Technical Service Report

ESSO PRODUCTION RESEARCH COMPANY

EPR69-ES18

GEOCHEMICAL ANALYSIS OF CANNED CUTTINGS SAMPLES FROM THE ESSO 16/2-1 WELL, NORWAY

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Stratigrapic Geology Division

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SUMMARY AND CONCLUSIONS

Canned cuttings samples from 1350-6200 feet in the Esso 16/2-1 well were analyzed for their hydrocarbon gases. Chips of uniform lithologies were picked from selected cuttings samples and analyzed for total organic matter, gasoline (C_4-C_7) yields, and visual kerogen characteristics.

Cuttings gas yields suggest that the intervals 1500-1700, 1900-2500, and 2900 to 3500 feet have generated considerable amounts of methane gas and that reservoirs associated with these intervals might contain dry gas accumulations. Kerogen alteration ratings of 1 to 2 for these zones suggest that the organic matter is diagenetically immature and that with deeper burial they might generate liquid as well as gaseous hydrocarbons. The predominantly amorphous character of the kerogen in these samples supports this possibility. The high total organic matter content of these beds, particularly in the 2900 to 3500 foot interval is consistent with the gas evidence that these zones are good source intervals.

The wet gas concentration (C_2-C_4 in total gas) shows a systematic increase from less than 5 percent at 4500 feet to over 65 percent at 5350 feet. This appears to be the depth interval at which significant amounts of gasoline and intermediate liquid hydrocarbons have begun to be generated. The interval below about 5000 to 5200 feet is interpreted to be a potential source of liquid as well as gaseous hydrocarbons.

INTRODUCTION

Canned cuttings samples from the interval 1350-6200 feet in the Esso 16/2-1 well were analyzed for their yields of hydrocarbon gases. Chips of uniform lithologies were hand picked from selected samples and analyzed further for characteristics of visual kerogen, total organic matter concentrations and light gasoline (C_4-C_7) yields.

The purpose of these analyses was to provide means for estimating the source character and the degree of diagenetic maturity of the organic matter in the sections penetrated by the well.

Results of cuttings gas analyses were plotted on 1:2000 vertical scale strip logs and transmitted to the North Sea Study Group with our letter of December 1, 1967. Samples that were selected for further analyses were chosen on the basis of results of the cuttings gas data.

This report includes complete tabulations of results of the cuttings gas, visual kerogen, total organic matter and gasoline analyses that were run, plus graphic plots of the various types of data. Explanations of our criteria for interpreting these types of data plus brief discussions of the results of the analyses are included.

Charges for this service work have been billed to the North Sea Study Group through our Job No. 9195.

PROCEDURE

Compositions and concentrations of hydrocarbon gases in the air spaces above the cuttings in the sample cans were determined by gas chromatography. Similar data were obtained on the gases released from a standard mixture of cuttings plus tap water after agitation for 2 minutes in a Waring blender. Combined results on air space gas plus cuttings gas were calculated for each sample. The data from the combined results were plotted graphically to show the vertical variations in total gas (C_1-C_4) and wet gas (C_2-C_4) and graphical plots were also made of the percent wet gas in total gas (Fig. 1).

Cuttings gas yields showed several vertical zonations which roughly correspond to different organic facies in the stratigraphic sections represented by the samples. Representative cuttings samples from the different distinctive zones defined by the cuttings gas were selected for further analyses. The selected samples were then picked by hand to provide materials of uniform lithologies for the additional work.

Some of the sample intervals that were chosen contained soft argillaceous cuttings dispersed in drilling mud, and they completely disaggregated when we attempted to wash the mud away. As a result, we were not able to obtain cuttings chips from all of the intervals of interest.

The 29 "picked" cuttings were analyzed for light gasoline (C_4-C_7) compounds, total organic matter and 17 of them were analyzed for visual kerogen characteristics.

Results of the cuttings gas analyses are given in Table I. Results of the additional chemical and visual kerogen analyses are given in Tables II and III.

BASES FOR INTERPRETING DATA

Cuttings Gas

Cuttings gas data give indications of the vertical variability in the source character of a section of interest. The ratio of wet gas (C_2-C_4) to total gas (C_1-C_4) may distinguish methane-prone from oil-and "wet" gas-prone sections. The critical value of this ratio varies from basin to basin. In Western Canada wet gas concentrations of about 45% or greater are considered to be indicative of sections that are likely to produce oil or gas with significant amounts of hydrocarbon liquids. In the Permian section of West Texas the significant ratio appears to be closer to 20% or greater of wet gas in total gas.

The significant values for total amounts of hydrocarbon gas yielded by the cuttings also appear to vary from basin to basin, and possibly must be established separately for each area of interest. Zones with the greatest yields of gas are considered to be of most interest as sources.

Oil in the drilling mud makes it nearly impossible to establish practical quantitative criteria that can be used in comparing different wells. The oil will tend to reduce the amount of cuttings gas released during agitation in the blender, and it will affect the composition of the hydrocarbon gas that is obtained for analysis. However, even with oil in the mud, significant vertical patterns in hydrocarbon gas concentrations and compositions can be established in each well. The patterns from different wells can be compared to establish regional trends or areal configurations of different organic facies within a section of interest.

Visual Kerogen

Kerogen data give two types of information. The color alteration (carbonization) provides a gross indication of the amount of thermal diagenesis that the organic matter has undergone. The types of materials comprising the kerogen help define different organic facies that are present in the sampled sections and they may indicate the source character of some of these facies.

Kerogen color alterations are rated on a 1 to 5 scale, from unaltered to almost completely carbonized, respectively. Ratings of 4 or 5 suggest that subsurface temperatures have been high enough to destroy most of the producible liquid hydrocarbons. Sections in which kerogen alteration is rated 4 and 5 are more likely to be characterized by dry gas production, if producible hydrocarbons are found in the associated reservoirs. Immobile pyrobitumens may also be found in these reservoir beds. Alteration ratings of 1 to 2 suggest that thermal diagenesis of the kerogen has barely begun, and reservoired hydrocarbons, if present, are likely to be gases,

possibly associated with heavy, asphaltic oils. Ratings of 2+ to 3 suggest that maturation of the material has progressed to the point that gas, liquid hydrocarbons, or mixed oil and gas may be produced, depending on the nature of the original source materials. A rating of 2 may be associated with either immature or moderately mature sediments, based on other chemical evidence, and hence is not diagnostic. The interpretation of the significance of alteration ratings of 4 or 5 is the most reliable of the above tentative rules of thumb.

Types of kerogen materials that are commonly recognized include amorphous, finely disseminated, algal, herbaceous, woody and coaly. The source significance of these types is not established, but there have been suggestions in some areas, such as the offshore of southern Australia, that gas production is possibly associated with woody and coaly kerogen, whereas beds rated as oil sources may include rocks containing amorphous, finely disseminated and algal materials. These observations are speculative.

Total Organic Matter

The total organic matter concentration gives a rough indication of the richness of a rock in materials that can produce hydrocarbons. However, this measure alone does not indicate whether the organic material is oil-prone, gas-prone or mixed oil and gas prone. Rocks containing less than about 0.5% total organic matter are generally rated as poor sources, but this is modified by lithology. Carbonate sequences possibly include source rocks with still lower concentrations of total organic matter than 0.5%.

Sections that are notable for their production of dry gas (mainly methane) have commonly been found to be characterized by source rocks containing greater than about 1.1% total organic matter. However, a measure of the liquid hydrocarbons in these richer rocks is also necessary to determine whether they should be rated as oil prone or gas prone.

Light Gasoline (C_4-C_7) Hydrocarbons

Light gasolines apparently do not appear in source beds in concentrations above one or two parts per million until a fair degree of maturation occurs. Therefore, gasoline concentrations give one criterion of the degree of thermal maturation that the organic matter has attained

In addition, ratios of specific gasoline compounds may indicate the possible source character of the rocks. In particular, the ratio of cyclohexane to methyl-cyclopentane (CH/MCP) has been found to be useful in the U. S. Gulf Coast and the Alaskan areas for distinguishing "non oily" from "oily" facies. To date commerical oil has not been found associated with strata having a CH/MCP ratio of less than 0.25. However, dry gas has been found in strata characterized by lower ratio values as well as in sections with ratios greater than 0.25.

