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OPEN-FILE REPORT 287

HYDROCARBON SOURCE ROCK EVALUATION OF
PURE OIL COMPANY, RED HILLS WELL NO. 1
SEC. 32, T25S, R33E, LEA COUNTY, NEW MEXICO

By

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and

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June 1987

NEW MEXICO HYDROCARBON SOURCE
ROCK EVALUATION PROJECT

PURE OIL COMPANY, RED HILLS WELL NO.1
SEC. 32, T25S, R33E, LEA COUNTY, NEW MEXICO
API NO. 30-025-21036
SOUTHEAST AREA
GEOCHEM JOB NO. 3530

Prepared

for

PROGRAM PARTICIPANTS

by

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CONFIDENTIAL
JUNE, 1987

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

WELL NAME: PURE OIL COMPANY, RED HILLS WELL NO.1
 API NO.: 30-025-21036
 AREA: SOUTHEAST
 LOCATION: LEA COUNTY, NEW MEXICO SEC.32, T25S, R33E
 GEOCHEM JOB NO.: 3530
 TOTAL DEPTH:
 INTERVAL SAMPLED: 5730-21000 ft.
 TOTAL NUMBER OF SAMPLES: 29

GEOCHEM SAMPLE NUMBER	SAMPLE DEPTH	STRATIGRAPHIC INTERVAL	ANALYSES				
			LITHO	TOC	ROCK- EVAL	KEROGEN	OTHER
3530-001	5730-5800	Bell Canyon	X	X	X	X	
3530-002	5900-5930	Bell Canyon	X	X	X	X	
3530-003	5990-6000	Bell Canyon	X	X	X	X	
3530-004	9480-9510	Bone Springs	X	X	X	X	
3530-005	10200-10230	Bone Springs	X	X	X	X	
3530-006	11010-11070	Bone Springs	X	X	X	X	
3530-007	11350-11380	Bone Springs	X	X	X	X	
3530-008	11380-11420	Bone Springs	X	X	X	X	
3530-009	12160-12200	Bone Springs	X	X	X	Y	
3530-010	13070-13160	Wolfcamp	X	X	X	X	
3530-011	13600-13650	Wolfcamp	X	X	X	X	
3530-012	13650-13690	Wolfcamp	X	X	X	Y	
3530-013	14440-14470	Pennsylvanian	X	X	X	Y	
3530-014	14480-14510	Pennsylvanian	X	X	X	X	
3530-015	14680-14740	Pennsylvanian	X	X	X	Y	
3530-016	15350-15370	Pennsylvanian	X	X	X	Y	
3530-017	15390-15430	Pennsylvanian	X	X	X	Y	
3530-018	15430-15460	Pennsylvanian	X	X	X	X	
3530-019	15720-15770	Barnett	X	X	X	Y	
3530-020	15770-15800	Barnett	X	X	X	Y	
3530-021	16170-16210	Barnett	X	X	X	Y	
3530-022	17300-17330	Woodford	X	X	X	X	
3530-023	19550-19610	Montoya	X	X	X	X	
3530-024	19670-19700	Simpson	X	X	X	Y	
3530-025	19800-19840	Simpson	X	X	X	Y	
3530-026	19840-19890	Simpson	X	X	X	X	
3530-027	20270-20290	Ellenburger	X	X	X	X	
3530-028	20460-20470	Ellenburger	X	X	X	X	
3530-029	20940-21000	Ellenburger	X	X	X	X	

