have similar organic carbon contents to the shale/mudstone lithologies of the cuttings and so prove the sediments to be quite lean in organic matter. Extractabilities in the interval are variable though generally less than 7.3% with a full range of 5.0% to 17.3%. Hydrocarbon concentrations are very low and not greater than 55 ppm except in samples 39, 3,360-90 metres and 42, 3,475 metres with 175 ppm and 330 ppm hydrocarbons respectively.

The general leanness in both organic carbon and generated hydrocarbons discounts the majority of the analysed horizons as potential source rocks for either gaseous or liquid hydrocarbons. Analysis of sample 39, 3,360-90 metres has suggested an horizon with a fair potential for the sourcing of minor quantities of oil while sample 42, 3,475 metres, has indicated sediments with a good oil sourcing capability. However the very high proportion of hydrocarbons in the extract of this sample may in part be due to oil-staining, figure 8, and this possibility cannot be excluded.

4. Interval 3,873 to 4,320 metres (Samples 53 to 64)

Grey and dark grey shales are found in this interval and traces of coaly material were identified. Organic carbon contents are slightly higher than in the previous interval ranging from 0.24% to 2.81% though only occasional samples have average shale carbon contents of 1% to 2%. Sample 59, a shale with minor coal has a content of 2.81% organic carbon. Extractabilities in the interval are generally low at 2.7% to 6.3% with one higher value of 11.4% for sample 56, 3,990-4,020 metres. Hydrocarbon abundances are low throughout the interval and do not exceed 95 ppm.

The samples analysed from this interval are suggested only as possible gas sources by the analysis (figure 8). However they are generally too lean in organic matter for significant gas to be sourced except possibly at 4,080-110 metres, a richer horizon represented by sample 59. Sample 63, 4,260-90 metres suggests an horizon with a very limited potential for the sourcing of oil-with-gas. It is doubtful whether any of the horizons mentioned in this interval have reached an optimum state of maturity for the appreciable generation of their respective hydrocarbon products.

5. Interval 4,324 to 4,898 metres (Samples 65 to 87)

This interval comprises dark grey and black shales and siltstones with occasional sandstones. The organic carbon content of the samples is much greater than in any of the preceding intervals ranging from 1.16% to 9.0% in shale and siltstone dominated samples and the sidewall cores of black shales have organic carbon contents of between 6.6% and 9.0%. Extractabilities are quite variable over this interval varying from 0.4% to 14.2% though the majority of samples have extractabilities in the 3% to 10% range. Hydrocarbon abundances are high especially in the black shales and low as might be expected in the sandstone samples. No clearly identifiable hydrocarbon staining has been noted in the sandstones.

These samples have suggested a wide range in hydrocarbon products and source potential (figures 8 and 9) and are split into groups for discussion.

Samples 75, 77, 80, 83, 84 and 86 are suggested as containing gas-prone types of organic material and several have organic carbon contents of the order required to source significant gas. Of these six samples, samples 83 and 84 were noted to contain a black waxy substance, possibly bitumen or dead oil. Gas-with-oil is the predicted product from the horizons represented by samples 65 and 69 and both have a fair potential for the sourcing of these hydrocarbons. Oil-prone types of organic matter have been suggested in the analysis of samples 67, 72, 73, 76 and 79; black shales and siltstones, and the concentrations of hydrocarbons present suggest that horizons with fair and good oil-source potential are present. A sandstone sample, 85, from 4,816 metres contains a significant proportion of hydrocarbons but has a low extractability suggesting the existence of bitumen. Very high proportions of hydrocarbons have been found in the organic extracts of samples 66 and 70 suggesting that the siltstones and shales analysed contain non-indigenous hydrocarbons in addition to their indigenously generated hydrocarbons and this has given rise to oil staining.

It is clear from these results that several good source horizons for oil and oil-with-gas are present in this lower interval and that hydrocarbon migration has taken place. This interval is sufficiently mature to source significant quantities of oil with associated gas.

III

CONCLUSIONS

An integration of the results of maturation and source rock analyses of the section 1,800 to 4,898 metres of the Conoco Norway 24/9-1 well leads to the following conclusions;

i) Interval 1,800 to 2,500 metres. This interval though appearing marginally mature, is probably immature for hydrocarbon generation, migrant hydrocarbons having been detected during light hydrocarbon analysis. The sediments included in this interval are believed to have no present potential for the sourcing of hydrocarbons.

ii) Interval 2,500 to 2,820 metres. This interval is at a very early to transitional stage of maturity for liquid hydrocarbon generation. The sediments are generally lean in organic carbon and generated hydrocarbons. The interval is not considered to have a significant hydrocarbon sourcing capability at present.

iii) Interval 2,844.5 to 3,870 metres. This interval is mature for heavy, grading to medium gravity oil generation. The sediments are generally very lean and have no source potential. However, two hydrocarbon rich horizons, at 3,360-90 metres and 3,475 metres have been encountered and may have limited capability to source oil.

iv) Interval 3,873 to 4,320 metres. Though mature for liquid hydrocarbon generation this interval is organically lean and only low concentrations of hydrocarbons are present. It is doubtful whether any significant hydrocarbon source rocks occur on the basis of the analyses conducted.

v) Interval 4,324 to 4,898 metres. This interval is mature for the generation of medium to light oil and, below about 4,500 metres, significant gas generation is likely. Several good and fair potential oil-source horizons have been noted and also horizons with oil-and-gas and gas potential. Hydrocarbon staining is suspected at depths of 4,350-80 and 4,433 metres and

traces of bitumen have been seen. The interval between 4,324 and 4,699 metres appears to be capable of sourcing liquid and, in part, gaseous hydrocarbons.

TABLE 1

HEADSPACE GAS ANALYSIS DATA

CLIENT: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

Sample Depth Metres	Total C_1-C_4 Gas ppm	Percent C_1	Percent C_2	Percent C_3	Percent iso C_4	Percent nC_4
1800 - 30	34	52.9	17.64	8.82	14.71	5.88
1830 - 60	6988	56.3	13.44	11.55	12.26	6.45
1860 - 90	95	52.6	11.58	10.53	14.74	10.53
1890 - 920	10256	64.9	14.15	9.95	8.36	2.55
1920 - 50	-	-	-	-	-	-
1950 - 80	7255	71.4	13.23	7.44	5.78	2.15
1980 - 2010	7194	50.1	15.57	20.64	9.13	4.56
2010 - 40	1389	49.2	13.46	20.59	8.64	8.14
2040 - 70	218	25.7	12.39	26.61	17.89	17.43
2070 - 100	47	4.3	6.38	25.53	29.17	34.04
2100 - 30	2.87	34.9	1.74	12.54	28.57	22.29
2130 - 60	-	-	-	-	-	-
2160 - 90	-	-	-	-	-	-
2190 - 220	-	-	-	-	-	-
2220 - 50	-	-	-	-	-	-
2250 - 80	3774	53.3	12.98	19.16	6.31	8.24
2280 - 310	3566	28.6	17.36	33.96	8.55	11.49
2310 - 40	3596	45.9	13.04	29.00	5.17	6.84
2340 - 70	1302	19.6	11.83	41.24	12.59	14.75
2370 - 400	618	26.7	18.28	40.61	6.15	8.25
2400 - 30	128	36.7	14.17	41.67	3.33	4.21
2430 - 60	39	35.9	7.69	28.21	10.26	17.95
2460 - 90	771	63.4	8.82	14.53	4.67	8.56
2490 - 520	25	60.0	4.04	16.00	8.00	12.00
2520 - 50	1454	53.7	11.00	17.54	8.05	9.69
2550 - 80	No	Gas	No	Gas	No	Gas
2580 - 610	121	52.1	10.74	20.66	5.79	10.74
2610 - 40	1605	33.6	10.28	31.28	7.41	17.38
2640 - 70	3202	27.7	11.89	32.10	12.21	16.11
2670 - 700	1148	32.7	13.24	30.14	10.37	13.59
2700 - 30	No	Gas	No	Gas	No	Gas
2730 - 60	2.2	45.5	tr	18.18	9.09	27.27
2760 - 90	130	66.2	13.08	10.00	2.31	8.46
2790 - 820	29	27.6	27.59	20.69	6.89	17.24
2820 - 50	232	66.4	14.66	16.38	0.43	2.16
2850 - 80	315	71.4	8.88	12.38	1.27	6.03
2880 - 910	4.2	95.2	4.76	tr	-	-
2910 - 40	235	79.2	8.51	7.66	1.28	3.40
2940 - 70	895	79.8	8.72	7.26	0.89	3.35
2970 - 3000	2.4	83.3	4.16	8.33	tr	4.16
3000 - 30	481	82.9	6.45	6.03	0.62	3.95
3030 - 60	601	36.9	38.10	2.99	0.17	1.83
3060 - 90	No	Gas	No	Gas	No	Gas
3090 - 120	300.6	87.8	6.99	3.99	0.20	0.99
3120 - 50	188.4	89.2	6.37	3.18	0.21	1.06
3150 - 80	155.3	88.9	7.08	3.22	0.19	0.64
3180 - 210	263	82.9	7.98	5.32	0.38	3.42
3210 - 40	49.4	95.2	4.05	0.81	-	-

TABLE 1 (Cont'd)

