

Exxon Production Research Company

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EPR.13ES.75

HYDROCARBON SOURCE CHARACTERISTICS OF CANNED
CUTTINGS FROM THE 15/6-3 WELL, NORWAY

Report by: R. E. Metter

Analyses by: H. M. Fry
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Reservoir Evaluation Division

February 1975

EPR PROPRIETARY

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SUMMARY AND CONCLUSIONS

Canned cuttings samples from the interval 1200-12,542 ft were analyzed for hydrocarbon source characteristics. Sample spacing varied from 100 ft to 600 ft in the well.

This work was billed to our Job No. 7124.

The analytical results are interpreted grossly as follows:

<u>Approximate Interval (ft)</u>	<u>Source Richness</u>	<u>Maturity</u>	<u>Hydrocarbons Expected if Reservoired</u>
1200-5500	Mostly Poor; scattered "Good" zones	Immature	Dry Gas
5500-8500	Mostly Poor; a few "Fair" zones	Immature	Dry Gas
8500-10,200(?)	Poor	Immature	Lean
10,200(?)-11,100	Poor	Mature	Lean
11,100-11,500	Fair	Mature	Gas; Minor Liquids
12,100-12,452	Rich	Mature	Oil, Gas

The analytical data are listed in detail in Tables I-III and they are summarized graphically in Fig. 1. Interpretations of source quality based on the kerogen and total organic content of 15 "picked" samples are given in Table II.

The interval starting at about 11,100 ft to 11,200 ft appears from geochemical evidence to be the Malm. The unsampled interval beginning at about 11,500 ft presumably includes Dogger beds, and the "rich oil source" shales below are presumably Lias or older. The "Malm" is only rated as a "fair gas source" on the basis of kerogen, total organic matter and gasoline data. We generally expect Malm shales to be richer and "oilier" than this, so perhaps the samples include cavings from the overlying Cretaceous shales. On the other hand, the indicated source character of the "Malm" and "Lias" is consistent with the reported pattern of reservoired hydrocarbons, which suggests that the source ratings indicated above are probably valid.

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 (C₁-C₄) and wet gas (C₂-C₄), and a graphical plot was also made of the percent wet gas in total gas (Figure 1). Detailed results of the analyses are listed in Table I.

Chips of uniform lithologies were picked by hand from the heterogenous mixtures of chips in 15 of the original samples. These are described in Table II. Our standard analytical procedures were used for determining the C₄-C₇ 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 depth to the top of the "mature" zone is questionable. The percent C₂-C₄ in total gas pattern suggests that maturity is encountered at 7300 ft (Fig. 1) but the kerogen and gasoline data suggest it is considerably deeper. The interval in question is such a poor source overall that the top of the mature zone is not a vital problem here.

There appears to be a typical pattern of lean Cretaceous shales overlying richer Jurassic beds, but as was discussed in the SUMMARY the "Malm" shales appear to be leaner and less oily here than those encountered to the north and west in the North Sea.

RELATED SERVICE REPORT

EPR.9ES.72 "Source Evaluation of Canned Cuttings from the 15/6-1 and 15/6-2 Wells, Norway" by R. Metter et al., February 1972.

