OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

34-19-23E

August 18, 1951

Deep Rock Oil Corporation
Atlas Life Building
Tulsa, Oklahoma

Attention: Mr. T. F. Lawry

Gentlemen:

Enclosed herewith is the report of the analysis of the 3" Rotary core taken from the Whelan Lease, Well No. E-5, Linn County, Kansas, and submitted to our laboratory on August 6, 1951.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Clayton A. Nattier

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E-5

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DEEP ROCK OIL CORPORATION

CORE ANALYSIS REPORT

WHELAN LEASE WELL NO. E-5

LINN COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

AUGUST 18, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Deep Rock Oil Corporation Lease Whelan Well No. E-5

Location 660' North of the South Line & 660' West of the East Line, NE¼

Section 34 Twp. 19 Rge. 23 County Linn State Kansas

Name of Sand	Peru
Top of Core	235.30
Bottom of Core	253.40
Top of Pay Sand	240.58
Bottom of Pay Sand	257.20
Total Feet of Permeable Sand	13.65
Total Feet of Floodable Sand	11.80

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 4	1.95	1.95
4 - 8	4.29	6.24
8 - 12	3.78	10.02
12 - 16	0.98	11.00
16 - 20	1.34	12.34
20 - 24	2.56	14.90
24 & above	2.95	17.85

Average Permeability Millidarcys	15.53
Average Percent Porosity	18.90
Average Percent Oil Saturation	38.05
Average Percent Water Saturation	45.35
Average Oil Content, Bbls./A. Ft.	556.
Total Oil Content, Bbls./Acre	9,052.
Average Percent Oil Recovery by Laboratory Flooding Tests	10.08
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	145.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,798.
Total Calculated Oil Recovery, Bbls./Acre	1,380.
Packer Setting, Feet	239.00
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

The above averages are for that part of the cored section extending from the packer setting to the bottom of the core.

Salt water was used as a circulating fluid in the coring of the sand in this well.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
235.30 - 238.20	- According to log, brown limestone (Discarded at well).
238.20 - 238.40	- Gray sandy shale containing limestone inclusion.
238.40 - 238.85	- Gray sandy shale.
238.85 - 239.25	- Light brown fine grained micaceous shaley sandstone.
239.25 - 239.70	- Brown fine grained micaceous sandstone.
239.70 - 240.00	- Light brown fine grained micaceous shaley sandstone.
240.00 - 240.58	- Gray sandy shale containing limestone inclusion.
240.58 - 241.75	- Brown fine grained micaceous sandstone.
241.75 - 241.90	- Brown fine grained micaceous calcareous sandstone.
241.90 - 242.44	- Dark brown fine grained micaceous sandstone.
242.44 - 243.20	- Dark brown fine grained slightly laminated micaceous shaley sandstone.
243.20 - 244.30	- Brown fine grained micaceous calcareous sandstone.
244.30 - 245.25	- Dark brown fine grained micaceous sandstone.
245.25 - 246.28	- Brown fine grained micaceous sandstone.
246.28 - 246.44	- Shaley sandstone.
246.44 - 247.75	- Brown fine grained slightly laminated micaceous shaley sandstone.
247.75 - 247.85	- Gray shale.
247.85 - 249.20	- Brown fine grained laminated micaceous shaley sandstone.

249.20 - 249.55 - Laminated sandy shale.

249.55 - 251.30 - Brown fine grained laminated micaceous shaley sandstone.

251.30 - 251.51 - Laminated sandy shale.

251.51 - 253.00 - Brown fine grained laminated micaceous shaley sandstone.

253.00 - 253.50 - Laminated sandstone and shale.

253.50 - 253.70 - Laminated shaley sandstone.

253.70 - 257.20 - Brown fine grained micaceous sandstone.

257.20 - 258.25 - Laminated sandstone and shale.

258.25 - 258.75 - Brown fine grained laminated micaceous shaley sandstone.

258.75 - 259.50 - Brown fine grained slightly laminated micaceous shaley sandstone.

259.50 - 259.80 - Brown fine grained micaceous sandstone.

259.80 - 260.00 - Dark fine grained micaceous sandstone.

260.00 - 260.40 - Dark fine grained micaceous carbonaceous sandstone.

260.40 - 263.40 - According to log, sandy shale (Discarded at well).

Coring was started at a depth of 235.30 feet in brown limestone and completed at 263.40 feet in sandy shale. That part of the cored section extending from 235.30 to 238.20 feet and 260.40 and 263.40 feet was discarded at well. This core shows a total of 18.45 feet of sandstone of which 18.30 feet are in the pay sand section. The pay sand is composed mainly of brown fine grained micaceous sandstone.

PERMEABILITY

For the sake of distribution, the core was divided into three sections. The weighted average permeability of the upper, middle and lower sections is 13.36, 6.38 and 26.46 millidarcys respectively; while that of the pay sand, or that part of the cored section extending from the packer setting to the bottom of the core, is 15.53 millidarcys (See Table II). By ob-

serving the data given on the coregraph, it is noticeable that the sand has an irregular permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a good weighted average percent oil saturation, namely, 38.05. The weighted average percent oil saturation of the upper, middle and lower sections is 42.53, 36.10 and 34.10 respectively. The weighted average percent water saturation of the upper, middle and lower sections is 42.00, 51.83 and 44.46 respectively; while that of the pay sand is 45.35 (See Table IV). This is a weighted average total fluid saturation of 83.40 percent for the pay sand.