HEADSPACE GAS ANALYSIS DATA

CLIENT: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

Sample Depth Metres	Total C_1-C_4 Gas ppm	Percent C_1	Percent C_2	Percent C_3	Percent iso C_4	Percent nC_4
3240 - 70	973	87.2	8.22	3.08	0.31	1.23
3270 - 300	191.5	86.2	7.83	4.69	0.26	1.04
3300 - 30	496	87.7	8.27	3.23	0.20	0.60
3330 - 60	2528	86.1	9.29	3.68	0.24	0.67
3390 - 420	826	85.5	7.26	3.51	0.61	3.15
3420 - 50	1628	90.4	6.57	2.33	0.18	0.55
3450 - 80	No	Gas	No	Gas	No	Gas
3480 - 510	1542	88.6	8.30	2.39	0.19	0.58
3510 - 40	1480	89.3	7.91	2.09	0.20	0.54
3540 - 70	1018	90.7	6.58	2.16	0.19	0.39
3570 - 600	1994	73.8	8.58	17.20	0.15	0.30
3600 - 630	504	84.9	12.30	1.98	0.19	0.59
3630 - 60	82.2	79.1	15.81	3.65	0.49	0.97
3660 - 90	1270	91.7	6.29	1.57	0.15	0.31
3690 - 720	941	93.3	4.99	1.06	0.21	0.43
3720 - 50	592	88.9	7.43	2.36	0.34	1.01
3750 - 80	19.3	93.3	4.66	2.07	-	-
3780 - 810	334	85.1	8.36	4.48	0.59	1.19
3810 - 40	1222	87.2	6.14	4.42	0.57	1.63
3840 - 70	931	90.2	6.77	1.93	0.32	0.75
3870 - 900	426	91.5	5.87	1.87	0.23	0.46
3900 - 30	405	88.9	7.65	2.22	0.49	0.74
3930 - 60	1675	85.1	7.70	3.13	0.42	1.61
3960 - 90	21.1	80.6	4.27	9.48	1.42	4.27
3990 - 4020	2722	81.6	10.76	6.43	0.73	0.44
4020 - 50	No	Gas	No	Gas	No	Gas
4050 - 80	35.6	89.8	5.62	2.81	0.28	1.40
4080 - 110	No	Gas	No	Gas	No	Gas
4110 - 140	310.4	57.0	41.24	1.6	tr	0.13
4140 - 70	1078.3	73.8	25.68	0.46	tr	0.03
4170 - 200	10772	66.9	12.58	0.37	0.03	0.05
4200 - 30	19944	64.7	30.94	4.21	0.02	0.10
4230 - 60	2483	73.8	21.47	3.91	0.24	0.60
4260 - 90	2061	83.1	13.97	2.47	0.09	0.39
4290 - 320	886	14.5	16.89	33.78	3.57	16.79
4320 - 50	380	19.5	16.58	40.00	3.42	20.53
4350 - 80	5343	48.3	20.96	20.23	2.49	7.97
4380 - 410	2107	46.2	24.29	20.97	2.14	6.41
4410 - 40	17755	36.9	19.22	27.87	3.67	12.36
4440 - 470	7425	63.9	19.54	8.20	2.11	6.24
4470 - 500	-	-	-	-	-	-
4500 - 30	35030	66.0	16.14	12.49	1.73	3.63
4530 - 60	50669	52.2	19.79	18.63	2.63	6.79
4560 - 90	54762	42.8	23.76	22.66	3.17	7.63
4590 - 620	37924	59.4	19.41	15.06	1.88	4.28
4620 - 50	4360	49.6	24.70	24.45	0.39	0.87
4650 - 80	-	-	-	-	-	-

TABLE 1

HEADSPACE GAS ANALYSIS DATA

CLIENT: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

Sample Depth Metres	Total C_1-C_4 Gas ppm	Percent C_1	Percent C_2	Percent C_3	Percent iso C_4	Percent nC_4
4680 - 710	369	16.3	26.29	38.21	3.15	14.09
4740 - 70	14829	31.6	23.73	15.40	2.76	6.46
4770 - 800	261	13.8	14.18	35.25	8.81	27.97
4800 - 30	344	33.7	18.02	27.62	5.23	15.41
4830 - 60	4380	79.5	9.25	8.61	1.03	1.59
4860 - 90	45466	46.2	21.58	24.28	0.33	7.57
4890 - 98	54234	60.9	19.27	14.39	2.11	3.32

TABLE 2

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	3		4		6		8	
DEPTH METRES	1860-90		1920-50		2040-70		2100-30	
	P. P. B.	% $C_1 - C_4$	P. P. B.	% $C_1 - C_4$	P. P. B.	% $C_1 - C_4$	P. P. B.	% $C_1 - C_4$
C_1	4	80	5	83	5	11	5	14
C_2	1	20	1	17	1	2	1	3
C_3	*	*	tr	*	2	4	2	6
iC_4	*	*	*	*	11	24	8	22
nC_4	*	*	*	*	27	59	20	56
TOTAL	5	(100)	6	(100)	46	(100)	36	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	3		4		6		8	
DEPTH METRES	1860-90		1920-50		2040-70		2100-30	
	P. P. B.	% $C_5 - C_7$	P. P. B.	% $C_5 - C_7$	P. P. B	% $C_5 - C_7$	P. P. B.	% $C_5 - C_7$
ISO-PENTANE	*	*	9	2	9	1	75	7
N-PENTANE	*	*	2	1	8	1	80	7
CYCLOPENTANE	2	1	12	2	23	3	23	2
2-ME. PENTANE	11	6	60	11	42	5	84	7
3-ME. PENTANE	10	6	34	6	64	7	51	4
N-HEXANE	10	6	39	7	99	11	99	8
ME. CYCLOPENTANE	9	5	15	3	114	13	106	9
CYCLOHEXANE	7	4	19	3	100	11	104	9
2-ME. HEXANE	35	20	95	17	79	9	91	8
3-ME. HEXANE	27	15	78	14	76	9	70	6
3-ETHYLPENTANE	21	12	57	10	45	5	73	6
N-HEPTANE	7	4	22	4	48	5	44	4
BENZENE	tr	*	8	1	*	*	6	1
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	37	21	112	20	160	18	247	21
TOTAL	176	(100)	560	(100)	887	(100)	1153	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	10		11		12		14	
DEPTH METRES	2160-90		2220-50		2280-320		2400-30	
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$
C_1	5	21	5	8	7	29	9	41
C_2	1	5	2	3	1	4	1	5
C_3	2	9	7	11	2	8	1	5
iC_4	6	27	22	33	5	20	4	18
nC_4	8	36	29	45	9	37	7	32
TOTAL	22	(100)	65	(100)	24	(100)	22	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	10		11		12		14	
DEPTH METRES	2160-90		2220-50		2280-320		2400-30	
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	tr	*	39	11	2	3	2	9
N-PENTANE	4	8	15	4	2	3	1	4
CYCLOPENTANE	tr	*	10	3	1	2	tr	*
2-ME. PENTANE	2	4	32	9	3	5	1	4
3-ME. PENTANE	2	4	23	7	2	3	1	4
N-HEXANE	3	7	23	7	3	5	1	4
ME. CYCLOPENTANE	5	11	33	9	5	8	2	9
CYCLOHEXANE	*	*	26	8	6	10	2	9
2-ME. HEXANE	4	8	27	8	4	7	1	4
3-ME. HEXANE	3	7	19	6	4	7	1	4
3-ETHYLPENTANE	3	7	28	8	6	10	3	13
N-HEPTANE	7	15	6	2	2	3	1	4
BENZENE	*	*	*	*	*	*	*	*
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	13	28	64	19	21	34	7	30
TOTAL	46	(100)	345	(100)	61	(100)	23	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	18		21		27		-	
DEPTH METRES	2580-610		2700-30		2880-910		2970-3000	
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P.P.B.	$\%C_1 - C_4$
C_1	3	75	4	80	5	83	10	56
C_2	1	25	1	20	1	17	4	22
C_3	tr	*	*	*	*	*	2	11
iC_4	*	*	*	*	*	*	1	6
nC_4	*	*	*	*	*	*	1	6
TOTAL	4	(100)	5	(100)	6	(100)	18	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	18		21		27		-	
DEPTH METRES	2580-610		2700-30		2880-910		2970-3000	
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	4	6	2	10	tr	*	tr	*
N-PENTANE	5	7	2	10	4	24	4	22
CYCLOPENTANE	1	1	*	*	*	*	tr	*
2-ME. PENTANE	5	7	2	10	2	12	1	5
3-ME. PENTANE	4	6	1	5	1	6	1	5
N-HEXANE	12	17	4	20	3	9	4	22
ME. CYCLOPENTANE	3	4	1	5	1	6	1	5
CYCLOHEXANE	5	7	2	10	*	*	2	11
2-ME. HEXANE	4	6	1	5	2	12	1	5
3-ME. HEXANE	3	4	tr	*	1	6	tr	*
3-ETHYLPENTANE	4	6	tr	*	tr	*	tr	*
N-HEPTANE	3	4	1	5	tr	*	1	5
BENZENE	*	*	tr	*	1	6	*	*
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	16	23	4	20	2	12	3	16
TOTAL	69	(100)	20	(100)	17	(100)	18	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	33		40		45		50	
DEPTH METRES	3120-50		3420-50		3600-30		3780-810	
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$
C_1	5	100	23	96	18	90	11	73
C_2	tr	*	1	2	1	5	1	7
C_3	tr	*	1	2	1	5	3	20
iC4	tr	*	tr	*	tr	*	tr	*
nC4	tr	*	tr	*	tr	*	tr	*
TOTAL	5	(100)	25	(100)	20	(100)	15	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	33		40		45		50	
DEPTH METRES	3120-50		3420-50		3600-30		3780-810	
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	tr	*	tr	*	tr	*	tr	*
N-PENTANE	1	7	4	31	1	20	3	30
CYCLOPENTANE	tr	*	tr	*	*	*	tr	*
2-ME. PENTANE	1	7	1	8	tr	*	*	*
3-ME. PENTANE	1	7	1	8	tr	*	*	*
N-HEXANE	3	21	2	15	1	20	2	20
ME. CYCLOPENTANE	1	7	1	8	1	20	tr	*
CYCLOHEXANE	2	14	1	8	tr	*	1	10
2-ME. HEXANE	1	7	1	8	tr	*	1	10
3-ME. HEXANE	tr	*	tr	*	*	*	1	10
3-ETHYLPENTANE	tr	*	tr	*	*	*	*	*
N-HEPTANE	1	7	1	8	1	20	1	10
BENZENE	*	*	*	*	*	*	*	*
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	3	21	1	8	1	20	1	10
TOTAL	14	(100)	13	(100)	5	(100)	10	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	55		-		-		-	
DEPTH METRES	3960-90		4050-80		4230-60		4320-50	
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$
C_1	14	88	10	84	7	70	6	3
C_2	1	6	1	8	3	30	10	6
C_3	1	6	1	8	tr	*	64	4
iC_4	tr	*	*	*	tr	*	11	6
nC_4	tr	*	tr	*	tr	*	86	49
TOTAL	16	(100)	12	(100)	10	(100)	177	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	55		-		-		-	
DEPTH METRES	3960-90		4050-80		4230-60		4320-50	
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	4	10	8	3	10	16	73	5
N-PENTANE	7	17	58	23	12	19	181	12
CYCLOPENTANE	tr	*	5	2	2	3	15	1
2-ME. PENTANE	2	5	21	8	4	6	84	6
3-ME. PENTANE	1	2	12	5	1	2	54	4
N-HEXANE	7	17	42	17	10	16	158	11
ME. CYCLOPENTANE	2	5	12	5	2	3	67	5
CYCLOHEXANE	3	7	16	6	4	6	68	5
2-ME. HEXANE	3	7	14	6	3	5	98	7
3-ME. HEXANE	2	5	12	5	2	3	97	7
3-ETHYLPENTANE	tr	*	6	2	1	2	61	4
N-HEPTANE	5	12	21	8	7	11	233	16
BENZENE	tr	*	tr	*	tr	*	5	1
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	5	12	21	8	6	9	231	16
TOTAL	41	(100)	248	(100)	64	(100)	1425	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	-		71		-		78	
DEPTH METRES	4410-40		4500-30		4590-620		4680-710	
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$
C_1	6	1	5	7	10	14	13	5
C_2	31	5	3	4	2	3	4	1
C_3	225	33	19	27	14	20	66	24
iC_4	61	9	9	13	7	10	35	13
nC_4	350	52	35	49	38	54	154	57
TOTAL	673	(100)	71	(100)	71	(100)	272	(100)

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	-		71		-		78	
DEPTH METRES	4410-40		4500-30		4590-620		4680-710	
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	672	12	262	13	91	7	34	12
N-PENTANE	1086	18	438	21	131	10	42	14
CYCLOPENTANE	61	1	26	1	15	1	5	2
2-ME. PENTANE	264	5	204	10	98	8	34	12
3-ME. PENTANE	299	5	103	5	61	5	18	6
N-HEXANE	566	10	357	18	206	16	41	14
ME. CYCLOPENTANE	403	7	88	4	48	4	8	3
CYCLOHEXANE	385	7	78	4	68	5	12	4
2-ME. HEXANE	430	8	94	5	100	8	21	7
3-ME. HEXANE	368	7	76	4	84	7	16	6
3-ETHYLPENTANE	206	4	35	2	33	3	6	2
N-HEPTANE	393	7	100	5	190	15	27	9
BENZENE	18	1	8	1	9	1	3	1
DIME. PENTANE	*	*	*	*	*	*	*	*
ME. CYCLOHEXANE	359	7	133	7	133	10	23	8
TOTAL	5510	(100)	2002	(100)	1267	(100)	290	(100)

TABLE 2 (Cont'd.)