The CH/MCP ratio is also useful in helping distinguish different organic facies that may be present within an oil-like section. Ratios all above 0.25 in value may show groupings in vertical patterns that correlate with stratigraphic zones that have distinctive source characteristics. Definition of such zones may be quite useful for correlating reservoired oils with specific source intervals.

DISCUSSION AND INTERPRETATION OF RESULTS

The analytical results are summarized graphically in Fig. 1 and are tabulated in Tables I, II, and III. Cuttings gas results (Table I) were transmitted earlier to the North Sea Group. Tables II and III give results of chemical and visual kerogen analyses of those samples that were "picked" to give uniform lithologies suitable for these additional studies.

Cuttings Gas

Several zones gave high yields of total hydrocarbon gas (Fig. 1), in particular the intervals 1500-1700, 1900-2500, and 2900-3500 feet. Dry gas accumulations might be expected in porous zones that are either vertically adjacent or laterally equivalent to these intervals. The high methane could be produced by gas-prone organic material or it could be the early hydrocarbon generation from an immature oily section. If the latter is the case, heavy asphaltic oil might also be present in some of the associated reservoirs.

The cuttings from about 5600 feet also gave a very high gas yield consisting of a relatively high percentage of wet gas (Fig. 1). This suggests an oil prone section. Cuttings samples were not available for the interval immediately below this depth. Wet gas first starts appearing in significant quantities at about 4600 feet. The gradual increase in percentage of C_2-C_4 below this depth appears to represent a maturation profile in which appreciable generation of gasolines and intermediate liquid hydrocarbons has begun. It suggests that generation of medium gravity oils might not be expected above 5000 feet in this particular area, but that wet gas and hydrocarbon liquids might be expected in reservoirs below 5000 to 5200 feet.

Total Organic Matter

All samples except three from 6000-6200 feet contained more than 0.5% total organic matter, and most contained about 1% or greater (Table II, Fig. 1). Thus, strata throughout the section contain enough organic matter to be considered as possible sources of hydrocarbons. The samples from 3000 to 3850 feet were particularly rich in organic content, ranging up to 5.64% T.O.M. This high organic content accounts for the high cuttings gas yield in this general interval.

C_4-C_7 Hydrocarbons

The samples from the interval 1700-2600 feet gave up appreciable amounts of light gasoline (C_4-C_7) hydrocarbons (Table III, Fig. 1). The generation of gasoline at such shallow depths suggests that this interval is an oil-prone section. With greater depth of burial and the consequent more advanced organic maturation, this section could be associated with reservoired oil accumulations.

The rest of the samples yielded only very small amounts or traces of gasolines, suggesting that liquid hydrocarbons have not been generated in significant amounts in the deeper sections. This contradicts the evidence of

the high wet gas content below 5000 feet, and suggests that the cuttings analyzed from this interval may not be representative of the section. Cavings are always a serious problem when we are picking small samples for our analyses, and it is possible that the gasoline data for below 5000 feet were obtained from cavings.

All but one of the cyclohexane/methylcyclopentane ratios are 0.5 or greater, suggesting that the organic material could be productive of either oil or gas. The value 0.3 for the sample from 3350 feet is more suggestive of a gas facies, but this value is unreliable because of the low amount of total gasoline (0.2 ppm) obtained from this sample.

Kerogen

Visual kerogen in the picked samples (Table II, Fig. 1) ranged in alteration ratings from 1 to 2+. Essentially unaltered kerogen (ratings 1 and 1+) was present in the samples from 1450 to 2600 feet, and the remainder of the samples contained only moderately altered kerogen (ratings of 2). One sample, from 6050 feet, had an alteration rating of 2+, which is still only moderate. The relatively unaltered material above 2600 feet suggests an immature organic facies that might have generated mostly methane with only minor heavier hydrocarbons. This is consistent with the cuttings gas results. The alteration ratings of 2 from deeper beds are less diagnostic, and apparently (based on cuttings gas) there is a maturation gradient in these beds even though the alteration ratings are fairly constant.

The predominance of amorphous kerogen throughout the section suggests that the organic matter is mainly oil prone in all of the zones. The lack of significant wet gas or liquid hydrocarbons is thus likely to be due to diagenetic immaturity rather than to a gas-prone nature of the original organic material.

Tentative organic facies zonations of the section suggested by variations in kerogen types are suggested by the dashed lines on the log at the right in Fig. 1. These could be more effectively defined by someone familiar with the geology of the area.