PURE #1 RED HILLS
JOB NUMBER 3530

SUMMARY FIGURE 1

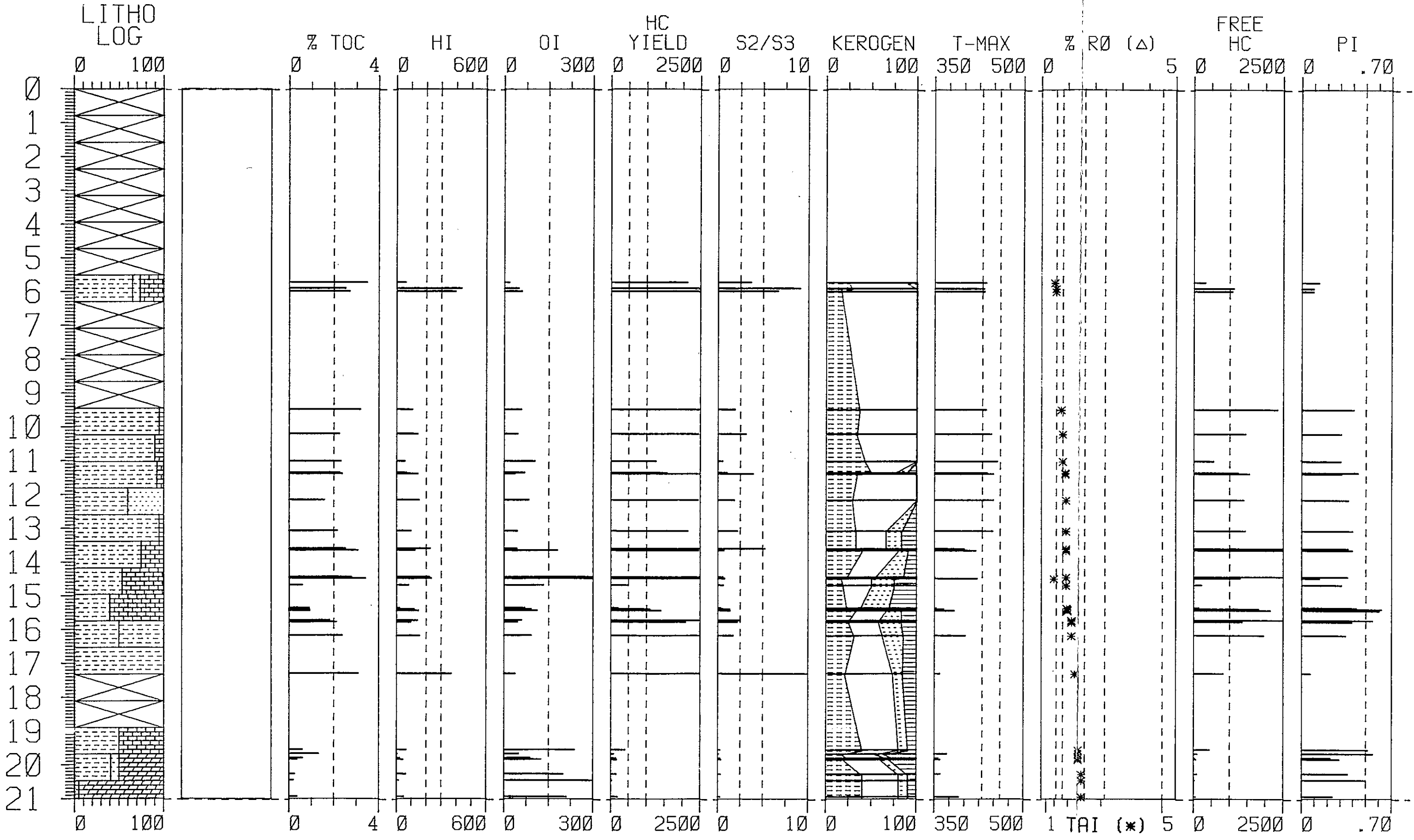


TABLE I

RESULTS OF TOTAL ORGANIC CARBON

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	TOTAL ORGANIC CARBON (% of Rock)
3530-001	5730-5800	3.49
3530-002	5900-5930	2.53/2.58
3530-003	5930-6000	2.71
3530-004	9480-9510	3.19
3530-005	10200-10230	2.26
3530-006	11010-11070	2.32
3530-007	11350-11380	2.27
3530-008	11380-11420	2.39
3530-009	12160-12200	1.59
3530-010	13070-13160	2.17/2.13
3530-011	13600-13650	2.53
3530-012	13650-13690	3.08
3530-013	14440-14470	2.80
3530-014	14480-14510	3.42
3530-015	14680-14740	0.60
3530-016	15350-15370	0.91
3530-017	15390-15430	0.92
3530-018	15430-15460	0.94
3530-019	15720-15770	1.82
3530-020	15770-15800	2.13/2.08
3530-021	16170-16210	2.39
3530-022	17300-17330	3.09
3530-023	19550-19610	0.61
3530-024	19670-19700	1.32
3530-025	19800-19840	0.62
3530-026	19840-19890	0.37/0.38
3530-027	20270-20290	0.25
3530-028	20460-20470	0.20
3530-029	20940-21000	0.37

TABLE II

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-001	5730-5800			3.49
-A		80% Limestone, finely crystalline, very light gray.	N8	
-B		15% Mudstone, slightly calcareous, olive-black.	5Y-2/1	
-C		5% Sandstone, very calcareous, very fine grained, light olive-gray.	5Y-6/1	
3530-002	5900-5930			2.53/2.58
-A		90% Mudstone, slightly calcareous, brownish black.	5YR-2/1	
-B		10% Sandstone, calcareous, light olive-gray.	5Y-6/1	
3530-003	5990-6000			2.71
-A		90% Mudstone, slightly calcareous, brownish black.	5YR-2/1	
-B		10% Sandstone, calcareous, light olive-gray.	5Y-6/1	
3530-004	9480-9510			3.19
-A		95% Shale, very calcareous, dark gray.	N3	
-B		5% Limestone, finely crystalline, very light gray.	N8	
3530-005	10200-10230			2.26
-A		95% Shale, very calcareous, dark gray.	N3	
-B		5% Limestone, finely crystalline, very light gray. Trace sandstone.	N8	

TABLE II (continued)

