OILFIELD RESEARCH LABORATORIES

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

May 12, 1977

Glenn Caldwell
Box 42
Garnett, Kansas 66032

Dear Mr. Caldwell:

Enclosed herewith is the report of the analysis of the Rotary core taken from the North Unit Lease, Well No. 23, Anderson County, Kansas, and submitted to our laboratory on May 3, 1977.

Your business is greatly appreciated.

Very truly yours,

OILFIELD RESEARCH LABORATORIES

Carl L. Pate

CLP:vm
4 c to Garnett, Kansas

Oilfield Research Laboratories

GENERAL INFORMATION & SUMMARY

Company Glenn Caldwell Lease North Unit Well No. 23

Location SW SE NE NE

Section 4 Twp. 21S Rge. 21E County Anderson State Kansas

Name of Sand	Bartlesville
Top of Core (Received)	719.0
Bottom of Core	755.0
Top of Pay Sand	720.5
Bottom of Pay Sand	744.2
Total Feet of Permeable Sand (Analyzed)	32.0
Total Feet of Floodable Sand	16.1

Distribution of Permeable Sand:

Permeability Range Millidarcys	Feet	Cum. Ft.
0 - 5	11.8	11.8
5 - 20	10.9	22.7
20 - 40	2.3	25.0
40 - 80	3.0	28.0
80 & above	4.0	32.0

Average Permeability Millidarcys	65.7
Average Percent Porosity	19.9
Average Percent Oil Saturation	46.4
Average Percent Water Saturation	42.8
Average Oil Content, Bbls./A. Ft.	724.
Total Oil Content, Bbls./Acre	23,471.
Average Percent Oil Recovery by Laboratory Flooding Tests	11.8
Average Oil Recovery by Laboratory Flooding Tests, Bbls./A. Ft.	203.
Total Oil Recovery by Laboratory Flooding Tests, Bbls./Acre	3,266.
Total Calculated Oil Recovery, Bbls./Acre	
Packer Setting, Feet	
Viscosity, Centipoises @	
A. P. I. Gravity, degrees @ 60 °F	
Elevation, Feet	

A salt water mud was used as a circulating fluid in the coring of the sand in this well. The sand reservoir, from which this core was taken, has been repressured with water. The core was sampled by the client.

FORMATION CORED

The detailed log of the formation cored is as follows:

Depth Interval, Feet	Description
719.0 - 720.5	Light brown very shaly sandstone.
720.5 - 723.0	Light brown shaly sandstone.
723.0 - 728.2	Light brown very shaly sandstone.
728.2 - 728.7	Brown slightly shaly sandstone.
728.7 - 731.7	Light brown laminated shaly sandstone.
731.7 - 734.8	Brown fine grained sandstone.
734.8 - 735.0	Gray sandy shale.
735.0 - 737.3	Light brown fine grained sandstone.
737.3 - 737.7	Brown conglomeratic sandstone.
737.7 - 738.4	Sandy conglomerate.
738.4 - 742.6	Dark brown slightly shaly sandstone.
742.6 - 742.8	Gray sandy shale.
742.8 - 744.2	Dark brown sandstone.
744.2 - 745.7	Dark slightly carbonaceous sandstone.
745.7 - 755.0	Dark gray carbonaceous sandstone.

Coring was started at a depth of 719.0 feet in light brown very shaly sandstone and completed at 755.0 feet in dark gray carbonaceous sandstone. This core shows a total of 34.9 feet of sandstone. For the most part, the pay is made up of fine grained shaly sandstone.

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 6.6, 165.9, and 22.6 millidarcys respectively; the overall average being 65.7 (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 0.99 to a maximum of 593. millidarcys.

PERCENT SATURATION & OIL CONTENT

The sand in this core shows a good weighted average percent oil saturation, namely, 46.4. The weighted average percent oil saturation of the upper, middle and lower sections is 40.9, 44.4, and 56.6 respectively. The weighted average percent water saturation of the upper, middle, and lower sections is 44.8, 44.7, and 37.7 respectively; the overall average being 42.8 (See Table III). This gives an overall weighted average total fluid saturation of 89.2 percent.

The weighted average oil content of the upper, middle, and lower sections is 559, 700, and 985 barrels per acre foot respectively; the overall average being 724. The total oil content, as shown by this core, is 23,471 barrels per acre of which 14,801 barrels are in the pay sand section. (See Table III).

