HYDROCARBON SOURCE ANALYSES OF CANNED CUTTINGS FROM THE 30/10-3 WELL, OFFSHORE NORWAY

by

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SUMMARY AND CONCLUSIONS

Routine geochemical and kerogen data on samples from the 30/10-3 well are interpreted as follows:

Approximate Interval (feet)	Maturity	Average Source Richness	Indigenous Hydrocarbons Expected if Reservoired
900-3900	Immature	Poor	Lean
3900-4100	"	Fair	Minor Gas
4100-5100	"	Poor	Lean
5100-6300	"	Marginal	Minor Gas
6300-7300	Mature (?)	Poor	Lean
7300-7397	Mature	Fair	Gas; Minor Liquids

Lil Paleocene.

The detailed analytical data are listed in Tables I-III and they are summarized graphically in Fig. 1.

The geochemical profiles at the 30/10-3 well are similar to those at 30/10-1, but somewhat different from those at 30/10-2. The sections at 30/10-1 and 30/10-3 are both rated as predominantly poor hydrocarbon sources above a depth of about 7400 ft, and both are rated as mainly gas-prone in character. In contrast, the section at 30/10-2 was rated as inherently oil-prone over the interval 6600-8600 ft. Also, overall it appeared to be a richer hydrocarbon source than the sections at 30/10-3 and 30/10-1. (See reports EPR.80ES.73 and EPR.46ES.74.)

The data suggest that the hydrocarbons reservoired in the Frigg sand came mainly from older strata than those penetrated at 30/10-3, or at least from a different facies than those represented by the 30/10-3 samples.

Charges for this service work have been billed to our Job No. 6924.

PROCEDURES

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 gases released from a standard mixture of cuttings and tap water after two minutes of agitation in a Waring blender. Combined results on the air space gas plus the cuttings gas were calculated for each sample. The data were plotted graphically to show vertical variations in total gas (C_1-C_4) and "wet" gas (C_2-C_4), and a graphical plot was also made of the percent wet gas in the total gas (Figure 1). Detailed results of the analyses are listed in Table I.

Chips of uniform lithologies were picked by hand from the heterogeneous mixtures of chips in the original samples. These are described in Table II. Our standard analytical procedures were used for determining the C_4-C_7 content and the total organic content of the "picked" chips. These results are given in Table III and they are plotted graphically in Fig. 1. Visual kerogen characteristics of these samples were also determined (Table II and Fig. 1).

DISCUSSION

The section at 30/10-3 was rated as "mature" at a shallower depth (7397 ft) than the sections at 30/10-1 (8100 ft) and at 30/10-2 (8500 ft). The comparison of the tops of the "mature" zones in the three wells is complicated somewhat by the change in character of the kerogen in 30/10-2 in contrast to 30/10-1 and 30/10-3. From about 6600 ft to 8600 ft in 30/10-2 the kerogen was predominantly amorphous, herbaceous or algal, whereas in the other two wells samples from equivalent strata contained kerogen that was predominantly woody. It is common in such situations to observe lower alterations in the predominantly amorphous kerogens, and this is the case at 30/10-2. (See EPR.46ES.74.) Furthermore, the samples from 6000-7000 ft in 30/10-3 were very lean in organic matter, and we have frequently observed that very lean samples have higher kerogen alteration ratings than slightly richer samples in the same interval. Thus, the shallowest ratings of "mature" were possibly modified in these three wells by differences in the kerogen contents of equivalent samples.

In any case, the source of the hydrocarbons at Frigg definitely appears to be from beds older than the reservoir sands, and the section penetrated at 30/10-3 does not represent the primary Frigg source section, except possibly at the very bottom of the well. The richer, more oil-prone facies observed in the interval 6600-8600 ft at 30/10-2 appears to be a more likely source, particularly if it exists in a more mature state down dip from the structure. However, there also exists a strong likelihood that the Frigg hydrocarbons originated in the underlying rich Jurassic source beds.

RELATED SERVICE REPORTS

EPR.80ES.73 "Hydrocarbon Source Evaluation of Canned Cuttings from the Esso 30/10-1 Well, Norway" by R. E. Metter et al., September 1973.

EPR.46ES.74 "Source Characteristics Canned Cuttings from the 30/10-2 Well, Offshore Norway" by R. E. Metter et al., June 1974.

TABLE I A

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)									
										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
65009A	4	900	0.68	0.06	0.03	0.0	0.0	0.09	0.77	11.6883	88.	8.	4.	0.	0.	67.33.	0.	0.	
65009C	4	1500	31.84	0.96	0.61	0.12	0.25	1.94	33.78	5.7430	94.	3.	2.	0.	1.	50.31.	6.13.		
65009E	4	2100	12.92	0.19	0.25	0.02	0.13	0.59	13.51	4.3671	96.	1.	2.	0.	1.	32.43.	3.22.		
65009F	4	2364	23.70	0.28	0.20	0.05	0.11	0.64	24.34	2.6293	98.	1.	1.	0.	0.	44.31.	8.17.		
65009G	4	2500	2.86	0.0	0.02	0.0	0.04	0.06	2.92	2.0548	98.	0.	1.	0.	1.	0.33.	0.67.		
65009I	4	2860	3.71	1.22	0.74	0.17	1.06	3.19	6.90	46.2319	54.	18.	11.	2.	15.	39.23.	5.38.		
65009J	4	3040	2.58	0.47	0.44	0.09	0.40	1.40	3.98	35.1758	65.	12.	11.	2.	10.	34.31.	6.29.		
65009K	4	3200	0.92	0.06	0.04	0.0	0.02	0.12	1.04	11.5384	88.	6.	4.	0.	2.	50.33.	0.17.		
65009L	4	3400	14.95	1.41	1.44	0.13	0.36	3.34	18.29	18.2611	81.	8.	8.	1.	2.	42.43.	4.11.		
65009M	4	3580	1179.92	8.47	4.38	0.47	0.49	13.81	1193.73	1.1569	99.	1.	0.	0.	0.	61.32.	3. 4.		
65009N	4	3760	52.21	0.95	0.58	0.05	0.13	1.71	53.92	3.1713	97.	2.	1.	0.	0.	55.34.	3. 8.		
65009O	4	3940	6157.03	23.41	2.60	0.30	0.45	26.75	6183.78	0.4326	100.	0.	0.	0.	0.	87.10.	1. 2.		
65009P	4	4180	42.05	0.67	0.16	0.0	0.05	0.88	42.93	2.0498	98.	2.	0.	0.	0.	76.18.	0. 6.		
65009Q	4	4270	25.10	1.13	0.86	0.17	0.47	2.63	27.73	9.4842	90.	4.	3.	1.	2.	43.33.	6.18.		
65009R	4	4360	0.29	0.0	0.0	0.0	0.0	0.0	0.29	0.0	100.	0.	0.	0.	0.	0. 0.	0. 0.		
65009S	4	4450	21.57.	0.90	0.47	0.05	0.19	1.61	23.18	6.9455	93.	4.	2.	0.	1.	56.29.	3.12.		
65009T	4	4540	285.51	7.82	1.26	0.19	0.18	9.45	294.96	3.2036	97.	3.	0.	0.	0.	83.13.	2. 2.		
65009U	4	4630	5667.34	28.75	5.77	2.67	1.24	38.43	5705.77	0.6735	99.	1.	0.	0.	0.	75.15.	7. 3.		
65010A	4	4720	923.35	28.08	0.80	2.30	0.50	31.68	955.03	3.3171	97.	3.	0.	0.	0.	88. 3.	7. 2.		
65010B	4	4810	977.29	24.15	2.95	0.06	2.27	29.43	1006.72	2.9233	98.	2.	0.	0.	0.	82.10.	0. 8.		
65010C	4	5020	3.60	1.28	0.09	0.01	0.12	1.50	5.10	29.4117	71.25.	2.	0.	2.		85. 6.	1. 8.		
65010D	4	5200	33.72	5.21	0.67	0.34	0.31	6.53	40.25	16.2236	83.13.	2.	1.	1.		80.10.	5. 5.		
65010E	4	5380	1189.18	47.61	5.57	3.00	1.16	57.34	1246.52	4.6000	96.	4.	0.	0.	0.	83.10.	5. 2.		
65010F	4	5620	3.22	0.54	0.19	0.10	0.08	0.91	4.13	22.0339	78.13.	5.	2.	2.		59.21.11.	8.		
65010G	4	5680	408.66	25.18	5.11	2.22	1.14	33.65	442.31	7.6077	92.	6.	1.	1.	0.	75.15.	7. 3.		
65010H	4	5770	2406.27	117.55	20.29	8.49	3.56	149.89	2556.16	5.8639	94.	5.	1.	0.	0.	78.14.	6. 2.		
65010I	4	5860	619.25	44.88	9.93	5.16	2.32	62.29	681.54	9.1395	91.	7.	1.	1.	0.	72.16.	8. 4.		
65010J	4	5950	1767.97	89.53	15.16	6.58	2.35	113.62	1881.59	6.0385	94.	5.	1.	0.	0.	79.13.	6. 2.		
65010K	4	6040	1848.18	147.86	23.18	4.36	3.83	179.23	2027.41	8.8403	92.	7.	1.	0.	0.	83.13.	2. 2.		
65010L	4	6160	1670.71	128.00	18.41	8.34	3.96	158.71	1829.42	8.6754	92.	7.	1.	0.	0.	81.12.	5. 2.		
65010M	4	6250	2294.11	211.86	19.49	8.86	3.26	243.47	2537.58	9.5946	91.	8.	1.	0.	0.	87. 8.	4. 1.		
65010N	4	6340	1169.83	142.29	19.16	9.41	4.40	175.26	1345.09	13.0296	87.11.	1.	1.	0.		81.11.	5. 3.		
65010O	4	6460	781.89	102.95	16.37	8.83	3.89	132.04	913.93	14.4475	86.11.	2.	1.	0.		78.12.	7. 3.		
65010P	4	6550	27.52	7.39	1.14	0.98	0.44	9.95	37.47	26.5545	73.20.	3.	3.	1.		75.11.10.	4.		
65010Q	4	6594	2047.55	245.43	43.28	43.13	16.66	348.50	2396.05	14.5448	85.10.	2.	2.	1.		71.12.12.	5.		
65010R	4	7000	932.81	229.17	35.84	0.37	15.02	280.40	1,213.21	23.1122	77.19.	3.	0.	1.		82.13.	0. 5.		
65010S	4	7200	504.58	222.72	29.41	20.89	9.03	282.05	786.63	35.8555	64.28.	4.	3.	1.		80.10.	7. 3.		
65010T	4	7397	511.27	288.00	110.38	41.14	26.78	466.30	977.57	47.6999	53.29.11.	4.	3.			61.24.	9. 6.		

