

OILFIELD RESEARCH LABORATORIES

536 NORTH HIGHLAND - CHANUTE, KANSAS 66720 - PHONE (316) 431-2650

March 18, 1981

Osage Drilling Company
916 South Steuben
Chanute, Kansas 66720

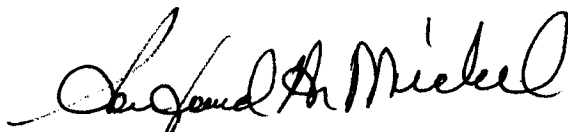
Gentlemen:

Enclosed herewith is the report of the analysis of the rotary core taken from the Ballard E Lease, Well No. 4, located in Chautauqua County, Kansas and submitted to our laboratory on February 2, 1981.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES



Sanford A. Michel

SAM/kas

5 c to Chanute, Kansas

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GENERAL INFORMATION & SUMMARY

Company Osage Drilling Company Lease Ballard E Well No. 4

Location _____

Section 20 Twp. 33S Rge. 13E County Chautauga State Kansas

Elevation, Feet

Name of Sand Wiser

Top of Core 1102.0

Bottom of Core 1116.5

Top of Sand 1102.0

Bottom of Sand 1114.5

Total Feet of Permeable Sand 11.7

Total Feet of Floodable Sand 7.3

Distribution of Permeable Sand: Permeability Range Millidarcys

Feet

Cum. Ft.

0 - 10

3.0

3.0

10 - 15

4.4

7.4

25 - 45

2.8

10.2

100 & Above

1.5

11.7

Average Permeability Millidarcys 27.0

Average Percent Porosity 13.7

Average Percent Oil Saturation 39.4

Average Percent Water Saturation 45.2

Average Oil Content, Bbls./A. Ft. 418.

Total Oil Content, Bbls./Acre 5,226.

Average Percent Oil Recovery by Laboratory Flooding Tests 6.0

Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft. 64.

Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre 468.

Total Calculated Oil Recovery, Bbls./Acre

See "Calculated Recovery"
Section

The core was sampled and the samples sealed in plastic bags by a representative of the client. Salt water mud was used as a drilling fluid.

FORMATION CORED

The detailed log of the formation cored is as follows:

<u>Depth Interval, Feet</u>	<u>Description</u>
1102.0 - 1106.0	Light brown slightly calcareous sandstone.
1106.0 - 1107.0	Light brown slightly calcareous shaly sandstone.
1107.0 - 1107.8	Light brown calcareous sandstone.
1107.8 - 1108.9	Light brown slightly calcareous sandstone.
1108.9 - 1110.1	Brown slightly calcareous shaly sandstone.
1110.1 - 1111.8	Brown slightly calcareous sandstone.
1111.8 - 1112.6	Brown slightly calcareous shaly sandstone.
1112.6 - 1114.5	Brown slightly calcareous sandstone.
1114.5 - 1116.5	Gray sandy shale.

LABORATORY FLOODING TESTS

The sand in this core responded to laboratory flooding tests, as a total recovery of 468 barrels of oil per acre was obtained from 7.3 feet of sand. The weighted average percent oil saturation was reduced from 41.9 to 35.9, or represents an average recovery of 6.0 percent. The weighted average effective permeability of the samples is 1.48 millidarcys, while the average initial fluid production pressure is 37.5 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 12 samples tested, 6 produced water and oil, and 4 samples produced water only. This indicates that approximately 50 percent of the sand represented by these samples is floodable pay sand.

CALCULATED RECOVERY

It would appear from a study of the core data, that efficient primary and waterflood operations in the vicinity of this well should recover approximately 1,280 barrels of oil per acre. This is an average recovery of 176 barrels per acre foot from 7.3 feet of floodable sand analyzed in this core.

