OIL FIELD RESEARCH LABORATORIES
CHANUTE, KANSAS

November 17, 1951

The Ohio Oil Company
Thompson Building
Tulsa, Oklahoma

Attention: Mr. R. E. McMillen

Gentlemen:

Enclosed herewith is the report of the analysis of the 3" Rotary core taken from the Luthi "C" Lease, Core Test Well No. 1, Greenwood County, Kansas, and submitted to our laboratory on November 9, 1951.

Very truly yours,

OIL FIELD RESEARCH LABORATORIES

Carl L. Pete

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6.6.

THE OHIO OIL COMPANY

CORE ANALYSIS REPORT

LUTHI "C" LEASE CORE TEST WELL NO. 1

GREENWOOD COUNTY, KANSAS

OIL FIELD RESEARCH LABORATORIES

CHANUTE, KANSAS

NOVEMBER 17, 1951

Oil Field Research Laboratories

GENERAL INFORMATION & SUMMARY

Company The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

Location 662' South of North Line & 1,292' East of West Line

Section 29 Twp. 22S Rge. 13E County Greenwood State Kansas

Name of Sand		Bartlesville
Top of Core		1657.00
Bottom of Core		1706.00
Top of Sand		1662.00
Bottom of Sand		1690.00
Total Feet of Permeable Sand	(Analyzed)	17.90
	(Analyzed)	11.95
Total Feet of Floodable Sand		

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 50	7.10	7.10
50 - 100	2.70	9.80
100 - 150	1.15	10.95
150 - 200	1.30	12.25
200 - 250	1.40	13.65
250 & above	4.25	17.90

Average Permeability Millidarcys	145.74
Average Percent Porosity	20.06
Average Percent Oil Saturation	25.77
Average Percent Water Saturation	59.55
Average Oil Content, Bbls./A. Ft.	404.
Total Oil Content, Bbls./Acre	5,616.
Average Percent Oil Recovery by Laboratory Flooding Tests	2.36
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	40.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	268.
Total Calculated Oil Recovery, Bbls./Acre	2,750.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

Fresh water was used in making up the circulating fluid used 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
1657.00 - 1662.00	Laminated sandy shale containing a vertical fracture.
1662.00 - 1662.75	Light brown fine grained laminated micaceous shaley sandstone.
1662.75 - 1664.40	Light brown fine grained slightly laminated micaceous shaley sandstone.
1664.40 - 1669.40	Gray shale.
1669.40 - 1670.60	Laminated sandy shale.
1670.60 - 1671.10	Light brown fine grained slightly laminated micaceous shaley sandstone.
1671.10 - 1671.70	Brown fine grained micaceous sandstone.
1671.70 - 1672.45	Brown fine grained slightly laminated micaceous carbonaceous sandstone.
1672.45 - 1673.05	Brown fine grained micaceous slightly carbonaceous sandstone.
1673.05 - 1673.70	Light brown fine grained micaceous sandstone.
1673.70 - 1674.40	Laginated sandy shale.
1674.40 - 1674.85	Light brown fine grained micaceous sandstone.
1674.85 - 1675.00	Laminated sandy shale.
1675.00 - 1675.40	Light brown fine grained slightly laminated micaceous shaley sandstone.
1675.40 - 1675.80	Finely laminated sandy shale.
1675.80 - 1675.80	Light brown fine grained micaceous sandstone.
1675.80 - 1676.00	Light brown fine grained slightly laminated micaceous carbonaceous sandstone.

1676.00 - 1678.10 - Light brown fine grained micaceous sandstone.

1678.10 - 1678.45 - Gray shale.

1678.45 - 1679.00 - Laminated sandy shale.

1679.00 - 1679.20 - Light brown fine grained micaceous sandstone.

1679.20 - 1679.35 - Light brown fine grained laminated micaceous shaley sandstone.

1679.35 - 1679.65 - Light brown fine grained micaceous sandstone.

1679.65 - 1679.80 - Finely laminated sandy shale.

1679.80 - 1680.10 - Light brown fine grained micaceous sandstone.

1680.10 - 1680.60 - Gray shale.

1680.60 - 1682.60 - Brown fine grained micaceous sandstone.

1682.60 - 1683.00 - Brown fine grained micaceous slightly shaley sandstone.

1683.00 - 1683.60 - Brown fine grained micaceous sandstone.

1683.60 - 1684.00 - Gray shale.

1684.00 - 1684.90 - Brown fine grained micaceous sandstone.

1684.90 - 1685.05 - Light brown fine grained micaceous slightly shaley sandstone.

1685.05 - 1685.60 - Gray shale.

1685.60 - 1687.20 - Brown fine grained micaceous sandstone.

1687.20 - 1687.75 - Brown fine grained slightly laminated micaceous carbonaceous sandstone.