TABLE I A

C₁-C₄ HYDROCARBON ANALYSES - AIR SPACE AT TOP OF CANS

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)								
			METHANE	ETHANE	PROPANE	ISO-BUTANE	NORMAL BUTANE	WET	TOTAL	TOTAL GAS					WET GAS			
			(C ₁)	(C ₂)	(C ₃)	(iC ₄)	(nC ₄)	(C ₂ -C ₄)	(C ₁ -C ₄)	C ₂ -C ₄	C ₁	C ₂	C ₃	iC ₄	nC ₄	C ₂	C ₃	iC ₄
65097B	4	1200	62.12	0.51	0.23	0.02	0.07	0.83	62.95	1.3185	99.	1.	0.	0.	0.	62.28.	2.	8.
65097D	4	1600	63.43	0.20	0.07	0.01	0.02	0.30	63.73	0.4707	100.	0.	0.	0.	0.	67.23.	3.	7.
65097F	4	2200	2001.15	0.71	1.17	0.32	0.43	2.63	2003.78	0.1212	100.	0.	0.	0.	0.	27.45.	12.	16.
65097G	4	2500	3722.28	0.17	0.34	0.59	0.49	1.59	3723.87	0.0427	100.	0.	0.	0.	0.	11.21.	37.	31.
65097H	4	2800	201.58	0.47	0.31	0.15	0.13	1.06	202.64	0.5231	100.	0.	0.	0.	0.	45.29.	14.	12.
65097I	4	3100	2350.86	1.64	0.19	0.02	0.09	1.94	2352.80	0.0624	100.	0.	0.	0.	0.	84.10.	1.	5.
65097J	4	3400	327.04	14.02	0.06	0.02	0.12	14.22	341.26	4.1667	96.	4.	0.	0.	0.	99.	0.	1.
65097K	4	3700	109.01	0.44	0.30	0.02	0.12	0.88	109.89	0.8C08	100.	0.	0.	0.	0.	50.34.	2.	14.
65097L	4	3950	3357.04	14.00	2.10	0.12	0.35	16.57	3373.61	0.4912	100.	0.	0.	0.	0.	84.13.	1.	2.
65097M	4	4300	272.31	5.62	2.99	0.09	0.67	9.37	281.68	3.2263	97.	2.	1.	0.	0.	60.32.	1.	7.
65097N	4	4600	6695.25	28.27	4.21	0.23	0.59	33.29	6728.54	0.4548	100.	0.	0.	0.	0.	84.13.	1.	2.
65097O	4	4900	108.94	4.15	1.76	0.51	1.39	7.81	116.75	6.6895	93.	4.	2.	0.	1.	52.23.	7.	18.
65097P	4	5200	134.57	8.15	3.24	2.76	1.76	15.91	150.48	10.5728	90.	5.	2.	2.	1.	52.20.	17.	11.
65097Q	4	5500	10067.76	123.60	41.24	15.80	5.60	86.23	10253.99	1.8162	99.	1.	0.	0.	0.	67.22.	8.	3.
65097R	4	5800	9.93	0.49	0.67	0.58	0.32	2.06	11.99	17.1810	82.	4.	6.	5.	3.	24.32.	28.	16.
65097S	4	6100	19.41	1.69	0.91	0.20	0.21	3.01	22.42	13.4254	86.	8.	4.	1.	1.	56.30.	7.	7.
65097T	4	6400	129.21	6.20	3.52	0.91	0.88	11.51	140.72	8.1793	91.	4.	3.	1.	1.	53.31.	8.	8.
65098A	4	6700	6.46	1.86	3.08	1.12	0.83	6.89	13.35	51.6105	49.	14.	23.	8.	6.	27.45.	16.	12.
65098B	4	7000	2964.30	282.48	73.09	11.58	7.12	374.27	3338.57	11.2105	90.	8.	2.	0.	0.	75.20.	3.	2.
65415A	4	7300	64.69	72.66	47.29	9.08	11.33	140.36	205.05	68.4516	32.	35.	23.	4.	6.	52.34.	6.	8.
65415C	4	7900	5.96	4.32	17.31	4.81	6.91	33.35	39.31	84.8384	15.	11.	44.	12.	18.	13.52.	14.	21.
