April 5, 1950

Deep Rock Oil Corporation
Atlas Life Building
Tulsa, Oklahoma

Attn: Mr. T. F. Lavry

Gentlemen:

Enclosed herewith is the report of the analysis made on the 2½ inch rotary core taken from the Engel No. 5 Lease, Core Test Well No. 3, Crawford County, Kansas, and submitted to our laboratory on March 28, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Fate

CLF:bb
c.c. to Mr. Neil Henderson

DEEP ROCK OIL CORPORATION

CORE ANALYSIS REPORT

ENGEL #5 LEASE CORE TEST WELL NO. 3

CRAWFORD COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

APRIL 5, 1950

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Deep Rock Oil Corporation Lease Engel #5 Core Test Well No. 3

Location 660' East of West Line and 660' South of North Line, NW¼,

Section 27 Twp. 28S Rge. 22E County Crawford State Kansas

Name of Sand	Bartlesville
Top of Core	372.38
Bottom of Core	386.40
Top of Sand	372.48
Bottom of Pay Sand	380.60
Total Feet of Permeable Sand	8.99

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 10	0.90	0.90
10 - 20	1.43	1.33
20 - 30	3.75	5.08
30 & above	2.85	8.93

Average Permeability, Millidarcys	25.36
Average Percent Porosity	18.17
Average Percent Oil Saturation	42.95
Average Percent Water Saturation	34.02
Average Oil Content, Bbls./A. Ft.	606.
Total Oil Content, Bbls./Acre	5,227.
Average Percent Oil Recovery by Laboratory Flooding Tests	7.26
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	99.
Aotal Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	676.
Total Calculated Oil Recovery, Bbls./Acre	2,250.
Packer Setting, Feet	373.00
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

Note: The above averages are for that part of the sand section extending from the packer setting to the top of the cement plug.

Fresh water was used as a circulating fluid in the coring of the sand in this well. We were advised that this well was drilled in virgin territory.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
372.38 - 372.48	Gray sandy shale.
372.48 - 373.00	Brown fine grained micaceous sandstone.
373.00 - 373.25	Laminated sandy shale.
373.25 - 373.65	Brown fine grained micaceous sandstone.
373.65 - 373.75	Light brown fine grained micaceous shaley sandstone.
373.75 - 377.40	Dark brown fine grained micaceous sandstone.
377.40 - 380.60	Brown fine grained micaceous sandstone.
380.60 - 381.38	Brown fine grained laminated micaceous sandstone.
381.38 - 381.60	Dark brown fine grained carbonaceous sandstone.
381.60 - 381.70	Laminated sandstone and shale.
381.70 - 381.85	Brown fine grained micaceous sandstone.
381.85 - 382.63	Dark fine grained micaceous carbonaceous sandstone.
382.63 - 382.88	Gray shale.
382.88 - 383.05	Brown fine grained micaceous slightly calcareous sandstone.
383.05 - 383.73	Laminated sandy shale.
383.73 - 384.10	Hard light brown fine grained micaceous sandstone.
384.10 - 384.30	Light brown fine grained laminated micaceous sandstone.
384.30 - 384.93	Laminated sandy shale.
384.93 - 385.25	Hard gray fine grained micaceous sandstone.
385.25 - 386.40	Gray shale.

Coring was started at a depth of 372.38 feet in grey sandy shale and completed at 386.40 feet in gray shale. This core shows a total of 10.54 feet of sandstone. For the most part, the sand body is made up of fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 27.74 and 9.41 millidarcys respectively; while that of the pay sand, or that part of the sand section extending from the packer setting to the top of the cement plug, is 25.36 millidarcys (See Table II). By observing the data given on the coregraph, you will note that most of the sand section has a fairly uniform permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core has a good weighted average percent oil saturation, namely, 42.95. The weighted average percent oil saturation of the upper and lower sections are 41.22 and 48.93 respectively. The weighted average percent water saturation of the upper and lower sections are 36.07 and 28.54 respectively; while that of the pay sand is 34.02 (See Table IV). This gives an overall weighted average total fluid saturation of 76.97 percent. This comparatively low total fluid saturation indicates that an appreciable amount of fluid was lost during coring, which was probably oil.

