OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

January 25, 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 Cable Tool core taken from the Mutt Smith Bredehoeft Lease, Well No. 2, Crawford County, Kansas, and submitted to our laboratory on January 11, 1951.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:mm
c.c. to Mr. Neil Henderson
Mr. Jack West
Mr. Mutt Smith

MUTT SMITH

CORE ANALYSIS REPORT

BREDEHOEFT LEASE WELL NO. 2

CRAWFORD COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

JANUARY 24, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Mutt Smith Lease Bredehoeft Well No. 2

Location

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

Name of Sand	Bartlesville
Top of Core	348.90
Bottom of Core	367.10
Top of Sand (According to Driller.)	347.00
Bottom of Sand	366.00
Total Feet of Permeable Sand	12.03

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 6	2.08	2.08
6 - 12	5.83	7.91
12 - 24	2.18	10.09
24 & above	1.94	12.03

Average Permeability Millidarcys	16.14
Average Percent Porosity	16.97
Average Percent Oil Saturation	42.02
Average Percent Water Saturation	42.05
Average Oil Content, Bbls./A. Ft.	552.
Total Oil Content, Bbls./Acre	4,909.
Average Percent Oil Recovery by Laboratory Flooding Tests	2.21
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	31.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	38.
Total Calculated Oil Recovery, Bbls./Acre	250.
Packer Setting, Feet	-
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	

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
348.90 - 350.62	Brown fine grained micaceous sandstone.
350.62 - 351.00	Dark fine grained micaceous carbonaceous sandstone.
351.00 - 351.52	Brown fine grained micaceous sandstone.
351.52 - 352.20	Dark fine grained micaceous carbonaceous sandstone.
352.20 - 353.50	Brown fine grained micaceous sandstone.
353.50 - 354.35	Dark fine grained micaceous carbonaceous sandstone.
354.35 - 354.75	Laminated sandy shale.
354.75 - 355.00	Brown fine grained micaceous sandstone.
355.00 - 356.65	Finely laminated sandy shale.
356.65 - 357.10	Dark fine grained micaceous carbonaceous sandstone.
357.10 - 357.92	Finely laminated sandy shale.
357.92 - 358.35	Dark fine grained micaceous carbonaceous sandstone.
358.35 - 359.00	Finely laminated sandy shale.
359.00 - 359.50	Gray shale.
359.50 - 361.70	Brown fine grained micaceous sandstone.
361.70 - 362.48	Brown fine grained micaceous slightly shaley sandstone.
362.48 - 363.15	Dark fine grained micaceous carbonaceous sandstone.
363.15 - 363.90	Brown fine grained micaceous slightly shaley sandstone.
363.90 - 364.35	Dark fine grained micaceous carbonaceous sandstone.
364.35 - 364.75	Brown fine grained micaceous sandstone.
364.75 - 366.00	Dark fine grained micaceous carbonaceous sandstone.

366.00 - 367.10 - Gray shale.

Coring was started at a depth of 348.90 feet in fine grained micaceous sandstone and completed at 367.10 feet in gray shale. This core shows a total of 12.98 feet of sandstone. For the most part, the sand section is made up of fine grained micaceous to carbonaceous sandstone. There is a broken section extending from 354.35 to 359.50 feet.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections are 30.17 and 8.48 millidarcys respectively; the overall averages being 16.14 (See Table II). By observing the data given on the coregraph, it is noticeable that the sand section has a very irregular permeability profile.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good overall weighted average percent oil saturation, namely, 42.02. The weighted average percent oil saturation of the upper and lower sections are 42.37 and 41.75 respectively. The weighted average percent water saturation of the upper and lower sections are 41.58 and 42.49 respectively; the overall average being 42.05 (See Table IV). This gives an overall weighted average total fluid saturation of 84.07 percent.

In an effort to determine whether or not any flushing of the sand occurred during coring, all of the saturation samples were analyzed 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 very little flushing of the sand occurred, or that salt water was used as a circulating fluid during the coring operation as the zones of higher permeability do not necessarily have the lower chloride content.