65415E	4	8500	14.64	16.42	34.54	13.24	16.05	80.25	94.89	84.5716	15.	17.	37.	14.	17.	20.44.	16.	20.
65415G	4	9100	3.48	0.01	0.27	0.03	0.25	0.56	4.04	13.8614	86.	0.	7.	1.	6.	2.48.	5.	45.
65415I	4	9600	2.18	0.06	0.09	0.01	0.05	0.21	2.39	8.7865	91.	3.	4.	0.	2.	29.42.	5.	24.
65415K	4	9800	2.34	0.28	0.32	0.38	0.97	1.95	4.29	45.4545	54.	7.	7.	9.	23.	14.16.	19.	51.
65415M	4	10000	3.99	0.58	0.52	0.33	0.13	1.56	5.55	28.1C81	73.	10.	9.	6.	2.	38.33.	21.	8.
65415N	4	10100	2.48	0.49	0.58	0.04	0.11	1.22	3.70	32.9730	67.	13.	16.	1.	3.	40.48.	3.	9.
65415O	4	10200	7.28	1.20	0.92	0.12	0.37	2.61	9.89	26.3903	74.	12.	9.	1.	4.	46.35.	5.	14.
65415Q	4	10400	14.99	5.61	2.23	0.43	0.78	9.05	24.04	37.6455	63.	23.	9.	2.	3.	61.25.	5.	9.
65416A	4	10500	17.18	3.67	1.06	0.20	0.43	5.36	22.54	23.7799	76.	16.	5.	1.	2.	68.20.	4.	8.
65416B	4	10600	30.98	7.20	3.58	0.65	1.12	12.55	43.53	28.8306	71.	17.	8.	1.	3.	57.29.	5.	9.
65416C	4	10700	21.33	6.52	3.53	0.71	0.93	11.69	33.02	35.4C27	64.	20.	11.	2.	3.	56.30.	6.	8.
65416D	4	10800	10.92	1.60	1.00	0.18	0.26	3.04	13.96	21.7765	79.	11.	7.	1.	2.	52.33.	6.	9.
65416E	4	10900	0.21	0.01	0.0	0.0	0.0	0.01	0.22	4.5455	95.	5.	0.	0.	0.	100.	0.	0.
65430A	4	11000	24.11	6.66	8.29	0.22	1.51	16.68	40.79	40.8523	59.	16.	20.	1.	4.	40.50.	1.	9.
65430B	4	11100	13.60	4.11	10.07	1.04	3.40	18.62	32.22	57.7501	42.	13.	31.	3.	11.	22.54.	6.	18.
65430C	4	11200	899.36	1265.46	2009.25	220.60	1134.29	4629.59	5528.95	83.7336	16.	23.	36.	4.	21.	27.43.	5.	25.
65430D	4	11300	473.09	1016.99	1814.79	374.21	1117.28	4323.27	4796.36	90.1265	10.	21.	38.	8.	23.	24.41.	9.	26.
65430E	4	11400	300.21	259.30	321.37	98.39	132.77	811.83	1112.04	73.0036	27.	23.	29.	9.	12.	32.40.	12.	16.
65430F	4	11500	9.40	17.06	7.68	0.86	2.12	27.72	37.12	74.6767	25.	46.	21.	2.	6.	61.28.	3.	8.
65430G	4	12100	4517.80	1040.90	500.15	70.62	155.28	1766.94	6284.74	28.1148	72.	17.	8.	1.	2.	59.28.	4.	9.
65430H	4	12200	1511.53	665.10	446.80	53.30	109.58	1274.78	2786.31	45.7515	54.	24.	16.	2.	4.	52.35.	4.	9.
65430I	4	12300	2226.50	1130.00	776.25	99.28	309.75	2315.28	4541.78	50.5773	49.	25.	17.	2.	7.	49.34.	4.	13.
65430J	4	12400	2518.26	791.21	447.67	53.62	118.26	1410.76	3929.02	35.9C61	65.	20.	11.	1.	3.	56.32.	4.	8.
65430K	4	12452	2859.26	942.55	780.43	101.26	306.89	2131.12	4990.38	42.7046	57.	19.	16.	2.	6.	44.37.	5.	14.