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-006	11010-11070			2.32
-A		90% Shale, very calcareous, dark gray.	N3	
-B		10% Limestone, finely crystalline, very light gray. Trace sandstone.	N8	
3530-007	11350-11380			2.27
-A		90% Shale, very calcareous, dark gray., brownish	N3	
-B		10% Limestone, finely crystalline, very light gray.	N8	
3530-008	11380-11420			2.39
-A		95% Shale, slightly calcareous, dark gray.	N3	
-B		5% Limestone, finely crystalline, very light gray. Trace wood fibers.	N8	
3530-009	12160-12200			1.59
-A		60% Shale, slightly calcareous, dark gray.	N3	
-B		40% Sandstone, very fine grained, very light gray. Trace limestone.	N8	
3530-010	13070-13160			2.17/2.13
-A		95% Mudstone, very calcareous, dark gray.	N3	
-B		5% Limestone, finely crystalline, very light gray.	N8	

TABLE II (continued)

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-011	13600-13650			2.53
-A		50% Mudstone, very calcareous, dark gray.	N3	
-B		50% Limestone, finely crystalline, very light gray.	N8	
3530-012	13650-13690			3.08
-A		50% Mudstone, calcareous, dark gray.	N3	
-B		50% Drilling cement.		
3530-013	14440-14470			2.80
-A		40% Mudstone, calcareous, dark gray.	N3	
-B		60% Drilling cement.		
3530-014	14480-14510			3.42
-A		30% Mudstone, calcareous, dark gray.	N3	
-B		20% Limestone, finely crystalline, light brownish gray.	5YR-6/1	
-C		50% Drilling cement.		
3530-015	14680-14740			0.60
-A		65% Limestone, finely crystalline, fossiliferous, brownish gray.	5YR-4/1	
-B		35% Limestone, finely crystalline, medium dark gray.	N4	
3530-016	15350-15370			0.91
-A		60% Limestone, finely crystalline, medium dark gray.	N4	

TABLE II (continued)

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-016 (continued) -B		40% Limestone, finely crystalline, fossiliferous, brownish gray.	5YR-4/1	
3530-017 -A	15390-15430	100% Limestone, finely crystalline, dark gray to brownish gray.	N3 to 5YR-4/1	0.92
3530-018 -A	15430-15460	60% Mudstone, calcareous, dark gray.	N3	0.94
-B		40% Limestone, finely crystalline, brownish gray. Trace quartz sand grains.	5YR-4/1	
3530-019 -A	15720-15770	100% Mudstone, calcareous, dark gray. Trace quartz sand grains.	N3	1.82
3530-020 -A	15770-15800	100% Mudstone, calcareous, dark gray. Trace quartz sand grains.	N3	2.13/2.08
3530-021 -A	16170-16210	100% Shale, calcareous, dark gray. Trace walnut shells.	N3	2.39
3530-022 -A	17300-17330	100% Shale, calcareous, dark gray. Trace walnut shells.	N3	3.09

TABLE II (continued)

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-023	19550-19610			0.61
-A		85% Limestone, finely crystalline, fossiliferous, dark gray.	N3	
-B		15% Shale, calcareous, dark gray.	N3	
3530-024	19670-19700			1.32
-A		85% Shale, calcareous, dark gray to dark greenish gray.	N3 to 5GY-4/1	
-B		15% Limestone, finely crystalline, moderate dark gray.	N4	
3530-025	19800-19840			0.62
-A		80% Shale, dark gray to dark greenish gray.	N3 to 5GY-4/1	
-B		20% Sandstone, very fine to fine grained, very light gray. Trace pyrite, wood fibers.	N8	
3530-026	19840-19890			0.37/0.38
-A		75% Shale, dark gray to dark greenish gray.	N3 to 5GY-4/1	
-B		15% Sandstone, very fine to fine grained, very light gray.	N8	
-C		10% Varied lithology Shale, sandy, grayish green. Shale, dusky red. Shale, mottled grayish green to dusky red. Trace mica, wood fibers.	5G-5/2 5R-3/4 5G-5/2 to 5R-3/4	

TABLE II (continued)

LITHOLOGICAL DESCRIPTIONS AND ORGANIC CARBON ANALYSES

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	LITHO DESCRIPTION	GSA NO.	ORGANIC CARBON (wt.%)
3530-027 -A	20270-20290	95% Dolomite, compact crystalline, brownish gray to dark gray.	5YR-4/1 to N3	0.25
-B		5% Shale, dark gray to dark greenish gray. Trace sandstone, mica.	N3 to 5GY-4/1	
3530-028 -A	20460-20470	100% Dolomite, compact crystalline, brownish gray to dark gray. Trace shale, mica.	5YR-4/1 to N3	0.20
3530-029 -A	20940-21000	95% Dolomite, compact crystalline, brownish gray to dark gray.	5YR-4/1 to N3	0.37
-B		5% Shale, mica, wood fibers.		