1687.75 - 1688.40 - Brown fine grained micaceous sandstone.

1688.40 - 1688.85 - Brown fine grained slightly laminated micaceous carbonaceous sandstone.

1688.85 - 1689.70 - Light brown fine grained micaceous sandstone.

1689.70 - 1690.00 - Light brown fine grained micaceous slightly carbonaceous shaley sandstone.

1690.00 - 1695.35 - Black shale containing a vertical fracture.

1695.35 - 1697.20 - Coal.

1697.20 - 1702.00 - Black shale.

1702.00 - 1706.00 - According to log, black shale and coal (Core not received).

Coring was started at a depth of 1697.00 feet in laminated sandy shale and completed at 1706.00 feet in black shale and coal (according to log). This core shows a total of 17.90 feet of sandstone. For the most part, the pay is made up of fine grained micaceous sandstone. The cored section is badly broken by layers of shale.

PERMEABILITY

For the sake of distribution, the core was divided into two sections. The weighted average permeability of the upper and lower sections is 38.94 and 271.90 millidarcys respectively; the overall average being 145.74 (See Table II). By observing the data given on the core-graph, it is noticeable that the sand has a very irregular permeability profile and that the lower part of the cored section is very loose.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a low weighted average percent oil saturation, namely, 28.77. The weighted average percent oil saturation of the upper and lower sections is 25.04 and 26.58 respectively. The weighted average percent water saturation of the upper and lower sections is 59.96 and 59.11 respectively; the overall average being 59.55 (See Table IV). This gives an overhil weighted average total fluid saturation of 85.32 percent. This comparatively low total fluid saturation indicates that an appreciable amount of fluid was lost during coring, which was probably oil.

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. By observing the data given in these tables and on the core-graph, it is evident that considerable flushing of the sand did occur during coring. As for the most part, the zones of higher permeability have the lower chloride content.

The weighted average oil content of the upper and lower sections is 350 and 464 barrels per acre foot respectively; the overall average being 404. The total oil content, as shown by this core, is 5,616 barrels per acre (See Table IV).

LABORATORY FLOODING TESTS

Inasmuch as the sand in this core shows a low average percent oil saturation, naturally, one would expect very little oil to be recovered by laboratory flooding tests. A total recovery of 208 barrels of oil per acre was obtained from 6.75 feet of sand. The weighted average percent oil saturation was reduced from 27.12 to 24.76, or represents an average recovery of 2.36 percent. The weighted average effective permeability of the samples is 6.92 millidarcys, while the average initial fluid production pressure is 6.4 pounds per square inch (See Table VI). The tests show that the sand did not flood down to quite as low residual oil saturation as expected.

By observing the data given in Table V, you will note that of the 18 samples tested, all produced and 9 oil. This indicates that all of the sand represented by these samples will take water. The tests also

show that the lower part of the sand section has a much higher effective permeability than the upper section.

CONCLUSION

From a study of the above data, we believe that an efficient water flood within the vicinity of this well will recover approximately 2,750 barrels of oil per acre, or an average of 230 barrels per acre foot from the 11.95 feet of floodable sand analyzed. In calculating this recovery, an allowance was made for oil lost during coring, and it was assumed that the primary production and the true water saturation of the sand are 12 and 36 percent respectively. Practically all of this recoverable oil was obtained from that part of the cored section extending from 1680.00 to 1690.00 feet.

The principle drawback of the sand in this core is the fact that it has a comparatively thin sand section for its depth. Inasmuch as the sand in this core is fairly broken, it may be that this well was drilled on or near a bone.

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RESULTS OF PERMEABILITY TESTS