Since salt water was used as a circulating fluid, no chloride determinations were made as the results would not be representative.

The weighted average oil content of the upper, middle and lower sections is 608, 465 and 569 barrels per acre foot respectively; while that of the pay sand is 556 barrels per acre foot. The total oil content, as shown by this core, is 9,052 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

This core responded well to laboratory flooding tests in that a total oil recovery of 1,798 barrels per acre was obtained from 12.40 feet of sand analyzed. The weighted average percent oil saturation was reduced from 39.59 to 29.51, or represents an average recovery of 10.08 percent. The weighted average effective permeability of the samples is 0.608 millidarcys, while the average initial fluid production pressure is 26.8 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 19 samples tested, 15 produced water and 14 oil. The tests also show

that the sand is tight and has a fairly wide variation in effective permeability.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 1,350 barrels of oil per acre. This is an average recovery of 114 barrels of oil per acre foot from the 11.80 feet of floodable sand analyzed. In calculating the above recovery, an allowance was made for oil lost during coring, and it was assumed that the true water saturation of the sand is 40 percent. Due to the variation in effective permeability, the calculated recovery is less than that obtained by laboratory flooding tests.

The effective permeability of the sand immediately surrounding this well might be increased by injecting a solvent such as blending fluid before water is injected.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Deep Rock Oil Corporation Lease Whelan Well No. E-5

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
244.00 - 257.50	13.5	4.0	2.5	33.75

Recommended Packer Setting 239.00 Feet

Note: Plug hole back to 258.50 Feet

Note: The above shot recommendation was made after core analysis. The shot used is shown on the coregraph.

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Whelan Well No. E-5

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	239.06	0.55	0.40	0.40	0.22
2	239.43	11.	0.45	0.85	4.95
3	239.82	6.1	0.30	1.15	1.83
4	240.67	10.	0.22	1.37	2.20
5	240.97	12.	0.40	1.77	4.80
6	241.38	8.6	0.55	2.32	4.73
7	241.82	0.45	0.15	2.47	0.07
8	242.25	18.	0.54	3.01	9.72
9	242.85	9.7	0.56	3.57	5.43
10	243.13	7.1	0.20	3.77	1.42
11	243.50	2.3	0.50	4.27	1.15
12	243.85	0.65	0.40	4.67	0.26
13	244.23	4.6	0.20	4.87	0.92
14	244.68	41.	0.60	5.47	24.60
15	245.05	35.	0.35	5.82	12.25
16	245.45	24.	0.45	6.27	10.80
17	245.94	13.	0.58	6.85	7.54
18	246.53	22.	0.36	7.21	7.91
19	246.95	6.8	0.40	7.61	2.72
20	247.45	10.	0.55	8.16	5.50
21	247.93	9.1	0.30	8.46	2.73
22	248.30	3.4	0.45	8.91	1.53
23	248.83	6.0	0.60	9.51	3.60
24	249.62	6.7	0.30	9.81	2.01
25	250.07	6.1	0.45	10.26	2.75
26	250.50	4.3	0.40	10.66	1.72
27	250.85	7.0	0.40	11.06	2.80
28	251.25	4.1	0.20	11.26	0.82
29	251.77	6.7	0.44	11.70	2.95
30	252.17	4.2	0.40	12.10	1.68
31	252.57	10.	0.45	12.55	4.50
32	252.95	11.	0.20	12.75	2.20
33	253.63	2.7	0.20	12.95	0.54
34	253.95	36.	0.50	13.45	18.00
35	254.47	18.	0.50	13.95	9.00
36	254.84	20.	0.50	14.45	10.00
37	255.42	22.	0.50	14.95	11.00
38	256.00	31.	0.50	15.45	15.50
39	256.36	30.	0.40	15.85	12.00
40	256.75	27.	0.40	16.25	10.80

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Whelan Well No. 3-5

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	857.15	32.	0.20	16.45	6.40
42	858.58	11.	0.50	16.95	5.50
43	859.13	46.	0.75	17.70	34.50
44	859.68	19.	0.30	18.00	5.70

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Deep Rock Oil Corporation Lease Whalen Well No. E-5

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
238.85-247.75	8.16	13.36	109.02
247.85-253.00	4.59	6.38	29.29
253.50-259.80	5.25	26.46	138.94
239.00-259.80	17.85	15.53	277.17

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RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Whelan Well No. B-5