TABLE 111

SUMMARY OF ORGANIC CARBON AND VISUAL KEROGEN DATA

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	TOTAL ORGANIC CARBON	ORGANIC MATTER TYPE	VISUAL ABUNDANCE NORMALIZED PERCENT					ALTERATION STAGE	THERMAL ALTERATION INDEX
				Al	Am	H	W	I		
3530-001	5730-5800	3.49	H;Am;W	0	25	63	12	0	2- to 2	2.0
3530-002	5900-5930	2.53/2.58	H;Am;-	0	29	71	0	0	2- to 2	2.1
3530-003	5930-6000	2.71	H;-;Am	0	17	83	0	0	2- to 2	2.1
3530-004	9480-9510	3.19	H*;Am;-	0	37	63	0	0	2 to 2+	2.4
3530-005	10200-10230	2.26	H*;Am;-	0	34	66	0	0	2 to 2+	2.5
3530-006	11010-11070	2.32	H*;Am;-	0	43	57	0	0	2 to 2+	2.5
3530-007	11350-11380	2.27	Am;H*;W-I	0	50	26	12	12	2+	2.6
3530-008	11380-11420	2.39	H*;Am;-	0	34	66	0	0	2+	2.6
3530-009	12160-12200	1.59	H;Am;-	0	29	71	0	0	2+ to 3-	2.7
3530-010	13070-13160	2.17/2.13	Am-H*;W-I;-	0	33	33	17	17	2+ to 3-	2.7
3530-011	13600-13650	2.53	Am-H*;W-I;-	0	33	33	17	17	2+ to 3-	2.7
3530-012	13650-13690	3.08	Am-H*;-;W-I	0	40	40	10	10	2+ to 3-	2.7
3530-013	14440-14470	2.80	H-W;Am;I	0	23	31	31	15	2+ to 3-	2.7
3530-014	14480-14510	3.42	H;W-I;Am	0	17	33	25	25	caved(2- to 2)material	(1.9)
3530-015	14680-14740	0.60	H;W-I;Am**	0	19	31	25	25	2+ to 3-	2.7
3530-016	15350-15370	0.91	W-I;Am**;H	0	23	15	31	31	2+ to 3-	2.8
3530-017	15390-15430	0.92	H*;Am;W-I	0	28	36	18	18	2+ to 3-	2.9
3530-018	15430-15460	0.94	Am-H*;W-I;-	0	33	33	17	17	2+ to 3-	2.9
3530-019	15720-15770	1.82	H*;Am-W;I	0	25	33	25	17	3- to 3	3.1
3530-020	15770-15800	2.13/2.08	H*;Am-W;I	0	25	33	25	17	3- to 3	3.1
3530-021	16170-16210	2.39	Am-H*;W;I	0	31	31	23	15	3- to 3	3.1
3530-022	17300-17330	3.09	H;Am**;W-I	0	22	56	11	17	3- to 3	3.2
3530-023	19550-19610	0.61	Am**;-H*;-;W-I	0	40	40	10	10	3- to 3	3.3

LEGEND:

KEROGEN KEY

Predominant;	Secondary;	Trace
60-100%	20-40%	0-20%

Al	=	Algal
Am	=	Amorphous-Sapropel
Am*	=	Relic Amorphous-Sapropel
H	=	Herbaceous-Spore/Pollen
H*	=	Degraded Herbaceous
W	=	Woody-Structured
U	=	Unidentified Material
I	=	Inertinite
C	=	Coaly

TABLE III (continued)

SUMMARY OF ORGANIC CARBON AND VISUAL KEROGEN DATA

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NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	DEPTH INTERVAL (feet)	TOTAL ORGANIC CARBON	ORGANIC MATTER TYPE	VISUAL ABUNDANCE NORMALIZED PERCENT					ALTERATION STAGE	THERMAL ALTERATION INDEX
				A1	Am	H	W	I		
3530-024	19670-19700	1.32	H-I;Am**;W	0	18	36	10	36	3- to $\frac{3}{3}$	3.3
3530-025	19800-19840	0.62	H;Am**-I;W	0	25	42	8	25	3- to $\frac{3}{3}$	3.3
3530-026	19840-19890	0.37/0.38	H;I;Am**(W)	0	20	40	10	30	3- to $\frac{3}{3}$	3.3
3530-027	20270-20290	0.25	Am-H*;--;W-I	0	40	40	10	10	3	3.4
3530-028	20460-20470	0.20	Am-H*;--;W-I	0	40	40	10	10	3	3.4
3530-029	20940-21000	0.37	Am-H*;--;W-I	0	40	40	10	10	3	3.4

LEGEND:

KEROGEN KEY

Predominant;	Secondary;	Trace
60-100%	20-40%	0-20%

A1 = Algal
 Am = Amorphous-Sapropel
 Am* = Relic Amorphous-Sapropel
 H = Herbaceous-Spore/Pollen
 H* = Degraded Herbaceous
 W = Woody-Structured
 U = Unidentified Material
 I = Inertinite
 C = Coaly