LABORATORY FLOODING TESTS

Part of the sand in this core responded rather well to laboratory flooding tests, as a total recovery of 3,266 barrels of oil per acre was obtained from 16.1 feet of sand. The weighted average percent oil saturation was reduced from 41.1 to 29.3, or

represents an average recovery of 11.8 percent. The weighted average effective permeability of the samples is 6.22 millidarcys, while the average initial fluid production pressure is 14.1 pounds per square inch (See Table V).

By observing the data given in Table IV, you will note that of the 34 samples tested, 17 produced water and oil. This indicates that approximately 50 percent of the sand represented by these samples is floodable pay sand. The tests also show that the sand has a wide variation in effective permeability.

CONCLUSION

Inasmuch as the sand reservoir has been subjected to water repressuring, no calculated oil recovery value is given, as there are too many unknown factors.

The core shows a shaly sand section having a good oil saturation, a moderate water saturation, a good porosity, and a wide variation in permeability. Laboratory flooding tests show that the pay sand section extends from a depth of 720.5 to 744.2 feet.

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RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Glenn Caldwell Lease North Unit Well No. 23

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	719.5	18.7	50	43	93	726	1.7	~~1.0~~	1.0	726	1.70
P-2	720.4	-	-	-	-	-	1.8	~~6.5~~	1.5	-	0.90
2	720.6	18.9	33	42	75	484	-	~~0.5~~	2.0	242	-
3	721.5	20.7	33	43	76	530	26.	1.0	3.0	530	26.00
4	722.5	21.5	47	26	73	784	18.	1.0	4.0	784	18.00
5	723.5	17.9	50	42	92	695	2.6	~~1.0~~	5.0	695	2.60
6	724.5	14.5	33	63	96	371	3.7	~~1.0~~	6.0	371	3.70
7	725.5	15.5	51	46	97	613	4.2	~~1.0~~	7.0	613	4.20
8	726.5	12.7	27	70	97	266	0.31	~~1.0~~	8.0	266	0.31
9	727.5	18.3	41	44	85	582	8.4	~~1.2~~	9.2	698	10.08
10	728.5	19.8	46	43	89	707	13.	0.5	9.7	353	6.50
11	729.5	15.9	44	39	83	543	1.4	~~1.3~~	11.0	706	1.82
12	730.5	17.8	40	35	75	553	0.99	~~1.0~~	12.0	553	0.99
13	731.5	16.1	32	47	79	400	3.1	~~0.7~~	12.7	280	2.17
14	732.5	20.2	51	34	85	799	20.	1.3	14.0	1039	26.00
15	733.5	21.5	41	39	80	684	60.	1.0	15.0	684	60.00
16	734.5	18.7	40	43	83	580	12.	0.8	15.8	464	9.60
17	735.5	18.8	45	40	85	656	42.	1.0	16.8	656	42.00
18	736.5	18.2	51	40	91	720	19.	1.0	17.8	720	19.00
19	737.2	22.3	41	55	96	709	296.	0.3	18.1	213	88.80
F-19	737.4	19.5	42	-	-	636	-	0.4	18.5	254	-
20	738.5	17.7	54	42	96	742	16.	0.6	19.1	445	9.60
21	739.5	22.7	40	56	96	705	593.	1.0	20.1	705	593.00
22	740.5	20.0	42	55	97	652	15.	1.0	21.1	652	15.00
23	741.5	20.2	45	51	96	705	58.	1.0	22.1	705	58.00
24	742.5	22.8	40	53	93	708	553.	0.6	22.7	425	331.80
25	743.5	22.4	42	54	97	730	408.	1.4	24.1	1022	571.20
26	744.5	22.8	52	42	94	920	9.1	~~0.8~~	24.9	736	72.80
27	745.5	24.2	54	43	97	1014	84.	0.7	25.6	710	58.80
28	746.5	23.2	51	45	96	918	4.2	~~1.3~~	26.9	1193	5.46
29	747.5	23.9	50	44	94	927	13.	1.0	27.9	927	13.00