GASEOUS AND GASOLINE HYDROCARBON DATA

CLIENT CONOCO NORWAY WELL 24/9-1 LOCATION NORWEGIAN N. SEA

GAS ($C_1 - C_4$)

SAMPLE NO.	-		87					
DEPTH METRES	4800-30		4890-98					
	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P. P. B.	$\%C_1 - C_4$	P.P.B.	$\%C_1 - C_4$
C_1	5	11	13	13				
C_2	1	2	10	10				
C_3	12	28	16	16				
iC_4	5	11	21	21				
nC_4	20	47	41	40				
TOTAL	43	(100)	101	(100)				

GASOLINE RANGE ($C_5 - C_7$)

SAMPLE NO.	-		87					
DEPTH METRES	4800-30		4890-98					
	P. P. B.	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$	P. P. B	$\%C_5 - C_7$	P. P. B.	$\%C_5 - C_7$
ISO-PENTANE	668	15	696	17				
N-PENTANE	1159	27	1028	25				
CYCLOPENTANE	62	1	58	1				
2-ME. PENTANE	402	9	363	9				
3-ME. PENTANE	209	5	190	5				
N-HEXANE	687	16	665	16				
ME. CYCLOPENTANE	167	4	172	4				
CYCLOHEXANE	188	4	195	5				
2-ME. HEXANE	159	4	156	4				
3-ME. HEXANE	126	3	121	3				
3-ETHYLPENTANE	54	1	44	1				
N-HEPTANE	263	6	242	6				
BENZENE	17	1	18	1				
DIME. PENTANE	*	*	*	*				
ME. CYCLOHEXANE	199	5	189	5				
TOTAL	4360	(100)	4137	(100)				

TABLE 3

GENERALISED KEROGEN DESCRIPTIONS AND SPORE COLOUR INDEX

Depth in Metres	Dominant Kerogen Types	Spore Colour Index
1800- 30	Inertinite, vitrinite and sapropel	2-3
1980-2010	Inertinite, vitrinite and sapropel (some vitrinitic additive)	2-3
2130- 60	Sapropel and some inertinite	2-3.5
2310- 70	Inertinite, little sapropel	2.5-3.5
2460- 90	Inertinite and sapropel	2.5-3.5
2610- 40	Inertinite and sapropel	2.5-3.5
2760- 90	Mainly inertinite	3-3.5
2880- 910	Mainly inertinite	2.5-3.5
3060- 90	Mainly inertinite, some sapropel	2.5-3.5
3210- 40	Inertinite	3-4
3360- 90	Inertinite, some vitrinite, minor sapropel	3-4
3450- 80	Inertinite, minor sapropel	3-4
3540- 70	Inertinite, minor sapropel	3-4
3630- 60	Inertinite, minor sapropel	3-4
3720- 50	Inertinite, minor sapropel	3-4
3810- 40	Inertinite, minor sapropel	3-4.5
3900- 30	Inertinite, minor sapropel	3-4.5
3990-4020	Inertinite, barren of spores	*
4080- 110	Inertinite and some vitrinite	3.5-4
4170- 200	Inertinite and minor exinite	3.5-4
4260- 90	Inertinite and minor exinite	4-4.5
4350- 80	Inertinite and ?bituminite	4-4.5
4440- 70	Inertinite	4-4.5
4530- 60	Inertinite	4.5-5
4620- 50	Inertinite	4.5-5
4740- 70	Inertinite	4.5
4830- 60	Inertinite and sapropel	4.5-5.5

TABLE 4

MATURATION EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH (METRES) OR NOTATION	SAMPLE TYPE	GENERALISED LITHOLOGY	MAXIMUM PALAEOTEMP--ERATURE °F	VITRINITE REFLECTIVITY %	SPORE COLOURATION (1-10)	LIGHT HYDROCARBONS
1. 1800-30	Ctgs	Ol-gy sh	312	-	2-3	-
2. 1804	S.W.C.	Gn-gy sh	<259	-	-	-
3. 1860-90	Ctgs	Ol-gy sh	218	-	-	Immature?
4. 1920-50	"	Ditto	221	-	-	Immature?
5. 1980-2010	"	Ditto	195	0.31	2-3	-
6. 2040-70	"	Med gy slty sh	< 266	-	-	Immature?
7. 2067	S.W.C.	Med gy sh	230	-	-	-
8. 2100-30	Ctgs	Med gy slty sh	255	-	-	Immature?
2130-60	"	Ditto	-	0.27	2-3.5	-
9. 2152	S.W.C.	Ditto	181	-	-	-
10. 2160-90	Ctgs	Ditto	234	-	-	Immature?
11. 2220-50	"	Ditto	313	-	-	Trans-Mature
12. 2280-310	"	Ditto	314	-	-	Transitional
2310-40	"	Ditto	-	0.35	2.5-3.5	-
13. 2340-70	"	Ditto	243	-	-	-
14. 2400-30	"	Ditto	220	-	-	Transitional
15. 2459	S.W.C.	Dk gn-gy sh	218	-	-	-
16. 2460-90	Ctgs	Lt gy sh	281	0.36	2.5-3.5	-
17. 2541	S.W.C.	Med gy sh	< 272	-	-	-
18. 2580-610	Ctgs	Dk gy sh	254	-	-	Transitional
2610-40	"	Ditto	-	0.36	2.5-3.5	-
19. 2640-70	"	Ditto	208	-	-	-
21. 2700-30	"	Med gy sh	259	-	-	Trans (Low)

TABLE 4 (Cont'd.)

MATURATION EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH (METRES) OR NOTATION	SAMPLE TYPE	GENERALISED LITHOLOGY	MAXIMUM PALAEOTEMP-ERATURE °F	VITRINITE REFLECTIVITY %	SPORE COLOURATION (1-10)	LIGHT HYDROCARBONS
22. 2705	S.W.C.	Gn-gy sh	284	-	-	-
23. 2740	"	Ditto	260	-	-	-
24. 2760-90	Ctgs	Lt gy sh	269	* (1.60)	3-3.5	-
25. 2820-50	"	Wht lstn	257	-	-	-
26. 2844.5	S.W.C.	Gy sh	282	-	-	-
27. 2880-910	Ctgs	Med gy sh+tr lstn	271	-	-	Trans (Low)
2910-40	"	Lt gy sh	-	* (1.54)	2.5-3.5	-
28. 2940-70	"	Med gy mdst	< 253	-	-	-
29. 2967	S.W.C.	Gy sh	287	-	-	-
2970 3000	Ctgs	Ditto	-	-	-	Trans (Low)
30. 3000-30	"	Med gy mdst	261	-	-	-
31. 3060-90	"	Lt gy sh	-	0.58	2.5-3.5	-
33. 3120-50	"	Ditto	-	-	-	Trans (Low)
34. 3180-210	"	Dk gy sh+lt gy mdst	265	-	-	-
3210-40	"	Ditto	-	0.20	3-4	-
35. 3240-70	"	Ditto	256	-	-	-
36. 3257	S.W.C.	Gy sh	285	-	-	-
37. 3270-300	Ctgs	Med gy mdst	241	-	-	-
39. 3360-90	"	Ditto	246	0.68	3-4	-
40. 3420-50	"	Med gy sh	-	-	-	Trans? (Low)
41. 3450-80	"	Lt gy sh	292	*	3-4	-
42. 3475	S.W.C.	Gy sh	303	-	-	-
44. 3540-70	Ctgs	Dk gy sh	298	*	3-4	-

TABLE 4 (Cont'd.)

MATURATION EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH (METRES) OR NOTATION	SAMPLE TYPE	GENERALISED LITHOLOGY	MAXIMUM PALAEOTEMP-ERATURE °F	VITRINITE REFLECTIVITY %	SPORE COLOURATION (1-10)	LIGHT HYDROCARBONS
45. 3600-30	Ctgs	Med gy sh/mdst	-	-	-	(Low)
46. 3630-60	"	Ditto	295	*	3-4	-
48. 3700	S.W.C.	Gy sh	312	-	-	-
49. 3720-50	Ctgs	Lt gy sh/mdst	306	*	3-4	-
3780-810	"	Ditto	-	-	-	(Low)
51. 3810-40	"	Lt gy sh	305	*	3-4.5	-
54. 3900-30	"	Dk gy sh	304	*	3-4.5	-
55. 3960-90	Ctgs	Dk gy sh	-	-	-	Transitional ?
56. 3990-4020	"	Med-dk gy sh	284	* (1.11)	Barren	-
57. 3993	S.W.C.	Gy sh	283	-	-	-
4050-80	Ctgs	Ditto	-	-	-	Mature
59. 4080-110	"	Gn-gy sh	348	0.39; 0.44	3.5-4	-
61. 4170-200	"	Med-dk gy sh	< 319	*	3.5-4	-
4230-60	"	Ditto	-	-	-	Mature
63. 4260-90	"	Gn-gy/gy sh	318	*	4-4.5	-
4320-50	"	Ditto	-	-		Mature
66. 4350-80	"	Dk gy sltst	310	0.37	4-4.5	-
67. 4369.5	S.W.C.	Blk sh	336	-	-	-
4410-40	Ctgs	Gn-gy sh	-	-	-	Mature
69. 4440-70	"	Ditto	345	0.37	4-4.5	-
4500-30	"	Ditto	-	-	-	Mature
72. 4530-60	"	Lt/dk gy sltst	340	0.55	4.5-5	-

TABLE 4 (Cont'd.)