These recovery values were calculated using the following data and assumptions:

Original formation volume factor, estimated	1.08
Reservoir water saturation, percent, estimated	25.0
Average porosity, percent	13.5
Oil saturation after flooding, percent	35.9
Performance factor, percent, estimated	50.0
Net floodable sand, feet	7.3

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Osage Drilling Company Lease Ballard E Well No. 4

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	1102.4	13.9	30	56	86	324	11.	1.0	1.0	324	11.00
2	1103.5	14.3	55	24	79	610	10.	1.5	2.5	915	15.00
3	1105.2	12.4	45	48	93	433	104.	1.5	4.0	650	156.00
4	1106.2	11.1	33	64	97	284	2.2	1.0	5.0	284	2.20
5	1107.3	12.9	31	54	85	310	9.2	0.8	5.8	248	7.36
6	1108.3	15.8	40	43	83	490	42.	1.1	6.9	539	46.20
7	1109.4	12.8	41	46	87	407	3.9	1.2	8.1	488	4.68
8	1110.7	16.0	31	47	78	385	31.	1.0	9.1	385	31.00
9	1111.4	13.8	38	30	68	407	26.	0.7	9.8	285	18.20
10	1112.2	12.1	33	50	83	310	Imp.	0.8	10.6	248	0.00
11	1113.5	14.6	42	45	87	476	12.	1.0	11.6	476	12.00
12	1114.3	14.1	39	42	81	427	14.	0.9	12.5	384	12.60

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SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company	Osage Drilling Company	Lease	Ballard E	Well No.	4
	Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.	
	1102.0 - 1114.5	11.7	27.0	316.24	
			</		

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Osage Drilling Company Lease Ballard F Well No. 4

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			
1	1102.4	14.0	30	326	2	22	28	60	14	0.60	45
2	1103.5	14.3	55	610	15	166	40	46	22	0.86	35
3	1105.2	12.5	45	436	7	68	38	56	26	1.25	40
4	1106.2	11.1	33	284	2	17	31	66	8	0.80	50
5	1107.3	13.3	30	310	0	0	30	56	0	Imp.	-
6	1108.3	15.9	40	493	4	49	36	52	170	4.40	20
7	1109.4	13.0	41	414	2	20	39	52	16	1.14	35
8	1110.7	16.1	31	387	0	0	31	65	136	3.60	20
9	1111.4	13.8	38	407	0	0	38	60	128	3.20	25
10	1112.2	12.4	32	308	0	0	32	52	0	Imp.	-
11	1113.5	14.6	42	476	0	0	42	49	46	1.67	30
12	1114.3	14.2	39	430	0	0	39	50	14	0.80	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.