TABLE I B

C₁-C₄ HYDROCARBON ANALYSES - CUTTINGS ONLY

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)							GAS COMPOSITION (PERCENT)									
			METHANE	ETHANE	PROPANE	ISO-BUTANE	NORMAL BUTANE	WET	TOTAL	TOTAL GAS					WET GAS				
			(C ₁)	(C ₂)	(C ₃)	(iC ₄)	(nC ₄)	(C ₂ -C ₄)	(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
65097B	4	1200	646.49	6.48	1.18	0.29	0.66	8.61	655.10	1.3142	99.	1.	0.	0.	0.	75.14.	3.	8.	
65097D	4	1600	812.05	2.30	0.43	0.08	0.33	3.14	815.19	0.3851	100.	0.	0.	0.	0.	72.14.	3.	11.	
65097F	4	2200	729.27	6.75	1.90	0.15	0.61	9.41	738.68	1.2738	99.	1.	0.	0.	0.	72.20.	2.	6.	
65097G	4	2500	830.45	3.90	0.29	0.06	0.24	4.49	834.94	0.5377	100.	0.	0.	0.	0.	88.6.	1.	5.	
65097H	4	2800	876.44	6.30	1.16	0.08	0.61	8.15	884.59	0.9213	99.	1.	0.	0.	0.	78.14.	1.	7.	
65097I	4	3100	1009.15	7.80	1.28	0.21	0.51	9.80	1018.95	0.9617	99.	1.	0.	0.	0.	80.13.	2.	5.	
65097J	4	3400	1281.15	7.08	1.54	0.29	0.91	9.82	1290.97	0.7606	99.	1.	0.	0.	0.	72.16.	3.	9.	
65097K	4	3700	814.68	4.47	0.62	0.15	0.33	5.57	820.25	0.6790	99.	1.	0.	0.	0.	80.11.	3.	6.	
65097L	4	3950	1211.51	7.68	2.13	0.08	0.94	10.83	1222.34	0.8660	99.	1.	0.	0.	0.	70.20.	1.	9.	
65097M	4	4300	1219.39	11.40	2.72	0.31	1.16	15.59	1234.98	1.2623	99.	1.	0.	0.	0.	74.17.	2.	7.	
65097N	4	4600	1285.09	21.60	2.95	0.08	0.46	25.09	1310.18	1.9150	98.	2.	0.	0.	0.	66.12.	0.	2.	
65097O	4	4900	538.74	12.60	2.95	2.43	1.60	19.58	558.32	3.5069	97.	2.	1.	0.	0.	65.15.	12.	8.	
65097P	4	5200	794.97	31.80	37.57	42.73	23.89	135.99	930.96	14.6075	85.	3.	4.	5.	3.	23.28.	31.	18.	
65097Q	4	5500	1500.59	72.24	55.89	34.19	22.21	184.53	1685.12	10.5505	90.	4.	3.	2.	1.	39.30.	19.	12.	
65097R	4	5800	473.04	6.00	6.60	2.33	3.82	18.75	491.79	3.6125	97.	1.	1.	0.	1.	32.36.	12.	20.	
65097S	4	6100	216.81	9.60	3.42	1.46	1.55	16.03	232.84	6.8845	93.	4.	1.	1.	1.	60.21.	9.	10.	
65097T	4	6400	424.42	5.47	12.03	4.95	3.65	26.10	450.52	5.7932	94.	1.	3.	1.	1.	21.46.	19.	14.	
65098A	4	6700	279.22	5.85	12.73	3.69	2.93	25.20	304.42	8.2779	92.	2.	4.	1.	1.	23.50.	15.	12.	
65098B	4	7000	2010.42	36.60	79.86	18.45	11.50	146.41	2156.83	6.7882	92.	2.	4.	1.	1.	25.54.	13.	8.	
65415A	4	7300	246.37	158.40	42.54	53.61	84.07	338.62	584.99	57.6647	43.	27.	7.	9.	14.	46.13.	16.	25.	
65415C	4	7900	548.59	34.32	178.85	76.92	155.76	445.85	994.44	44.6342	55.	3.	18.	8.	16.	8.40.	17.	35.	
