14-21-20E

Cochran 3-H

November 16, 1950

Deep Rock Oil Corporation
Atlas Life Building
Tulsa, Oklahoma

Attention: Mr. T. F. Laury

Gentlemen:

Enclosed herewith is the report of the analysis made on the 2½" rotary core taken from the Cochran Lease, Well No. 3-H, Anderson County, Kansas, and submitted to our laboratory on October 11, 1950.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLPimm
c.c. to Mr. Neil Henderson
Mr. Jack McQueeney

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Location 1100' North of South Line & 710' West of East Line, NW¼.

Section 14 Twp. 21 Rge. 20 County Anderson State Kansas

Name of Sand	Squirrel
Top of Core	717.60
Bottom of Core	748.04
Top of Pay Sand	723.70
Bottom of Sand	742.70
Total Feet of Permeable Sand	9.51

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 2	0.80	0.80
2 - 4	3.06	3.86
4 - 6	1.18	5.04
6 - 8	1.10	6.14
8 - 12	1.65	7.79
12 & above	1.72	9.51

Average Permeability, Millidarcys	7.80
Average Percent Porosity	17.10
Average Percent Oil Saturation	40.52
Average Percent Water Saturation	37.73
Average Oil Content, Bbls./A. Ft.	539.
Total Oil Content, Bbls./Acre	7,192.
Average Percent Oil Recovery by Laboratory Flooding Tests	15.83
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	229.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,884.
Total Calculated Oil Recovery, Bbls./Acre	1,900.
Packer Setting, Feet	723.50
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.

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
717.60 - 718.40	Laminated sandy shale.
718.40 - 718.65	Laminated shaley sandstone.
718.65 - 719.25	Finely laminated sandy shale.
719.25 - 719.52	Laminated shaley sandstone.
719.52 - 719.80	Finely laminated sandstone and shale.
719.80 - 720.10	Gray sandy shale.
720.10 - 720.75	Laminated sandy shale.
720.75 - 721.15	Gray sandy shale.
721.15 - 721.45	Finely laminated sandy shale.
721.45 - 721.75	Light brown fine grained laminated micaceous shaley sandstone.
721.75 - 723.45	Gray sandy shale.
723.45 - 723.70	Brown fine grained laminated micaceous shaley sandstone.
723.70 - 723.95	Brown fine grained slightly laminated micaceous shaley sandstone.
723.95 - 724.10	Brown fine grained laminated micaceous shaley sandstone.
724.10 - 724.65	Finely laminated shaley sandstone.
724.65 - 724.95	Brown fine grained slightly laminated micaceous shaley sandstone.
724.95 - 725.20	Brown fine grained laminated micaceous shaley sandstone.
725.20 - 725.50	Brown fine grained slightly laminated micaceous shaley sandstone.
725.50 - 726.35	Finely laminated shaley sandstone.
726.35 - 726.65	Brown fine grained laminated micaceous shaley sandstone.

726.65 - 726.93 - Laminated sandy shale.

726.93 - 727.85 - Brown fine grained laminated micaceous shaley sandstone.

727.85 - 727.95 - Laminated shaley sandstone.

727.95 - 728.70 - Laminated sandy shale.

728.70 - 729.37 - Brown fine grained micaceous sandstone.

729.37 - 729.70 - Finely laminated shaley sandstone.

729.70 - 729.95 - Brown fine grained micaceous sandstone.

729.95 - 730.05 - Laminated sandy shale.

730.05 - 730.42 - Brown fine grained micaceous sandstone.

730.42 - 731.15 - Finely laminated shaley sandstone.

731.15 - 731.82 - Laminated sandy shale.

731.82 - 732.10 - Brown fine grained finely laminated micaceous shaley sandstone.

732.10 - 732.60 - Brown fine grained micaceous sandstone.

732.60 - 732.90 - Gray sandy shale.

732.90 - 733.60 - Brown fine grained micaceous sandstone.

733.60 - 734.30 - Laminated sandy shale.

734.30 - 734.60 - Brown fine grained laminated micaceous shaley sandstone.

734.60 - 734.95 - Laminated shaley sandstone.

734.95 - 735.72 - Brown fine grained micaceous sandstone.

735.72 - 735.85 - Laminated sandy shale.

735.85 - 736.07 - Brown fine grained micaceous sandstone.

736.07 - 736.30 - Laminated shaley sandstone.

736.30 - 736.65 - Brown fine grained slightly laminated micaceous shaley sandstone.