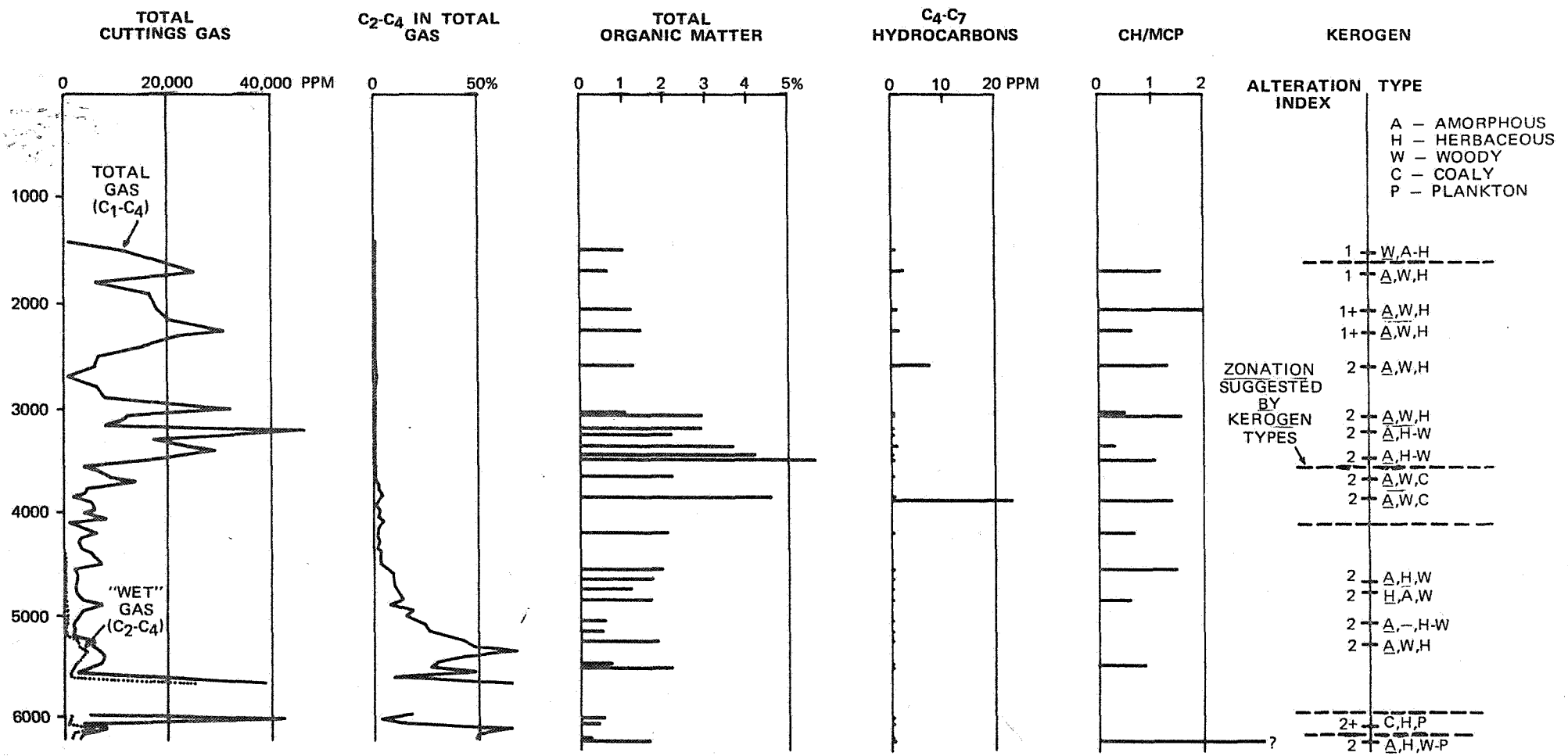

FIG. 1. GEOCHEMICAL PATTERNS, WELL 16/2-1, NORWAY

TABLE 1A

C_1-C_4 HYDROCARBON ANALYSES - AIR SPACE AT TOP OF CANS

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)									NOTES
											TOTAL GAS						WET GAS			
			METHANE (C_1)	ETHANE (C_2)	PROPANE (C_3)	ISO-BUTANE (iC_4)	NORMAL BUTANE (nC_4)	WET (C_2-C_4)	TOTAL (C_1-C_4)	C_2-C_4	C_1	C_2	C_3	iC_4	nC_4	C_2	C_3	iC_4	nC_4	
54222A	4	1350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222B	4	1430	18.21	0.15	0.12	0.05	0.09	0.41	18.62	2.2018	98.	1.	1.	0.	0.	37.	29.	12.	22.	
54222C	4	1450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222D	4	1530	10818.17	1.09	1.34	0.66	0.83	3.91	10822.08	0.0362	100.	0.	0.	0.	0.	28.	34.	17.	21.	
54222E	4	1550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222F	4	1615	18542.68	5.72	3.39	1.29	1.21	11.60	18554.28	0.0625	100.	0.	0.	0.	0.	50.	29.	11.	10.	
54222G	4	1650	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222H	4	1730	24651.26	13.08	3.16	0.95	0.63	17.81	24669.07	0.0722	100.	0.	0.	0.	0.	73.	18.	5.	4.	
54222I	4	1750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222J	4	1810	4998.09	1.30	0.96	0.52	0.21	2.98	5001.07	0.0596	100.	0.	0.	0.	0.	44.	32.	17.	7.	
54222K	4	1850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222L	4	1930	13749.99	1.62	1.31	0.50	0.27	3.70	13753.68	0.0269	100.	0.	0.	0.	0.	44.	35.	14.	7.	
54222M	4	1950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222N	4	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222O	4	2050	16758.51	2.10	9.26	4.96	6.60	22.91	16781.42	0.1365	100.	0.	0.	0.	0.	9.	40.	22.	29.	
54222P	4	2120	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222Q	4	2150	13963.09	7.07	10.41	6.86	12.22	36.55	18999.64	0.1924	100.	0.	0.	0.	0.	19.	28.	19.	34.	
54222R	4	2230	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223A	4	2250	28933.22	4.93	12.30	5.72	7.66	30.58	28933.80	0.1057	100.	0.	0.	0.	0.	16.	40.	19.	25.	
54223B	4	2310	20488.88	4.92	10.58	5.72	7.54	28.75	20517.63	0.1401	100.	0.	0.	0.	0.	17.	37.	20.	26.	
54223C	4	2350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223D	4	2430	14526.85	4.61	11.12	6.31	9.62	31.65	14557.70	0.2174	100.	0.	0.	0.	0.	15.	35.	20.	30.	
54223E	4	2490	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223F	4	2530	4326.40	1.72	4.37	1.99	3.25	11.32	4337.72	0.2611	100.	0.	0.	0.	0.	15.	38.	18.	29.	
54223G	4	2550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223H	4	2670	3626.80	0.56	1.27	0.59	0.73	3.15	3631.95	0.0867	100.	0.	0.	0.	0.	18.	40.	19.	23.	
54223I	4	2690	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223J	4	2770	132.79	0.81	0.13	0.05	0.18	1.17	133.96	0.8734	99.	1.	0.	0.	0.	70.	11.	4.	15.	
54223K	4	2750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223L	4	2800	5792.39	1.30	1.28	1.00	3.94	7.51	5797.90	0.1296	100.	0.	0.	0.	0.	17.	17.	13.	53.	
54223M	4	2850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223N	4	2900	6376.66	1.22	4.85	0.84	3.06	9.96	6388.62	0.1560	100.	0.	0.	0.	0.	12.	49.	8.	31.	
54223O	4	2950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54223P	4	3000	25760.00	3.85	4.84	1.10	2.25	12.04	25772.04	0.0467	100.	0.	0.	0.	0.	32.	40.	9.	19.	
54223Q	4	3050	9923.07	1.36	2.41	0.67	2.01	6.44	9929.51	0.0649	100.	0.	0.	0.	0.	21.	38.	10.	31.	
54223R	4	3100	10355.95	1.32	2.04	0.69	2.79	6.83	10372.78	0.0659	100.	0.	0.	0.	0.	19.	30.	10.	41.	
54224A	4	3150	7127.03	0.88	3.79	0.45	1.76	6.87	7133.90	0.0964	100.	0.	0.	0.	0.	13.	54.	7.	26.	
54224B	4	3225	40069.57	3.78	6.98	1.42	2.65	14.82	40084.39	0.0370	100.	0.	0.	0.	0.	26.	46.	10.	18.	
54224C	4	3250	26640.00	4.88	9.88	8.31	3.60	26.66	26666.66	0.1000	100.	0.	0.	0.	0.	18.	37.	31.	14.	
54224D	4	3300	15808.72	1.60	15.48	1.89	2.16	21.12	15829.84	0.1334	100.	0.	0.	0.	0.	8.	73.	9.	10.	
54224E	4	3350	20059.80	6.67	4.63	5.76	1.35	18.40	20078.20	0.0917	100.	0.	0.	0.	0.	37.	25.	31.	7.	
54224F	4	3400	27454.71	3.26	5.67	0.89	2.34	12.15	27466.86	0.0442	100.	0.	0.	0.	0.	27.	47.	7.	19.	
54224G	4	3450	19327.97	2.83	2.51	4.27	1.40	11.00	19338.97	0.0569	100.	0.	0.	0.	0.	26.	23.	38.	13.	
54224H	4	3500	12999.99	3.36	3.82	0.81	2.12	10.10	13010.09	0.0776	100.	0.	0.	0.	0.	33.	38.	8.	21.	
54224I	4	3550	3432.64	1.28	2.48	1.18	4.32	9.26	3441.90	0.2690	100.	0.	0.	0.	0.	14.	27.	13.	46.	
54224J	4	3600	5354.25	0.91	2.71	1.16	3.41	8.18	5362.22	0.1525	100.	0.	0.	0.	0.	11.	33.	14.	42.	
54224K	4	3650	7686.00	2.62	6.14	4.02	6.88	19.65	7699.65	0.2552	100.	0.	0.	0.	0.	13.	31.	20.	36.	
54224L	4	3700	12568.88	3.30	3.40	2.62	7.42	16.73	12585.61	0.1329	100.	0.	0.	0.	0.	20.	20.	16.	44.	