65415E	4	8500	388.94	103.80	526.61	205.13	446.04	1281.58	1670.52	76.7174	23.	6.	32.	12.	27.	6.41.	16.	35.	
65415G	4	9100	466.47	3.75	3.88	1.94	5.92	15.49	481.96	3.2139	97.	1.	1.	0.	1.	24.25.	13.	38.	
65415I	4	9600	555.16	5.85	2.64	1.94	1.33	11.76	566.92	2.0743	99.	1.	0.	0.	0.	51.22.	16.	11.	
65415K	4	9800	275.94	2.17	0.47	0.47	1.33	4.44	280.38	1.5635	99.	1.	0.	0.	0.	48.11.	11.	30.	
65415M	4	10000	689.85	4.95	0.39	0.08	0.17	5.59	695.44	0.6038	99.	1.	0.	0.	0.	89.7.	1.	3.	
65415N	4	10100	465.24	2.85	0.57	0.08	0.42	3.92	469.16	0.6354	99.	1.	0.	0.	0.	72.15.	2.	11.	
65415O	4	10200	525.60	10.05	2.48	0.24	0.33	13.10	538.70	2.4317	98.	2.	0.	0.	0.	76.19.	2.	3.	
65415Q	4	10400	1176.03	6.67	3.88	2.38	2.65	15.58	1191.61	1.3074	99.	1.	0.	0.	0.	43.25.	15.	17.	
65416A	4	10500	985.50	12.00	6.05	2.33	3.26	23.64	1009.14	2.3425	98.	1.	1.	0.	0.	50.26.	10.	14.	
65416B	4	10600	1189.17	8.62	5.28	4.76	3.76	22.42	1211.59	1.6504	99.	1.	0.	0.	0.	38.24.	21.	17.	
65416C	4	10700	657.00	12.96	8.54	7.03	6.90	35.43	692.43	5.1167	95.	2.	1.	1.	1.	37.24.	20.	19.	
65416D	4	10800	320.62	6.18	6.49	2.53	5.81	21.01	341.63	6.1498	93.	2.	2.	1.	2.	29.31.	12.	28.	
65416E	4	10900	683.28	8.44	8.07	1.03	3.52	21.06	704.34	2.9899	98.	1.	1.	0.	0.	40.38.	5.	17.	
65430A	4	11000	151.11	12.12	6.47	0.39	10.40	29.38	180.49	16.2779	83.	7.	4.	0.	6.	42.22.	1.	35.	
65430B	4	11100	498.01	223.20	40.55	194.25	0.88	458.88	956.89	47.9553	53.	23.	4.	20.	0.	49.	9.	42.	0.
65430C	4	11200	505.89	816.00	5619.80	2337.22	8983.10	17756.11	18262.00	97.2298	3.	4.	31.	13.	49.	5.32.	13.	50.	
65430D	4	11300	459.90	438.00	1987.20	424.24	1734.60	4584.04	5043.94	90.8821	9.	9.	40.	8.	34.	10.43.	9.	38.	
65430E	4	11400	840.96	859.20	2235.60	528.36	2201.88	5825.04	6666.00	87.3843	13.	13.	33.	8.	33.	15.38.	9.	38.	
65430F	4	11500	1655.64	3777.60	1763.64	202.02	799.15	6542.40	8198.04	79.6044	20.	46.	22.	2.	10.	58.27.	3.	12.	
65430G	4	12100	3705.48	2131.20	1559.95	285.16	787.65	4763.95	8469.43	56.2488	45.	25.	18.	3.	9.	44.33.	6.	17.	
65430H	4	12200	2712.09	2788.80	4053.88	11.65	787.65	7641.97	10354.06	73.6065	26.	27.	39.	0.	8.	36.54.	0.	10.	
65430I	4	12300	420.48	357.60	608.58	93.24	650.47	1709.89	2130.37	80.2626	20.	17.	29.	4.	30.	21.36.	5.	38.	
65430J	4	12400	1697.69	1416.00	1738.80	264.18	952.26	4371.23	6068.93	72.0265	28.	23.	29.	4.	16.	32.40.	6.	22.	
65430K	4	12452	756.86	612.00	943.92	170.94	559.32	2286.18	3043.04	75.1282	25.	20.	31.	6.	18.	27.42.	7.	24.	