TABLE IB

C_1-C_4 HYDROCARBON ANALYSES - CUTTINGS ONLY

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)									
										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
65009A	4	900	906.66	12.00	2.10	0.80	0.77	15.67	922.33	1.6989	99.	1.	0.	0.	0.	77.13	5.	5.	
65009C	4	1500	362.66	1.50	0.93	0.29	0.39	3.11	365.77	0.8502	100.	0.	0.	0.	0.	48.30.	9.13.		
65009E	4	2100	967.10	6.60	2.17	0.78	0.77	10.32	977.42	1.0558	99.	1.	0.	0.	0.	64.21.	8.	7.	
65009F	4	2364	929.26	9.00	3.80	1.46	1.66	15.92	945.18	1.6843	99.	1.	0.	0.	0.	57.24.	9.10.		
65009G	4	2500	1776.53	3.52	1.86	0.12	0.46	5.96	1782.49	0.3343	100.	0.	0.	0.	0.	59.31.	2.	8.	
65009I	4	2860	1576.80	11.55	3.92	1.17	4.09	20.73	1597.53	1.2976	99.	1.	0.	0.	0.	55.19.	6.20.		
65009J	4	3040	1145.81	7.50	3.03	0.39	1.90	12.82	1158.63	1.1064	99.	1.	0.	0.	0.	58.24.	3.15.		
65009K	4	3200	1156.32	9.90	1.71	0.87	2.65	15.13	1171.45	1.2915	99.	1.	0.	0.	0.	65.11.	6.18.		
65009L	4	3400	1145.81	10.80	11.49	1.46	4.20	27.95	1173.76	2.3812	98.	1.	1.	0.	0.	39.41.	5.15.		
65009M	4	3580	1534.75	20.40	10.25	1.77	3.48	35.90	1570.65	2.2857	98.	1.	1.	0.	0.	56.29.	5.10.		
65009N	4	3760	1379.17	12.30	7.30	1.26	2.82	23.68	1402.85	1.6879	98.	1.	1.	0.	0.	52.31.	5.12.		
65009O	4	3940	454.64	11.37	2.45	0.02	0.01	13.85	468.49	2.9562	97.	2.	1.	0.	0.	82.18.	0.	0.	
65009P	4	4180	1787.04	9.75	2.33	0.37	0.77	13.22	1800.26	0.7343	99.	1.	0.	0.	0.	73.18.	3.	6.	
65009Q	4	4270	664.36	7.12	1.40	0.15	0.72	9.39	673.75	1.3936	99.	1.	0.	0.	0.	75.15.	2.	8.	
65009R	4	4360	767.38	3.52	1.63	0.68	2.49	8.32	775.70	1.0725	100.	0.	0.	0.	0.	42.20.	8.30.		
65009S	4	4450	646.49	7.12	1.82	0.63	2.42	11.99	658.48	1.8208	99.	1.	0.	0.	0.	60.15.	5.20.		
65009T	4	4540	2333.66	31.80	3.76	2.04	2.77	40.37	2374.03	1.7004	99.	1.	0.	0.	0.	79.	9.	5.	7.
65009U	4	4630	1972.05	30.00	5.51	4.37	3.65	43.53	2015.58	2.1597	99.	1.	0.	0.	0.	69.13.10.	8.		
65010A	4	4720	2223.29	28.32	9.28	10.68	3.98	52.26	2275.55	2.2966	99.	1.	0.	0.	0.	54.18.20.	8.		
65010B	4	4810	236.52	1.20	0.19	0.17	0.37	1.93	238.45	0.8094	99.	1.	0.	0.	0.	62.10.	9.19.		
65010C	4	5020	793.66	12.00	2.17	5.95	2.21	22.33	815.99	2.7365	98.	1.	0.	1.	0.	53.10.27.10.			
65010D	4	5200	859.35	17.76	4.75	4.94	2.58	30.03	889.38	3.3765	96.	2.	1.	1.	0.	59.16.16.	9.		
65010E	4	5380	1805.44	84.00	22.73	14.34	6.59	127.66	1933.10	6.6039	94.	4.	1.	1.	0.	66.18.11.	5.		
65010F	4	5620	730.58	6.06	2.48	2.43	1.99	12.96	743.54	1.7430	99.	1.	0.	0.	0.	47.19.19.15.			
65010G	4	5680	262.80	8.04	2.76	1.19	0.59	12.58	275.38	4.5680	96.	3.	1.	0.	0.	64.22.	9.	5.	
65010H	4	5770	1482.19	79.20	24.84	15.15	7.46	120.65	1602.84	7.5272	92.	5.	2.	1.	0.	60.21.13.	6.		
65010I	4	5860	809.42	45.60	18.16	11.75	6.53	82.04	891.46	9.2028	91.	5.	2.	1.	1.	56.22.14.	8.		
65010J	4	5950	2168.10	153.36	37.26	9.19	2.70	202.51	2370.61	8.5425	92.	6.	2.	0.	0.	76.18.	3.	1.	
65010K	4	6040	2152.33	215.04	51.05	23.00	11.75	300.84	2453.17	12.2633	88.	9.	2.	1.	0.	71.17.	8.	4.	
65010L	4	6160	2486.09	343.68	62.97	25.64	13.94	446.23	2932.32	15.2176	85.	12.	2.	1.	0.	77.14.	6.	3.	
65010M	4	6250	1287.72	220.80	42.48	21.13	10.80	295.21	1582.93	18.6496	81.	14.	3.	1.	1.	75.14.	7.	4.	
65010N	4	6340	919.80	118.56	22.36	12.24	6.57	159.73	1079.53	14.7962	85.	11.	2.	1.	1.	74.14.	8.	4.	
65010O	4	6460	325.87	56.76	14.44	9.13	5.75	86.08	411.95	20.8957	79.	14.	4.	2.	1.	65.17.11.	7.		
65010P	4	6550	704.30	87.60	21.92	15.58	8.03	133.13	837.43	15.8974	84.	10.	3.	2.	1.	65.16.12.	6.		
65010Q	4	6594	762.12	94.08	27.45	35.66	16.59	173.78	935.90	18.5682	81.	10.	3.	4.	2.	54.16.21.10.			
65010R	4	7000	1090.62	544.32	64.34	45.69	24.47	678.82	1769.44	38.3635	61.	31.	4.	3.	1.	80.	9.	7.	4.
65010S	4	7200	538.74	301.44	43.10	33.80	16.81	395.15	933.89	42.3122	57.	32.	5.	4.	2.	76.11.	9.	4.	
65010T	4	7397	935.57	588.48	245.92	111.73	74.34	1020.47	1956.04	52.1702	47.	30.	13.	6.	4.	58.24.	11.	7.	