54224M	4	3750	3360.00	29.89	6.46	12.40	7.14	55.89	3415.89	1.6362	99.	1.	0.	0.	0.	53.	12.	22.	13.	
54224N	4	3800	3042.00	19.17	1.96	2.01	6.37	29.51	3071.51	0.9607	99.	1.	0.	0.	0.	64.	7.	7.	22.	
54224O	4	3850	922.27	3.51	4.45	5.35	6.12	19.43	941.70	2.0632	98.	0.	0.	0.	1.	18.	23.	28.	31.	
54224P	4	3900	3478.50	7.81	4.62	1.84	6.06	20.33	3498.83	0.5810	100.	0.	0.	0.	0.	38.	23.	9.	30.	
54224Q	4	3950	3237.81	2.27	2.74	1.22	3.93	10.16	3247.97	0.3128	100.	0.	0.	0.	0.	22.	27.	12.	39.	
54224R	4	4000	2872.00	22.18	2.92	2.26	8.61	35.97	2907.97	1.2369	99.	1.	0.	0.	0.	62.	8.	6.	24.	
54225A	4	4050	6423.99	4.41	4.83	2.31	7.93	19.47	6443.46	0.3022	100.	0.	0.	0.	0.	23.	25.	12.	40.	
54225B	4	4100	275.50	3.42	0.68	0.33	1.38	5.81	281.31	2.0652	99.	1.	0.	0.	0.	58.	12.	6.	24.	
54225C	4	4150	3551.31	39.56	2.78	1.31	5.23	48.88	3600.19	1.3577	99.	1.	0.	0.	0.	80.	6.	3.	11.	
54225D	4	4200	4999.67	53.03	3.25	1.74	6.00	64.02	5063.68	1.2642	99.	1.	0.	0.	0.	83.	5.	3.	9.	
54225E	4	4250	1854.40	23.63	1.90	1.31	4.73	31.57	1885.97	1.6739	99.	1.	0.	0.	0.	75.	6.	4.	15.	
54225F	4	4300	1811.03	23.70	1.80	1.06	3.74	30.30	1841.33	1.6455	99.	1.	0.	0.	0.	79.	6.	3.	12.	
54225G	4	4350	1895.77	23.84	2.12	1.23	4.54	31.73	1927.50	1.6461	99.	1.	0.	0.	0.	75.	7.	4.	14.	
54225H	4	4400	4382.40	89.49	9.25	2.80	7.15	108.68	4491.08	2.4200	98.	2.	0.	0.	0.	81.	9.	3.	7.	
54225I	4	4450	4695.57	63.60	16.84	2.94	4.96	88.33	4783.90	1.8464	99.	1.	0.	0.	0.	72.	19.	3.	6.	
54225J	4	4500	5356.79	91.27	29.08	5.10	5.67	131.11	5487.90	2.3891	97.	2.	1.	0.	0.	70.	22.	4.	4.	
54225K	4	4550	861.87	12.54	4.44	1.12	1.41	19.51	881.38	2.2135	98.	1.	1.	0.	0.	64.	23.	6.	7.	
54225L	4	4600	1560.53	56.77	18.86	4.55	5.29	85.47	1646.00	5.1925	96.	3.	1.	0.	0.	67.	22.	5.	6.	
54225M	4	4650	1519.31	58.41	18.27	3.85	4.41	84.94	1604.25	5.2947	95.	4.	1.	0.	0.	68.	22.	5.	5.	
54225N	4	4700	1235.20	43.80	15.08	3.13	3.56	65.57	1300.77	5.0408	96.	3.	1.	0.	0.	67.	23.	5.	5.	
54225O	4	4750	1341.93	64.29	23.96	4.58	4.84	97.69	1439.62	6.7858	94.	4.	2.	0.	0.	65.	25.	5.	5.	
54225P	4	4800	1460.34	97.98	47.96	9.41	8.26	163.61	1623.95	10.0748	89.	6.	3.	1.	1.	60.	29.	6.	5.	
54225Q	4	4850	1972.80	161.99	83.28	15.00	11.96	272.23	2245.03	12.1259	87.	7.	4.	1.	1.	59.	31.	6.	4.	
54225R	4	4900	5472.00	147.59	72.70	11.22	8.98	240.48	5712.48	4.2098	96.	3.	1.	0.	0.	61.	30.	5.	4.	
54225S	4	4950	1814.00	197.86	91.56	12.70	9.50	311.62	2125.62	14.6602	86.	9.	4.	1.	0.	64.	29.	4.	3.	
54226A	4	5000	1131.27	83.13	35.40	5.09	4.70	128.32	1259.59	10.1874	90.	7.	3.	0.	0.	64.	28.	4.	4.	
54226C	4	5050	1276.80	160.81	98.98	15.58	12.41	287.78	1564.58	18.3934	82.	10.	6.	1.	1.	57.	34.	5.	4.	
54226D	4	5100	733.33	100.69	136.80	32.24	29.68	299.41	1032.74	28.9918	71.	10.	13.	3.	3.	34.	45.	11.	10.	
54226E	4	5150	1023.33	152.30	124.79	21.25	20.99	319.33	1342.66	23.7834	76.	11.	9.	2.	2.	47.	39.	7.	7.	
54226F	4	5200	633.68	115.61	121.78	20.59	19.07	277.05	910.13	30.4406	70.	13.	13.	2.	2.	42.	44.	7.	7.	
54226G	4	5250	2555.15	630.23	441.74	50.02	54.68	1176.67	3731.82	31.5307	69.	17.	12.	1.	1.	53.	38.	4.	5.	
54226H	4	5300	2011.88	537.92	397.74	45.15	47.97	1028.78	3040.66	33.8341	66.	18.	13.	1.	2.	52.	39.	4.	5.	
54226I	4	5350	1586.96	1087.65	1260.94	203.25	202.78	2754.61	4341.57	63.4473	36.	25.	29.	5.	5.	39.	47.	7.	7.	
54226J	4	5400	2494.66	472.82	316.90	39.98	50.11	879.81	3374.77	26.0702	75.	14.	9.	1.	1.	53.	36.	5.	6.	
54226K	4	5450	3675.00	567.46	350.72	43.62	55.65	1017.44	4692.44	21.6825	79.	12.	7.	1.	1.	57.	34.	4.	5.	
54226L	4	5500	3270.97	563.35	423.64	50.40	70.78	1108.16	4379.13	25.3055	74.	13.	10.	1.	2.	51.	38.	5.	6.	
54226M	4	5550	982.76	231.93	446.57	85.52	110.02	874.04	1856.80	47.0724	53.	12.	24.	5.	6.	27.	50.	10.	13.	
54226N	4	5600	8506.14	282.33	82.50	6.98	8.41	380.21	8946.35	4.2499	96.	3.	1.	0.	0.	74.	22.	2.	2.	
54226O	4	5650	10981.99	3318.16	7277.75	1616.21	2150.95	14363.06	25345.05	56.6701	44.	13.	29.	6.	8.	23.	51.	11.	15.	
54226P	4	5950	3220.00	165.20	223.44	50.84	111.30	550.78	3770.78	14.6065	86.	4.	6.	1.	3.	30.	41.	9.	20.	
54226Q	4	6000	32571.39	70.46	215.05	50.49	89.19	425.18	32996.57	1.2886	99.	0.	0.	1.	0.	17.	50.	12.	21.	
54226R	4	6050	1610.28	80.24	126.51	33.67	62.57	302.99	1913.27	15.8362	84.	4.	7.	2.	3.	26.	42.	11.	21.	
54227A	4	6100	1747.06	895.41	1351.90	235.78	355.41	2838.49	4585.55	61.9008	38.	20.	29.	5.	8.	32.	47.	8.	13.	
54227B	4	6150	805.46	163.03	403.20	137.74	196.82	900.79	1706.25	52.7935	46.	10.	24.	8.	12.	18.	45.	15.	22.	
54227C	4	6200	861.16	119.18	460.56	79.10	125.37	784.21	1645.37	47.6616	52.	7.	28.	5.	8.	15.	59.	10.	16.	