TABLE IV

RESULTS OF ROCK-EVAL PYROLYSIS ANALYSIS

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	CLIENT IDENTIFICATION	TMAX (c)	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	PI	PC*	T.O.C. (wt.%)	HYDROGEN INDEX	OXYGEN INDEX
3530-001	5730-5800	437	0.33	2.13	0.58	0.13	0.20	3.49	61	16
3530-002	5900-5930	433	1.12	10.98	1.21	0.09	1.00	2.56	428	47
3530-003	5930-6000	434	1.08	10.67	1.60	0.09	0.97	2.71	393	59
3530-004	9480-9510	437	2.35	3.42	1.82	0.41	0.48	3.19	107	57
3530-005	10200-10230	446	1.45	3.26	1.04	0.31	0.39	2.26	144	46
3530-006	11010-11070	456	0.55	1.26	2.41	0.31	0.15	2.32	54	103
3530-007	11350-11380	439	1.25	1.57	1.56	0.44	0.23	2.27	69	68
3530-008	11380-11420	449	1.56	3.44	0.87	0.31	0.41	2.39	143	36
3530-009	12160-12200	449	1.40	2.44	1.33	0.36	0.32	1.59	153	83
3530-010	13070-13160	448	1.44	2.15	0.97	0.40	0.29	2.15	100	45
3530-011	13600-13650	400	3.29	5.78	1.10	0.36	0.75	2.53	228	43
3530-012	13650-13690	420	2.54	3.82	5.54	0.40	0.26	3.08	124	179
3530-013	14440-14470	351	3.50	6.28	10.75	0.36	0.32	2.80	224	383
3530-014	14480-14510	422	1.30	8.02	10.50	0.14	0.38	3.42	234	307
3530-015	14680-14740	331	0.22	0.49	0.80	0.31	0.05	0.60	81	133
3530-016	15350-15370	353	0.15	0.20	0.64	0.44	0.02	0.91	21	70
3530-017	15390-15430	366	1.82	1.10	0.84	0.62	0.24	0.92	119	91
3530-018	15430-15460	383	2.15	1.40	1.04	0.61	0.29	0.94	148	110
3530-019	15720-15770	326	3.23	2.61	1.08	0.55	0.48	1.82	143	59
3530-020	15770-15800	338	1.36	2.10	0.96	0.39	0.28	2.11	99	45

T.O.C. = Total organic carbon, wt.%
 S1 = Free hydrocarbons, mg Hc/g of rock
 S2 = Residual hydrocarbon potential
 (mg HC/g or rock)

S3 = CO₂ produced from kerogen pyrolysis
 (mg CO₂/g of rock)
 PC* = 0.083 (S1 + S2)
 Hydrogen
 Index = mg HC/g organic carbon

Oxygen
 Index = mg CO₂/g organic carbon
 PI = S1/S1 + S2
 TMAX = Temperature Index, degrees C.

TABLE IV (continued)

RESULTS OF ROCK-EVAL PYROLYSIS ANALYSIS

NEW MEXICO HYDROCARBON SOURCE ROCK EVALUATION

PURE OIL COMPANY, RED HILLS WELL NO.1
 SEC.32, T25S, R33E, LEA COUNTY, NEW MEXICO
 API #30-025-21036

GEOCHEM SAMPLE NUMBER	CLIENT IDENTIFICATION	TMAX (c)	S1 (mg/g)	S2 (mg/g)	S3 (mg/g)	PI	PC*	T.O.C. (wt.%)	HYDROGEN INDEX	OXYGEN INDEX
3530-021	16170-16210	402	1.96	3.76	2.19	0.34	0.47	2.39	157	91
3530-022	17300-17330	359	0.83	11.37	1.13	0.38	0.18	3.09	44	36
3530-023	19550-19610	323	0.44	0.41	1.45	0.52	0.07	0.61	67	237
3530-024	19670-19700	371	0.10	0.08	0.65	0.56	0.01	1.32	6	49
3530-025	19800-19840	357	0.04	0.14	0.55	0.22	0.01	0.62	22	88
3530-026	19840-19890	360	0.07	0.17	0.46	0.29	0.02	0.38	44	121
3530-027	20270-20290	360	0.09	0.16	0.50	0.37	0.02	0.25	64	200
3530-028	20460-20470	335	0.03	0.03	0.82	0.50	0.00	0.20	15	410
3530-029	20940-21000	391	0.06	0.19	0.78	0.25	0.02	0.37	51	210

T.O.C. = Total organic carbon, wt. %
 S1 = Free hydrocarbons, mg HC/g of rock
 S2 = Residual hydrocarbon potential
 (mg HC/g of rock)

S3 = CO₂ produced from kerogen pyrolysis
 (mg CO₂/g of rock)
 PC* = 0.083 (S1 + S2)
 Hydrogen
 Index = mg HC/g organic carbon

Oxygen
 Index = mg CO₂/g organic carbon
 PI = S1/S1 + S2
 TMAX = Temperature Index, degrees C.