TABLE IC

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)									
										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
65009A	4	900	907.34	12.06	2.13	0.80	0.77	15.76	923.10	1.7072	99.	1.	0.	0.	0.	76.14.	5.	5.	
65009C	4	1500	394.50	2.46	1.54	0.41	0.64	5.05	399.55	1.2638	99.	1.	0.	0.	0.	49.30.	8.13.		
65009E	4	2100	980.02	6.79	2.42	0.80	0.90	10.91	990.93	1.1009	99.	1.	0.	0.	0.	63.22.	7.	8.	
65009F	4	2364	952.96	9.28	4.00	1.51	1.77	16.56	969.52	1.7080	99.	1.	0.	0.	0.	56.24.	9.11.		
65009G	4	2500	1779.39	3.52	1.88	0.12	0.50	6.02	1785.41	0.3371	100.	0.	0.	0.	0.	59.31.	2.	8.	
65009I	4	2860	1580.51	12.77	4.66	1.34	5.15	23.92	1604.43	1.4908	99.	1.	0.	0.	0.	53.19.	6.22.		
65009J	4	3040	1148.39	7.97	3.47	0.48	2.30	14.22	1162.61	1.2231	99.	1.	0.	0.	0.	57.24.	3.16.		
65009K	4	3200	1157.24	9.96	1.75	0.87	2.67	15.25	1172.49	1.3006	99.	1.	0.	0.	0.	65.11.	6.18.		
65009L	4	3400	1160.76	12.21	12.93	1.59	4.56	31.29	1192.05	2.6249	98.	1.	1.	0.	0.	39.41.	5.15.		
65009M	4	3580	2714.67	28.87	14.63	2.24	3.97	49.71	2764.38	1.7982	98.	1.	1.	0.	0.	58.29.	5.	8.	
65009N	4	3760	1431.38	13.25	7.88	1.31	2.95	25.39	1456.77	1.7428	98.	1.	1.	0.	0.	52.31.	5.12.		
65009O	4	3940	6611.66	34.78	5.05	0.32	0.46	40.60	6652.27	0.6103	99.	1.	0.	0.	0.	86.12.	1.	1.	
65009P	4	4180	1829.09	10.42	2.49	0.37	0.82	14.10	1843.19	0.7649	99.	1.	0.	0.	0.	73.18.	3.	6.	
65009Q	4	4270	689.46	8.25	2.26	0.32	1.19	12.02	701.48	1.7135	99.	1.	0.	0.	0.	68.19.	3.10.		
65009R	4	4360	767.67	3.52	1.63	0.68	2.49	8.32	775.99	1.0721	100.	0.	0.	0.	0.	42.20.	8.30.		
65009S	4	4450	668.06	8.02	2.29	0.68	2.61	13.60	681.66	1.9951	99.	1.	0.	0.	0.	59.17.	5.19.		
65009T	4	4540	2619.17	39.62	5.02	2.23	2.95	49.82	2668.99	1.8666	99.	1.	0.	0.	0.	80.10.	4.	6.	
65009U	4	4630	7639.39	58.75	11.28	7.04	4.89	81.96	7721.34	1.0614	99.	1.	0.	0.	0.	71.14.	9.	6.	
65010A	4	4720	3146.64	56.40	10.08	12.98	4.48	83.94	3230.58	2.5983	98.	2.	0.	0.	0.	68.12.15.	5.		
65010B	4	4810	1213.81	25.35	3.14	0.23	2.64	31.36	1245.17	2.5185	98.	2.	0.	0.	0.	81.10.	1.	8.	
65010C	4	5020	797.26	13.28	2.26	5.96	2.33	23.83	821.09	2.9022	97.	2.	0.	1.	0.	56.	9.25.10.		
65010D	4	5200	893.07	22.97	5.42	5.28	2.89	36.56	929.63	3.9327	96.	2.	1.	1.	0.	63.15.14.	8.		
65010E	4	5380	2994.62	131.61	28.30	17.34	7.75	185.00	3179.62	5.8183	94.	4.	1.	1.	0.	72.15.	9.	4.	
65010F	4	5620	733.80	6.60	2.67	2.53	2.07	13.87	747.67	1.8551	99.	1.	0.	0.	0.	48.19.18.15.			
65010G	4	5680	671.46	33.22	7.87	3.41	1.73	46.23	717.69	6.4414	94.	5.	1.	0.	0.	72.17.	7.	4.	
65010H	4	5770	3888.46	190.75	45.13	23.64	11.02	270.54	4159.00	6.5049	93.	5.	1.	1.	0.	70.17.	9.	4.	
65010I	4	5860	1428.67	90.48	28.09	16.91	8.85	144.33	1573.00	9.1754	90.	6.	2.	1.	1.	63.19.12.	6.		
65010J	4	5950	3936.07	242.89	52.42	15.77	5.05	316.13	4252.20	7.4345	93.	6.	1.	0.	0.	76.17.	5.	2.	
65010K	4	6040	4000.51	362.90	74.23	27.36	15.58	480.07	4480.58	10.7144	89.	8.	2.	1.	0.	76.15.	6.	3.	
65010L	4	6160	4156.80	471.68	81.38	33.98	17.90	604.94	4761.74	12.7042	87.10.	2.	1.	0.	78.13.	6.	3.		
65010M	4	6250	3581.83	432.66	61.97	29.99	14.06	538.68	4120.51	13.0731	86.11.	2.	1.	0.	79.12.	6.	3.		
65010N	4	6340	2089.63	260.85	41.52	21.65	10.97	334.99	2424.62	13.8161	86.11.	2.	1.	0.	79.12.	6.	3.		
65010O	4	6460	1107.76	159.71	30.81	17.96	9.64	218.12	1325.88	16.4509	84.12.	2.	1.	1.	74.14.	8.	4.		
65010P	4	6550	731.82	94.99	23.06	16.56	8.47	143.08	874.90	16.3538	83.11.	3.	2.	1.	66.16.12.	6.			
65010Q	4	6594	2809.67	339.51	70.73	78.79	33.25	522.28	3331.95	15.6749	85.10.	2.	2.	1.	65.14.15.	6.			
65010R	4	7000	2023.43	773.49	100.18	46.06	39.49	959.22	2982.65	32.1600	68.26.	3.	2.	1.	81.10.	5.	4.		
65010S	4	7200	1043.32	524.16	72.51	54.69	25.84	677.20	1720.52	39.3602	61.30.	4.	3.	2.	77.11.	8.	4.		
65010T	4	7397	1447.84	876.48	356.30	152.87	101.12	1486.77	2933.61	50.6805	49.30.12.	5.	3.	59.24.10.	7.				

TABLE II Descriptions of "Picked" Cuttings and of Visual Kerogen, 30/10-3 Samples

(Kerogen by J. L. Morgan)

Depth (feet)	EPR No.	Gross Lithology	GSA Color Code	Total Organic Matter (%)	Kerogen Alteration	Types of Kerogen **			Visual Pyrite in Kerogen
						Predominant	Secondary	Other	
2680-2860	65009-I	Claystone, lt. gray to v. lt. gray, sl. calc. (cement ?)	N7-N8	.21	1+	W	H	Al,C	Abundant
3760-3940	-O	Mudstone, lt. olive gray; tr. forams	5Y 6/1	1.15	1+	W	H	Al,C	Moderate
4540-4630	-U	Shale, lt. olive gray, sl. silty	5Y 6/1	.34	2-	W	H,C	Al	"
5020-5200	65010-D	Shale, as above	5Y 6/1	.61	2-	W	H,M	C	Trace
5440-5620	-F	Shale, lt. olive gray	5Y 6/1	.59	2	W	H	C	"
5680-5770	-H	Shale, as above, some sl. silty with trace of microfossils	5Y 6/1	.66	2	W	H	Al,C	"
5860-5950	-J	Shale, med. to lt. olive gray, tr. microfossils	5Y 5/1-6/1	.37	2	W	H	Al,C	Moderate
6040-6160	-L	Shale, med. to lt. olive gray, looks tuffaceous	5Y 5/1-6/1	.65	2	W	C	H	"
6250-6340	-N	Shale, med. olive gray	5Y 5/1	.34	2+	W	H	C	Trace
6460-6550	-P	Shale, med. olive gray	5Y 5/1	.26	2+	W	M	C	"
6800-7000	-R	Shale, olive gray to med. dk. gray	5Y-4/1-N4	.44	2+	W	H	C	Abundant
7200-7397	-T	Shales, med. dk. gray and lt. olive gray	N4; 5Y-6/1	1.17	2+	W	H	Al,C	"