B = CUTTINGS NOT ANALYZED *C* = AIR SPACE GAS NOT RUN *BC* = NO ANALYSES RUN

Analyses by S.R. Tillotson

TABLE 1B

C_1-C_4 HYDROCARBON ANALYSES - CUTTINGS ONLY

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)								NOTES
											TOTAL GAS					WET GAS				
			METHANE (C_1)	ETHANE (C_2)	PROPANE (C_3)	ISO-BUTANE (iC_4)	NORMAL BUTANE (nC_4)	WET (C_2-C_4)	TOTAL (C_1-C_4)	C_2-C_4	C_1	C_2	C_3	iC_4	nC_4	C_2	C_3	iC_4	nC_4	
54222A	4	1350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222B	4	1400	975.00	0.62	1.18	1.05	2.08	4.93	979.93	0.5030	100.	0.00.	00.	00.	0.0	13.	24.	21.	42.	
54222C	4	1450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222D	4	1500	1167.00	0.71	0.71	0.90	1.67	3.99	1170.99	0.3407	100.	0.00.	00.	00.	0.0	18.	18.	23.	41.	
54222E	4	1550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222F	4	1600	816.00	1.77	1.17	7.21	1.69	11.84	827.84	1.4302	99.	0.	00.	0	1.0.0	15.	10.	61.	14.	
54222G	4	1650	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222H	4	1700	939.00	1.15	0.85	1.02	0.72	3.74	942.74	0.3967	100.	0.	00.	00.	0.0	31.	23.	27.	19.	
54222I	4	1750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222J	4	1800	1425.00	0.97	0.68	0.90	0.79	3.34	1428.34	0.2338	100.	0.	00.	00.	0.0	29.	20.	27.	24.	
54222K	4	1850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222L	4	1900	3018.00	0.88	1.17	0.93	1.03	4.01	3022.01	0.1327	100.	0.	00.	00.	0.0	22.	29.	23.	26.	
54222M	4	1950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222N	4	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222O	4	2050	1650.00	1.06	4.31	10.32	11.72	27.41	1677.41	1.6340	98.	0.	00.	0	1. 1.	4.	16.	38.	42.	
54222P	4	2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54222Q	4	2150	1548.00	1.77	3.04	4.58	12.40	21.79	1569.79	1.3880	99.	0.	00.	00.	0.0	8.	14.	21.	57.	
54222R	4	2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223A	4	2250	2100.00	0.71	3.54	4.00	8.06	16.31	2116.31	0.7707	100.	0.	00.	00.	0.0	4.	22.	25.	49.	
54223B	4	2300	1299.00	1.77	5.13	6.70	12.45	26.05	1325.05	1.9659	98.	0.	00.	0	1. 1.	7.	20.	26.	47.	
54223C	4	2350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223D	4	2400	780.00	24.43	6.84	32.74	12.72	76.73	856.73	8.9561	91.	3.	1.	4.	1.	32.	9.	42.	17.	
54223E	4	2450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223F	4	2500	2451.00	2.48	4.14	4.28	10.21	21.11	2472.11	0.8539	100.	0.	00.	00.	0.0	12.	20.	20.	48.	
54223G	4	2550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223H	4	2600	2271.00	13.81	3.76	31.62	5.22	54.41	2325.41	2.3398	98.	1.	0.	0	1. 0.	25.	7.	58.	10.	
54223I	4	2650	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223J	4	2700	487.50	1.77	0.80	1.39	5.98	9.94	497.44	1.9981	99.	0.	00.	00.	0.0	18.	8.	14.	60.	
54223K	4	2750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223L	4	2800	690.00	1.52	1.78	2.27	11.03	16.60	616.60	2.6920	98.	0.	00.	00.	0.0	9.	11.	14.	66.	
54223M	4	2850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223N	4	2900	1384.50	1.77	6.72	3.18	10.49	22.16	1406.66	1.5753	99.	0.	00.	00.	0.0	8.	30.	14.	48.	
54223O	4	2950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	00.	00.	00.	0.0	0.00.	00.	00.	0.0	*BC*
54223P	4	3000	6611.99	4.42	5.47	24.33	6.65	40.86	6652.85	0.6142	100.	0.	00.	00.	0.0	11.	13.	60.	16.	
54223Q	4	3050	2403.00	2.48	3.04	1.67	6.46	13.65	2416.65	0.5648	100.	0.	00.	00.	0.0	18.	22.	12.	48.	
54223R	4	3100	852.00	1.59	1.37	0.69	3.82	7.47	859.47	0.8691	100.	0.	00.	00.	0.0	21.	18.	9.	52.	
54224A	4	3150	990.00	1.06	1.44	0.82	3.53	6.85	996.85	0.6871	100.	0.	00.	00.	0.0	15.	21.	12.	52.	
54224B	4	3200	6011.99	2.12	4.07	2.12	5.71	14.01	6026.00	0.2325	100.	0.	00.	00.	0.0	15.	29.	15.	41.	
54224C	4	3250	2826.00	2.48	6.33	2.73	4.94	16.48	2842.48	0.5798	100.	0.	00.	00.	0.0	15.	38.	17.	30.	
54224D	4	3300	1773.00	2.48	13.54	3.05	5.20	24.27	1797.27	1.3504	99.	0.	0	1.	0. 0.0	10.	56.	13.	21.	
54224E	4	3350	3683.99	2.76	2.56	0.86	3.02	9.20	3693.19	0.2491	100.	0.	00.	00.	0.0	30.	28.	9.	33.	
54224F	4	3400	1953.00	2.12	2.22	0.87	1.91	7.12	1960.12	0.3632	100.	0.	00.	00.	0.0	30.	31.	12.	27.	
54224G	4	3450	1833.00	1.77	1.72	0.60	2.07	6.16	1839.16	0.3349	100.	0.	00.	00.	0.0	29.	28.	10.	33.	
54224H	4	3500	1110.00	1.06	1.26	0.59	1.71	4.62	1114.62	0.4144	100.	0.	00.	00.	0.0	23.	27.	13.	37.	
54224I	4	3550	321.37	0.97	1.26	0.89	3.71	6.83	328.20	2.0809	99.	0.	00.	00.	0 1.	14.	18.	13.	55.	
54224J	4	3600	1240.50	1.06	2.38	1.86	6.55	11.85	1252.35	0.9462	99.	0.	00.	00.	0 1.	9.	20.	16.	55.	
54224K	4	3650	937.50	1.02	2.28	2.88	6.32	12.50	950.00	1.3157	99.	0.	00.	00.	0 1.	8.	18.	23.	51.	
54224L	4	3700	1389.00	1.42	3.16	3.56	14.31	22.45	1411.45	1.5905	99.	0.	00.	00.	0 1.	6.	14.	16.	64.	
54224M	4	3750	856.50	1.57	2.05	3.81	17.27	24.70	881.20	2.8029	98.	0.	00.	00.	0 2.	6.	8.	15.	71.	
54224N	4	3800	1020.00	1.06	2.74	5.47	23.05	32.32	1052.32	3.0713	97.	0.	00.	0	1. 2.	3.	8.	17.	72.	
54224O	4	3850	710.25	1.77	2.58	5.59	23.21	33.15	743.40	4.4592	96.	0.	00.	0	1. 3.	5.	8.	17.	70.	
54224P	4	3900	1671.00	1.42	10.43	7.70	27.25	46.80	1717.80	2.7244	97.	0.	0	1.	0.0 2.	3.	22.	16.	59.	
54224Q	4	3950	2718.00	4.25	11.92	7.70	27.54	51.41	2769.41	1.8563	99.	0.	00.	00.	0 1.	8.	23.	15.	54.	
54224R	4	4000	840.00	2.83	6.22	6.51	25.82	41.38	881.38	4.6948	95.	0.	0	1.	1. 3.	7.	15.	16.	62.	
54225A	4	4050	1608.00	7.08	9.92	6.32	25.12	48.44	1656.44	2.9243	97.	0.	0	1.	0.0 2.	15.	20.	13.	52.	
54225B	4	4100	735.00	13.81	4.10	4.17	17.90	39.98	774.98	5.1588	94.	2.	1.	1.	2.	35.	10.	10.	45.	
54225C	4	4150	720.00	7.68	3.93	4.35	18.83	34.19	754.19	4.5333	95.	1.	1.	1.	2.	21.	11.	13.	55.	
54225D	4	4200	1482.00	4.25	4.10	3.87	18.92	31.14	1513.14	2.0579	99.	0.	00.	00.	0 1.	14.	13.	12.	61.	
54225E	4	4250	1110.00	3.54	3.69	3.98	16.85	28.06	1138.06	2.4656	99.	0.	00.	00.	0 1.	13.	13.	14.	60.	
54225F	4	4300	990.00	2.83	5.44	4.46	18.44	31.17	1021.17	3.0524	97.	0.	0	1.	0.0 2.	9.	17.	14.	60.	
54225G	4	4350	1224.00	3.54	3.59	2.60	14.53	24.26	1248.26	1.9434	99.	0.	00.	00.	0 1.	15.	15.	11.	59.	
54225H	4	4400	712.50	6.37	6.16	2.98	10.27	25.78	738.28	3.4918	97.	1.	1.	0.	0 1.	25.	24.	12.	39.	
54225I	4	4450	1150.50	4.89	22.64	8.33	17.30	53.16	1203.66	4.4165	96.	0.	0	2.	1. 1.	9.	42.	16.	33.	
54225J	4	4500	1470.00	7.47	26.57	10.71	14.21	58.96	1528.96	3.8562	96.	0.	0	2.	1. 1.	13.	45.	18.	24.	
54225K	4	4550	697.50	24.60	25.65	13.91	19.40	83.56	781.06	10.6982	90.	3.	3.	2.	2.	29.	31.	17.	23.	
54225L	4	4600	372.75	29.38	29.75	15.25	20.29	94.67	467.42	20.2537	81.	6.	6.	3.	4.	31.	32.	16.	21.	
54225M	4	4650	562.50	37.88	42.00	17.86	21.12	118.86	681.36	17.4445	82.	6.	6.	3.	3.	32.	35.	15.	18.	
54225N	4	4700	643.20	44.04	45.14	17.86	21.24	128.28	771.48	16.6277	83.	6.	6.	2.	3.	34.	35.	14.	17.	
54225O	4	4750	508.20	38.94	46.99	20.61	22.26	128.80	637.00	20.2197	81.	6.	7.	3.	3.	30.	37.	16.	17.	
54225P	4	4800	799.20	33.77	51.03	24.25	25.50	134.55	933.75	14.4096	85.	4.	5.	3.	3.	25.	38.	18.	19.	
54225Q	4	4850	796.80	50.98	76.61	32.74	33.45	193.78	990.58	19.5623	81.	5.	8.	3.	3.	26.	40.	17.	17.	
54225R	4	4900	1312.50	77.31	118.74	46.57	44.77	287.39	1599.89	17.9631	82.	5.	7.	3.	3.	27.	41.	16.	16.	
54226A	4	4950	912.00	82.55	126.68	40.18	38.29	287.70	1199.70	23.9810	76.	7.	11.	3.	3.	29.	44.	14.	13.	
54226B	4	5000	1354.69	98.55	131.88	37.94	39.94	308.31	1663.00	18.5394	82.	6.	8.	2.	2.	32.	43.	12.	13.	
54226C	4	5050	272.10	26.90	60.47	23.81	25.06	136.24	408.34	33.3643	66.	7.	15.	6.	6.	20.	45.	17.	18.	
54226D	4	5100	363.60	10.51	21.55	13.88	17.65	63.59	427.19	14.8855	86.	2.	5.	3.	4.	17.	33.	22.	28.	
54226E	4	5150	249.00	24.07	60.19	22.32	27.48	134.06	383.06	34.9970	65.	6.	16.	6.	7.	18.	45.	17.	20.	
54226F	4	5200	340.80	39.65	105.88	37.20	47.06	229.79	570.59	40.2723	59.	7.	19.	7.	8.	17.	47.	16.	20.	
54226G	4	5250	704.40	306.99	630.56	154.75	193.85	1286.15	1990.55	64.6128	35.	15.	32.	8.	10.	24.	49.	12.	15.	
54226H	4	5300	675.00	307.27	722.30	171.12	218.78	1419.47	2094.47	67.7723	32.	15.	35.	8.	10.	22.	51.	12.	15.	
54226I	4	5350	352.50	205.32	656.64	199.39	281.11	1342.46	1694.96	79.2030	21.	12.	38.	12.	17.	15.	49.	15.	21.	
54226J	4	5400	1707.00	618.79	1180.58	267.84	379.06	2446.27	4153.27	58.8998	42.	15.	28.	6.	9.	25.	49.	11.	15.	
54226K	4	5450	1200.00	293.11	519.84	123.50	176.81	1113.26	2313.26	48.1251	52.	13.	22.	5.	8.	26.	47.	11.	16.	
54226L	4	5500	844.50	80.71	203.83	56.54	90.95	432.03	1276.53	33.8441	67.	6.	16.	4.	7.	19.	47.	13.	21.	
54226M	4	5550	102.75	14.34	64.64	14.88	42.93	136.79	239.54	57.1053	43.	6.	27.	6.	18.	10.	48.	11.	31.	
54226N	4	5600	4643.99	344.09	333.79	73.10	111.30	862.27	5506.26	15.6599	85.	6.	6.	1.	2.	40.	39.	8.	13.	
54226O	4	5650	2190.00	841.10	4202.49	2362.94	3597.21	11003.73	13193.73	83.4012	17.	6.	32.	18.	27.	8.	38.	21.	33.	
54226P	4	5950	817.50	10.35	108.41	62.50	135.15	316.41	1133.91	27.9043	71.	1.	10.	6.	12.	3.	34.	20.	43.	
54226Q	4	6000	8999.99	24.78	102.26	55.24	124.18	306.45	9306.44	3.2929	97.	0.	0	1.	1. 1.	8.	33.	18.	41.	
54226R	4	6050	1284.00	13.27	46.17	35.06	80.14	174.64	1458.64	11.9728	89.	1.	3.	2.	5.	8.	26.	20.	46.	
54227A	4	6100	874.50	152.93	861.84	410.69	796.27	2221.73	3096.23	71.7560	28.	5.	28.	13.	26.	7.	39.	18.	36.	
54227B	4	6150	651.00	40.36	169.29	110.11	224.51	544.27	1195.27	45.5353	55.	3.	14.	9.	19.	7.	31.	20.	42.	
54227C	4	6200	342.00	15.75	87.55	71.42	150.10	324.82	666.82	48.7117	51.	2.	13.	11.	23.	5.	27.	22.	46.	