TABLE I C

C₁-C₄ HYDROCARBON ANALYSES - CUTTINGS AND AIR SPACE

SAMPLE NUMBER	R	DEPTH	GAS CONCENTRATION (VOLUME GAS PER MILLION VOLUMES CUTTINGS)						GAS COMPOSITION (PERCENT)								
			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)	TOTAL GAS					WET GAS		
										C ₂ -C ₄	C ₁	C ₂	C ₃	iC ₄	nC ₄	C ₂	C ₃
65097D	4	1600	875.48	2.50	0.50	0.09	0.35	3.44	878.92	0.3913	100.	0.	0.	0.	0.	72.15.	3.10.
65097F	4	2200	2730.42	7.46	3.07	0.47	1.04	12.04	2742.46	0.4390	100.	0.	0.	0.	0.	62.25.	4.9.
65097G	4	2500	4552.73	4.07	0.63	0.65	0.73	6.08	4558.81	0.1333	100.	0.	0.	0.	0.	67.10.	11.12.
65097H	4	2800	1078.02	6.77	1.47	0.23	0.74	9.21	1087.23	0.8471	99.	1.	0.	0.	0.	74.16.	2.8.
65097I	4	3100	3360.01	9.44	1.47	0.23	0.60	11.74	3371.75	0.3482	100.	0.	0.	0.	0.	80.13.	2.5.
65097J	4	3400	1608.19	21.10	1.60	0.31	1.03	24.04	1632.23	1.4727	99.	1.	0.	0.	0.	88.7.	1.4.
65097K	4	3700	923.69	4.91	0.92	0.17	0.45	6.45	930.14	0.6934	99.	1.	0.	0.	0.	76.14.	3.7.
65097L	4	3950	4568.55	21.68	4.23	0.20	1.29	27.40	4595.95	0.5562	100.	0.	0.	0.	0.	79.15.	1.5.
65097M	4	4300	1491.70	17.02	5.71	0.40	1.83	24.96	1516.66	1.6457	99.	1.	0.	0.	0.	68.23.	2.7.
65097N	4	4600	7980.34	49.87	7.16	0.31	1.05	58.38	8038.72	0.7263	99.	1.	0.	0.	0.	85.12.	1.2.
65097O	4	4900	647.68	16.75	4.71	2.94	2.99	27.39	675.07	4.0573	97.	2.	1.	0.	0.	61.17.	11.11.
65097P	4	5200	529.54	39.95	40.81	45.49	25.65	151.90	1081.44	14.0460	86.	4.	4.	4.	2.	26.27.	30.17.
65097Q	4	5500	11568.35	195.84	97.13	49.99	27.81	370.76	11939.11	3.1054	97.	2.	1.	0.	0.	53.26.	13.8.
65097R	4	5800	482.97	6.49	7.27	2.91	4.14	20.81	503.78	4.1307	96.	1.	1.	1.	1.	31.35.	14.20.
65097S	4	6100	236.22	11.29	4.33	1.66	1.76	19.04	255.26	7.4590	92.	4.	2.	1.	1.	59.23.	9.9.
65097T	4	6400	553.63	11.67	15.55	5.86	4.53	37.61	591.24	6.3611	93.	2.	3.	1.	1.	31.41.	16.12.
65098A	4	6700	285.68	7.71	15.81	4.81	3.76	32.09	317.77	10.0984	90.	2.	5.	2.	1.	24.49.	15.12.
65098B	4	7000	4974.72	319.08	152.95	30.03	18.62	520.68	5495.40	9.4748	90.	6.	3.	1.	0.	61.29.	6.4.
65415A	4	7300	312.06	231.06	89.83	62.69	95.40	478.98	790.04	60.6272	39.	29.	11.	8.	12.	48.19.	13.20.
65415C	4	7900	554.55	38.64	196.16	81.73	162.67	479.20	1033.75	46.3555	53.	4.	19.	8.	16.	8.41.	17.34.
65415E	4	8500	403.58	120.22	561.15	218.37	462.09	1361.83	1765.41	77.1396	23.	7.	32.	12.	26.	9.41.	16.34.
65415G	4	9100	469.95	3.76	4.15	1.97	6.17	16.05	486.00	3.3024	97.	1.	1.	0.	1.	23.26.	12.39.
65415I	4	9600	557.34	5.91	2.73	1.95	1.38	11.97	569.31	2.1025	99.	1.	0.	0.	0.	49.23.	16.12.
65415K	4	9800	278.28	2.45	0.79	0.85	2.30	6.39	284.67	2.2446	98.	1.	0.	0.	1.	39.12.	13.36.
65415M	4	10000	693.84	5.53	0.91	0.41	0.30	7.15	700.99	1.0199	99.	1.	0.	0.	0.	77.13.	6.4.
65415N	4	10100	467.72	3.34	1.15	0.12	0.53	5.14	472.86	1.0869	99.	1.	0.	0.	0.	66.22.	2.10.
65415O	4	10200	532.88	11.25	3.40	0.36	0.70	15.71	548.59	2.8636	97.	2.	1.	0.	0.	72.22.	2.4.
65415Q	4	10400	1191.02	12.28	6.11	2.81	3.43	24.63	1215.65	2.0260	98.	1.	1.	0.	0.	50.25.	11.14.
65416A	4	10500	1002.68	15.67	7.11	2.53	3.69	29.00	1031.68	2.8109	97.	2.	1.	0.	0.	53.25.	9.13.
65416B	4	10600	1220.15	15.82	8.86	5.41	4.88	34.97	1255.12	2.7861	98.	1.	1.	0.	0.	46.25.	15.14.
65416C	4	10700	678.33	19.48	12.07	7.74	7.83	47.12	725.45	6.4552	93.	3.	2.	1.	1.	41.26.	16.17.
65416D	4	10800	331.54	7.78	7.49	2.71	6.07	24.05	355.59	6.1633	93.	2.	2.	1.	2.	33.31.	11.25.
65416E	4	10900	683.49	8.45	8.07	1.03	3.52	21.07	704.56	2.9904	98.	1.	1.	0.	0.	40.38.	5.17.
65430A	4	11000	175.22	18.78	14.76	0.61	11.91	46.06	221.28	20.8152	80.	8.	7.	0.	5.	41.32.	1.26.
65430B	4	11100	511.61	227.31	50.62	195.29	4.28	477.50	989.11	48.2757	52.	23.	5.	20.	0.	47.11.	41.1.
65430C	4	11200	1404.25	2081.46	7629.05	2557.82	10117.39	22385.70	23790.95	94.0933	6.	9.	32.	11.	43.	9.34.	11.46.
65430D	4	11300	932.99	1454.99	3801.99	798.45	2851.88	8907.30	9840.30	90.5186	9.	15.	39.	8.	29.	16.43.	9.32.
65430E	4	11400	1141.17	1118.50	2556.97	626.75	2334.65	6636.86	7778.04	85.3283	15.	14.	33.	8.	30.	17.39.	9.35.
65430F	4	11500	1665.04	3794.66	1771.32	202.88	801.27	6570.12	8235.16	79.7813	20.	46.	22.	2.	10.	58.27.	3.12.
65430G	4	12100	8223.27	3172.10	2060.10	355.78	942.93	6530.89	14754.17	44.2647	57.	21.	14.	2.	6.	49.32.	5.14.
65430H	4	12200	4224.62	3453.90	4500.68	64.95	897.23	8916.75	13140.37	67.6577	32.	26.	34.	0.	7.	39.50.	1.10.
65430I	4	12300	2646.98	1487.60	1384.83	192.52	960.22	4025.17	6672.14	60.3279	40.	22.	21.	3.	14.	37.34.	5.24.
65430J	4	12400	4215.95	2207.21	2186.47	317.80	1070.52	5781.99	9997.94	57.8318	42.	22.	22.	3.	11.	38.38.	5.19.
65430K	4	12452	3617.12	1554.55	1724.35	272.20	866.21	4417.30	8033.42	54.9865	45.	19.	21.	3.	11.	35.39.	6.20.