736.65 - 737.00 - Brown fine grained finely laminated micaceous shaley sandstone.

737.00 - 737.35 - Laminated shaley sandstone.

737.35 - 737.45 - Brown fine grained laminated micaceous shaley sandstone.

737.45 - 737.85 - Finely laminated sandy shale.

737.85 - 738.13 - Brown fine grained laminated micaceous shaley sandstone.

738.13 - 738.75 - Laminated shaley sandstone.

738.75 - 739.30 - Brown fine grained slightly laminated micaceous shaley sandstone.

739.30 - 739.45 - Brown fine grained laminated micaceous shaley sandstone.

739.45 - 739.75 - Laminated sandy shale.

739.75 - 740.03 - Brown fine grained slightly laminated micaceous shaley sandstone.

740.03 - 740.42 - Laminated sandstone and shale.

740.42 - 742.70 - Brown fine grained micaceous sandstone.

742.70 - 744.60 - Gray shale.

744.60 - 746.05 - Gray calcareous sandy shale.

746.05 - 746.22 - Limestone.

746.22 - 748.04 - Gray calcareous sandy shale.

Coring was started at a depth of 717.60 feet in laminated sandy shale and completed at 748.04 feet in calcareous sandy shale. This core shows a total of 15.48 feet of formation containing oil. The pay sand is made up mostly of fine grained micaceous to shaley sandstone. Furthermore, the cored section is badly broken by layers of sandy shale.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 4.44 and 8.87 millidarcys respectively while that of the pay sand, or that part of the cored section extending from the packer setting to the top of the cement plug, is 7.50 (See Table II). From the data given above and on the coregraph, it is noticeable that the sand is tight and has a very irregular permeability profile.

PERCENT SATURATION & OIL CONTENT

The pay sand in this core shows a good weighted average percent oil saturation, namely, 40.52. The weighted average percent oil saturation of the upper and lower sections are 36.33 and 43.53 respectively. The weighted average percent water saturation of the upper and lower sections are 50.68 and 30.11 respectively while that of the pay sand is 37.73 (See Table IV). This gives an overall weighted average total fluid saturation of 78.25 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 determine whether or not the sand was flushed by drilling fluid during the coring operation, all of the saturation samples were tested for chloride content. The results of these tests are given in Tables VII and VIII. From the data given in these tables and on the coregraph, it is evident that salt water was used as a circulating fluid as the chloride content of the brine in the sand samples does not, for the most part, vary indirectly with the permeability.

The weighted average oil content of the upper and lower sections are 431 and 630 barrels per acre foot respectively while that of the pay sand is 559. The total oil content, as shown by this core, is 7,891 barrels per acre of which 7,192 barrels are in the pay sand section (See Table IV).

LABORATORY FLOODING TESTS

The pay sand in this core responded fairly well to laboratory flooding tests as a total recovery of 1,884 barrels of oil per acre was obtained from 8.22 feet of sand, however, comparatively high pressures were necessary. The weighted average percent oil saturation was reduced from

44.22 to 68.39, or represents an average recovery of 15.83 percent. The weighted average effective permeability of the samples is 0.549 millidarcys while the average initial fluid production pressure is 24.6 pounds per square inch (See Table VI).

By observing the data given in Table V, you will note that of the 20 samples tested, 13 produced water and 15 oil. This indicates that only part of the sand is floodable. The tests also show that the sand has a low 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 1,200 barrels of oil per acre. In calculating this recovery, an allowance was made for oil lost during coring and it is assumed that the true water saturation of the sand is 37 percent and that the sand is not pressured up.

The principle drawback of this core is the fact that the sand is very tight and that it contains only approximately 7.3 feet of floodable sand. Due to the broken and tight condition of the sand section, it is apparent that this well was drilled near the edge of the trend or near a bone.