** Al - Algal W - Woody
H - Herbaceous C - Coaly
M - Microplankton

TABLE III Total Organic Matter and Light Gasolines (C_4-C_7) in "Picked" Cuttings from 30/10-3

(Analyses by R. R. Dudley; H. M. Fry)

Depth (feet)	EPR No.	T.O.M. (%)	Total C_4-C_7 (ppm)	Correlation Ratios (See Table III-A) C_1/C_2	A/D_2	C_1/D_2	CH/MCP*
2860	65009-I	.21	.25	3.97	4.93	7.70	1.09
3940	-O	1.15	.11	1.26	45.97	6.58	.96
4630	-U	.34	.10	.76	8.39	3.22	.77
5200	65010-D	.61	.09	.96	11.07	7.14	.89
5620	-F	.59	0.	-	-	-	-
5770	-H	.66	.66	1.11	10.57	8.29	.64
5950	-J	.37	.11	.86	12.79	9.55	.30
6160	-L	.65	.12	1.06	13.63	11.21	.74
6340	-N	.34	.11	1.19	15.56	11.72	.51
6550	-P	.26	.11	.84	9.18	5.95	.28
7000	-R	.44	.45	2.19	12.34	63.64	2.42
7397	-T	1.17	6.33	1.26	2.29	51.55	1.83

* CH = cyclohexane
MCP = methylcyclopentane

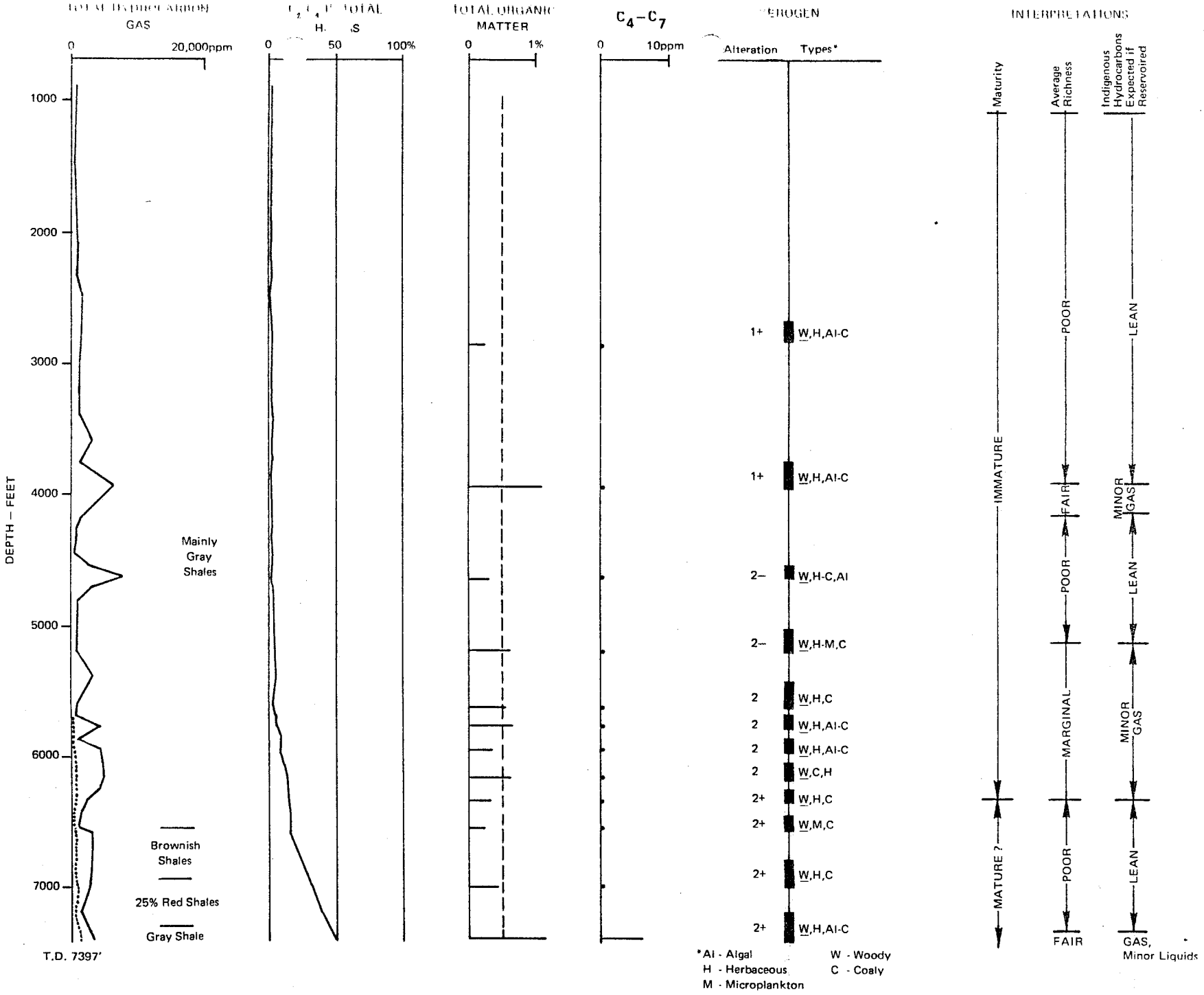


FIG. 1 GEOCHEMICAL PATTERNS, 30/10-3 CANNED CUTTINGS

TABLE III-A

DEFINITION OF SIGNIFICANT GASOLINE RATIOS

Light Gasoline Compounds Determined by Gas Chromatography

1. Pentane
2. Hexane
3. Heptane
4. Iso-Pentane
5. 2-Methylpentane
6. 3-Methylpentane
7. 2,3-Dimethylbutane
8. 2,2-Dimethylbutane
9. 3-Methylhexane
10. 2-Methylhexane + 1,1-Dimethylcyclopentane
11. 2,3-Dimethylpentane
12. 2,4-Dimethylpentane
13. 2,2-Dimethylpentane
14. 2,2,3-Trimethylbutane
15. 2,2,4-Trimethylpentane
16. Cyclopentane
17. Methylcyclopentane
18. 1-c-3-Dimethylcyclopentane
19. 1-t-3-Dimethylcyclopentane
20. 1-c-2-Dimethylcyclopentane
21. 1-t-2-Dimethylcyclopentane + 3-Ethylpentane*
22. Cyclohexane + 3,3-Dimethylpentane*
23. Methylcyclohexane
24. Benzene
25. Toluene

Significant Groupings of Molecular Data

A. Hexane + Heptane

B. Pentane + iso-Pentane + 2-Methylpentane + 3-Methylpentane

C. Naphthenes

C_1 2-Methylhexane + 1 , 1-Dimethylcyclopentane* + Cyclohexane + 3,3-Dimethylpentane* + Methylcyclohexane

C_2 Methylcyclopentane + 1-c-3-Dimethylcyclopentane + 1-t-3-Dimethylcyclopentane + 1-c-2-Dimethylcyclopentane + (1-t-2-Dimethylcyclopentane + 3-Ethylpentane)*

D. Aromatics Plus 3-Methylhexane

D_1 Benzene + Toluene

D_2 3-Methylhexane

*Analyzed together by gas chromatography.

HYDROCARBON SOURCE EVALUATION OF CANNED CUTTINGS FROM WELL 30/10-5 OFFSHORE NORWAY

by

R. E. Metter

SUMMARY AND CONCLUSIONS

Canned cuttings from the interval 9713-17,011 ft (2930-5185 meters) were analyzed routinely for their hydrocarbon source characteristics. The analytical results are given in Tables I-III and in Fig. 1.

The samples starting at about 14,700 ft were quite contaminated with a black greasy or asphaltic substance which we assume was a drilling mud additive. Small tarry pellets were present. Despite repeated washings, we fear that chemical analyses of some of the deeper samples are erroneous due to contamination.

This service work was requested in the April 3, 1975 letter S-267 by Alan M. Warren. Charges for the work have been billed to our Job No. 7397.

The analytical data are interpreted grossly as follows:

Interval (ft)	Maturity	Average Richness	Indigenous Hydrocarbons Expected if Reservoired
9,713 - 13,000(?)	Mature	Fair	Gas, Condensate
13,000(?) - 15,000	Very Mature	Good	Gas, Condensate
15,000 - 16,600	Overmature	Good to Rich	Gas
16,600 - 17,011 T.D.	Overmature	Good	Dry Gas

These interpretations are also summarized graphically in Fig. 1. We did not know stratigraphic tops and therefore have not made source ratings of individual units.

