OILFIELD RESEARCH LABORATORIES
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October 25, 1968

King Resources Company
100 Park Avenue Building, Suite 333
Oklahoma City, Oklahoma 73102

Gentlemen:

Enclosed herewith is the report of the analysis of the Rotary core taken from the C. Fedell Lease, Well No. CT-2, Wilson County, Kansas, and submitted to our laboratory on October 21, 1968.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

Carl L. Pate

CLP:dp

6 c. - Oklahoma City, Oklahoma

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company King Resources Company Lease C. Fedell Well No. CT-2

Location 220' SNL & 220' EWL, S/2 NE/4

Section 27 Twp. 28S Rge. 14E County Wilson State Kansas

Name of Sand	New Albany
Top of Core	260.0
Bottom of Core	304.0
Top of ~~Sand~~ Pay	277.7
Bottom of ~~Sand~~ Pay	293.3
Total Feet of Permeable Sand	22.4
Total Feet of Floodable Sand	13.4

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 50	2.6	2.6
50 - 100	5.2	7.8
100 - 150	6.6	14.4
150 - 200	5.3	19.7
200 & above	2.7	22.4

Average Permeability Millidarcys	125.9
Average Percent Porosity	23.4
Average Percent Oil Saturation	27.2
Average Percent Water Saturation	48.9
Average Oil Content, Bbls./A. Ft.	517.
Total Oil Content, Bbls./Acre	12,197.
Average Percent Oil Recovery by Laboratory Flooding Tests	4.6
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	88.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	1,182.
Total Calculated Oil Recovery, Bbls./Acre (Primary & Secondary)	4,020.
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A fresh water mud was used as a circulating fluid in the coring of the sand in this well. The core was sampled and sealed in tin cans by a representative of Oilfield Research Laboratories.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
260.0 - 262.2	Hard gray limestone.
262.2 - 269.7	Gray sandy shale.
269.7 - 270.0	Coal.
270.0 - 275.4	Gray finely laminated shaly sandstone.
275.4 - 277.7	Grayish brown laminated shaly sandstone.
277.7 - 280.3	Brown fine grained micaceous slightly laminated shaly sandstone - containing a vertical fracture.
280.3 - 281.0	Grayish brown fine grained micaceous slightly calcareous sandstone.
281.0 - 286.3	Brown fine grained micaceous sandstone.
286.3 - 289.0	Grayish brown fine grained micaceous sandstone.
289.0 - 293.3	Brown fine grained micaceous slightly calcareous sandstone.
293.3 - 294.7	Gray fine grained micaceous calcareous sandstone.
294.7 - 296.4	Brownish gray fine grained micaceous slightly calcareous sandstone.
296.4 - 298.0	Gray fine grained micaceous slightly calcareous sandstone.
298.0 - 301.3	Gray fine grained micaceous slightly laminated carbonaceous sandstone.
301.3 - 302.4	Gray sandy shale.
302.4 - 302.7	Dark shale.

Depth Interval, Feet	Description
302.7 - 304.0	Gray sandy shale.

Coring was started at a depth of 260.0 feet in hard gray limestone and completed at 304.0 feet in gray sandy shale. This core shows a total of 31.3 feet of sandstone. For the most part, the pay is made up of brown micaceous to slightly calcareous sandstone. The core showed a vertical fracture extending from a depth of 278 to 279 feet.

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 20.4, 138.7 and 121.6 millidarcys respectively; the overall average being 125.9 (See Table III). By observing the data given on the coregraph, it is noticeable that the sand has a very irregular permeability profile. The permeability of the sand varies from 1.3 to a maximum of 277. millidarcys.

In order to determine whether there is any vertical permeability between the pay zone and the water sand below, five samples were analyzed (See Table 1A). These tests show vertical permeability, however, the average is considerable lower than the horizontal permeability of the pay zone.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a fairly low weighted average percent oil saturation, namely, 27.2. The weighted average percent oil saturation of the upper, middle, and lower sections is 16.2, 33.5, and 14.4

respectively. The weighted average percent water saturation of the upper, middle, and lower sections is 64.4, 41.1, and 65.6 respectively; the overall average being 48.9 (See Table III). This gives an overall weighted average total fluid saturation of 76.1 percent. This fairly low total fluid saturation indicates some 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 VI and VII. From the data given in these tables and on the coregraph, it is evident that some flushing of the sand did occur during coring as the lower permeable zone (upper section) had the higher chloride content.

The weighted average oil content of the upper, middle, and lower sections is 294, 642, and 263 barrels per acre foot respectively; the overall average being 517. The total oil content, as shown by this core, is 12,197 barrels per acre of which 10,022 barrels are in the pay sand section (See Table III). The pay sand section extends from a depth of 277.7 to 293.3 feet (middle section).