MATURATION EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA

SAMPLE DEPTH (METRES) OR NOTATION	SAMPLE TYPE	GENERALISED LITHOLOGY	MAXIMUM PALAEOTEMP-ERATURE °F	VITRINITE REFLECTIVITY %	SPORE COLOURATION (1-10)	LIGHT HYDROCARBONS
73. 4535	S.W.C.	Blk sh	< 393	-	-	-
4590-620	Ctgs	Gy-gn/gy mdst	-	-	-	Mature
76. 4620-50	"	Lt-dk gy sh	292	* (0.83)	4.5-5	-
4680-710	"	Dk gy sh/sltst	-	-	-	Mature
79. 4699	S.W.C.	Blk sh	342	-	-	-
80. 4740-70	Ctgs	Lt gy sltst	260	* (0.84)	4.5	-
4800-30	"	Gn-gy sh, dk gy sh+sst	-	-	-	Mature
84. 4805	S.W.C.	Blk waxy sh	345	-	-	-
86. 4830-60	Ctgs	Gy-gn sh	298	0.65	4.5-5.5	-
4890-98	"	Ditto	-	-	-	Mature
Core 12	S.W.C.	Dk gn-gy sh	235	-	-	-
Core 24	"	Gn-gy sh	210	-	-	-
Core 27	"	Ditto	222	-	-	-

TABLE 5

SOURCE ROCK EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH (METRES OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO--CARBONS P.P.M. OF ROCK	HYDRO-CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO CARBONS
1. 1800-830	Ctgs	Ol-gy calc sh	0.67	450	6.7	130	29	66
2. 1804	Core	Gn-gy sh	0.55	315	5.7	20	6	64
3. 1860-890	Ctgs	Ol-gy calc sh	0.58	30	0.5	<20	-	-
4. 1920-950	"	Ol-gy/gn-gy sl calc sh	0.89	430	4.8	105	24	64
5. 1980-2010	"	Ditto+mnr snd (walnut shell)	1.52	435	2.9	180	41	67
6. 2040-070	"	Lt-med gy sl slty sh	1.12	505	4.5	95	19	58
7. 2067	Core	Med gy sh	0.92	1750	19.0	95	5	57
8. 2100-130	Ctgs	Lt-med gy sl slty sh+ mnr lt brn-gy sltst+ mnr sst	1.55	755	4.9	190	25	72
9. 2152	Core	Med gy sh	0.97	1660	17.1	95	6	64
10. 2160-190	Ctgs	Lt-med gy sl slty sh+ 10% lt brn-gy sltst	0.69	325	4.7	20	6	57
11. 2220-250	"	Ditto + 25% gn-gy sh+ 20% brn-gy sltst+ pyrite modules+ mnr snd	1.09	520	4.8	95	18	61
12. 2280-310	"	Ditto+ 15% ditto+ kaolin/qtz	0.61	240	3.9	30	12	58
13. 2340-370	"	Ditto+50% kaolin/qtz	0.68	295	4.3	50	17	58
14. 2400-430	"	Ditto + 70% ditto	0.47	180	3.8	<20	-	-
15. 2459	Core	Dk gn-gy sh	0.46	345	7.5	<20	-	-
16. 2460-490	Ctgs	Lt gy sh + 50% kaolin/ qtz	0.56	1250	22.3	<20	-	-
17. 2541	Core	Med gy sh	1.30	1495	11.5	80	5	72
18. 2580-610	Ctgs	Dk gy sh+ 15% kaolin/ qtz	0.62	320	5.2	50	16	73
19. 2640-670	"	Med gy/dk gy sh+ kaolin/snd	0.43	385	9.0	60	15	76
20. 2660	Core	Bl-gy calc sh	0.13	-	-	-	-	-
21. 2700-730	Ctgs	Med gy calc sh + 10% kaolin+mnr dk brn lstn	0.32	350	10.9	25	7	60
22. 2705	Core	Gn-gy calc sh	0.27	-	-	-	-	-

TABLE 5 (Cont.d)

SOURCE ROCK EVALUATION DATA

COMPANY : CONOCO NORWAY WELL: 24/9-1 LOCATION : NORWEGIAN NORTH SEA

SAMPLE DEPTH (METRES OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO--CARBONS P.P.M. OF ROCK	HYDRO-CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO CARBONS
23. 2740	Core	Dk gn-gy calc sh	0.25	-	-	-	-	-
24. 2760-790	Ctgs	Lt gy/med gy calc sh+ mnr kaolin	0.41	155	3.8	<20	-	-
25. 2820-850	"	Wht lstn+10% med gy sh sh+ mnr wht sst	0.48	185	3.9	<20	-	-
26. 2844.5	SWC	Gy calc sh	0.40	210	5.2	55	26	59
27. 2880-910	Ctgs	Med gy calc sh+40% kaolin+tr lstn +tr pyr sst	0.50	275	5.5	35	13	60
28. 2940-970	"	Med gy calc mdst +10% dk gy calc sh + mnr lstn + kaolin	0.44	270	6.1	<20	-	-
29. 2967	SWC	Gy calc sh	0.33	165	5.0	<20	-	-
30. 3000-030	Ctgs	Med gy calc mdst+10% dk gy calc sh	0.22	-	-	-	-	-
31. 3060-090	"	Lt gy calc sh+40 med -dk gy sh/mdst+red mud	0.16	-	-	-	-	-
32. 3118	SWC	Pp calc sh	0.13	-	-	-	-	-
33. 3120-150	Ctgs	Lt gy calc sh +40% med gy mdst/sh	0.16	-	-	-	-	-
34. 3180-210	"	Dk gy calc sh +lt gy mdst/sh	0.31	480	15.5	50	11	85
35. 3240-270	"	Med gy calc mdst/sh	0.28	-	-	-	-	-
36. 3257	SWC	Gy calc sh	0.27	-	-	-	-	-
37. 3270-300	Ctgs	Med gy calc mdst/sh	0.38	210	5.5	30	14	76
38. 3300-330	"	Med gy sh +mnr gy-gy sh + mnr coal	0.60	-	-	-	-	-
39. 3360-390	"	Med gy mdst	0.42	725	17.3	175	24	87
40. 3420-450	"	Med gy sh/sltst	0.30	-	-	-	-	-
41. 3450-480	"	Lt gy sh/sltst+mnr coal	0.28	-	-	-	-	-
42. 3475	SWC	Gy calc sh	0.42	490	11.7	330	67	82
43. 3480-510	Ctgs	Med dk gy sh/mdst	0.31	-	-	-	-	-
44. 3540-570	"	Dk gy sh/mdst	0.37	270	7.3	45	17	81

TABLE 5 (Cont'd)

SOURCE ROCK EVALUATION DATA

COMPANY : CONOCO NORWAY WELL: 24/9-1 LOCATION : NORWEGIAN NORTH SEA

SAMPLE DEPTH (METRES OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO-CARBONS P.P.M. OF ROCK	HYDRO-CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO CARBONS
45. 3600-630	Ctgs	Med gy sh/mdst + mnr lt gy sltst	0.33	-	-	-	-	-
46. 3630-660	"	Ditto (sl calc)	0.29	-	-	-	-	-
47. 3660-690	"	Ditto	0.30	-	-	-	-	-
48. 3700	SWC	Gy calc sh	0.37	190	5.1	50	26	73
49. 3720-750	Ctgs	Med-lt gy sh/mdst	0.20	-	-	-	-	-
50. 3780-810	"	Ditto +gn/gy sltst	0.44	-	-	-	-	-
51. 3810-840	"	Lt gy calc sh	0.20	-	-	-	-	-
52. 3840-870	"	Lt gy sh	0.21	-	-	-	-	-
53. 3873	SWC	Gy calc sh	0.51	320	6.3	<20	-	-
54. 3900-930	Ctgs	Dk gy sh +mnr coal	0.64	175	2.7	<20	-	-
55. 3960-990	"	Dk gy sh +mnr lt gy sltst	0.87	-	-	-	-	-
56. 3990-4020	"	Med-dk gy sh	0.77	875	11.4	35	4	79
57. 3993	SWC	Gy calc sh	0.24	-	-	-	-	-
58. 4020-050	Ctgs	Med gy mdst + iron stain	0.66	-	-	-	-	-
59. 4080-110	"	Gn-gy sh + mnr coal	2.81	1045	3.7	65	6	76
60. 4140-170	"	Gn/gy sh + mnr coal	0.70	-	-	-	-	-
61. 4170-200	"	Med-dk gy sh + mnr lstn	0.48	180	3.8	<20	-	-
62. 4200-230	"	Gn-gy/gy sh + brn-gy sltst	0.48	-	-	-	-	-
63. 4260-290	"	Ditto (sl calc)	1.12	310	2.8	95	30	75
64. 4320-350	"	Ditto (sl calc)	0.61	-	-	-	-	-
65. 4324	SWC	Med-dk gy calc sh	2.44	1310	5.4	390	30	77
66. 4350-380	Ctgs	Dk gy sltst	1.74	1675	9.6	1350	81	75

TABLE 5 (Cont'd)

SOURCE ROCK EVALUATION DATA

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN NORTH SEA

SAMPLE DEPTH METRES OR NOTATION	SAMPLE TYPE	ANALYSED LITHOLOGY	ORGANIC CARBON % OF ROCK	TOTAL EXTRACT P.P.M.	EXTRACT % OF ORGANIC CARBON	HYDRO--CARBONS P.P.M. OF ROCK	HYDRO-CARBONS % OF EXTRACT	TOTAL ALKANES % HYDRO CARBONS
67. 4369.5	SWC	Blk sh	7.5	7415	9.9	3200	43	70
68. 4380-410	Ctgs	Gn gy sh (sl calc)	1.35	-	-	-	-	-
69. 4440-470	"	Ditto (sl calc) +mnr lt gy sltst	3.3	2095	6.3	510	24	77
70. 4473	SWC	Blk sh	6.9	4105	5.9	3560	87	70
71. 4500-530	Ctgs	Med gy/gn-gy/lt gy sh (sl calc) + mnr snd	0.6	-	-	-	-	-
72. 4530-560	"	Lt/dk gy sltst	1.63	595	3.7	260	44	80
73. 4535	SWC	Blk sh	6.6	3385	5.1	1490	44	87
74. 4560-590	Ctgs	Gy/gn gy mdst/sltst + mnr red sh	1.16	-	-	-	-	-
75. 4591.5	SWC	Gy slty sst	0.81	695	8.6	130	19	61
76. 4620-650	Ctgs	Dk/med/lt gy sh + mnr coal	3.3	1730	5.2	1085	63	87
77. 4620.5	SWC	Gy slty sst +tr dk gy sh	1.75	1070	6.1	80	7	*
78. 4680-710	Ctgs	Lt gy/dk gy sltst, red sh, mnr snd	2.80	-	-	-	-	-
79. 4699	SWC	Blk sh	8.2	3195	3.9	1250	39	83
80. 4740-770	Ctgs	Lt gy sltst (sl calc) +dk gy sltst	2.48	3525	14.2	200	6	81
81. 4770-800	"	Lt/dk gy sltst	3.1	-	-	-	-	-
82. 4777.5	SWC	Blk sh	9.0	-	-	-	-	-
83. 4801	"	Crs sst with blk surface deposit	1.51	475	3.1	40	8	*
84. 4805	"	Blk waxy (oily?) sh	9.0	1425	1.6	65	5	*
85. 4816	"	Sst with blk intergran deposit	1.79	800	0.4	445	56	*
86. 4830-860	Ctgs	Gy-gn sh + lt gy sltst (calc) + mnr coal	2.62	2660	10.2	420	16	70
87. 4890-98	"	Lt to dk gy calc sltst + mnr coal	3.9	-	-	-	-	-
Core 12	SWC	Dk gn-gy sl calc sh	0.98	1000	10.2	360	36	83
Core 24	"	Dk gn-gy sh	0.32	200	6.2	20	10	*
Core 27	"	Gn-gy sh	0.82	830	10.1	25	3	*