Oil Field Research Laboratories

SHOT RECOMMENDATION

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
728.50 - 741.50	13.0	4.0	2.5	32.5

Recommended Packer Setting 723.50 feet
Note: Plug hole back to 742.50 feet

Oil Field Research Laboratories

RESULTS OF PERMEABILITY TESTS

TABLE I

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	724.00	0.51	0.15	0.15	0.08
2	724.27	Imp.	0.55	0.70	0.00
3	725.04	2.9	0.25	0.95	0.73
4	725.41	9.5	0.30	1.25	2.85
5	726.28	Imp.	0.45	1.70	0.00
6	726.55	3.0	0.30	2.00	0.90
7	727.28	3.3	0.92	2.92	3.04
8	727.90	1.0	0.10	3.02	0.10
9	728.78	7.2	0.40	3.42	2.88
10	729.28	3.1	0.27	3.69	0.84
11	730.10	0.70	0.20	3.89	0.14
12	730.38	12.	0.17	4.06	2.04
12A	732.22	8.7	0.50	4.56	4.35
12B	733.18	3.3	0.70	5.26	2.31
13	734.80	0.71	0.35	5.61	0.25
14	735.70	4.8	0.42	6.03	2.02
15	736.34	9.5	0.35	6.38	3.33
15A	736.82	12.	0.35	6.73	4.20
16	737.38	7.0	0.10	6.83	0.70
16A	737.99	4.4	0.28	7.11	1.23
17	738.45	2.8	0.62	7.73	1.74
17A	738.98	6.5	0.55	8.28	3.58
18	739.40	11.	0.15	8.43	1.65
19	739.61	Imp.	0.30	8.73	0.00
20	740.40	Imp.	0.39	9.12	0.00
21	740.45	5.9	0.48	9.60	2.83
22	741.20	11.	0.35	9.95	3.85
23	741.30	27.	0.55	10.50	14.85
24	742.15	18.	0.55	11.05	9.90
25	742.65	6.3	0.35	11.40	2.21

Oil Field Research Laboratories

SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
723.45 - 732.10	3.06	4.44	13.60
732.10 - 742.70	6.65	8.87	59.00
723.50 - 742.50	9.51	7.50	71.34

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

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	718.52	14.1	32.6	53.5	86.1	336	0.25	0.25	89
2	719.38	12.6	35.2	55.7	90.9	344	0.27	0.52	93
F-4	721.60	21.8	34.7	-	-	587	0.60	1.12	352
6	723.58	14.5	31.8	49.1	80.9	368	0.25	1.37	90
F-6	723.81	16.1	42.3	-	-	529	0.25	1.62	132
7	724.50	14.2	30.0	54.2	85.0	340	0.55	2.17	187
F-7	724.80	16.4	46.8	-	-	585	0.30	2.47	178
8	725.65	13.9	39.7	48.8	88.5	425	0.85	3.32	364
F-9	727.07	14.4	40.1	-	-	466	0.47	3.79	210
10	727.55	15.9	42.9	44.3	87.2	529	0.45	4.24	238
11	728.28	13.6	31.2	52.4	83.6	389	0.75	4.99	246
12	729.56	14.2	32.8	54.8	87.6	361	0.33	5.32	119
F-12	729.82	17.5	48.9	-	-	664	0.25	5.57	166
13	730.70	15.4	31.7	50.0	81.7	379	1.10	6.67	417
F-14	731.94	16.4	31.2	-	-	397	0.28	6.95	111
15	732.22	20.0	46.7	26.8	73.5	725	0.50	7.45	362
16	733.18	20.1	54.0	31.5	85.5	843	0.70	8.15	590
F-17	734.44	16.6	36.6	-	-	497	0.30	8.45	149
18	735.12	20.4	45.8	26.0	74.8	771	0.77	9.22	593
19	735.97	20.0	50.0	25.6	75.6	776	0.22	9.44	171

Oil Field Research Laboratories

RESULTS OF SATURATION TESTS

TABLE III

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

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.	
F-19	736.80	14.3	18.3	-	-	203	0.23	9.67	47
20	736.83	15.9	48.1	35.9	84.0	594	0.70	10.37	416
F-20	737.15	14.6	22.8	-	-	258	0.35	10.72	90
21	737.96	15.9	44.7	43.5	88.2	551	0.28	11.00	154
F-21	738.25	14.0	24.5	-	-	266	0.62	11.62	165
22	738.92	19.9	42.1	34.7	76.8	650	0.55	12.17	358
23	739.93	17.7	44.6	37.8	82.4	612	0.28	12.45	171
24	740.73	18.8	46.3	36.0	82.3	677	0.78	13.23	529
25	741.56	19.8	47.9	35.3	83.2	735	1.50	14.73	1,102
							Total - - - - -		7,891

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-W

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
718.40-732.10	6.95	15.30	36.33	50.88	431	2,992
732.10-742.70	7.78	18.62	43.53	30.11	630	4,899
723.50-742.50	13.36	17.10	40.52	37.73	539	7,192