TABLE V
VISUAL KEROGEN ASSESSMENT WORKSHEET

GEOCHEM No. DEPTH		INDIGENOUS POPULATION (INTERPRETED)										GENERAL CHARACTERISTICS							CAVED AND/OR REWORKED POPULATION(S)					SUMMARY ORGANIC MATTER TYPE
		TYPE OF ORGANIC MATTER					MATURATION INDEX					COLOR OF ORGANIC MATTER		STATE OF ORGANIC MATTER		%			TYPE OF ORGANIC MATTER		MATURATION INDEX			
		1	2	3	4	5	1	2	3	4	5	1	2	1	2	1	2	3	1	2	3	1	2	
PURE OIL COMPANY RED HILLS WELL NO.1 SEC. 32, T25S, R33E LEA COUNTY, NEW MEXICO API #30-025-21036																								
3530-001	5730-5800																							
3530-002	5900-5930																							H;Am;W
3530-003	5930-6000																							H;Am;-
3530-004	9480-9510																							H;-;Am
3530-005	10200-10230																							H*;Am;-
3530-006	11010-11070																							H*;Am;-
3530-007	11350-11380																							H*;Am;-
3530-008	11380-11420																							Am;H*;W-I
3530-009	12160-12200																							H*;Am;-
3530-010	13070-13160																							H;Am;-
3530-011	13600-13650																							Am-H*;W-I;-
3530-012	13650-13690																							Am-H*;W-I;-
3530-013	14440-14470																							Am-H*;-;W-I
3530-014	14480-14510																							H-W;Am;l
3530-015	14680-14740																							H;W-I;Am
3530-016	15350-15370																							H;W-I;Am**
3530-017	15390-15430																							W-I;Am**;H
3530-018	15430-15460																							H*;Am;W-I
3530-019	15720-15770																							Am-H*;W-I;-
3530-020	15770-15900																							H*;Am-W;l

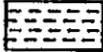

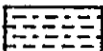

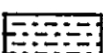

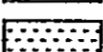

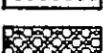
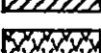
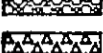
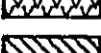
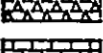

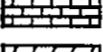


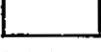
TABLE V (continued)
VISUAL KEROGEN ASSESSMENT WORKSHEET

PURE OIL COMPANY RED HILLS WELL NO.1 SEC. 32, T25S, R33E LEA COUNTY, NEW MEXICO API #30-025-21036		INDIGENOUS POPULATION (INTERPRETED)								GENERAL CHARACTERISTICS						CAVED AND/OR REWORKED POPULATION(S)				SUMMARY ORGANIC MATTER TYPE		
		TYPE OF ORGANIC MATTER				MATURATION INDEX				COLOR OF ORGANIC MATTER			STATE OF ORGANIC MATTER			%		TYPE OF ORGANIC MATTER			MATURATION INDEX	
		1	2	3	4	1	2	3	4	1	2	3	1	2	3	1	2	3	1		2	1
GEOCHEM No.	DEPTH	REMARKS																REMARKS				
3530-021	16170-16210																	Am-H*;W;I				
3530-022	17300-17330																	H;Am**;W-I				
3530-023	19550-19610																	Am**-H*; ;W-I				
3530-024	19670-19700																	H-I;Am**;W				
3530-025	19800-19840																	H;Am**-I;W				
3530-026	19840-19890																	H;I;Am**(W)				
3530-027	20270-20290																	Am-H*; ;W-I				
3530-028	20460-20470																	Am-H*; ;W-I				
3530-029	20940-21000																	Am-H*; ;W-I				

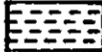


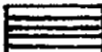
LEGEND FOR SUMMARY DIAGRAM

<u>DEPTH:</u>	in feet
<u>LITHO LOG:</u>	see lithology symbols
<u>STRATIGRAPHY:</u>	by age
<u>% TOC:</u>	percent total organic carbon
<u>HI:</u>	Rock-Eval, Hydrocarbon Index = $100 S2(0/00 \text{ Wt})/TOC$
<u>OI:</u>	Rock-Eval, Oxygen Index = $100 S3(0/00 \text{ Wt})/TOC$
<u>HC YIELD:</u>	Rock-Eval, S2 peak (ppm)
<u>S2/S3:</u>	Rock-Eval, Ratio of S2 to S3 peak
<u>KEROGEN:</u>	see Kerogen symbols
<u>T-MAX:</u>	Rock-Eval, maximum temperature of S2 peak, in degrees Centigrade
<u>%RO (Δ):</u>	Vitrinite Reflectance (scale 0 to 5)
<u>TAI (*):</u>	Thermal Alteration Index (Scale 1 to 5)
<u>FREE HC:</u>	Rock-Eval, S1 peak (ppm)
<u>PI:</u>	Rock-Eval, Productivity Index = $S1/(S1+S2)$

LITHOLOGIES

	SHALE		SILICEOUS ROCKS
	MUDSTONE		EVAPORITES
	SILTSTONE		COAL
	SANDSTONE		IGNEOUS ROCKS
	CONGLOMERATE		VOLCANICS
	BRECCIA		METAMORPHIC ROCKS
	LIMESTONE		BASEMENT
	DOLOMITE		OTHER
	MARL		MISSING SECTION

KEROGEN TYPES

	AMORPHOUS
	HEREACEOUS
	WOODY
	INERTINITE

APPENDIX A

Brief Description of Organic Geochemical analyses Carried Out by GeoChem

C₁-C₇ Hydrocarbon

The C₁-C₇ hydrocarbon content and composition of sediments reflects source type, source quality and thermal maturity.