The kerogen alteration was "3+" below 15,700 ft, which suggests an "overmature" thermal gas-prone section. All samples below about 13,500 ft had kerogen alterations of "3-" or greater, which is generally regarded

as indicative of a very mature section prone to gas and possibly condensate. Relatively low gasoline yields from samples below 13,000 ft support the gas-prone interpretation.

PROCEDURES

Esso hildebrandanalyse

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 gases released from a standard mixture of cuttings and tap water after two minutes of agitation in a Waring blender. Combined results on the air space gas plus the cuttings gas were calculated for each sample. The data were plotted graphically to show vertical variations in total gas (C_1-C_4) and wet gas (C_2-C_4), and a graphical plot was also made of the percent wet gas in total gas (Fig. 1). Detailed results of these analyses are listed in Table I.

Chips of uniform lithologies were picked by hand from the heterogeneous mixtures of chips in the original samples. These are described in Table II. Out standard analytical procedures were used for determining C_4-C_7 light gasoline content and total organic content of the picked chips. These results are tabulated in Table II and they are plotted graphically in Fig. 1. Visual kerogen characteristics of 18 of the "picked" samples were also determined (Table II and Fig. 1).

As is always the case when dealing with cuttings, cavings were probably "picked" in some instances when we selected uniform lithologies for T.O.M., kerogen and gasoline determinations. We tried to minimize this. Lithologies are listed in Table II, and a geologist familiar with the section can possibly distinguish and eliminate those samples comprised of cavings.

DISCUSSION

The sample analysis was routine except for the deeper "contaminated" samples. Total organic matter values of samples below about 15,000 ft are probably too high due to small tarry pellets that we could not entirely eliminate by washing and "picking". We assume these were introduced as a mud additive. These might also have given C_4-C_7 values that are too high, which would enforce the "overmature gas-prone" interpretation for this interval.

The section as a whole represents a good source interval, but one in which peak generation is past. We assume that large quantities of gas and some hydrocarbon liquids have been generated by the sampled section, particularly from those beds below about 13,500 ft.

TABLE I A

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	
65804B	4	2930	886.42	1384.47	1654.21	372.29	601.61	4012.58	4899.00	81.9061	18.28.	34.	8.12.			35.41.	9.15.			
65804D	4	2990	1509.41	585.85	1219.83	644.87	1461.38	3911.93	5421.34	72.1580	27.11.	23.	12.27.			15.31.	16.38.			
65804F	4	3050	1396.59	373.03	1127.02	433.34	1070.09	3003.48	4400.07	68.2598	32.	8.	26.10.24.			12.38.	14.36.			
65804H	4	3110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0. 0.	0.		0.	0.	0.	0.	*C*
65804J	4	3170	5419.52	1487.64	2022.53	630.81	1090.84	5231.81	10651.33	49.1189	51.14.	19.	6.10.			28.39.	12.21.			
65804L	4	3230	559.38	400.74	924.81	351.81	748.18	2425.54	2984.92	81.2598	19.13.	31.	12.25.			17.37.	15.31.			
65804N	4	3290	8.03	10.60	3.43	7.09	10.78	31.90	39.93	79.8898	20.27.	9.	18.26.			33.11.	22.34.			
65804P	4	3350	6368.51	1388.15	1466.21	420.60	648.38	3923.33	10291.84	38.1208	63.13.	14.	4. 6.			35.37.	11.17.			
65804R	4	3410	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0. 0.	0.		0.	0.	0.	0.	*C*
65804T	4	3470	13291.25	2348.95	3518.79	1209.85	2080.48	9158.06	22449.31	40.7944	60.10.	16.	5. 9.			26.38.	13.23.			
65805B	4	3530	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0. 0.	0.		0.	0.	0.	0.	*C*
65805D	4	3590	2645.93	1024.66	1769.66	600.09	1227.15	4621.55	7267.48	63.5922	37.14.	24.	8.17.			22.38.	13.27.			
65805F	4	3650	6802.43	2632.53	4919.42	1447.64	2668.37	11667.95	18470.38	63.1711	37.14.	27.	8.14.			23.42.	12.23.			
65805H	4	3710	181.80	89.65	182.94	71.58	136.39	480.56	662.36	72.5527	27.14.	27.	11.21.			19.38.	15.28.			
65805J	4	3770	205.86	100.60	224.80	78.99	179.18	582.57	788.43	73.8898	26.13.	28.	10.23.			17.38.	14.31.			
65805L	4	3830	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0. 0.	0.		0.	0.	0.	0.	*C*
65805N	4	3890	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0. 0.	0.		0.	0.	0.	0.	*C*
65805P	4	3950	1195.30	359.91	408.53	112.17	204.47	1085.08	2280.38	47.5833	52.16.	18.	5. 9.			33.38.	10.19.			
65805R	4	4010	1245.21	333.47	386.98	79.94	134.89	935.28	2180.49	42.8931	57.15.	18.	4. 6.			36.41.	9.14.			
65805T	4	4070	2278.73	790.02	658.13	157.52	224.53	1830.20	4108.93	44.5419	56.19.	16.	4. 5.			43.36.	9.12.			
65806B	4	4130	11254.83	3168.00	2202.48	585.34	628.94	6584.75	17839.58	36.9109	63.18.	12.	3. 4.			48.33.	9.10.			
65806D	4	4190	728.33	1349.48	1212.19	270.84	393.45	3225.96	3954.29	81.5813	18.34.	31.	7.10.			42.38.	8.12.			
65806F	4	4250	30995.36	9435.42	4809.02	1104.67	1270.35	16619.45	47614.81	34.9039	65.20.	10.	2. 3.			56.29.	7. 8.			
65806H	4	4310	19.18	10.30	12.12	3.64	4.62	30.68	49.86	61.5323	39.21.	24.	7. 9.			34.39.	12.15.			
65806J	4	4370	9194.49	5939.19	5394.58	1392.38	1857.79	14583.93	23778.42	61.3326	38.25.	23.	6. 8.			40.37.	10.13.			
65806L	4	4430	86.43	32.00	40.85	13.23	23.32	109.40	195.83	55.8648	44.16.	21.	7.12.			29.38.	12.21.			
65900A	4	4490	3689.01	2504.02	2923.04	863.28	1221.16	7511.49	11200.50	67.0639	33.22.	26.	8.11.			33.40.	11.16.			
65900B	4	4520	847.69	554.50	974.52	480.37	752.18	2761.57	3609.26	76.5135	23.15.	28.	13.21.			20.36.	17.27.			
65900C	4	4550	4036.60	1867.77	2053.97	649.45	1001.39	5572.57	9609.17	57.9922	43.19.	21.	7.10.			34.36.	12.18.			
65900D	4	4580	5084.20	1476.75	1171.88	331.05	486.29	3465.96	8550.16	40.5368	59.17.	14.	4. 6.			42.34.	10.14.			
65900E	4	4610	65.52	51.46	62.50	11.08	29.17	154.21	219.73	70.1816	31.23.	28.	5.13.			33.41.	7.19.			
65900F	4	4700	9986.40	3724.80	557.66	89.74	90.93	4463.12	14449.52	30.8877	68.26.	4.	1. 1.			84.12.	2. 2.			
65900G	4	4730	204.81	280.00	110.70	28.19	35.24	454.13	658.94	68.9182	31.43.	17.	4. 5.			62.24.	6. 8.			
65900H	4	4795	172.23	365.98	88.28	41.96	57.02	553.24	725.47	76.2595	24.50.	12.	6. 8.			66.16.	8.10.			
65900I	4	4890	7.22	11.95	2.11	0.22	0.86	15.14	22.36	67.7101	32.54.	9.	1. 4.			79.14.	1. 6.			
65900J	4	5020	96.71	456.41	142.32	18.03	32.23	648.99	745.70	87.0309	13.62.	19.	2. 4.			70.22.	3. 5.			
65900K	4	5085	5547C.37	3162.35	271.78	53.93	28.02	3516.07	58986.44	5.9608	95.	5.	0. 0.			89.	8. 2. 1.			
65900L	4	5140	38302.89	2747.73	195.90	37.83	32.10	3013.55	41316.44	7.2938	93.	7.	0. 0.			91.	7. 1. 1.			
65900M	4	5185	56932.98	2520.00	167.67	50.99	26.11	2764.77	59697.74	4.6313	96.	4.	0. 0.			91.	6. 2. 1.			