FIGURE 1

HEADSPACE GAS ($C_1 - C_4$) HYDROCARBONS

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN NORTH SEA

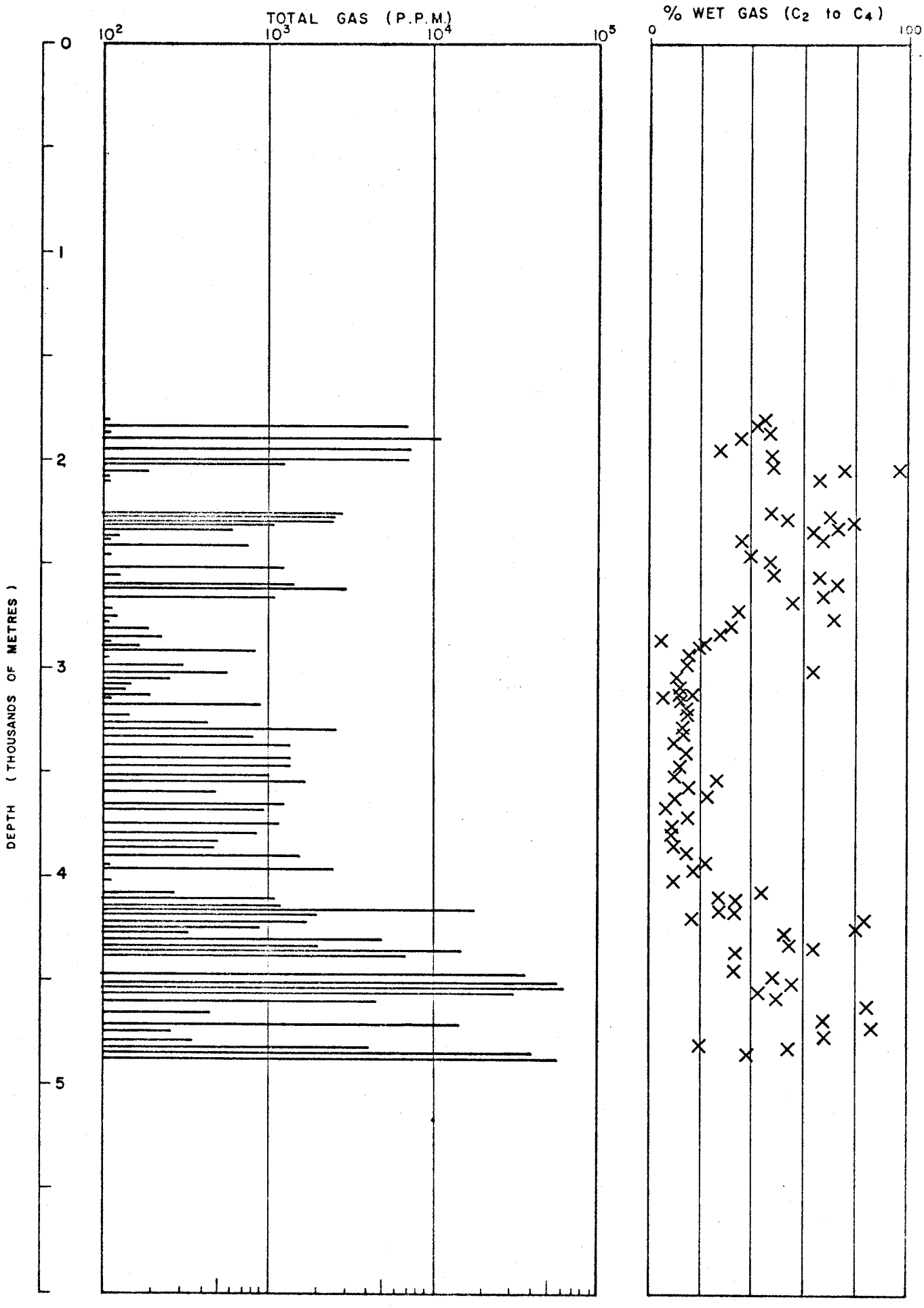


FIGURE 2

GASEOUS ($C_1 - C_4$) HYDROCARBONS

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN N. SEA

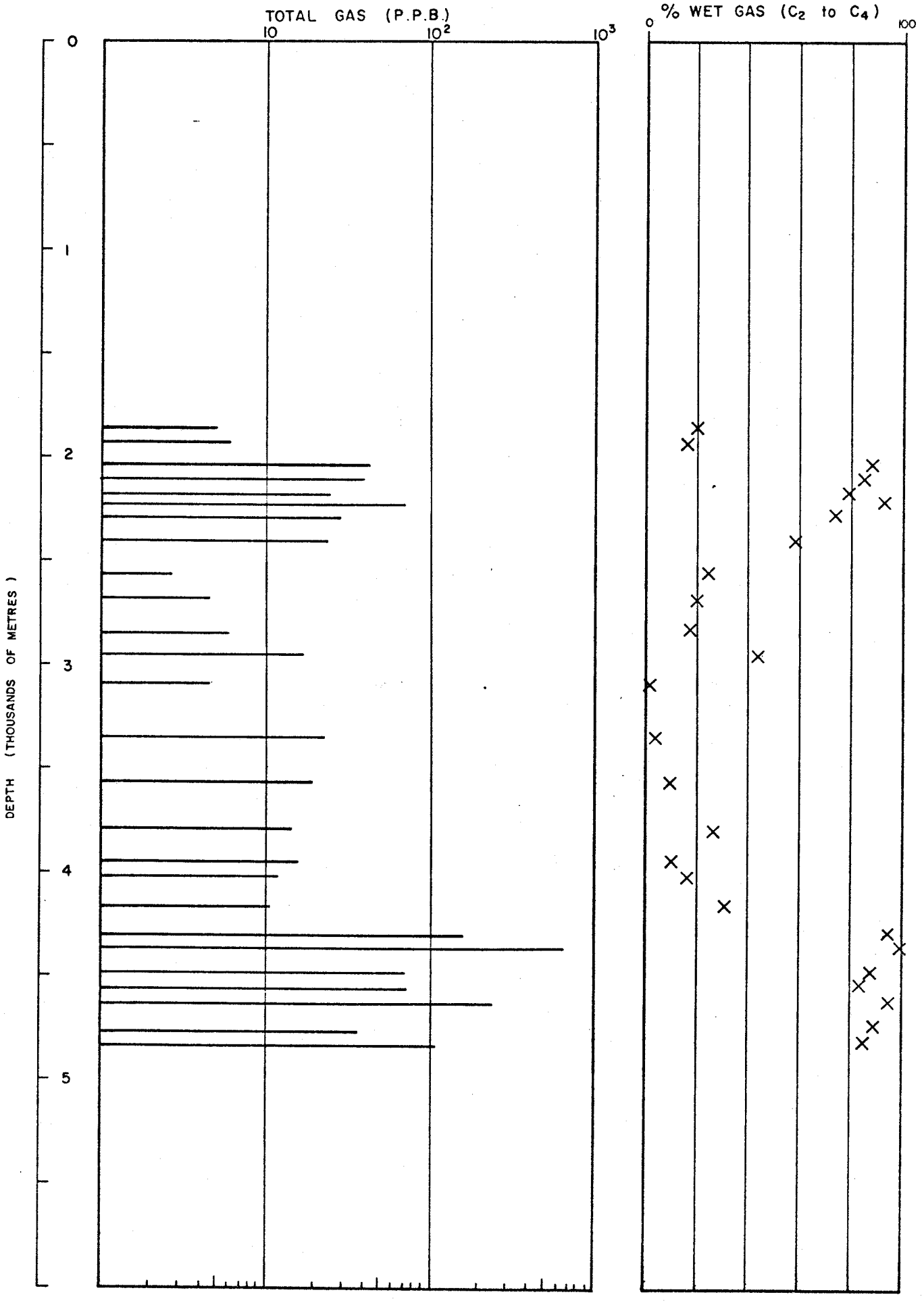
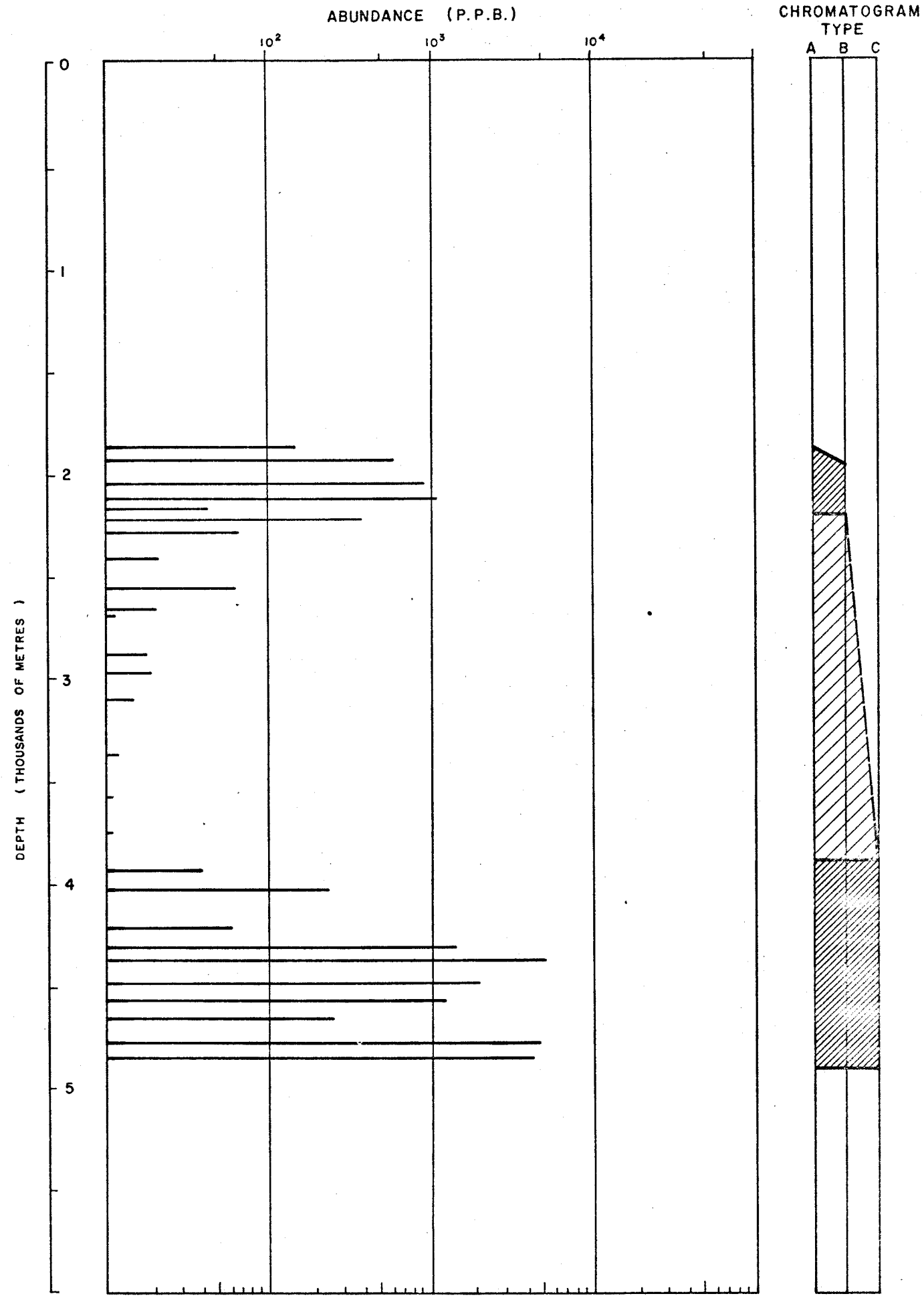