In order to get some idea of the degree of flushing of the sand during coring, all of the saturation samples were analyzed for chloride content. The results of these tests are given in Tables VII and VIII. By observing the data given in these tables and on the coregraph, it is

evident that the sand was not flushed to any appreciable extent during coring. We are inclined to believe that most of the oil lost during coring was due to the expansion of gas carried in solution by the oil.

The weighted average oil content of the upper and lower sections are 580 and 673 barrels per acre foot respectively; while that of the pay sand is 606 barrels. The total oil content, as shown by this core, is 5,475 barrels per acre of which 5,227 barrels is in the pay sand section.

LABORATORY FLOODING TESTS

The sand in this core did not respond very well to laboratory flooding tests, as a total recovery of only 676 barrels of oil per acre was obtained from 6.85 feet of sand. The weighted average percent oil saturation was reduced from 81.45 to 34.19, or represents an average recovery of 7.26 percent. The weighted average effective permeability of the samples is 0.548 millidarcys, while the average initial fluid production pressure is 23.6 pounds per square inch (See Table VI). By observing the data given above, you will note that the sand samples after flooding have a high residual oil saturation.

From the data given in Table V, it is noticeable that of the ten samples tested, eight produced oil and took water. This would indicate that most of the sand represented by these samples is floodable, however, comparatively high pressures were required to force the sand to take water.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 2,250 barrels of oil per acre provided the sand will take the required amount

of water satisfactorily. In calculating this recovery, it was assumed that this well was drilled in virgin territory and that the true water saturation of the sand is 36 percent.

The principle drawback of this core is that the sand is comparatively tight and that the oil contained in same is fairly viscous. Furthermore, the core contained only approximately 7.37 feet of floodable sand.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Deep Rock Oil Corporation Lease Engel #3 Core Test Well No. 3

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
377.00 - 381.00	4.0	4½	3.1	12.40

Recommended Packer Setting - 373.00
Note: Plug hole back to 383.00

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Engel #5 Core Test 3 Well No. 3

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	372.49	13.	0.52	0.52	6.76
2	373.60	12.	0.40	0.92	4.80
3	374.15	29.	0.55	1.47	15.95
4	374.40	24.	0.25	1.72	6.00
5	374.70	22.	0.45	2.17	9.90
6	375.30	23.	0.40	2.57	9.20
7	375.58	38.	0.50	3.07	19.00
8	376.30	39.	0.50	3.57	19.50
9	376.50	30.	0.25	3.82	7.50
10	376.75	22.	0.75	4.57	16.50
11	377.50	20.	0.25	4.82	5.00
12	377.80	15.	0.25	5.07	3.75
13	378.05	29.	0.60	5.67	17.40
14	378.80	21.	0.50	6.17	10.50
15	379.20	30.	0.50	6.67	15.00
16	379.75	52.	0.40	7.07	20.80
17	380.10	40.	0.70	7.77	28.00
18	380.65	16.	0.20	7.97	3.20
19	381.00	18.	0.58	8.55	10.44
20	381.65	Imp.	0.10	8.65	0.00
21	382.00	5.0	0.78	9.43	3.90
22	382.95	1.3	0.17	9.60	0.22
23	383.75	0.79	0.17	9.77	0.13
24	384.00	Imp.	0.20	9.97	0.00
25	385.02	Imp.	0.32	10.29	0.00

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Deep Rock Oil Corporation Lease Engel #5 Core Test 3 Well No.