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

TABLE I8

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	
65804B	4	2930	7568.64	6912.00	21898.93	10741.24	25176.46	64728.61	72297.25	89.5312	10.	10.	30.	15.	35.	11.	34.	17.	38.	
65804D	4	2990	81.63	109.50	412.96	260.29	743.40	1526.15	1607.78	94.9228	5.	7.	26.	16.	46.	7.	27.	17.	49.	
65804F	4	3050	1264.07	20.77	91.91	247.09	683.93	1043.70	2307.77	45.2255	54.	1.	4.	11.	30.	2.	9.	24.	65.	
65804H	4	3110	1604.13	46.20	221.08	220.67	685.34	1173.29	2777.42	42.2439	57.	2.	8.	8.	25.	4.	19.	19.	58.	*C*
65804J	4	3170	3292.36	1056.00	2833.75	1636.05	3868.51	9394.30	12686.66	74.0486	26.	8.	22.	13.	31.	11.	30.	17.	42.	
65804L	4	3230	3489.98	428.16	1991.17	1387.41	3902.49	7709.22	11199.20	68.8372	31.	4.	18.	12.	35.	6.	26.	18.	50.	
65804N	4	3290	2602.77	734.40	2177.97	1330.22	2996.26	7238.84	9841.61	73.5534	26.	7.	22.	14.	31.	10.	30.	18.	42.	
65804P	4	3350	4398.22	1432.32	2583.36	1770.32	2679.07	8465.06	12863.28	65.8079	34.	11.	20.	14.	21.	17.	31.	21.	31.	
65804R	4	3410	2855.06	883.20	2026.94	1143.74	2435.52	6489.39	9344.46	69.4464	31.	9.	22.	12.	26.	14.	31.	18.	37.	*C*
65804T	4	3470	2577.54	700.80	1589.76	823.00	1999.39	5112.94	7690.48	66.4840	33.	9.	21.	11.	26.	14.	31.	16.	39.	
65805B	4	3530	1744.99	137.52	625.97	482.36	1189.44	2435.29	4180.28	58.2566	42.	3.	15.	12.	28.	6.	26.	20.	48.	*C*
65805D	4	3590	1639.87	294.72	1001.55	606.68	1515.12	3418.07	5057.94	67.5783	32.	6.	20.	12.	30.	9.	29.	18.	44.	
65805F	4	3650	3246.10	1261.44	3402.08	1772.80	4055.42	10491.73	13737.83	76.3711	24.	9.	25.	13.	29.	12.	32.	17.	39.	
65805H	4	3710	3405.89	700.80	1418.86	643.98	1509.45	4273.08	7678.97	55.6465	45.	9.	18.	8.	20.	16.	33.	15.	36.	
65805J	4	3770	2943.36	620.16	1510.27	702.41	1653.89	4486.72	7430.08	60.3858	41.	8.	20.	9.	22.	14.	34.	16.	36.	
65805L	4	3830	1555.78	475.20	3513.37	3023.46	7193.28	14205.30	15761.08	90.1290	10.	3.	22.	19.	46.	3.	25.	21.	51.	*C*
65805N	4	3890	1425.43	23.10	80.61	160.06	491.35	755.12	2180.55	34.6298	65.	1.	4.	7.	23.	3.	11.	21.	65.	*C*
65805P	4	3950	2813.01	554.88	898.21	315.77	795.79	2564.65	5377.66	47.6908	52.	10.	17.	6.	15.	22.	35.	12.	31.	
65805R	4	4010	4078.65	1132.80	1605.66	571.87	1359.36	4669.68	8748.33	53.3779	46.	13.	18.	7.	16.	24.	35.	12.	29.	
65805T	4	4070	6744.49	3248.64	3632.60	1029.37	1925.76	9836.36	16580.85	59.3236	40.	20.	22.	6.	12.	33.	37.	10.	20.	
65806B	4	4130	11268.84	6748.79	8982.14	3058.27	5097.60	23886.79	35155.63	67.9458	31.	19.	26.	9.	15.	28.	38.	13.	21.	
65806D	4	4190	2980.15	2448.00	3393.14	781.56	1476.18	8098.97	11079.12	73.1012	27.	22.	31.	7.	13.	30.	42.	10.	18.	
65806F	4	4250	8777.52	6528.00	5444.92	1198.13	2152.32	15323.36	24100.88	63.5801	36.	27.	23.	5.	9.	42.	36.	8.	14.	
65806H	4	4310	2512.37	1992.00	3174.55	1002.33	1770.00	7938.87	10451.24	75.9610	24.	19.	30.	10.	17.	25.	40.	13.	22.	
65806J	4	4370	2057.72	1471.20	2449.22	836.05	1493.88	6250.34	8308.06	75.2322	25.	18.	29.	10.	18.	24.	39.	13.	24.	
65806L	4	4430	6170.54	4992.00	7253.28	2206.68	5154.24	19606.20	25776.73	76.0616	24.	19.	28.	9.	20.	25.	38.	11.	26.	
65900A	4	4490	1330.82	1294.08	2813.87	1128.82	2282.59	7519.36	8850.18	84.9628	15.	15.	31.	13.	26.	17.	38.	15.	30.	
65900B	4	4520	534.01	93.60	399.43	299.61	856.68	1649.32	2183.33	75.5415	24.	4.	18.	14.	40.	6.	24.	18.	52.	
65900C	4	4550	930.31	529.92	1649.38	826.73	1600.08	4606.11	5536.42	83.1965	17.	10.	29.	15.	29.	12.	35.	18.	35.	
65900D	4	4580	1534.75	630.72	963.79	453.77	852.43	2900.71	4435.46	65.3981	35.	14.	22.	10.	19.	22.	33.	16.	29.	
65900E	4	4610	367.92	0.82	2.35	1.81	1.36	6.34	374.26	1.6938	99.	0.	1.	0.	0.	13.	37.	29.	21.	
65900F	4	4700	1305.59	1520.64	798.85	267.29	351.88	2938.66	4244.25	69.2386	31.	36.	19.	6.	8.	52.	27.	9.	12.	
65900G	4	4730	503.52	130.80	112.28	64.34	112.75	420.17	923.69	45.4882	55.	14.	12.	7.	12.	31.	27.	15.	27.	
65900H	4	4795	510.88	242.40	55.64	40.64	54.87	393.55	904.43	43.5136	57.	27.	6.	4.	6.	62.	14.	10.	14.	
65900I	4	4890	493.01	643.20	138.36	18.69	31.86	832.11	1325.12	62.7951	37.	50.	10.	1.	2.	77.	17.	2.	4.	
65900J	4	5020	1496.51	5414.40	1581.81	100.39	306.56	7403.15	8900.06	83.1809	17.	61.	18.	1.	3.	74.	21.	1.	4.	
65900K	4	5085	59539.89	16319.98	1445.69	194.25	179.21	18139.05	77678.94	23.3513	77.	21.	2.	0.	0.	90.	8.	1.	1.	
65900L	4	5140	9250.56	2232.00	165.19	34.96	42.04	2474.18	11724.74	21.1022	80.	19.	1.	0.	0.	90.	7.	1.	2.	
65900M	4	5185	26279.98	6182.39	422.28	109.95	88.50	6803.11	33083.09	20.5637	80.	19.	1.	0.	0.	91.	6.	2.	1.	