The weighted average oil content of the upper and lower sections are 578 and 531 barrels per acre foot respectively; the overall average being 552. The total oil content, as shown by this core, is 4,909 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

The sand in this core did not respond, to any appreciable extent, to laboratory flooding tests as a total recovery of only 38 barrels of oil per acre was obtained from 1.22 feet of sand. The weighted average percent oil saturation was reduced from 42.70 to 40,49, or represents an average recovery of 2.21 percent. The weighted average effective permeability of the samples is 0.341 millidarcys while the average initial fluid production pressure is 37.5 pounds per square inch (See Table VI). The tests show that the sand has a high percent residual oil saturation.

From the data given in Table V, you will note that of the 12 samples tested, 6 produced water and only 2 oil. This indicates that only a small portion of the sand section is floodable. The tests also show that the sand has a very low effective permeability and 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 approxi-

mately 250 barrels of oil per acre. In calculating this recovery, an allowance was made for oil lost during coring, and it was assumed that the true water saturation of the sand is 35 percent.

The principle drawback of this core is the fact that the sand has a low effective permeability and apparently contains a fairly viscous oil. According to the above data, the core contains only 1.22 feet of floodable sand. A considerable portion of the sand is the so-called dark carbonaceous sandstone which is not floodable. Due to the tight and broken condition of the cored section, it would appear that this well was drilled near the edge of the trend.

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SHOT RECOMMENDATION

Company Mutt Smith Lease Bredehoeft Well No. 2

Depth Interval, Feet	Feet of Sand	Size of Shell Inches	Qts./Ft.	Total Quarts
349.0 - 354.0	5	4½	3.1	15.5
354.0 - 360.0	6	Spacer	-	-
360.0 - 366.0	6	4½	3.1	18.6
			Total - - -	34.1

Note: Shot with solidified.

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company Mutt Smith Lease Bredehoeft Well No. 2

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	349.40	41.	0.80	0.80	32.80
2	350.15	82.	0.60	1.40	49.20
3	350.60	35.	0.32	1.72	11.20
4	350.88	18.	0.38	2.10	6.84
5	351.20	21.	0.30	2.40	6.30
6	351.50	42.	0.22	2.62	9.24
7	352.05	4.5	0.68	3.30	3.06
8	352.50	9.3	0.50	3.80	4.65
9	352.90	Broken	0.35	4.15	-
10	353.25	11.	0.45	4.60	4.95
11	353.63	2.0	0.25	4.85	0.50
12	353.90	16.	0.35	5.20	5.60
13	354.30	1.9	0.25	5.45	0.48
14	355.20	Imp.	0.30	5.75	0.00
15	356.95	Imp.	0.45	6.20	0.00
16	358.00	11.	0.43	6.63	4.73
17	359.65	6.4	0.60	7.23	3.84
18	360.45	7.4	0.50	7.73	3.70
19	360.80	11.	0.55	8.28	6.05
20	361.45	7.4	0.40	8.68	2.96
21	361.65	16.	0.15	8.83	2.40
22	361.95	11.	0.45	9.28	4.95
23	362.45	19.	0.33	9.61	6.27
24	362.80	12.	0.67	10.28	8.04
25	363.25	6.9	0.75	11.03	5.18
26	364.10	6.8	0.45	11.48	3.06
27	364.65	5.4	0.40	11.88	2.16
28	365.35	6.7	0.75	12.63	5.03
29	365.75	2.0	0.50	13.13	1.00

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company Mutt Smith Lease Bredehoeft Well No. 2

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
348.90 - 353.50	4.25	30.17	128.24
353.50 - 366.00	7.78	8.48	65.95
348.90 - 366.00	12.03	16.14	194.19

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RESULTS OF SATURATION TESTS

TABLE III

Company Mutt Smith Lease Bredehoeft Well No. 2

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	349.22	17.0	41.2	23.3	64.5	543	0.70	0.70	380
2	349.95	17.8	41.9	53.3	95.2	579	0.60	1.30	347
3	350.50	18.6	40.5	43.2	83.7	584	0.42	1.72	245
F-3	350.70	18.2	31.0	-	-	438	0.38	2.10	166
4	351.20	17.6	47.3	38.8	86.1	646	0.52	2.62	336
5	352.72	17.5	44.6	46.0	90.6	606	0.80	3.42	485
6	353.40	17.1	46.3	47.5	93.8	615	0.50	3.92	308
7	359.90	17.4	38.2	45.6	83.8	516	0.95	4.87	490
8	361.00	16.5	38.2	41.0	79.2	489	1.25	6.12	611
9	362.10	16.4	42.5	38.3	80.8	540	0.78	6.90	421
10	363.52	16.8	36.2	45.6	81.8	471	0.75	7.65	353
F-11A	364.95	15.6	51.6	-	-	624	0.65	8.30	406
F-12A	365.96	15.4	50.4	-	-	601	0.60	8.90	361
							Total	- - - - -	4,909