Oil Field Research Laboratories

RESULTS OF LABORATORY FLOODING TESTS

TABLE V

Company Deep Rock Oil Corporation Lease Cochran Well No. 2-E

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.			
4	721.60	21.8	34.7	567	8.5	141	26.4	68.8	446	58	0.818	20
5	723.61	16.1	42.3	589	14.8	179	28.0	61.4	350	0	0.024	30
7	724.60	16.4	46.8	695	18.3	233	28.3	67.5	362	4	0.150	25
8	725.98	14.0	39.7	451	4.0	45	35.7	58.4	306	0	0.004	50
9	727.07	14.4	40.1	448	9.6	107	30.5	69.3	341	4	0.069	35
10	727.75	16.8	41.1	504	6.1	75	35.0	64.5	429	18	0.349	30
11	728.56	13.5	29.4	308	3.2	34	26.2	63.1	274	11	0.165	30
12	729.82	17.5	46.9	654	26.5	357	20.8	71.4	307	4	0.091	25
13	731.00	15.0	32.4	377	0.0	0	32.4	64.2	377	0	Imp.	50+
14	731.94	16.4	31.2	397	0.0	0	31.2	68.4	397	0	Imp.	50+
15	732.48	13.7	47.9	732	23.6	364	24.1	65.7	368	12	0.283	15
16	733.45	20.7	53.8	664	30.9	496	22.9	71.0	368	30.6	0.687	10
17	734.44	16.8	38.6	497	8.1	104	30.5	64.0	393	18	0.332	25
18	735.45	19.2	49.1	731	23.9	341	25.2	62.0	390	16	0.373	15
19	736.80	14.3	18.5	303	0.0	0	18.3	69.6	303	0	Imp.	50+
20	737.13	14.6	25.8	258	0.0	0	22.8	70.5	350	0	Imp.	50+
21	738.85	14.0	24.5	266	0.0	0	24.5	68.7	266	0	Imp.	50+
22	739.18	10.6	44.3	642	10.6	185	33.9	62.5	499	15	0.298	25
24	740.97	18.8	47.8	669	24.3	356	23.5	69.8	339	37	0.922	15
23	741.69	19.7	46.8	715	17.8	272	29.0	64.1	445	56	1.61	15

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.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-E

Depth Interval, Feet	721.45 - 729.95	732.10 - 742.70	723.50 - 742.50
Feet of Core Analyzed	3.92	5.10	8.22
Average Percent Porosity	15.89	19.31	17.48
Average Percent Original Oil Saturation	38.47	47.59	44.22
Average Percent Oil Recovery	8.60	20.57	15.83
Average Percent Residual Oil Saturation	29.87	27.02	28.39
Average Percent Residual Water Saturation	61.56	65.51	63.88
Average Percent Total Residual Fluid Saturation	91.43	92.53	92.27
Average Original Oil Content, Bbls./A. Ft.	476.	715.	610.
Average Oil Recovery, Bbls./A. Ft.	111.	311.	229.
Average Residual Oil Content, Bbls./A. Ft.	365.	404.	381.
Total Original Oil Content, Bbls./Acre	1,866.	3,646.	5,016.
Total Oil Recovery, Bbls./Acre	435.	1,588.	1,884.
Total Residual Oil Content, Bbls./Acre	1,431.	2,058.	3,132.
Average Effective Permeability, Millidarcys	0.227	0.877	0.549
Average Initial Fluid Production Pressure, p.s.i.	30.6	17.1	24.6

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

Oil Field Research Laboratories

RESULTS OF WATER DIFFERENTATION TESTS

TABLE VII

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	718.52	18,600			
2	719.38	19,200			
6	723.58	24,100			
7	724.50	20,500			
8	725.65	25,600			
10	727.55	23,900			
11	728.28	18,300			
12	729.58	25,700			
13	730.70	22,200			
15	732.22	24,100			
16	733.18	24,600			
18	735.12	25,500			
19	735.97	22,200			
20	736.83	14,000			
21	737.98	22,200			
22	738.92	23,200			
23	739.93	20,000			
24	740.73	21,700			
25	741.55	18,500			

Note: ppm = parts per million

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTATION TESTS

TABLE VIII

Company Deep Rock Oil Corporation Lease Cochran Well No. 3-H

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
718.40 - 731.15	22,147		
732.10 - 742.70	21,154		
723.50 - 742.50	21,757		

Note: ppm - parts per million