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

TABLE IC

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	
65804B	4	2930	8455.05	8296.47	23553.14	11113.53	25778.07	68741.19	77196.19	89.0474	11.	11.	31.	14.	33.	12.	34.	16.	38.	
65804D	4	2990	1591.04	695.35	1632.73	905.16	2204.78	5438.07	7029.11	77.3650	23.	10.	23.	13.	31.	13.	30.	17.	40.	
65804F	4	3050	2660.66	393.80	1218.93	680.43	1754.02	4047.18	6707.83	60.3351	40.	6.	18.	10.	26.	10.	30.	17.	43.	
65804H	4	3110	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	*C*
65804J	4	3170	8711.88	2543.64	4856.28	2266.86	4959.35	14626.11	23338.00	62.6708	37.	11.	21.	10.	21.	17.	33.	15.	35.	
65804N	4	3290	2610.80	745.00	2181.40	1337.31	3007.04	7270.74	9881.54	73.5790	26.	8.	22.	14.	30.	10.	30.	18.	42.	
65804P	4	3410	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	*C*
65804T	4	3470	15868.79	3049.75	5109.55	2032.85	4079.87	14271.00	30139.80	47.3494	52.	10.	17.	7.	14.	21.	36.	14.	29.	
65805B	4	3530	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	*C*
65805D	4	3590	4285.80	1319.38	2771.21	1206.77	2742.27	8039.62	12325.42	65.2279	35.	11.	22.	10.	22.	16.	34.	15.	35.	
65805F	4	3650	10048.53	3893.97	8321.50	3220.44	6723.79	22159.68	32208.21	68.8013	31.	12.	26.	10.	21.	18.	37.	15.	30.	
65805H	4	3710	3567.69	790.45	1601.80	715.56	1645.84	4753.64	8341.33	56.9890	43.	9.	19.	9.	20.	17.	34.	15.	34.	
65805J	4	3770	3149.22	720.76	1735.07	781.40	1832.07	5069.29	8218.51	61.6813	38.	9.	21.	10.	22.	14.	34.	15.	37.	
65805L	4	3830	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	*C*
65805N	4	3890	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.	0.	0.	0.	0.	0.	0.	0.	0.	*C*
65805P	4	3950	4008.31	914.79	1306.74	427.94	1000.26	3649.73	7658.04	47.6588	52.	12.	17.	6.	13.	25.	36.	12.	27.	
65805R	4	4010	8323.86	1466.27	1992.64	651.81	1494.25	5604.96	10928.82	51.2860	49.	13.	18.	6.	14.	26.	35.	12.	27.	
65805T	4	4070	9022.21	4038.66	4290.73	1186.89	2150.29	11666.55	20689.77	56.3880	44.	20.	21.	6.	10.	35.	37.	10.	18.	
65806B	4	4130	22522.67	9916.79	11184.61	3643.61	5726.54	30471.55	52995.21	57.4987	43.	19.	21.	7.	11.	33.	36.	12.	19.	
65806D	4	4190	3708.48	3797.48	4605.33	1052.50	1869.63	11324.93	15033.41	75.3317	25.	25.	31.	7.	12.	34.	40.	9.	17.	
65806F	4	4250	39772.88	15963.42	10253.94	2302.80	3422.67	31942.82	71715.69	44.5409	56.	22.	14.	3.	5.	50.	32.	7.	11.	
65806H	4	4310	2531.55	2002.30	3186.67	1005.97	1774.62	7969.55	10501.10	75.8925	24.	19.	30.	10.	17.	25.	40.	13.	22.	
65806J	4	4370	11253.21	7410.39	7843.80	2228.43	3351.67	20834.27	32088.48	64.9316	35.	23.	24.	7.	10.	36.	37.	11.	16.	
65806L	4	4430	6256.97	5024.00	7294.13	2219.91	5177.55	19715.59	25972.56	75.9093	24.	19.	28.	9.	20.	25.	38.	11.	26.	
65900A	4	4490	5019.83	3798.10	5736.91	1992.10	3503.75	15030.84	20050.68	74.9643	25.	19.	29.	10.	17.	25.	39.	13.	23.	
65900B	4	4520	1381.70	648.10	1373.95	779.98	1608.86	4410.89	5792.59	76.1471	24.	11.	24.	13.	28.	15.	31.	18.	36.	
65900C	4	4550	4966.91	2397.69	3703.35	1476.18	2601.47	10178.68	15145.59	67.2055	33.	16.	24.	10.	17.	24.	35.	15.	26.	
65900D	4	4580	6618.95	2107.47	2135.67	784.82	1338.72	6366.67	12985.62	49.0286	52.	16.	16.	6.	10.	33.	34.	12.	21.	
65900E	4	4610	433.44	52.28	64.85	12.89	30.53	160.55	593.99	27.0290	73.	9.	11.	2.	5.	33.	40.	8.	19.	
65900F	4	4700	11291.99	5245.44	1356.51	357.03	442.81	7401.78	18693.77	39.5949	61.	28.	7.	2.	2.	71.	18.	5.	6.	
65900G	4	4730	706.33	410.80	222.98	92.53	147.99	874.30	1582.63	55.2435	45.	26.	14.	6.	9.	46.	26.	11.	17.	
65900H	4	4795	683.11	608.38	143.92	82.60	111.89	946.79	1629.90	58.0888	42.	37.	9.	5.	7.	64.	15.	9.	12.	
65900I	4	4890	501.23	655.15	140.47	18.91	32.72	847.25	1347.48	62.8766	37.	49.	10.	1.	2.	77.	17.	2.	4.	
65900J	4	5020	1593.62	5870.80	1724.13	118.42	338.79	8052.14	9645.76	83.4785	17.	60.	18.	1.	4.	74.	21.	1.	4.	
65900K	4	5085	115010.25	19482.32	1717.47	248.18	207.23	21655.13	136665.38	15.8454	85.	14.	1.	0.	0.	90.	8.	1.	1.	
65900L	4	5140	47553.45	4979.73	361.09	72.79	74.14	5487.73	53041.18	10.3462	90.	9.	1.	0.	0.	91.	7.	1.	1.	
65900M	4	5185	83212.94	8702.39	589.95	160.94	114.61	9567.88	92780.81	10.3123	90.	9.	1.	0.	0.	91.	6.	2.	1.	

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

TABLE II

Sample Descriptions and Visual Kerogen Characteristics, "Picked" Cuttings from 30/10-5 Well

(Kerogen by J. L. Morgan; T.O.M. by H. M. Fry)

Depth				GSA Color Code (Dry)	Total Organic Matter	Kerogen Alteration	Types of Kerogen*			Source Ratings		
Meters	Feet	EPR No.	Gross Lithology				Predominant	Secondary	Other	Maturity	Richness	Source Type at Maturity
3050	10,006	65804-F	Shale, med. dk. gray	N4	.76	2+	C	W,H	M	Mature	Fair	Gas
3170	10,400	-J	Shale, med. gray, sl. calc.	N5	.81	2+	C	W,H	Al	Mature	Fair	Gas
3230	10,597	-L	Shale, med. dk. gray, some sl. calc.	N4	.81						Fair	
3350	10,991	-P	Shale, med. dk. gray to med. gray, some calc. or dol., trace of pyrite	N4-N5	.81	2+	W,C	H	-	Mature	Fair	Gas
3410	11,188	-R	Shale, as above	N4-N5	.78						Fair	
3470	11,384	-T	Shale, as above	N4	.73						Fair	
3530	11,581	65805-B	Shale, as above	N4-N5	.71						Fair	
3590	11,778	-D	Shale, med. dk. gray to med. gray	N4-N5	2.15	2+	C	W	H	Mature	Good	Gas
3650	11,975	-F	Shale, as above, trace of limestone	N4-N5	.68	2+	C	W	A,H,M	Mature	Fair	Gas
3770	12,369	-J	Shale, as above, plus drilling mud	N4-N5	.68	2+	C	W	H	Mature	Fair	Gas
3830	12,566	-L	Shale, as above, very muddy	N4-N5	1.67						Good	
3950	12,959	-P	Shale, as above	N4-N5	.83						Fair	
4130	13,550	65806-B	Shale, med. dk. gray to med. gray, trace of pyrite	N4-N5	1.49	3-	W,C	-	H	Very Mature	Good	Gas
4190	13,747	-D	Shale, dk. to med. dk. gray, tr. pyrite	N3-N4	1.83	3-	W	C	H	Very Mature	Good	Gas
4250	13,943	-F	Shale, med. dk. gray to olive gray	N4-5Y 4/1	1.98	3	W	C	H	Overmature	Good	Gas
4310	14,140	-H	Shale, dk. gray to med. gray	N3-N5	1.71	3	W	C	H	Overmature	Good	Gas
4370	14,337	-J	Shale, as above	N3-N5	1.95	3	W	C	H	Overmature	Good	Gas
4490	14,731	65900-A	Shale, dk. gray, sl. tr. pyrite	N3	1.33	3-	W	C	H	Very Mature	Good	Gas
4610	15,124	-E	Shale, med. dk. gray and pale brown, v. muddy, numerous particles of tarry material	N4;5YR 2/1	9.76**	3	C	E	W,H	Overmature	Rich?**	Gas
4700	15,420	-F	Mixture of shale, claystone, siltstone, some calc., with traces of tar	N4;5YR 7/1	2.44	3	W	C	E	Overmature	Good?**	Gas
4795	15,731	-H	Shale and claystone, med. dk. gray, med. brown and pale yel. brown, some sl. calc.	N4;5YR 4/4; 10YR 6/2-7/2	4.12	3+	W,C	-	E	Overmature	Rich	Gas
4890	16,043	-I	As above	N4;10YR 6/2	3.61						Rich	
5020	16,470	-J	As above, plus coal particles	N4;10YR 6/2	3.54	3+	W	C	H	Overmature	Rich	Gas
5085	16,683	-K	Shale, dk. olive gray to brownish gray, plus coal and quartz grains	5Y 3/1-5YR 4/1	2.67						Good	
5140	16,863	-L	Shale, dk. olive gray to dk. gray, traces of coal, pyrite and quartz; slickensides	N3-5Y 3/1	1.53	3+	W,C	-	H	Overmature	Good	Gas
5185	17,011	-M	Shale, dk. gray to med. dk. gray, as above	N3-N4	1.42	3+	W	C	H	Overmature	Good	Gas

** Sample was contaminated with tarry particles probably accounting for high T.O.M.

* A - Amorphous
Al - Algal
H - Herbaceous
M - Microplankton
W - Woody
C - Coaly
E - Extraneous Mud Additives (Walnut Shells, etc.)