LABORATORY FLOODING TESTS

Part of the sand in this core responded fairly well to laboratory flooding tests, as a total recovery of 1,182 barrels of oil per acre was obtained from 13.4 feet of sand. The weighted average percent oil saturation was reduced from 35.5 to 30.9, or represents an average recovery of 4.6 percent. The weighted average effective permeability of the samples is 6.47 millidarcys, while the average initial fluid production pressure is 11.2 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 24 samples tested, all produced water and 13 oil. This indicates that approximately 54 percent of the sand represented by these samples is floodable pay sand.

CONCLUSION

From a study of the above data, we estimate that approximately 4,020 barrels of oil per acre or an average of 300 barrels per acre foot can be recovered from the area, represented by this core, by efficient primary and waterflooding methods provided injected water can be confined to the pay sand. The following data and assumptions were used in calculating the above oil recovery value:

Original formation volume factor	1.02
Irreducible water saturation, percent	37.0
Primary recovery, percent	None
Present oil saturation, percent	61.8
Average porosity, percent	25.0
Oil saturation after flooding, percent	30.9
Performance factor, percent	50.0
Net floodable pay sand, feet	13.4

This core shows a clean pay sand section (277.7 - 293.3 feet) having a fair oil saturation, a moderate water saturation, and a good porosity and permeability. The results of the chloride tests indicate that a small amount of flushing did occur during the cutting of the core.

Before this well is placed on production, we recommend that the hole be plugged back to 292.5 feet.

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RESULTS OF PERMEABILITY AND POROSITY TESTS

TABLE I A

Company King Resources Company Lease C. Fedell Well No. CT-2

Vertical

Sample No.	Depth Feet	Permeability Millidarcys	Feet of Core Ft.	Feet of Core Cum. Ft.	Permeability Capacity Ft. x Md.	Percent Porosity
V-1	295.3	30				
V-2	296.3	48				
V-3	293.7	39				
V-4	293.9	57				
V-5	294.2	43				

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company King Resources Company Lease C. Fedell Well No. CT-2

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. /A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
1	275.5	23.9	14	66	80	260	52.	0.6	0.6	156	31.20
F-2	276.4	23.2	12	-	-	216	-	0.5	1.1	108	-
2	276.6	21.2	12	77	89	197	3.7	0.5	1.6	98	1.85
3	277.4	24.2	31	52	83	582	1.3	0.5	2.1	291	0.65
F-3	277.6	21.0	7	-	-	114	-	0.2	2.3	23	-
4	278.5	25.3	30	43	73	589	153.	1.3	3.6	766	199.00
5	279.5	25.8	34	41	75	681	91.	1.3	4.9	886	118.30
P-6	280.4	-	-	-	-	-	13.	0.2	5.1	-	2.60
6	280.6	23.2	35	42	77	630	-	0.5	5.6	315	-
7	281.5	24.8	37	37	74	712	168.	1.0	6.6	712	168.00
8	282.5	24.7	35	39	74	671	155.	1.0	7.6	671	155.00
9	283.5	25.8	40	37	77	801	165.	1.0	8.6	801	165.00
10	284.5	26.2	38	36	74	773	277.	1.0	9.6	773	277.00
11	285.5	25.4	32	36	68	631	141.	1.3	10.9	820	183.30
12	286.5	26.3	39	39	78	796	85.	0.7	11.6	557	59.50
13	287.5	26.2	32	39	71	651	102.	1.0	12.6	651	102.00
14	288.5	23.8	26	47	73	480	112.	1.0	13.6	480	112.00
15	289.5	21.2	22	50	72	362	79.	1.0	14.6	362	79.00
16	290.5	20.4	37	45	82	586	109.	1.0	15.6	586	109.00
17	291.5	26.0	36	39	75	726	197.	1.0	16.6	726	197.00
18	292.5	23.3	39	46	85	705	128.	1.3	17.9	916	166.40
19	293.5	16.7	9	84	93	117	17.	0.7	18.6	82	11.90
20	294.5	11.0	11	82	93	94	20.	0.7	19.3	66	14.00

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company King Resources Company Lease C. Fedell Well No. CT-2

Sample No.	Depth, Feet	Effective Porosity Percent	Percent Saturation			Oil Content Bbls. /A Ft.	Perm., Mill.	Feet of Sand		Total Oil Content	Perm. Capacity Ft. X md.
			Oil	Water	Total			Ft.	Cum. Ft.		
21	295.5	27.9	26	33	59	563	244.	1.7	21.0	957	415.00
22	296.5	18.0	8	73	81	112	62.	0.6	21.6	67	37.20
23	297.5	22.0	2	93	95	34	149.	1.0	22.6	34	149.00
24	298.5	22.2	17	65	82	293	66.	1.0	23.6	293	66.00

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company King Resources Company Lease C. Fedell Well No. CT-2

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
275.4 - 277.7	1.6	20.4	33.70
277.7 - 293.3	15.1	138.7	2,094.10
293.3 - 299.0	5.7	121.6	693.10
275.4 - 299.0	22.4	125.9	2,820.90