B = CUTTINGS NOT ANALYZED *C* = AIR SPACE GAS NOT RUN *BC* = NO ANALYSES RUN

TABLE 1C

C_1-C_4 HYDROCARBON ANALYSES - CUTTINGS AND AIR SPACE

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)									NOTES
										TOTAL GAS						WET GAS			
			METHANE (C_1)	ETHANE (C_2)	PROPANE (C_3)	ISO-BUTANE (iC_4)	NORMAL BUTANE (nC_4)	WET (C_2-C_4)	TOTAL (C_1-C_4)	C_2-C_4	C_1	C_2	C_3	iC_4	nC_4	C_2	C_3	iC_4	nC_4	
54222A	4	1350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	0.00.	*BC*
54222B	4	1400	993.21	0.77	1.30	1.10	2.17	5.34	998.55	0.5347	100.	0.00.	0.00.	0.00.	0.0	14.	24.	21.	41.	
54222C	4	1450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222D	4	1500	11985.17	1.80	2.05	1.56	2.50	7.90	11993.07	0.0659	100.	0.00.	0.00.	0.00.	0.0	23.	26.	20.	31.	
54222E	4	1550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222F	4	1600	19358.68	7.49	4.56	8.50	2.90	23.44	19382.12	0.1209	100.	0.00.	0.00.	0.00.	0.0	32.	19.	37.	12.	
54222G	4	1650	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222H	4	1700	25590.26	14.23	4.01	1.97	1.35	21.55	25611.81	0.0841	100.	0.00.	0.00.	0.00.	0.0	66.	19.	9.	6.	
54222I	4	1750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222J	4	1800	6423.09	2.27	1.64	1.42	1.00	6.32	6429.41	0.0983	100.	0.00.	0.00.	0.00.	0.0	36.	26.	22.	16.	
54222K	4	1850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222L	4	1900	16767.99	2.50	2.48	1.43	1.30	7.70	16775.69	0.0459	100.	0.00.	0.00.	0.00.	0.0	32.	32.	19.	17.	
54222M	4	1950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222N	4	2000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222O	4	2050	18408.51	3.16	13.57	15.28	18.32	50.32	18458.82	0.2726	100.	0.00.	0.00.	0.00.	0.0	6.	27.	30.	37.	
54222P	4	2100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54222Q	4	2150	20511.09	8.84	13.45	11.44	24.62	58.34	20569.43	0.2836	100.	0.00.	0.00.	0.00.	0.0	15.	23.	23.	42.	
54222R	4	2200	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223A	4	2250	31003.22	5.64	15.84	9.70	15.72	46.89	31050.11	0.1510	100.	0.00.	0.00.	0.00.	0.0	12.	34.	21.	33.	
54223B	4	2300	21787.88	6.69	15.71	12.42	19.99	54.80	21842.68	0.2509	100.	0.00.	0.00.	0.00.	0.0	12.	29.	23.	36.	
54223C	4	2350	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223D	4	2400	15306.05	29.04	17.96	39.05	22.34	108.38	15414.43	0.7031	100.	0.00.	0.00.	0.00.	0.0	27.	17.	35.	21.	
54223E	4	2450	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223F	4	2500	6777.40	4.20	8.51	6.27	13.46	32.43	6809.83	0.4763	100.	0.00.	0.00.	0.00.	0.0	13.	26.	19.	42.	
54223G	4	2550	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223H	4	2600	5899.80	14.37	5.03	32.21	5.95	57.56	5957.36	0.9662	99.	0.00.	0.0	1.0.	0.0	25.	9.	56.	10.	
54223I	4	2650	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223J	4	2700	620.29	2.58	0.93	1.44	6.16	11.11	631.40	1.7595	99.	0.00.	0.00.	0.0	1.	23.	8.	13.	56.	
54223K	4	2750	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223L	4	2800	6390.39	2.82	3.06	3.27	14.97	24.11	6414.50	0.3759	100.	0.00.	0.00.	0.00.	0.0	12.	13.	14.	61.	
54223M	4	2850	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223N	4	2900	7763.16	2.99	11.57	4.02	13.55	32.12	7795.28	0.4121	100.	0.00.	0.00.	0.00.	0.0	9.	36.	13.	42.	
54223O	4	2950	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	00.	00.	00.	0.0	0.	00.	00.	0.0	*BC*
54223P	4	3000	32371.99	8.27	10.31	25.43	8.90	52.90	32424.89	0.1631	100.	0.00.	0.00.	0.00.	0.0	16.	19.	48.	17.	
54223Q	4	3050	12326.07	3.84	5.45	2.34	8.47	20.09	12346.16	0.1627	100.	0.00.	0.00.	0.00.	0.0	19.	27.	12.	42.	
54223R	4	3100	11217.95	2.91	3.41	1.38	6.61	14.30	11232.25	0.1273	100.	0.00.	0.00.	0.00.	0.0	20.	24.	1.	46.	
54224A	4	3150	8117.03	1.94	5.23	1.27	5.29	13.72	8130.75	0.1688	100.	0.00.	0.00.	0.00.	0.0	14.	38.	9.	39.	
54224B	4	3200	46081.55	5.90	11.05	3.54	8.36	28.83	46110.38	0.0625	100.	0.00.	0.00.	0.00.	0.0	20.	39.	12.	29.	
54224C	4	3250	29466.00	7.36	16.21	11.04	8.54	43.14	29509.14	0.1462	100.	0.00.	0.00.	0.00.	0.0	17.	37.	26.	20.	
54224D	4	3300	17581.72	4.08	29.02	4.94	7.36	45.39	17627.11	0.2575	100.	0.00.	0.00.	0.00.	0.0	9.	64.	11.	16.	
54224E	4	3350	23743.79	9.43	7.19	6.62	4.37	27.60	23771.39	0.1161	100.	0.00.	0.00.	0.00.	0.0	34.	26.	24.	16.	
54224F	4	3400	29407.71	5.38	7.89	1.76	4.25	19.27	29426.98	0.0655	100.	0.00.	0.00.	0.00.	0.0	28.	41.	9.	22.	
54224G	4	3450	21160.97	4.60	4.23	4.87	3.47	17.16	21178.13	0.0810	100.	0.00.	0.00.	0.00.	0.0	27.	25.	28.	20.	
54224H	4	3500	14109.99	4.42	5.08	1.40	3.83	14.72	14124.71	0.1042	100.	0.00.	0.00.	0.00.	0.0	30.	34.	10.	26.	
54224I	4	3550	3754.01	2.25	3.74	2.07	8.03	16.09	3770.10	0.4268	100.	0.00.	0.00.	0.00.	0.0	14.	23.	13.	50.	
54224J	4	3600	6594.55	1.97	5.09	3.02	9.96	20.03	6614.57	0.3027	100.	0.00.	0.00.	0.00.	0.0	10.	25.	15.	50.	
54224K	4	3650	8617.50	3.64	8.42	6.90	13.20	32.15	8649.65	0.3717	100.	0.00.	0.00.	0.00.	0.0	11.	26.	21.	42.	