The C₁-C₇ hydrocarbon content of well cuttings is determined by analyzing both a sample of the cuttings and the air space at the top of the can. The results of the two analyses are summed to give an inventory of the C₁-C₇ hydrocarbon content of the well cuttings prior to any losses from the cuttings during the lapsed time period between collection at the wellsite and laboratory analysis.

The air space C₁-C₇ hydrocarbon analysis involves taking a measured volume of the air space gas out of the can with a syringe and injecting same into a gas chromatograph. GeoChem uses a Varian Aerograph Model 1400 instrument equipped with a Porapac Q column. The gas sample is taken through the column by a carrier gas and before reaching the detector is separated into its various C₁ (methane), C₂ (ethane), C₃ (propane), iC₄ (isobutane), nC₄ (normal butane), and C₅, C₆, C₇ hydrocarbon components.

This particular analysis gives a complete separation of the C₁-C₄ gas-range hydrocarbons and a partial separation of the C₅-C₇ gasoline-range hydrocarbons. (A detailed C₄-C₇ analysis, to be discussed later, involving a capillary column, effects a complete separation of this molecular range into its several individual molecular species.)

The electrical response of the various hydrocarbons as they reach the detector is recorded on a paper strip chart as a peak. This response is simultaneously fed to an integrator which computes the area of each peak. The concentration of C₁-C₇ hydrocarbons in the air space, expressed as volumes of gas per million volumes of cuttings, is determined by a calculation involving the volume of cuttings, volume of air space in the can, volume of sample injected, volume of standard gas sample used in the calibration, calibration factor for C₁, C₂, C₃, etc. determined by gc analysis of a standard gas sample, and the gc peak response.

The C₁-C₇ hydrocarbon content of the cuttings is determined by degasification of a measured volume of cuttings (in a medium of a measured volume of water) in a closed blender, sampling of the air space at the top of the blender, and injection of a measured volume of gas into the gas chromatograph.

The C₁-C₇ hydrocarbon data from the air space and cuttings gas analyses are summed to give a "restored" C₁-C₇ hydrocarbon content of the cuttings.

Sample Washing and Hand-Picking of Uncaved Lithology Samples

The cuttings samples are washed to remove all drilling mud from the cuttings. Care is taken in the washing procedure not to remove any soft clays, claystones, etc. and any loose fine sand and silt. The washed cuttings are usually kept under water cover until picked, to prevent loss of any gasoline-range hydrocarbons. Using the C₁-C₇ hydrocarbon data profile and the electrical well log supplied to us and our visual examination of the cuttings material under the binocular microscope, we carefully hand-pick and describe a suite of uncaved lithologies representative of the various stratigraphic zones penetrated by the well. The lithological data is used to compile a gross litho percentage log which is shown on all Figures. The 2-4 gram picked lithology samples are stored under water in small glass vials in those instances where we wish to run detailed C₄-C₇ hydrocarbon analyses. This sample set is used not only for the C₄-C₇ hydrocarbon analysis, but also for the visual kerogen and total organic carbon analyses. All remaining cuttings material is dried and packaged in labelled plastic bags for possible C₁₅₊ soxhlet extraction and/or eventual return to the client. Sample material from this study will be retained at GeoChem until advised of disposition.

Detailed C₄-C₇ Hydrocarbon

The C₄-C₇ gasoline-range hydrocarbon content of sediments reflects source quality, thermal maturation and organic facies. Compositional data can be used in crude oil-parent rock correlation work.

The C₄-C₇ hydrocarbon content and detailed molecular composition of hydrocarbon, in hand-picked lithologies, is determined by a gc analysis of the light hydrocarbon extracted from 1-2 gram cuttings samples macerated in a microblender. A measured volume of sample is placed in a sealed microblender along with a measured volume of hot water. The rock sample is pulverized by the blades of the blender. A sample of the liberated light hydrocarbons which collect in the air space at the top of the blender is injected into our Varian Aerograph 1400 gc unit which is equipped with a capillary column. Data recording, computations, etc. are comparable to those used for the C₁-C₇ analysis discussed previously in this report. Hydrocarbon concentration is expressed as volume gas per million volumes of cuttings.

Organic Carbon

The total organic carbon content of a rock is a measure of its total organic richness. This data is used, in conjunction with visual kerogen and C₁-C₄, C₄-C₇ and C₁₅₊ hydrocarbon content of a rock, to indicate the hydrocarbon source quality of rocks.

The procedure for determining the total organic carbon content of a rock involves drying the sample, grinding to a powder, weighing out 0.2729 gram sample into a crucible, acidizing with hot and cold hydrochloric acid to remove calcium and magnesium carbonate, and carbon analysis by combustion in a Leco carbon analyzer.