TABLE III

Total Organic Matter and Light Gasolines (C_4-C_7)

(Analyses by H. M. Fry; R. R. Dudley)

Depth (ft)	EPR No.	Total Organic Matter (%)	C_4-C_7 Hydrocarbons (ppm)	Correlation Ratios*			
				C_1/C_2	A/D_2	C_1/D_2	CH/MCP**
10,006	65804-F	.76	30.9	3.69	5.08	3.38	1.70
10,400	-J	.81	41.8	3.86	4.90	3.80	1.76
10,597	-L	.81	27.7	3.03	5.00	3.54	1.78
10,991	-P	.81	27.8	3.45	4.80	4.06	2.00
11,188	-R	.78	26.2	3.25	3.74	3.69	1.75
11,384	-T	.73	15.2	3.18	4.16	3.61	1.91
11,581	65805-B	.71	47.3	3.26	3.87	3.78	1.64
11,778	-D	2.15	105.1	3.17	5.29	4.91	1.67
11,975	-F	.68	55.7	3.05	1.58	4.33	1.48
12,369	-J	.68	12.7	3.75	4.26	5.70	1.97
12,566	-L	1.67	34.0	2.91	5.84	5.18	1.52
12,959	-P	.83	15.9	3.17	5.36	4.09	1.90
13,550	65806-B	1.49	6.5	4.28	3.52	4.70	2.75
13,747	-D	1.83	22.3	3.27	4.99	4.39	1.94
13,943	-F	1.98	8.9	3.95	4.28	5.44	2.61
14,140	-H	1.71	7.1	4.06	3.97	4.69	2.55
14,337	-J	1.95	5.0	4.63	4.28	4.46	2.80
14,731	65900-A	1.33	3.2	6.14	5.01	6.13	4.36
15,124	-E	9.76	16.8	2.38	6.92	7.03	1.44
15,420	-F	2.44	22.4	2.71	13.72	8.05	1.64
15,731	-H	4.12	2.0	3.46	5.05	4.07	1.13
16,043	-I	3.61	14.2	3.19	5.27	3.87	1.62
16,470	-J	3.54	34.2	2.61	9.34	9.58	1.38
16,683	-K	2.67	12.1	3.84	7.24	9.79	1.71
16,863	-L	1.53	3.0	2.20	4.90	5.60	1.23
17,011	-M	1.42	6.1	1.41	6.37	4.25	.69

*See Table III-A

**CH - cyclohexane
MCP - Methycyclopentane

TABLE III A

DEFINITION OF SIGNIFICANT GASOLINE RATIOS

Light Gasoline Compounds Determined by Gas Chromatography

1. Pentane
2. Hexane
3. Heptane
4. Iso-Pentane
5. 2-Methylpentane
6. 3-Methylpentane
7. 2,3-Dimethylbutane
8. 2,2-Dimethylbutane
9. 3-Methylhexane
10. 2-Methylhexane + 1,1-Dimethylcyclopentane
11. 2,3-Dimethylpentane
12. 2,4-Dimethylpentane
13. 2,2-Dimethylpentane
14. 2,2,3-Trimethylbutane
15. 2,2,4-Trimethylpentane
16. Cyclopentane
17. Methylcyclopentane
18. 1-c-3-Dimethylcyclopentane
19. 1-t-3-Dimethylcyclopentane
20. 1-c-2-Dimethylcyclopentane
21. 1-t-2-Dimethylcyclopentane + 3-Ethylpentane*
22. Cyclohexane + 3,3-Dimethylpentane*
23. Methylcyclohexane
24. Benzene
25. Toluene

Significant Groupings of Molecular Data

A. Hexane + Heptane

B. Pentane + iso-Pentane + 2-Methylpentane + 3-Methylpentane

C. Naphthenes

C_1 2-Methylhexane + 1 , 1-Dimethylcyclopentane* + Cyclohexane + 3,3-Dimethylpentane* + Methylcyclohexane

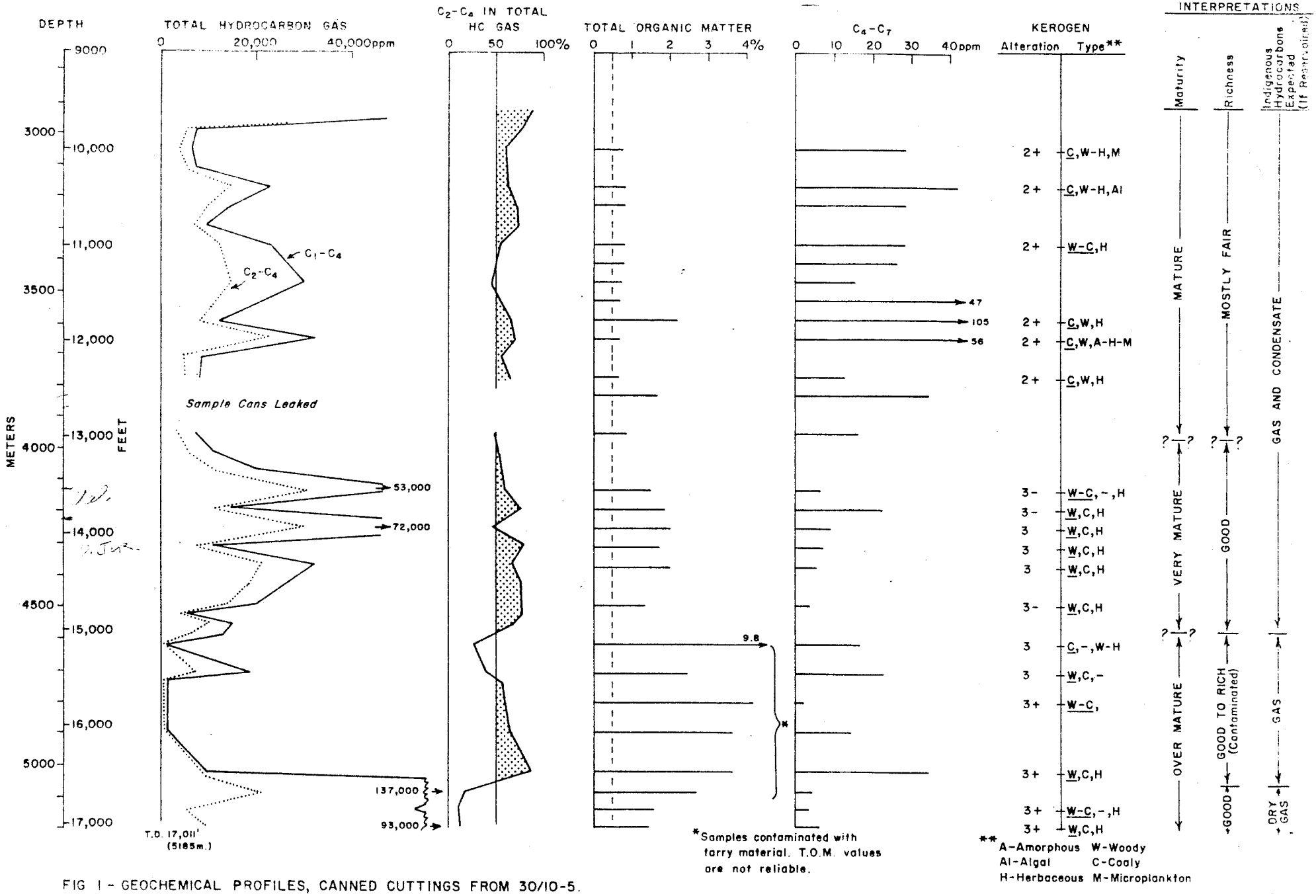
C_2 Methylcyclopentane + 1-c-3-Dimethylcyclopentane + 1-t-3-Dimethylcyclopentane + 1-c-2-Dimethylcyclopentane + (1-t-2-Dimethylcyclopentane + 3-Ethylpentane)*

D. Aromatics Plus 3-Methylhexane

D_1 Benzene + Toluene

D_2 3-Methylhexane

*Analyzed together by gas chromatography.



*Samples contaminated with tarry material. T.O.M. values are not reliable.

** A-Amorphous W-Woody
Al-Algal C-Coaly
H-Herbaceous M-Microplankton

FIG 1 - GEOCHEMICAL PROFILES, CANNED CUTTINGS FROM 30/10-5.