FIGURE 3

GASOLINE RANGE ($C_5 - C_7$) HYDROCARBONS

COMPANY: CONOCO NORWAY WELL: 24/9-1 LOCATION: NORWEGIAN N. SEA



A, IMMATURE ; B, TRANSITIONAL ; C, OIL-LIKE

FIGURE 4

SPORE COLOUR INDEX AGAINST DEPTH

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN N. SEA

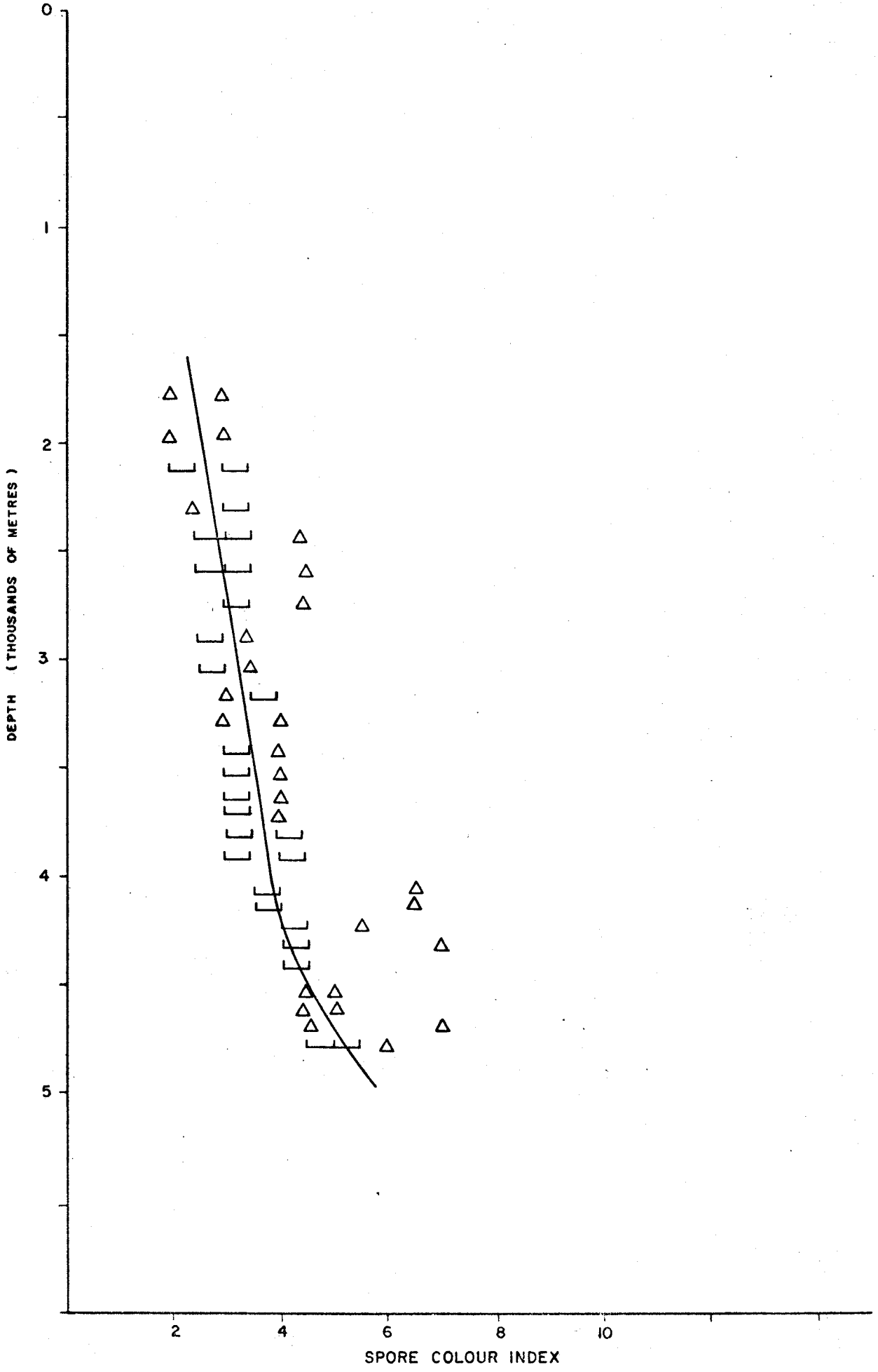


FIGURE 5

VITRINITE REFLECTIVITY AGAINST DEPTH

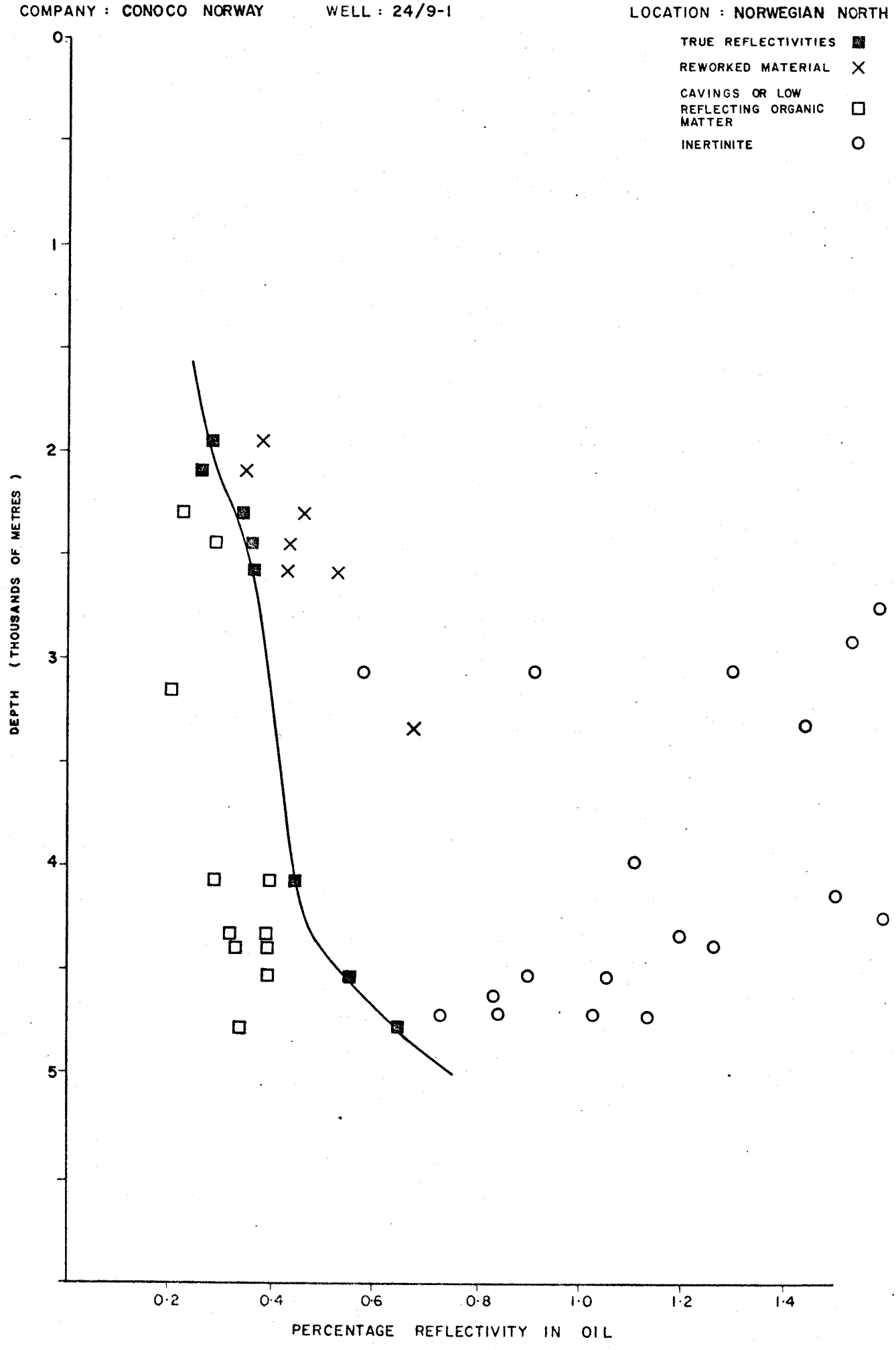


FIGURE 6

MAXIMUM PALAEOTEMPERATURE AGAINST DEPTH

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN NORTH SEA

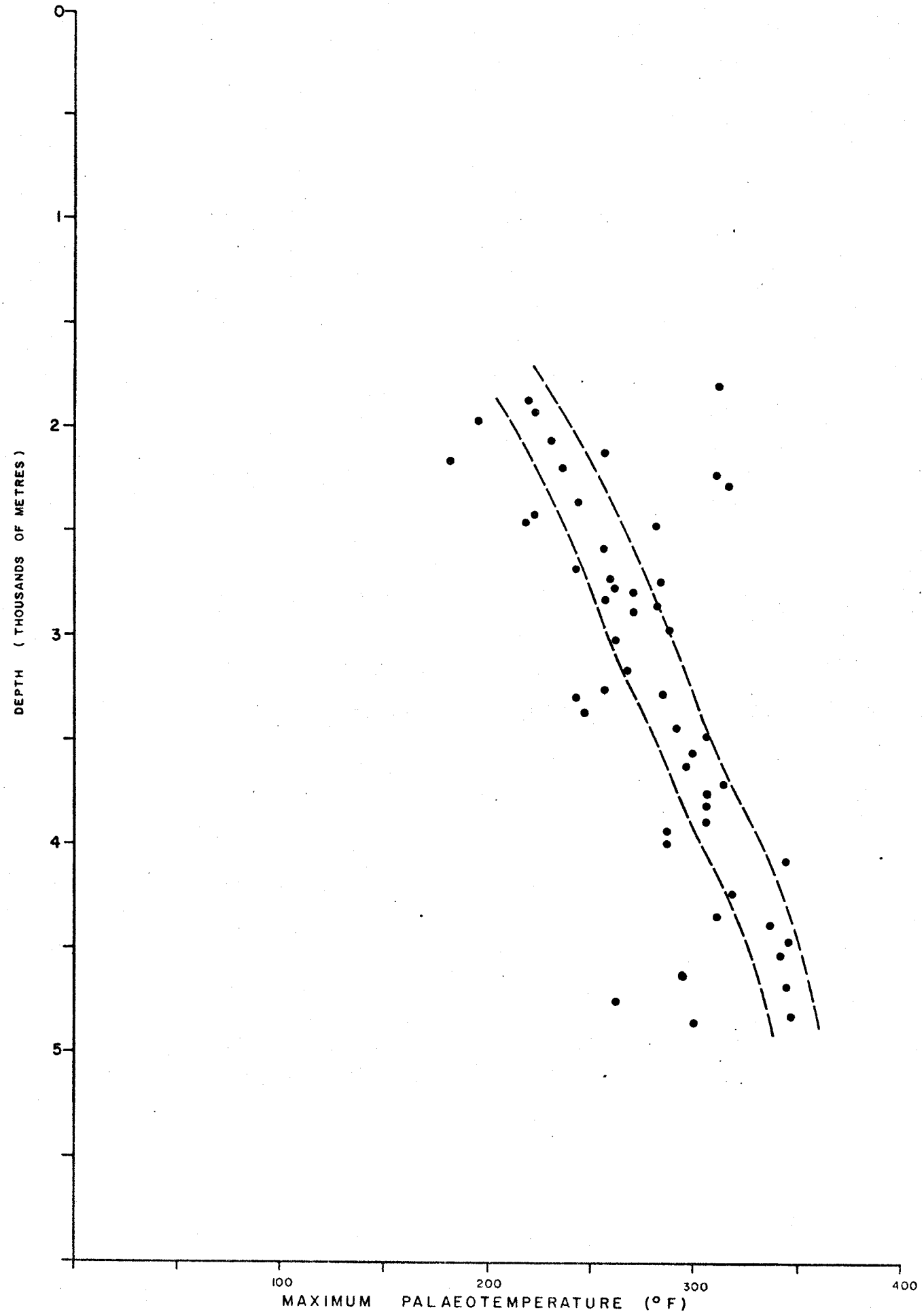


FIGURE 7

MATURATION INDICES AGAINST DEPTH

COMPANY: CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN N.SEA

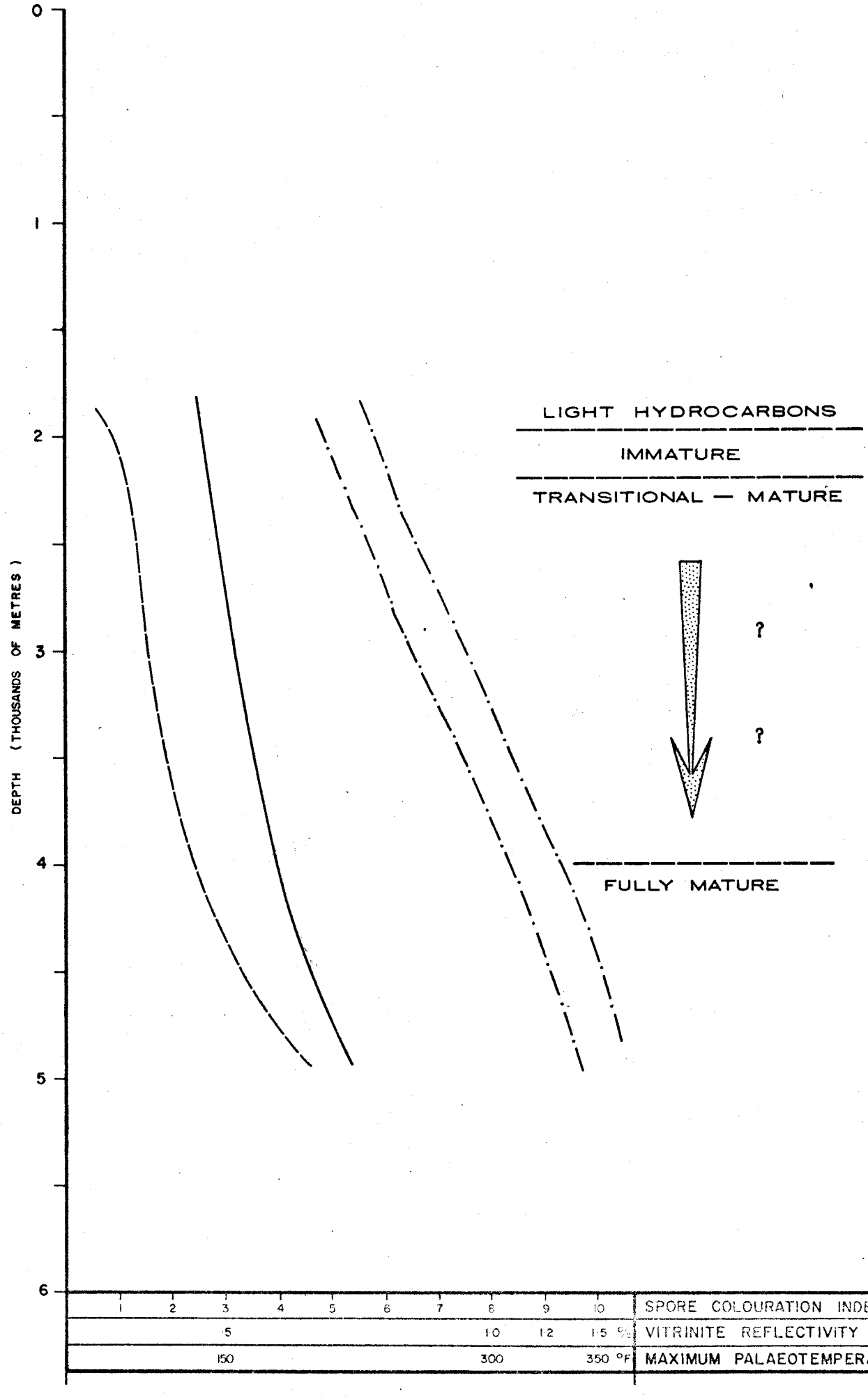


FIGURE 8

TYPE OF HYDROCARBON PRODUCT FROM SOURCE ROCKS

COMPANY : CONOCO NORWAY . WELL : 24/9-1 LOCATION : NORWEGIAN NORTH SEA

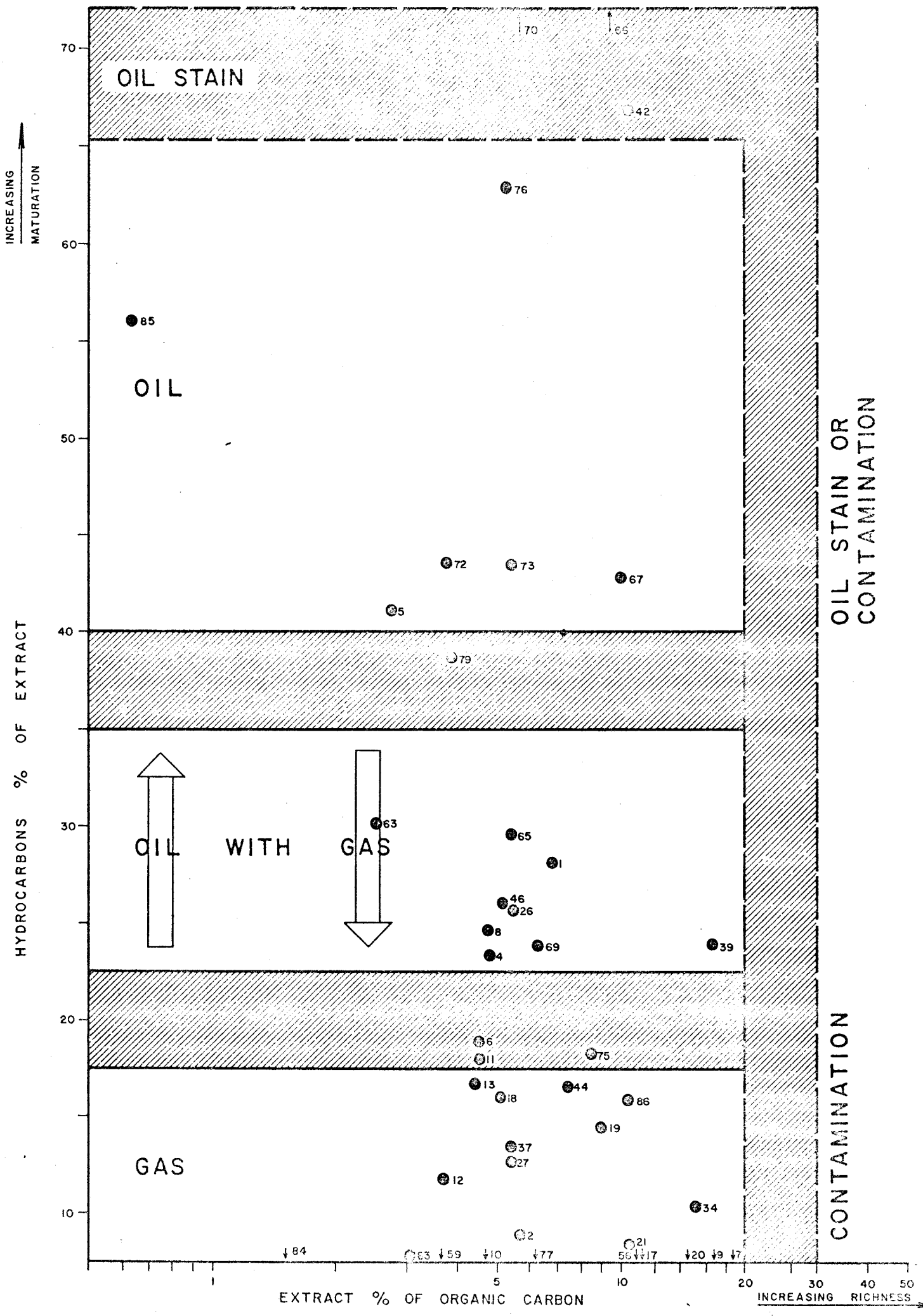