54224L	4	3700	13957.88	4.72	6.56	6.18	21.73	39.18	13997.06	0.2799	100.	0.00.	0.00.	0.00.	0.0	12.	17.	16.	55.	
54224M	4	3750	4216.50	31.46	8.51	16.21	24.41	80.59	4297.09	1.8754	98.	1.0.	0.00.	0.0	1.	39.	11.	20.	30.	
54224N	4	3800	4062.00	20.23	4.70	7.48	29.42	61.83	4123.83	1.4993	99.	0.00.	0.00.	0.0	1.	33.	8.	12.	47.	
54224O	4	3850	1632.52	5.28	7.03	10.94	29.33	52.58	1685.10	3.1202	97.	0.00.	0.0	1.	2.	10.	13.	21.	56.	
54224P	4	3900	5149.50	9.23	15.05	9.54	33.31	67.13	5216.63	1.2868	99.	0.00.	0.00.	0.0	1.	14.	22.	14.	50.	
54224Q	4	3950	5955.81	6.52	14.66	8.92	31.47	61.57	6017.38	1.0232	99.	0.00.	0.00.	0.0	1.	11.	24.	14.	51.	
54224R	4	4000	3712.00	25.01	9.14	8.77	34.43	77.35	3789.35	2.0412	98.	1.0.	0.00.	0.0	1.	32.	12.	11.	45.	
54225A	4	4050	8031.99	11.49	14.75	8.63	33.05	67.91	8099.90	0.8384	100.	0.00.	0.00.	0.00.	0.0	17.	22.	13.	48.	
54225B	4	4100	1010.50	17.23	4.78	4.50	19.28	45.79	1056.29	4.3349	96.	2.0.	0.00.	0.0	2.	38.	10.	17.	42.	
54225C	4	4150	4271.31	46.64	6.71	5.66	24.06	83.07	4354.37	1.9077	98.	1.0.	0.00.	0.0	1.	56.	8.	7.	29.	
54225D	4	4200	6481.67	57.28	7.35	5.61	24.92	95.16	6576.82	1.4468	99.	1.0.	0.00.	0.0	0.	60.	8.	6.	26.	
54225E	4	4250	2964.40	27.17	5.59	5.29	21.58	59.63	3024.03	1.9718	98.	1.0.	0.00.	0.0	1.	46.	9.	9.	36.	
54225F	4	4300	2801.03	26.53	7.24	5.52	22.18	61.47	2862.50	2.1474	98.	1.0.	0.00.	0.0	1.	43.	12.	9.	36.	
54225G	4	4350	3119.77	27.38	5.71	3.83	19.07	55.99	3175.76	1.7630	98.	1.0.	0.00.	0.0	1.	49.	10.	7.	34.	
54225H	4	4400	5094.90	95.86	15.41	5.78	17.42	134.46	5229.36	2.5713	98.	2.0.	0.00.	0.0	0.	72.	11.	4.	13.	
54225I	4	4450	5846.07	68.49	39.48	11.27	22.26	141.49	5987.55	2.3631	98.	1.	1.0.	0.0	0.	48.	28.	8.	16.	
54225J	4	4500	6826.79	98.74	55.65	15.81	19.88	190.07	7016.86	2.7088	98.	1.	1.0.	0.0	0.	53.	29.	8.	10.	
54225K	4	4550	1559.37	37.14	30.09	15.03	20.81	103.07	1662.44	6.1999	94.	2.	2.	1.	1.	36.	29.	15.	20.	
54225L	4	4600	1933.28	86.15	48.61	19.80	25.58	180.14	2113.42	8.5236	92.	4.	2.	1.	1.	48.	27.	11.	14.	
54225M	4	4650	2081.81	96.29	60.27	21.71	25.53	203.80	2285.61	8.9166	91.	4.	3.	1.	1.	46.	30.	11.	13.	
54225N	4	4700	1878.40	87.84	60.22	20.99	24.80	193.85	2072.25	9.3545	91.	4.	3.	1.	1.	45.	31.	11.	13.	
54225O	4	4750	1850.13	103.23	70.97	25.19	27.10	226.49	2076.62	10.9066	90.	5.	3.	1.	1.	46.	31.	11.	12.	
54225P	4	4800	2259.54	131.75	98.99	33.66	33.76	298.16	2557.70	11.6573	89.	5.	4.	1.	1.	45.	33.	11.	11.	
54225Q	4	4850	2769.60	212.97	159.89	47.74	45.41	466.01	3235.61	14.4025	86.	7.	5.	1.	1.	46.	34.	10.	10.	
54225R	4	4900	6784.50	224.90	191.44	57.79	53.75	527.87	7312.37	7.2189	92.	3.	3.	1.	1.	43.	36.	11.	10.	
54226A	4	4950	2726.00	280.41	218.24	52.88	47.79	599.32	3325.32	18.0229	82.	8.	7.	2.	1.	47.	36.	9.	8.	
54226B	4	5000	2485.96	181.68	167.28	43.03	44.64	436.63	2922.59	14.9398	85.	6.	6.	1.	2.	42.	38.	10.	10.	
54226C	4	5050	1548.90	187.71	159.45	39.39	37.47	424.02	1972.92	21.4920	78.	10.	8.	2.	2.	44.	38.	9.	9.	
54226D	4	5100	1096.93	111.20	158.35	46.12	47.33	363.00	1459.93	24.8642	75.	8.	11.	3.	3.	31.	43.	13.	13.	
54226E	4	5150	1272.33	176.37	184.98	43.57	48.47	453.39	1725.72	26.2725	73.	10.	11.	3.	3.	39.	40.	10.	11.	
54226F	4	5200	973.88	155.26	227.66	57.79	66.13	506.84	1480.72	34.2292	67.	10.	15.	4.	4.	31.	45.	11.	13.	
54226G	4	5250	3259.55	937.22	1072.30	204.77	248.53	2462.82	5722.37	43.0385	57.	16.	19.	4.	4.	38.	44.	8.	10.	
54226H	4	5300	2686.88	845.19	1120.04	216.27	266.75	2448.25	5135.13	47.6765	53.	16.	22.	4.	5.	35.	45.	9.	11.	
54226I	4	5350	1939.46	1292.97	1917.58	402.64	483.89	4097.07	6036.53	67.8713	32.	21.	32.	7.	8.	32.	46.	10.	12.	
54226J	4	5400	4201.96	1091.61	1497.48	307.82	429.17	3326.08	7528.04	44.1825	55.	15.	20.	4.	6.	33.	45.	9.	13.	
54226K	4	5450	4875.00	860.57	870.56	167.12	232.46	2130.70	7005.70	30.4138	71.	12.	12.	2.	3.	40.	41.	8.	11.	
54226L	4	5500	4115.47	644.06	627.47	106.94	161.73	1540.19	5655.66	27.2328	73.	11.	11.	2.	3.	41.	41.	7.	11.	
54226M	4	5550	1085.51	246.27	511.21	100.40	152.95	1010.83	2096.34	48.2188	52.	12.	24.	5.	7.	24.	51.	10.	15.	
54226N	4	5600	13210.12	626.42	416.29	80.08	119.71	1242.48	14452.61	8.5970	91.	4.	3.	1.	1.	50.	34.	6.	10.	
54226O	4	5650	13171.99	4159.26	11480.24	3979.15	5748.16	25366.79	38538.78	65.8215	34.	11.	30.	10.	15.	16.	45.	16.	23.	
54226P	4	5950	4037.50	175.55	331.85	113.34	246.45	867.19	4904.69	17.6808	82.	4.	7.	2.	5.	20.	39.	13.	28.	
54226Q	4	6000	41571.37	95.24	317.31	105.73	213.37	731.63	42303.01	1.7295	98.	0.0	1.	0.0	1.	13.	44.	14.	29.	
54226R	4	6050	2894.28	93.51	172.68	68.73	142.71	477.63	3371.91	14.1649	86.	3.	5.	2.	4.	20.	36.	14.	30.	
54227A	4	6100	2621.56	1048.34	2213.74	646.47	1151.68	5060.22	7681.78	65.8730	34.	14.	29.	8.	15.	21.	43.	13.	23.	
54227B	4	6150	1455.46	203.39	572.49	247.85	421.33	1445.06	2901.52	49.8035	50.	7.	20.	9.	15.	14.	40.	17.	29.	
54227C	4	6200	1203.16	134.93	548.11	150.52	275.47	1109.03	2312.19	47.9644	51.	6.	24.	7.	12.	12.	49.	14.	25.	