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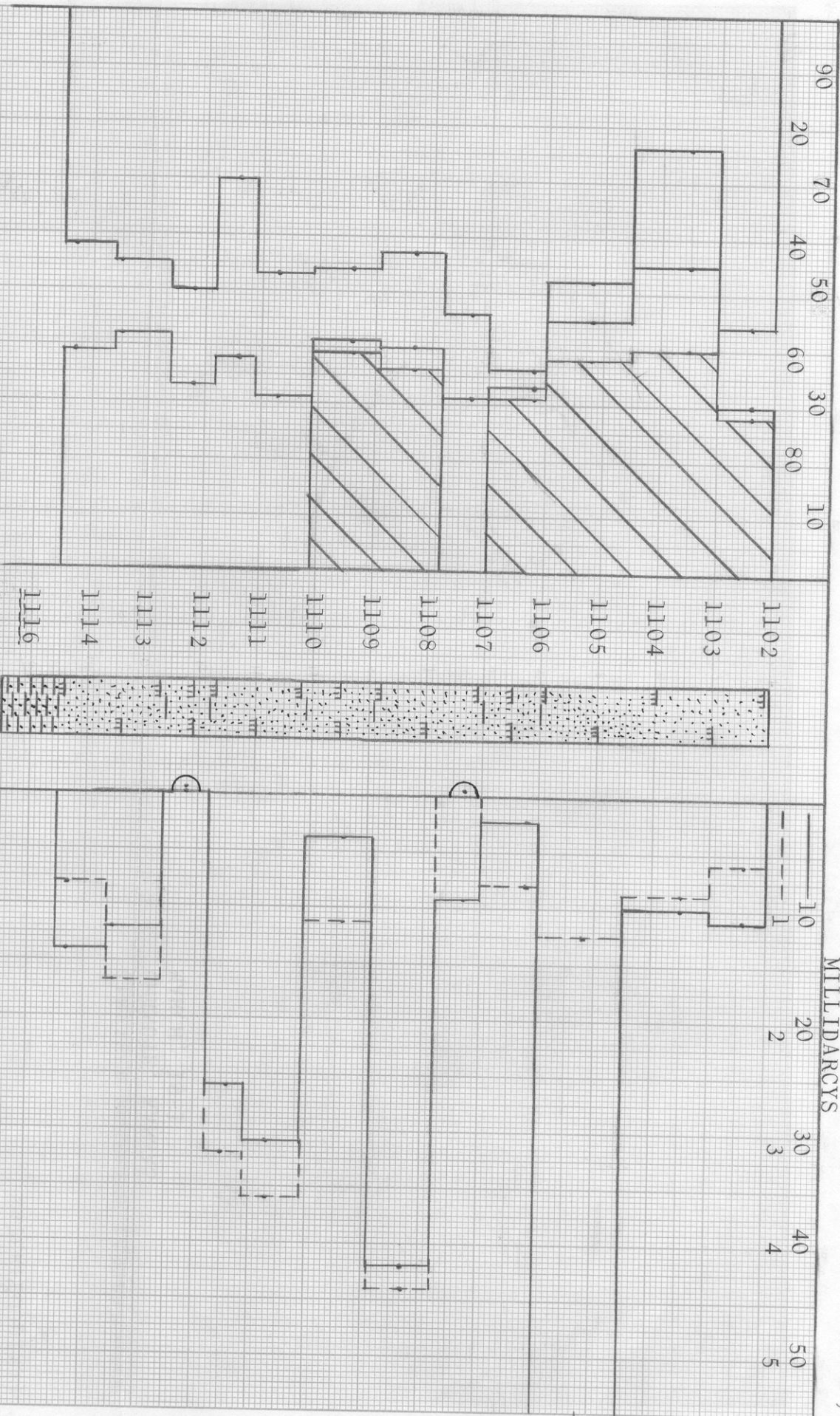
SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company	Osage Drilling Company	Lease	Ballard E	Well No.	4
Depth Interval, Feet	1102.0 - 1114.5				
Feet of Core Analyzed	7.3				
Average Percent Porosity	13.5				
Average Percent Original Oil Saturation	41.9				
Average Percent Oil Recovery	6.0				
Average Percent Residual Oil Saturation	35.9				
Average Percent Residual Water Saturation	54.6				
Average Percent Total Residual Fluid Saturation	90.5				
Average Original Oil Content, Bbls./A. Ft.	441.				
Average Oil Recovery, Bbls./A. Ft.	64.				
Average Residual Oil Content, Bbls./A. Ft.	377.				
Total Original Oil Content, Bbls./Acre	3,218.				
Total Oil Recovery, Bbls./Acre	468.				
Total Residual Oil Content, Bbls./Acre	2,750				
Average Effective Permeability, Millidarcys	1.48				
Average Initial Fluid Production Pressure, p.s.i.	37.5				

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

WATER SAT., PERCENT → OIL SAT., PERCENT



KEY:



SANDY SHALE



CALCAREOUS SANDSTONE



SHALY CALCAREOUS SANDSTONE



FLOODPOT RESIDUAL OIL SATURATION



IMPERMEABLE TO WATER

PERMEABILITY, IN MILLIDARCS
--- EFFECTIVE PERMEABILITY TO WATER, IN MILLIDARCS

OSAGE DRILLING

CHAUTAUQUA COUNTY, KANSAS

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE PERCENT POROSITY	AVG. OIL SATURATION PERCENT	AVG. WATER SATURATION PERCENT	AVERAGE PERMEABILITY, MILLIDARCYS	CALCULATED OIL RECOVERY BBLs. / ACRE
1102.0 - 1114.5	12.5	13.7	39.4	45.2	27.0	1280

(PRIMARY AND
WATERFLOODING)

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CHANUTE, KANSAS
MARCH, 1981

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