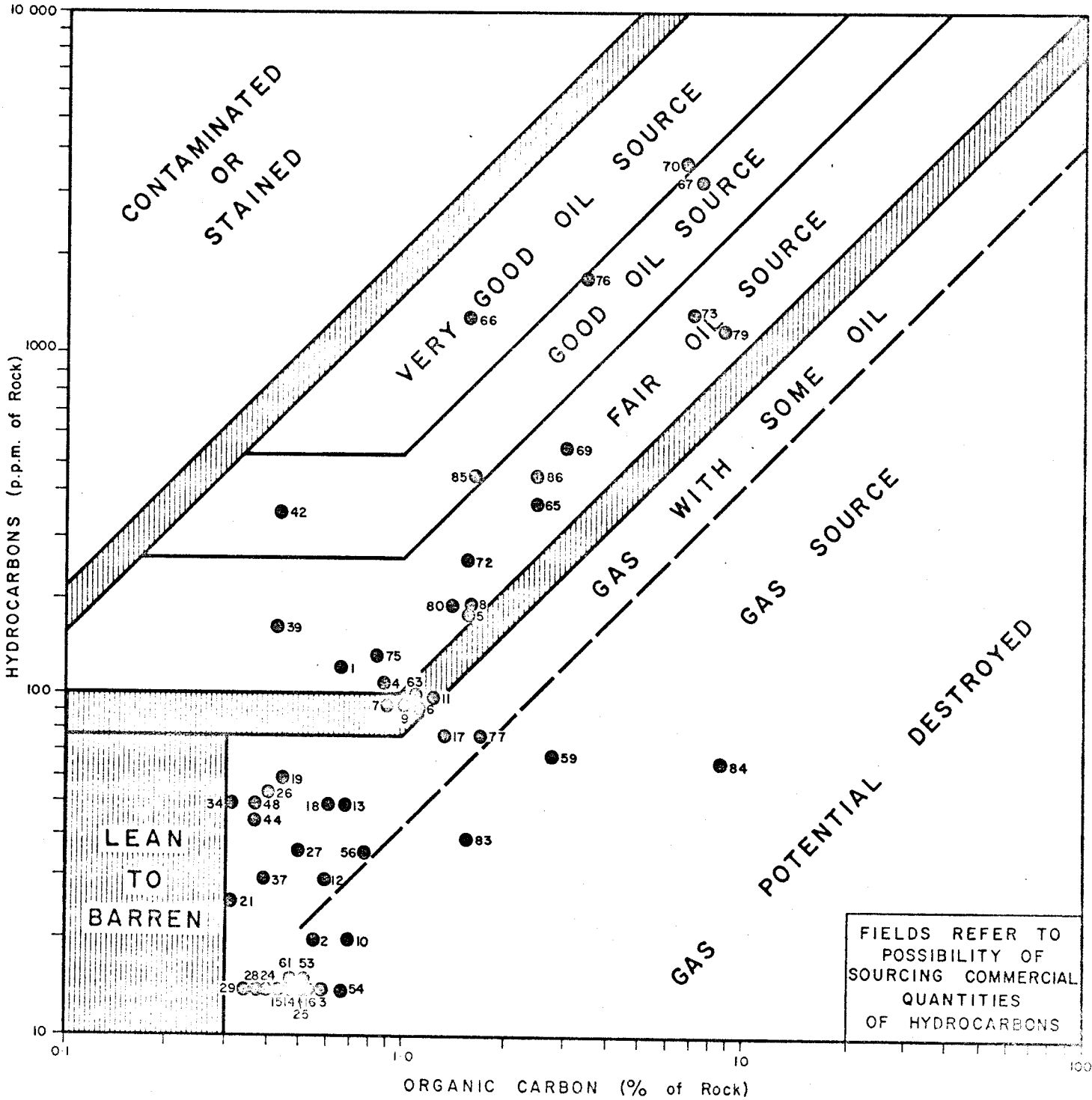


FIGURE 9

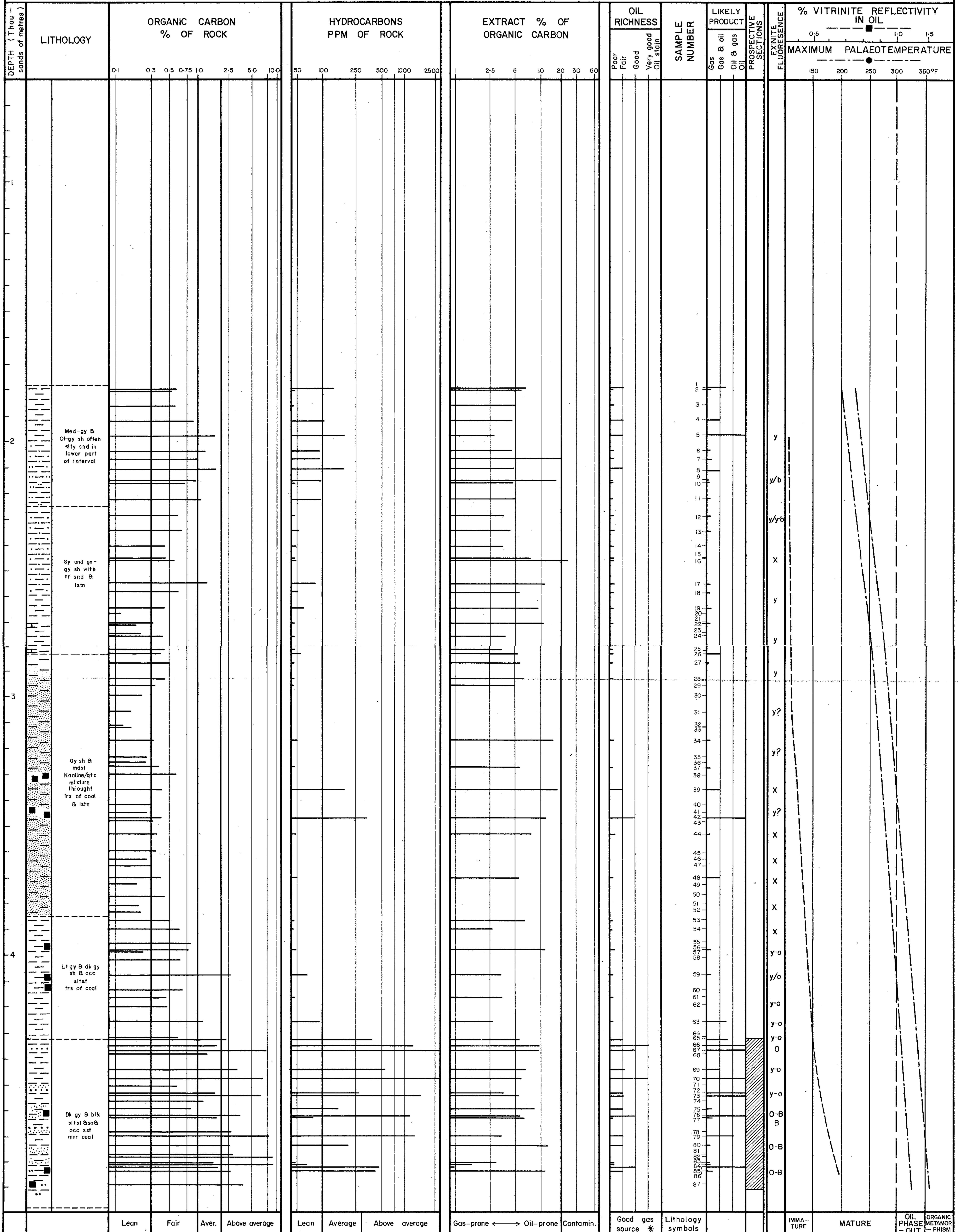
MATURE SOURCE ROCK RICHNESS

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN NORTH SEA



SOURCE ROCK SUMMARY CHART

COMPANY : CONOCO NORWAY WELL : 24/9-1 LOCATION : NORWEGIAN NORTH SEA



Drawing No. 023P / 2321 / 3597

EXINITE FLUORESCENCE Abundant exinite content B, Moderate exinite content b } Orange-brown; O, o } Orange; Y, y } Yellow; G, g } Yellow-green; No observed fluorescence X

FIGURE 10

APPENDIX I

ABBREVIATIONS USED IN ANALYTICAL DATA SHEETS

Alg	-	Algae	Mtl	-	Mottled
Aren	-	Arenaceous	Musc	-	Muscovite
Arg	-	Argillaceous	NS	-	No sample
Bit	-	Bitumen/bituminous	Occ	-	Occasional
Bl	-	Blue	Ol	-	Olive
Blk	-	Black	Ool	-	Oolite/oolitic
Brn	-	Brown	Orng	-	Orange
Calc	-	Calcareous	Pnk	-	Pink
Carb	-	Carbonaceous	Pop	-	Population
Chk	-	Chalk	Pp	-	Purple
Cht	-	Chert	Pyr	-	Pyrite/pyritic