B = CUTTINGS NOT ANALYZED *C* = AIR SPACE GAS NOT RUN *BC* = NO ANALYSES RUN

TABLE II

Sample Descriptions and Results of Total Organic and Visual Kerogen Analyses - Esso 16/2-1 Well, Norway
(Lithology by R. E. Hukill; Kerogen by J. L. Morgan)

Depth (Feet)	EPR Sample No.	Gross Lithology	GSA Color Code	Total Organic Matter-%	Kerogen Alteration Index	Types of Kerogen Materials* Predominant	Secondary	Other
1450-1500	54222-C	Claystone, sl. calcareous and silty	5Y5/1	.99	1	W	A, H	-
1650-1700	-G	Claystone, as above	5Y5/1	.62	1	A	W	H
2000-2050	-N	Claystone, sl. Calc., Mod. silty, trace of pyrite and sand	5Y5/1	1.20	1	A	W	H
2200-2250	-R	Claystone, as above	5Y5/1	1.43	1+	A	W	H
2550-2600	54223-G	Claystone, as above	5GY4/1	1.26	1+	A	W	H
3000-3050	-P1	Mudstone, sl. calc. and micaceous, moderately silty	5Y3/1	2.93	2	A	W	H
"	-P2	Claystone, silty micromicaceous	5Y3/1	1.05	-	-	-	-
3150-3200	54224-A	Claystone, sl. silty and micaceous	5Y3/1	2.89	2	A	W	H
3200-3250	-B	Claystone, sl. silty	5Y3/1	2.14	2	A	H, W	-
3300-3350	-D	Claystone, silty, pyritic, minor fine sand	5Y5/1	3.67	-	-	-	-
3400-3450	-F	Shale, sl. silty and micaceous, trace of microfossils	5YR2/1	4.23	2	A	H, W	-
3450-3500	-G	Shale, silty, glauconitic, pyritic, micaceous	5Y2/1	5.64	-	-	-	-
3600-3650	-J	Shale, sl. silty and micaceous, trace of microfossils	5YR2/1	2.16	2	A	W	C
3800-3850	-N	Shale, sl. silty and micaceous	5YR2/1	4.62	2	A	W	C
3850-3900	-O	Siltstone, argillaceous, sl. calcareous, diesel odor	10YR5/2	not anal.	-	-	-	-
4150-4200	54225-C	Shale, silty, glauconitic, pyritic, micromicaceous	5Y4/1	2.06	-	-	-	-
4500-4550	-J	Shale, as above	5Y4/1	1.96	-	-	-	-
4600-4650	-L	Shale, sl. silty and micaceous	5Y3/1	1.74	2	A	H	W
4700-4750	-N	Shale	5Y4/1	1.16	2	H	A	W
4800-4850	-P	Shale, sl. silty	5Y4/1	1.73	-	-	-	-
5000-5050	54226-B	Shale, trace of pyrite	5Y3/2	.57	2	A	-	H, W
5100-5150	-D	Shale	10Y5/2-4/2	.51	-	-	-	-
5200-5250	-F	Shale	5Y3/1	1.78	2	A	W	H
5450-5500	-K1	Shale, minor silt and pyrite	10Y5/2-4/2	.70	-	-	-	-
"	-K2	Shale, silty, micromicaceous, tr. of pyrite, very hard	5Y3/1	2.20	-	-	-	-
5950-6000	-P	Shale, trace of pyrite and glauconite	5GY5/1	.49	-	-	-	-
6000-6050	-Q	Shale, trace of silt and pyrite	10Y4/2	.41	2+	C	H	P
6150-6200	54227-B1	Shale, sl. silty, trace of pyrite and glauconite	5Y3/1	1.58	2	A	H	W, P
"	-B2	Shale, very hard	5YR5/1	.23	-	-	-	-

* A-Amorphous W- Woody P-Plankton
H-Herbaceous C- Coaly

TABLE III

Results of Chemical Analyses of Selected Cuttings Chips
Esso 16/2-1 Well, Norway
(Hydrocarbon Analyses by H. M. Fry)

Approximate Depth	EPR Sample No.	T.O.M. %	C_4-C_7 ppm	Cyclohexane Methylcyclopentane
1500	54222-C	.99	trace	-
1700	-G	.62	2.3	1.2
2050	-N	1.20	0.3	2.0
2250	-R	1.43	1.3	0.6
2600	54223-G	1.26	7.3	1.3
3050	-P1	2.93	trace	1.6
"	-P2	1.05	0.1	.5
3200	54224-A	2.89	trace	-
3250	-B	2.14	"	-
3350	-D	3.67	0.2	0.3
3450	-F	4.23	trace	-
3500	-G	5.64	0.2	1.1
3650	-J	2.16	0.2	-
3850	-N	4.62	trace	-
3900	-O	n.a.	23.2	1.4
4200	54225-C	2.06	0.1	.7
4550	-J	1.96	0.2	1.5
4650	-L	1.74	trace	-
4750	-N	1.16	trace	-
4850	-P	1.73	0.1	0.6
5050	54226-B	.57	trace	-
5150	-D	.51	trace	-
5250	-F	1.78	trace	-
5500	-K1	.70	trace	-
"	-K2	2.20	0.1	0.9
6000	-P	.49	trace	-
6050	-Q	.41	trace	-
6200	-B1	1.58	trace	3.2 ?
"	-B2	.23	trace	-