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

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SUMMARY OF SATURATION TESTS

TABLE IV

Company Mutt Smith Lease Bredehoeft Well No. 2

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
348.90-353.50	3.92	17.63	42.37	41.58	578	2,267
359.50-366.00	4.98	16.45	41.75	42.49	531	2,642
348.90-366.00	8.90	16.97	42.02	42.05	552	4,909

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RESULTS OF LABORA

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Company Mutt Smith Lease Bredel

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery	
			Percent	Bbls./A. Ft.	Percent	Bbls./A. F
1	349.00	18.3	40.5	574	3.1	44
2	349.74	18.4	39.8	568	0.0	0
3	350.70	18.2	31.0	438	0.0	0
4	351.10	18.9	45.4	665	0.9	13
5	352.30	17.1	47.2	625	0.0	0
6	353.10	17.9	45.0	625	0.0	0
7	360.10	17.4	37.1	501	0.0	0
8	361.75	17.1	37.6	499	0.0	0
9	362.30	16.5	40.4	517	0.0	0
10	363.76	16.1	37.1	463	0.0	0
11A	364.95	15.6	51.6	624	0.0	0
12A	365.96	15.4	50.4	601	0.0	0

Notes: cc - cubic centimeter.
*Volume of water recovered at the time of r
**Determined by passing water through sampl
"A" samples were taken from the core after

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TORY FLOODING TESTS

LE V

ıoeft Well No. 2

	Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
t.	% Oil	% Water	Bbls./A. Ft.			
	37.4	61.4	530	14	0.390	30
	39.8	43.5	568	3	0.151	45
	31.0	41.8	438	0	Imp.	50+
	44.5	50.0	652	5	0.275	45
	47.2	40.0	625	0	Imp.	50+
	45.0	50.9	625	0	Imp.	50+
	37.1	58.2	501	1	0.143	50
	37.6	51.9	499	2	0.169	45
	40.4	51.8	517	0	0.109	50
	37.1	50.0	463	0	Imp.	50+
	51.6	30.0	624	0	Imp.	50+
	50.4	30.0	601	0	Imp.	50+

ıaximum oil recovery.
.e which still contains residual oil.
it was received in the laboratory.

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SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company Mutt Smith Lease Bredehoeft Well No. 2

Depth Interval, Feet	348.90 - 351.52
Feet of Core Analyzed	1.22
Average Percent Porosity	18.52
Average Percent Original Oil Saturation	42.70
Average Percent Oil Recovery	2.21
Average Percent Residual Oil Saturation	40.49
Average Percent Residual Water Saturation	56.48
Average Percent Total Residual Fluid Saturation	96.97
Average Original Oil Content, Bbls./A. Ft.	612.
Average Oil Recovery, Bbls./A. Ft.	31.
Average Residual Oil Content, Bbls./A. Ft.	581.
Total Original Oil Content, Bbls./Acre	747.
Total Oil Recovery, Bbls./Acre	38.
Total Residual Oil Content, Bbls./Acre	709.
Average Effective Permeability, Millidarcys	0.341
Average Initial Fluid Production Pressure, p.s.i.	37.5

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

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RESULTS OF WATER DIFFERENTATION TESTS

TABLE VII

Company Mutt Smith Lease Bredehoeft Well No. 2

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	349.22	16,000			
2	349.95	13,500			
3	350.50	10,600			
4	351.20	15,000			
5	352.72	13,500			
6	353.40	18,800			
7	359.90	10,900			
8	361.00	16,000			
9	362.10	11,400			
10	363.52	12,400			

Note: ppm - parts per million.

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company Mutt Smith Lease Bredehoeft Well No. 2

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
348.90 - 353.50	14,619		
359.50 - 363.90	13,015		
348.90 - 363.90	13,798		

Note: ppm - parts per million