TABLE II Descriptions of Samples and of Visual Kerogen Characteristics:
"Picked" Cuttings from the 15/6-3 Well

(T.O.M. by R. R. Dudley; Kerogen by J. L. Morgan)

Depth (feet)	EPR No.	Gross Lithology	GSA Color Code (dry)	Total Organic Matter (%)	Kerogen Alteration	Types of Kerogen*			Source Ratings from Kerogen and T.O.M. Alone		
						Predominant	Secondary	Other	Richness	Maturity	Source Type at Maturity
2500	65097-G	Quartz-mica schist, dk. gray, sl. dol. and calc. claystone, med. dk. gray	N3 - N4	.21	1+	W	C	H	Poor	Immature	Lean
3950	-L	Mudstone and argillaceous siltstone, dk. brownish gray, sl. to mod. calcareous	5YR 3/1	3.09	2	A,W	C	Al	Rich	"	Gas, Oil
5200	-P	Shale, lt. olive gray, sl. silty	5Y 6/1	1.98	2	W	H	C	Good	"	Gas
5500	-Q	Shale, med. olive gray, sl. silty	5Y 5/1	1.81	2	W	H	C	Good	"	Gas
7000	65098-B	Shale, greenish gray	5GY 6/1	.34	2+	W	C	H,M	Poor	Mature ?	Lean
7300	65415-A	Shale, dk. greenish gray, plus med. olive gray calc. shale	5G 4/1; 5Y 5/1	.94	1+	H	Al?	W,C	Fair	Immature	Oil, Gas
8500	-E	Shale, med. greenish gray, slickensided	5GY 5/1	1.49	1+	H	Al,W	C	Good	"	Oil, Gas
9100	-G	Shale, as above, some calc.	5GY 5/1	.60	1+	H	W,C	Al	Marginal	"	Oil, Gas
10,500	65416-A	Mixture of mostly limestone plus minor amounts of med. greenish gray shale; chips all sand- sized	5GY 5/1	.17	2+	C	Al?	H	Poor	Mature	Lean
11,000	65430-A	Mixture of sand-sized grains of shale and limestone	5GY 5/1	.26	2+	C	W	H	Poor	"	Lean
11,200	-C	Mixture of shales: dk. greenish gray, med. greenish gray, and grayish brown	5G 3/1; 5GY 5/1; 5YR 3/2	.92	2+	C	W	Al	Fair	"	Gas
11,400	-E	Mixture of shales, as above; no browns but some dark gray	-	.89	2+	C	W	Al	Fair	"	Gas
11,978	-G	Mixture of shales, as above	-	4.06	2	Al	C	W	Rich	"	Oil, Gas
12,300	-I	As above; some are calc.	-	3.07	2+	Al	C	W	Rich	"	Oil, Gas
12,452 (TD)	-K	Shale, dark gray, very splintery, some calc.	N3	3.60	2+	C	W	H,Al	Rich	"	Gas

* A - Amorphous
Al - Algal
H - Herbaceous

W - Woody
C - Coaly

TABLE III Total Organic Matter and Light
Gasolines (C₄-C₇) in 15/6-3 Samples

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

Depth (ft)	EPR No.	Total Organic Matter (%)	Total C ₄ -C ₇ (ppm)	Correlation Ratios (See Table III-A)			CH/MCP**
				C ₁ /C ₂	A/D ₂	C ₁ /D ₂	
2500	65097-G	.21	0.	-	-	-	-
3950	-L	3.09	0.	-	-	-	-
5200	-P	1.98	0.	-	-	-	-
5500	-Q	1.81	0.	-	-	-	-
7000	65098-B	.34	0.	-	-	-	-
7300	65415-A	.94	.17	.58	3.15	6.37	.22
8500	-E	1.49	.30	.77	4.10	7.69	.45
9100	-G	.63	0.	-	-	-	-
10,500	65416-A	2.21	0.	-	-	-	-
11,000	65430-A	.26	0.	-	-	-	-
11,200	-C	.92	.64	1.27	4.15	5.40	.76
11,400	-E	.89	.80	1.73	5.37	8.08	.96
12,100	-G	4.06	21.8	1.44	4.16	8.64	.96
12,300	-I	3.07	20.2	1.43	4.33	8.46	.96
12,452	-K	3.60	19.8	1.36	4.63	8.54	.94

* CH - cyclohexane
MCP - methylcyclopentane

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 Groups of Molecular Data

- A. Hexane + Heptane
- B. Pentane + iso-Pentane + 2-Methylpentane + 3-Methylpentane
- C. Naphthenes
 - C₁ 2-Methylhexane + 1, 1-Dimethylcyclopentane* + Cyclohexane + 3,3-Dimethylpentane* + Methylcyclohexane
 - C₂ Methylcyclopentane + 1-c-3-Dimethylcyclopentane + 1-t-3-Dimethylcyclopentane + 1-c-2-Dimethylcyclopentane + (1-t-2-Dimethylcyclopentane + 3-Ethylpentane)*
- D. Aromatics Plus 3-Methylhexane
 - D₁ Benzene + Toluene
 - D₂ 3-Methylhexane

*Analyzed together by gas chromatography.