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	239.60	19.8	53.4	26.0	79.4	820	0.45	0.45	369
2	240.80	18.0	46.4	35.2	81.6	648	1.17	1.62	758
3	242.00	20.7	49.9	30.2	80.1	300	0.54	2.16	432
4	243.30	15.7	47.0	44.0	91.0	572	1.10	3.26	629
5	244.45	14.8	37.7	48.2	85.9	433	0.95	4.21	411
6	245.70	20.4	34.6	47.3	81.9	548	1.03	5.24	565
7	246.75	20.9	38.6	42.2	80.8	626	1.31	6.55	820
8	248.12	15.8	38.6	47.5	86.1	474	0.75	7.30	355
F-8A	249.05	16.6	29.5	-	-	509	0.60	7.90	305
9	249.85	16.5	37.7	51.5	89.2	483	0.95	8.85	459
10	251.05	18.0	39.1	49.0	88.1	546	0.80	9.65	437
11	252.35	16.3	30.8	55.7	86.5	390	1.49	11.14	580
12	253.80	21.0	37.4	41.5	78.9	610	0.70	11.84	427
13	255.13	22.2	32.6	41.2	73.8	562	1.30	13.14	730
14	256.20	22.0	33.7	52.0	85.7	575	0.90	14.04	517
F-14A	257.03	21.8	35.2	-	-	561	0.60	14.64	337
15	258.85	20.3	32.5	48.1	80.6	512	1.05	15.69	538
F-15A	259.88	20.9	28.8	-	-	467	0.20	15.89	94
16	260.25	22.0	42.4	33.9	76.3	724	0.40	16.29	289
								Total- - - -	9,032

Note: "A" Sample was taken from core after it was received in the laboratory.

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Deep Rock Oil Corporation Lease Chelan Well No. 2-5

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
239.25-247.75	6.55	18.46	42.53	42.00	608	3,984
247.85-253.00	4.58	16.60	36.10	51.83	465	2,136
253.70-260.40	5.15	21.50	34.10	44.46	569	2,932
239.00-260.40	16.29	18.90	38.05	45.35	556	9,052

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Deep Rock Oil Corporation Lease Whelan Well No. 3-5

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery		Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	239.60	19.9	53.3	622	34.8	385	28.4	62.7	439	7	0.264	20
2	240.80	17.8	48.8	674	14.0	193	34.8	63.3	481	12	0.325	20
3	242.00	20.8	49.8	603	22.7	366	27.1	66.6	457	102	3.56	10
4	243.30	15.6	48.6	669	24.1	292	24.5	71.2	297	14	0.369	20
5	244.45	15.1	37.2	444	5.8	68	32.1	65.4	378	10	0.328	35
6	245.70	20.2	36.8	561	9.6	150	26.2	72.0	411	29	0.907	25
7	246.73	20.6	37.6	601	8.2	131	29.4	65.2	470	21	0.577	20
8	248.12	15.2	36.0	448	0.0	0	36.0	54.0	448	0	Imp.	50✓
8A	249.05	16.6	39.5	509	4.4	57	35.1	55.5	452	0	0.015	50
9	249.85	16.1	36.3	465	8.0	100	28.3	57.5	353	8	0.060	30
10	251.05	16.1	39.5	558	9.3	131	30.2	64.2	424	2	0.136	55
11	252.35	16.7	31.0	402	0.0	0	31.0	62.5	402	0	Imp.	50✓
12	253.60	21.1	37.9	620	10.2	167	27.7	64.3	453	7	0.252	35
13	253.13	22.2	31.5	548	3.9	50	28.6	64.7	492	14	0.329	30
14	256.20	21.9	34.1	579	5.2	54	30.9	63.3	525	62	1.47	20
14A	257.03	21.8	33.2	561	2.5	42	30.7	64.3	519	37	0.863	25
15	258.65	20.1	31.7	494	0.0	0	31.7	62.0	494	4	0.202	35
15A	259.28	20.9	28.8	467	0.0	0	28.8	63.6	467	24	0.622	25
16	260.25	22.4	40.0	695	0.0	0	40.0	38.7	696	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.
"A" = Sample was taken from core after it was received in the laboratory.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Deep Rock Oil Corporation Lease Shelan Well No. 2-5

Depth, Interval, Feet	239.25 - 247.75	245.60 - 251.30	253.70 - 257.20	259.00 - 267.20
Feet of Core Analyzed	6.55	2.35	3.50	12.40
Average Percent Porosity	16.37	15.94	21.57	19.00
Average Percent Original Oil Saturation	43.23	38.21	33.74	39.59
Average Percent Oil Recovery	14.12	7.53	4.37	10.08
Average Percent Residual Oil Saturation	29.16	30.68	29.37	29.51
Average Percent Residual Water Saturation	66.90	58.68	64.17	64.57
Average Percent Total Residual Fluid Saturation	96.06	89.36	93.54	94.08
Average Original Oil Content, Bbls./A. Ft.	615.	502.	670.	551.
Average Oil Recovery, Bbls./A. Ft.	200.	100.	73.	145.
Average Residual Oil Content, Bbls./A. Ft.	415.	402.	497.	436.
Total Original Oil Content, Bbls./Acre	4,027.	1,179.	1,996.	7,202.
Total Oil Recovery, Bbls./Acre	1,308.	234.	256.	1,798.
Total Residual Oil Content, Bbls./Acre	2,719.	946.	1,740.	5,404.
Average Effective Permeability, Millidarcys	0.747	0.083	0.702	0.608
Average Initial Fluid Production Pressure, p.s.i.	21.4	38.3	27.5	26.8

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