TABLE I

Core Test

Company The Ohio Oil Company Lease Luthi "C" Well No. 1

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
1	1662.25	1.61	0.75	0.75	1.21
2	1662.85	4.2	0.35	1.10	1.47
3	1663.40	4.0	0.60	1.70	2.40
4	1663.80	3.3	0.20	1.90	1.66
5	1664.00	5.3	0.50	2.40	2.65
6	1671.00	4.0	0.50	2.90	2.00
7	1671.38	61.	0.40	3.30	24.40
8	1671.65	57.	0.20	3.50	11.40
9	1672.40	60.	0.75	4.25	45.00
10	1672.98	40.	0.60	4.85	24.00
11	1673.25	67.	0.65	5.50	43.55
12	1674.76	14.	0.45	5.95	6.30
13	1675.30	3.0	0.40	6.35	1.20
14	1675.88	20.	0.20	6.55	4.00
15	1676.25	48.	0.70	7.25	33.60
16	1676.95	102.	0.30	7.55	30.60
17	1677.07	93.	0.35	7.90	32.55
18	1677.61	19.	0.40	8.30	7.60
19	1677.98	36.	0.35	8.65	12.60
20	1679.10	24.	0.20	8.85	4.80
21	1679.45	31.	0.30	9.15	9.30
22	1679.90	30.	0.30	9.45	9.00
23	1680.95	156.	0.55	10.00	85.80
24	1681.20	68.	0.35	10.35	23.70
25	1681.64	223.	0.35	10.70	77.70
26	1682.15	258.	0.50	11.20	129.00
27	1682.36	284.	0.25	11.45	71.00
28	1682.95	103.	0.40	11.85	41.20
29	1683.45	162.	0.60	12.45	97.20
30	1684.15	235.	0.30	12.75	75.50
31	1684.46	473.	0.90	13.65	255.00
32	1684.95	177.	0.15	13.80	26.55
33	1685.72	360.	0.40	13.90	144.00
34	1686.20	535.	0.40	14.30	214.00
35	1686.57	500.	0.20	14.50	150.00
36	1686.92	240.	0.50	15.10	120.00
37	1687.20	212.	0.30	15.40	63.60
38	1687.65	235.	0.25	15.65	58.25
39	1688.00	406.	0.65	16.30	263.90
40	1688.50	117.	0.45	16.75	52.65

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RESULTS OF PERMEABILITY TESTS

TABLE I

Company The Ohio Oil Company Lease Luthi "C" Well No. Core Test 1

Sample No.	Depth, Feet	Permeability Millidarcys	Feet of Core		Permeability Capacity Ft. x Md.
			Ft.	Cum. Ft.	
41	1688.98	366.	0.30	17.05	109.80
42	1689.30	364.	0.55	17.60	200.20
43	1689.55	7.9	0.30	17.90	2.37

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SUMMARY OF PERMEABILITY TESTS

TABLE II

Company The Ohio Oil Company Lease Luthi "C" Well No. Core Test 1

Depth Interval Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity, Ft. x Md.
1662.00 - 1680.10	9.45	32.94	311.29
1680.60 - 1690.00	8.45	271.90	2,297.52
1662.00 - 1690.00	17.90	145.74	2,608.81

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RESULTS OF SATURATION TESTS

TABLE III

Company The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

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	1663.15	17.5	22.3	61.5	83.8	303	0.95	0.95	286
2	1664.25	17.4	23.7	63.5	87.2	320	0.70	1.65	224
3	1670.75	17.6	21.4	62.7	84.1	292	0.50	2.15	146
4	1671.85	17.6	29.3	62.1	91.4	401	0.75	2.90	301
5	1672.75	18.8	33.0	58.9	91.9	481	0.60	3.50	289
6	1673.55	17.9	22.4	61.4	83.8	311	0.65	4.15	202
7	1674.55	17.8	21.8	67.4	89.2	302	0.45	4.60	136
8	1675.65	18.1	28.5	59.5	88.0	401	0.30	4.90	120
9	1676.65	18.5	25.2	54.0	79.2	362	1.00	5.90	362
10	1677.35	18.3	25.7	53.3	79.0	366	1.10	7.00	403
11	1679.57	17.8	20.0	69.2	89.2	277	0.30	7.30	83
12	1680.75	22.0	22.6	57.5	80.1	386	0.70	8.00	270
13	1681.85	22.2	30.6	53.6	84.2	527	1.30	9.30	686
14	1683.15	21.9	27.2	65.4	92.6	462	0.60	9.90	277
15	1684.75	23.6	24.9	59.9	84.8	456	0.90	10.80	410
16	1685.95	23.3	26.6	58.0	84.6	481	0.90	11.70	434
17	1687.05	22.5	26.1	62.4	88.5	456	0.70	12.40	319
18	1688.25	23.5	26.3	63.4	89.7	480	0.65	13.05	312
19	1689.55	21.0	25.7	58.7	84.4	419	0.85	13.90	356
								Total - - -	5,616

Oil Field Research Laboratories

SUMMARY OF SATURATION TESTS

TABLE IV

Company The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

Depth Interval, Feet	Feet of Core Analyzed	Average Percent Porosity	Average Percent Oil Saturation	Average Percent Water Saturation	Average Oil Content Bbl./A. Ft.	Total Oil Content Bbls./Acre
1662.75 - 1679.65	7.30	17.95	25.04	59.96	350	2,552
1680.60 - 1689.70	6.60	22.41	26.58	59.11	464	3,064
1662.75 - 1689.70	13.90	20.06	25.77	59.55	404	5,616