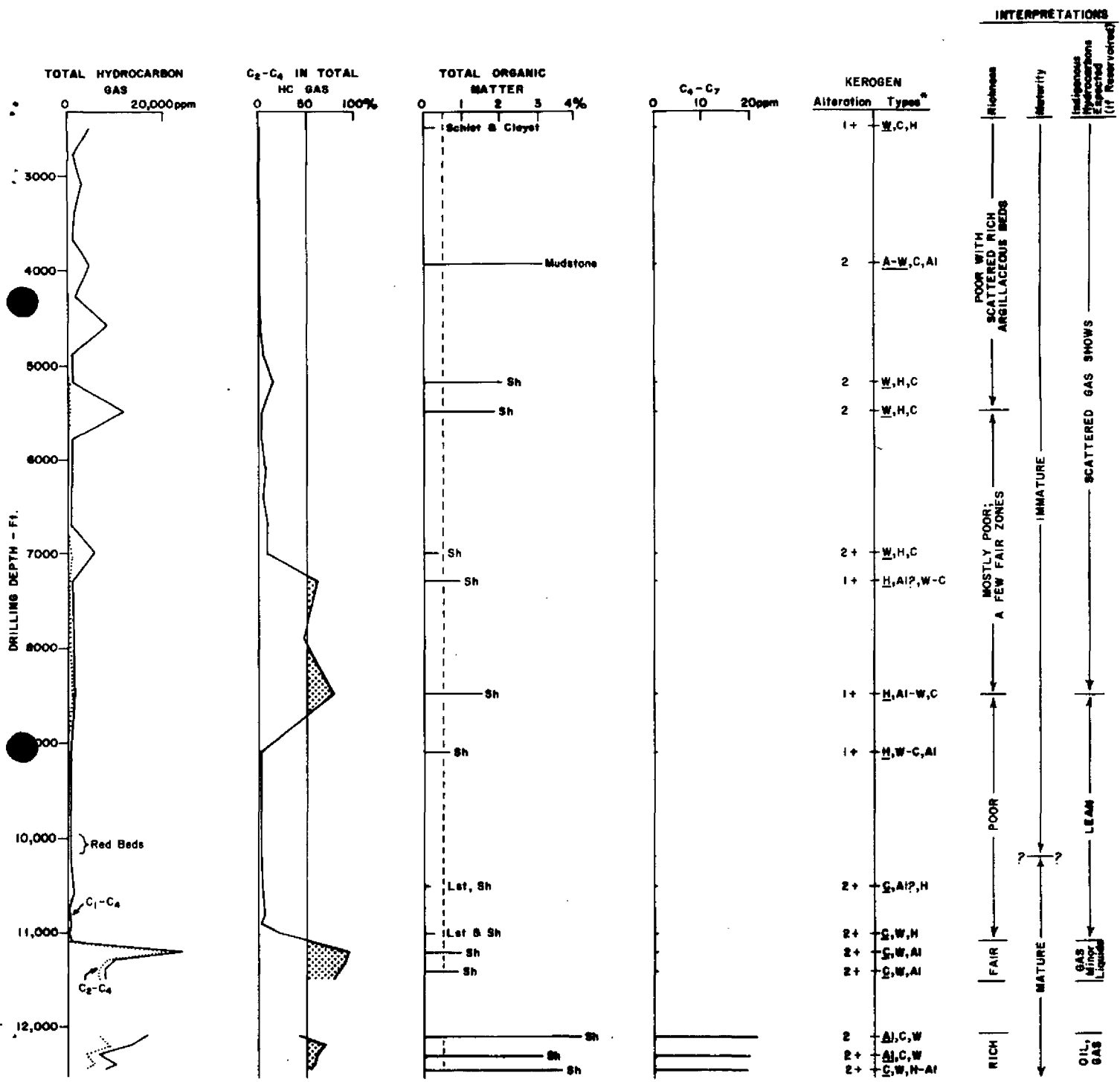


FIG. 1 - GEOCHEMICAL PATTERNS, 15/6-3 SAMPLES.

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