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
372.48 - 380.60	7.77	27.74	215.56
380.60 - 382.63	1.90	9.41	17.89
373.00 - 383.00	8.93	25.36	226.50

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RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Engel #5 Core Tests Well No. 3

Sat. No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls./A. Ft.	Feet of Core		Total Oil Content Bbls./Acre
			Oil	Water	Total		Ft.	Cum. Ft.	
1	372.88	15.8	38.9	44.1	83.0	476	0.52	0.52	248
2	374.06	17.9	45.3	30.8	76.1	630	0.75	1.27	473
3	374.90	17.5	38.6	37.5	76.1	524	1.00	2.27	524
4	375.82	18.0	41.4	33.4	74.8	577	1.00	3.27	577
5	377.28	17.6	46.2	36.8	83.0	641	0.90	4.17	577
6	378.25	19.3	40.6	32.3	72.9	609	1.50	5.67	914
7	379.31	18.7	38.3	37.8	76.1	556	1.00	6.67	556
8	380.48	18.3	41.0	42.0	83.0	582	0.70	7.37	407
9	381.25	18.2	44.3	38.4	82.7	626	0.78	8.15	489
F.9	381.50	17.3	49.8	-	-	667	0.22	8.37	147
10	382.22	17.5	53.1	26.7	79.8	721	0.78	9.15	563
							Total - - - -		5,475

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Deep Rock Oil Corporation Lease Engel #5 Core Test Well No. 3

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbls./A. Ft.	Total Oil Content Bbls./Acre
378.48-380.60	7.37	18.10	41.22	36.07	580	4,276
380.60-382.63	1.76	17.75	48.93	28.54	673	1,199
378.00-383.00	8.63	18.17	42.95	34.08	606	5,227

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Deep Rock Oil Corporation Lease Engel #6 O.W.O. Well No. 3

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	[redacted] Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	372.63	17.4	37.5	506	4.3	58	33.2	60.9	448	19	0.416	25
2	373.65	17.3	45.2	580	11.8	168	31.4	65.3	422	13.5	0.356	20
3	375.10	17.9	38.7	537	7.4	103	31.3	58.5	434	13.5	0.326	30
4	376.10	17.5	48.2	586	8.1	110	35.1	59.8	476	26.5	0.679	20
5	377.05	17.9	46.0	638	7.7	107	38.3	59.6	531	14.5	0.408	25
6	378.55	17.8	41.0	429	6.0	63	35.0	59.3	346	29	0.681	20
7	379.58	17.1	37.3	500	4.8	64	32.9	64.5	436	29.5	0.656	20
8	380.22	17.0	41.4	546	6.6	87	34.8	58.4	459	15	0.362	30
9	381.50	17.3	49.8	667	0.0	0	49.8	25.6	667	0	Imp.	50 +
10	382.48	15.9	55.3	684	0.0	0	55.3	23.3	684	0	Imp.	50 +

Notes: cc - cubic centimeter
*Volume of water recovered at the time of maximum oil recovery.

**Determined by passing water through sample which still contains residual oil.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Deep Rock Oil Corporation Lease Engel #5 Core Test Well No. 3

Depth Interval, Feet	373.00 - 383.00
Feet of Core Analyzed	6.85
Average Percent Porosity	17.56
Average Percent Original Oil Saturation	41.45
Average Percent Oil Recovery	8.26
Average Percent Residual Oil Saturation	34.19
Average Percent Residual Water Saturation	61.09
Average Percent Total Residual Fluid Saturation	95.28
Average Original Oil Content, Bbls./A. Ft.	534.
Average Oil Recovery, Bbls./A. Ft.	99.
Average Residual Oil Content, Bbls./A. Ft.	435.
Total Original Oil Content, Bbls./Acre	3,658.
Total Oil Recovery, Bbls./Acre	676.
Total Residual Oil Content, Bbls./Acre	2,982.
Average Effective Permeability, Millidarcys	0.548
Average Initial Fluid Production Pressure, p.s.i.	83.6

NOTE: Only those samples which recovered oil were used in calculating the above averages.

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RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VII

Company Deep Rock Oil Corporation Lease Engel #5 Core Test 3 Well No.

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	372.88	11,500			
2	374.05	15,600			
3	374.90	13,180			
4	375.82	14,750			
5	377.28	15,650			
6	378.25	12,300			
7	379.31	13,200			
8	380.48	15,200			
9	381.25	14,350			
10	382.22	16,700			

Note: ppm - parts per million.

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Deep Rock Oil Corporation Lease Engel # 5 Core Test Well No. 3

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
372.48 - 380.60	13,773		
380.60 - 382.63	15,513		
373.00 - 383.00	14,237		

Note: ppm - parts per million.