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RESULTS OF LABORAT

TABL

Company The Ohio Oil Company

Sample No.	Depth, Feet	Effective Porosity Percent	Original Oil Saturation		Oil Recovery	
			Percent	Bbls./A. Ft.	Percent	Bbls./A. Ft.
1	1663.15	17.3	21.8	293	0.0	0
2	1664.25	17.4	22.5	304	0.0	0
3	1670.75	17.5	21.5	293	0.0	0
4	1671.85	18.0	30.9	431	0.0	0
5	1672.75	18.9	30.9	453	0.7	10
6	1673.55	18.3	23.6	335	0.0	0
7	1674.55	18.0	21.8	305	0.0	0
8	1675.65	17.8	28.3	391	3.0	41
9	1676.65	18.7	26.3	382	2.2	32
10	1677.35	18.1	26.2	368	0.0	0
12	1680.75	21.5	21.9	364	1.7	28
13	1681.85	22.5	30.2	528	4.1	72
14	1683.15	21.5	28.4	474	2.7	45
15	1684.75	23.5	24.7	451	0.0	0
16	1685.95	23.7	25.8	474	2.4	44
17	1687.05	22.5	25.6	447	1.0	17
18	1688.25	23.3	25.9	469	2.1	38
19	1689.55	20.8	24.7	399	0.0	0

Notes: cc - cubic centimeter
* - Volume of water recovered at the time of
** - Determined by passing water through samp

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OF LABORATORY FLOODING TESTS

TABLE V

_____ Lease Luthi "C" Coretest Well No. 1 _____

ecovery	Residual Saturation			Volume of Water Recovered cc*	Effective Permeability, Millidarcys **	Initial Fluid Production Pressure Lbs./Sq. In.
Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
0	21.8	69.0	293	2	0.101	45
0	22.5	70.5	304	3	0.195	45
0	21.5	75.5	293	14	0.244	20
0	30.9	62.7	431	30	0.500	15
10	30.2	62.3	443	70	1.08	5
0	23.6	61.3	335	30	0.650	20
0	21.8	71.8	305	124	2.92	10
41	25.3	67.5	350	106	1.57	5
32	24.1	64.3	350	125	3.98	15
0	26.2	62.0	368	106	1.94	10
28	20.2	71.1	336	199	5.89	10
72	26.1	62.5	456	164	7.27	5
45	25.7	61.2	429	142	7.85	5
0	24.7	65.0	451	199	10.88	5
44	23.4	63.1	430	154	10.52	3
17	24.6	67.0	430	130	8.74	5
38	23.8	65.0	431	158	11.88	5
0	24.7	68.5	399	94	1.62	10

he time of maximum oil recovery.
rough sample which still contains residual oil.

Oil Field Research Laboratories

SUMMARY OF LABORATORY FLOODING TESTS

TABLE VI

Company The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

Depth Interval, Feet	1672.45 - 1677.00	1680.60 - 1688.40	1672.45 - 1688.40
Feet of Core Analyzed	1.90	4.85	6.75
Average Percent Porosity	18.58	22.64	21.47
Average Percent Original Oil Saturation	28.05	26.75	27.12
Average Percent Oil Recovery	1.84	2.56	2.36
Average Percent Residual Oil Saturation	26.21	24.19	24.76
Average Percent Residual Water Saturation	64.21	63.44	63.66
Average Percent Total Residual Fluid Saturation	90.42	87.63	88.42
Average Original Oil Content, Bbls./A. Ft.	406.	469.	451.
Average Oil Recovery, Bbls./A. Ft.	26.	45.	40.
Average Residual Oil Content, Bbls./A. Ft.	380.	424.	411.
Total Original Oil Content, Bbls./Acre	771.	2,272.	3,043.
Total Oil Recovery, Bbls./Acre	50.	218.	268.
Total Residual Oil Content, Bbls./Acre	721.	2,054.	2,775.
Average Effective Permeability, Millidarcys	2.68	8.58	6.92
Average Initial Fluid Production Pressure, p.s.i.	7.6	5.5	6.4

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 The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation		
			Connate	Drilling & Foreign	Total
1	1663.15	26,100			
2	1664.25	21,500			
3	1670.75	19,300			
4	1671.85	19,400			
5	1672.75	8,400			
6	1673.85	4,300			
7	1674.85	18,900			
8	1675.65	6,500			
9	1676.65	7,000			
10	1677.35	4,300			
11	1679.57	18,900			
12	1680.75	3,800			
13	1681.85	3,100			
14	1683.15	4,800			
15	1684.75	3,600			
16	1685.95	3,200			
17	1687.05	3,100			
18	1688.25	2,900			
19	1689.55	4,300			

Note: ppm = parts per million.

Oil Field Research Laboratories

SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VIII

Company The Ohio Oil Company Lease Luthi "C" Core Test Well No. 1

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
1662.75-1679.65	13,600		
1680.60-1689.70	3,700		
1662.75-1689.70	8,900		

Note: ppm = parts per million.