We run several blank crucibles, standards (iron rings of known carbon content) and duplicate rock samples in this analysis at no additional charge to the client for purposes of data quality control.

C₁₅₊ Soxhlet Extraction, Deasphalting and Chromatographic Separation

The amount and composition of the organic matter which can be solvent-extracted from a rock reflects source quality and source type. C¹³/C¹² carbon isotopic, high mass spectrometric and gc analyses of the paraffin-naphthene and aromatic hydrocarbon fractions of the soluble extract gives data which is used in crude oil-parent rock correlations. This analysis involves grinding of a dry rock sample to a powder and removal of the soluble organic matter by soxhlet extraction using a co-distilled toluene-methanol azeotrope solvent. Where the amount of available sample material permits, we like to use at least 100 grams of rock for this analysis.

The extracted bitumen is separated into an asphaltene (ASPH) and a pentane soluble fraction by normal pentane precipitation. The pentane soluble components are separated into a C₁₅₊ paraffin-naphthene (P-N) hydrocarbon, C₁₅₊ aromatic hydrocarbon (AROM) and C₁₅₊ nitrogen-sulfur-oxygen containing fraction (NSO) by adsorption chromatography on a silica gel-alumina column using pentane, toluene and toluene-methanol azeotrope eluents.

GC Analysis of C₁₅₊ Paraffin-Naphthene (P-N) Hydrocarbons

The content and molecular composition of the heavy C₁₅₊ paraffin-naphthene (P-N) hydrocarbons of rocks, as determined by gc analysis, reflects source quality, source type and degree of thermal maturation.

In this analysis, we subject a very small fraction of the total amount of the P-N fraction extracted from a rock sample to gc analysis. The gas chromatograph is a Varian Aerograph Model 1400 equipped with a solid rod injection system and a eutectic column.

The calculated C. P. I. (carbon preference index) values for the normal paraffin data is defined as the mean of two ratios which are determined by dividing the sum of concentrations of odd-carbon numbered n-paraffins by the sum of even-carbon numbered n-paraffins. The C. P. Indices A and B were obtained by the formulas:

$$C. P. Index A = \frac{C_{21}+C_{23}+C_{25}+C_{27}}{C_{22}+C_{24}+C_{26}+C_{28}} + \frac{C_{21}+C_{23}+C_{25}+C_{27}}{C_{20}+C_{22}+C_{24}+C_{26}} \quad C. P. Index B = \frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{26}+C_{28}+C_{30}+C_{32}} + \frac{C_{25}+C_{27}+C_{29}+C_{31}}{C_{24}+C_{26}+C_{28}+C_{30}}$$

Visual Kerogen

A visual study of kerogen, the insoluble organic matter in rocks, can indicate the relative abundance, size, and state of preservation of the various recognizable kerogen types and thereby indicate the hydrocarbon source character of a rock. The color of the kerogen can be used to indicate the state of thermal maturity of the sediments (i.e. their time-temperature history). Thermal maturation plays an important role in the generation of hydrocarbons from organic matter, and also affects the composition of reservoir hydrocarbons.

Our procedure for visual kerogen slide preparation involves isolation of the organic matter of a rock by removal of the rock material with hydrochloric and hydrofluoric acid treatment and heavy liquid separation. This procedure is comparable to that used by the palynologist except it does not include an oxidation stage. (The oxidation treatment is deleted from our procedure because it removes a great deal of kerogen and bleaches any remaining kerogen to an extent whereby it is useless for our kerogen color observations.) The kerogen residue is mounted on a glass slide and is examined visually under a high power microscope.

Vitrinite Reflectance

Measurement of the reflectivity of vitrinite particles (%R_o) present in the kerogen isolated from sedimentary rocks provides a method of determining the state of maturation, and the diagenetic (time-temperature) history of the organic matter present in the sediments.

The kerogen, obtained from a 25 gram aliquot of crushed rock by the acid procedure previously discussed, is dried and embedded in a Bioplastic plug. The surface of the plug is polished using 0.05 micron alumina and the reflectivity determined under oil using a Zeiss high resolution microscope. A minimum of 40 values are required to adequately determine the Maturation Rank.

Fluorescence Spectrophotometric Analysis

Fluorescence spectrophotometry can be used to characterize and fingerprint crude oils, establish crude oil-source rock relationships, and to measure the hydrocarbon source potential of fine-grained sediments.

A one (1) microliter aliquot of either (1) a crude oil or (1) the solvent extractable rock bitumen, is passed through an alumina silica gel micro column and the C₁₀₊ aromatic hydrocarbons isolated. The aromatic hydrocarbon is diluted and the emission and excitation spectra determined at 240 nm and 420 nm using a Perkin-Elmer Model 512 Double Beam Fluorescence Spectrophotometer.

GEOHERMAL DIAGENETIC CRITERIA

(GEOCHEM LABORATORIES, INC.)