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
275.4 - 277.7	2.3	22.9	16.2	64.4	294	676
277.7 - 293.3	15.6	24.3	33.5	41.1	642	10,022
293.3 - 299.0	5.7	21.2	14.4	65.6	263	1,499
275.4 - 299.0	23.6	23.4	27.2	48.9	517	12,197

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company King Resources Company Lease C. Fedell Well No. CT-2

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.
			%	Bbls./A. Ft.	%	Bbls./A. Ft.	% Oil	% Water	Bbls./A. Ft.			
1	275.5	23.4	16	291	0	0	16	73	291	78	2.20	10
2	276.4	23.2	12	216	0	0	12	80	216	126	3.10	5
3	277.6	21.0	7	114	0	0	7	89	114	72	1.60	10
4	278.5	25.3	30	589	2	39	28	66	550	126	4.00	10
5	279.5	25.6	34	675	1	20	33	64	655	98	3.50	15
6	280.6	22.8	35	619	1	18	34	66	601	53	1.60	15
7	281.5	25.1	37	720	5	97	32	60	623	161	4.60	10
8	282.5	25.1	35	681	3	58	32	63	623	127	3.60	10
9	283.5	25.5	40	791	9	178	31	63	613	158	5.50	10
10	284.5	26.6	38	784	8	165	30	68	619	347	17.55	5
11	285.5	25.8	32	641	1	20	31	67	621	172	7.20	10
12	286.5	25.8	39	780	11	220	28	70	560	153	5.80	10
13	287.5	26.0	32	645	2	40	30	68	605	215	7.30	10
14	288.5	23.5	24	438	0	0	24	74	438	201	6.70	10
15	289.5	20.8	24	387	0	0	24	72	387	80	2.60	15
16	290.5	20.8	37	597	4	65	33	59	532	99	3.10	15
17	291.5	25.6	36	715	5	99	31	67	616	270	10.60	10
18	292.5	23.6	39	715	9	165	30	68	550	186	8.00	10
19	293.5	17.0	8	106	0	0	8	87	106	100	3.00	10
20	294.5	11.4	11	97	0	0	11	85	97	53	1.50	15
21	295.5	27.4	25	531	0	0	25	72	531	265	19.12	5
22	296.5	18.5	6	86	0	0	6	91	86	247	27.50	5
23	297.5	22.4	4	70	0	0	4	93	70	227	41.97	5
24	298.5	22.6	14	245	0	0	14	83	245	397	10.20	5

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 V

Company King Resources Company   Lease C. Fedell   Well No. CT-2

Depth Interval, Feet	275.4 - 299.0
Feet of Core Analyzed	13.4
Average Percent Porosity	25.0
Average Percent Original Oil Saturation	35.5
Average Percent Oil Recovery	4.6
Average Percent Residual Oil Saturation	30.9
Average Percent Residual Water Saturation	65.3
Average Percent Total Residual Fluid Saturation	96.2
Average Original Oil Content, Bbls./A. Ft.	686.
Average Oil Recovery, Bbls./A. Ft.	88.
Average Residual Oil Content, Bbls./A. Ft.	598.
Total Original Oil Content, Bbls./Acre	9,192.
Total Oil Recovery, Bbls./Acre	1,182.
Total Residual Oil Content, Bbls./Acre	8,010.
Average Effective Permeability, Millidarcys	6.47
Average Initial Fluid Production Pressure, p.s.i.	11.2

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

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RESULTS OF WATER DIFFERENTIATION TESTS

TABLE VI

Company King Resources Company Lease C. Fedell Well No. CT-2

Sample No.	Depth, Feet	Chloride Content of Brine in Sand ppm	Percent Water Saturation Connate	Drilling & Foreign	Total
1	275.5	80,100			
2	276.6	87,100			
3	277.4	74,450			
4	278.5	69,800			
5	279.5	75,150			
6	280.6	70,800			
7	281.7	55,420			
8	282.5	67,150			
9	283.5	62,450			
10	284.5	66,750			
11	285.5	71,300			
12	286.5	66,000			
13	287.5	60,700			
14	288.5	73,300			
15	289.5	80,800			
16	290.5	73,400			
17	291.5	69,000			
18	292.5	77,400			
19	293.5	80,750			
20	294.5	85,100			
21	295.5	65,350			
22	296.5	84,900			
23	297.5	55,450			
24	298.5	62,900			

Note: ppm — parts per million

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SUMMARY OF WATER DIFFERENTIATION TESTS

TABLE VII

Company King Resources Company Lease C. Fedell Well No. CT-2

Depth Interval, Feet	Chloride Content of Brine in Sand, ppm	Average Percent Connate Water	Average Percent Drilling & Foreign Water
275.4 - 277.7	80,531		
277.7 - 293.3	69,628		
293.3 - 299.0	69,561		
275.4 299.0	70,380		

Note: ppm — parts per million.