Cgl	-	Conglomerate	Qtz	-	Quartz
Cly	-	Clay	Ref	-	Reflectivity
CMT	-	Cement	Sap	-	Sapropel
Crs	-	Coarse	Sft	-	Soft
Ctgs	-	Ditch cuttings	Sh	-	Shale
Dk	-	Dark	Shly	-	Shaly
Dol	-	Dolomite	Sil	-	Siliceous
F	-	Fine	Slt	-	Silt
Fer	-	Ferruginous	Sltst	-	Siltstone
Flu	-	Fluorescence	Slty	-	Silty
Fm	-	Formation	Snd	-	Sand
Foram	-	Foraminifera	Sndy	-	Sandy
Fr	-	Friable	Sst	-	Sandstone
Frags	-	Fragments	SWC	-	Sidewall core
Glc	-	Glauconite	Tr	-	Trace
Gn	-	Green	V	-	Very
Gy	-	Grey	Vgt	-	Variegated
Gyp	-	Gypsum	Vit	-	Vitrinite
Hd	-	Hard	Wht	-	White
Inert	-	Inertinite	Yel	-	Yellow
Lam	-	Laminae/laminated	-	-	Sample not analysed
LCM	-	Lost circulation material	*	-	No results obtained
Lig	-	Lignite/lignitic	Gy-gn	-	Greyish green
Lst	-	Limestone	Gn/gy	-	Green to/and grey
Lt	-	Light	Gn-gy	-	Greenish grey
Mdst	-	Mudstone			
Med	-	Medium			
Mic	-	Micaceous			
Mnl	-	Mineral			
Mnr	-	Minor			