Oilfield Research Laboratories

RESULTS OF SATURATION & PERMEABILITY TESTS

TABLE 1-B

Company Glenn Caldwell Lease North Unit Well No. 23

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.		
30	748.5	20.8	57	38	95	920	4.8	~~1.0~~	28.9	920	4.80
31	749.5	25.8	65	29	94	1301	14.	1.0	29.9	1301	14.00
32	750.5	20.4	53	44	97	839	1.8	~~1.0~~	30.9	839	1.80
33	751.5	21.7	63	24	87	1061	14.	1.0	31.9	1061	14.00
34	752.5	19.8	64	31	95	983	14.	1.0	32.9	983	14.00

Oilfield Research Laboratories

SUMMARY OF PERMEABILITY & SATURATION TESTS

TABLE III

Company Glenn Caldwell Lease North Unit Well No. 23

Depth Interval, Feet	Feet of Core Analyzed	Average Permeability, Millidarcys	Permeability Capacity Ft. x Md.
719.0 - 731.7	12.2	6.6	79.87
731.7 - 744.2	11.0	165.9	1824.90
744.2 - 753.0	8.8	22.6	198.66
719.0 - 753.0	32.0	65.7	2103.43

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
719.0 - 731.7	12.2	17.4	40.9	44.8	559	6,817
731.7 - 744.2	11.4	20.4	44.4	44.7	700	7,984
744.2 - 753.0	8.8	22.5	56.6	37.7	985	8,670
719.0 - 753.0	32.4	19.9	46.4	42.8	724	23,471

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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Glenn Caldwell Lease North Unit Well No. 23

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	719.5	18.7	50	726	0	0	50	43	726	0	Imp.	-
2	720.6	21.0	33	537	11	179	22	68	358	115	3.60	15
3	721.5	20.7	33	530	0	0	33	43	530	0	Imp.	-
4	722.5	21.1	47	770	18	295	29	63	475	50	1.50	10
5	723.5	19.3	50	748	23	344	27	69	404	9	0.33	15
6	724.5	16.7	33	428	7	91	26	68	337	14	0.50	20
7	725.5	16.1	51	637	0	0	51	48	637	0	Imp.	-
8	726.5	12.7	27	266	0	0	27	70	266	0	Imp.	-
9	727.5	16.4	41	522	0	0	41	51	522	0	Imp.	-
10	728.5	18.5	46	618	13	187	30	69	431	4	0.30	15
11	729.5	15.9	44	543	0	0	44	39	543	0	Imp.	-
12	730.5	17.8	40	593	0	0	40	35	553	0	Imp.	-
13	731.5	16.1	32	432	0	0	32	47	400	0	Imp.	-
14	732.5	21.2	51	839	18	296	33	60	543	20	0.90	10
15	733.5	23.4	41	744	10	181	31	69	563	89	4.80	20
16	734.5	20.7	40	643	12	193	28	71	450	133	5.80	15
17	735.5	18.6	45	649	19	274	26	73	375	9	0.40	10
18	736.5	20.3	51	803	20	315	31	69	488	12	0.50	15
19	737.4	19.5	42	636	4	61	38	54	575	15	0.70	25
20	738.5	21.5	54	901	11	184	43	56	717	165	6.40	10
21	739.5	23.5	40	730	12	219	28	69	511	380	68.72	5
22	740.5	21.8	42	710	7	118	35	65	592	51	2.30	15
23	741.5	21.2	45	740	13	214	32	67	526	202	9.00	10
24	742.5	22.1	40	686	9	154	31	69	532	186	8.00	15
25	743.5	23.7	42	773	2	37	40	59	736	52	2.40	25
26	744.5	22.8	52	920	0	0	52	42	920	0	Imp.	-
27	745.5	24.2	54	1014	0	0	54	43	1014	0	Imp.	-
28	746.5	23.2	51	918	0	0	51	45	918	0	Imp.	-
29	747.5	23.9	50	927	0	0	50	44	927	0	Imp.	-

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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RESULTS OF LABORATORY FLOODING TESTS

TABLE IV

Company Glenn Caldwell Lease North Unit Well No. 23

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.			
30	748.5	20.8	57	920	0	0	57	38	920	0	Imp.	-
31	749.5	25.8	65	1301	0	0	65	29	1301	0	Imp.	-
32	750.5	20.4	53	839	0	0	53	44	839	0	Imp.	-
33	751.5	21.7	63	1061	0	0	63	24	1061	0	Imp.	-
34	752.5	19.8	64	983	0	0	64	31	983	0	Imp.	-

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.

Oilfield Research Laboratories

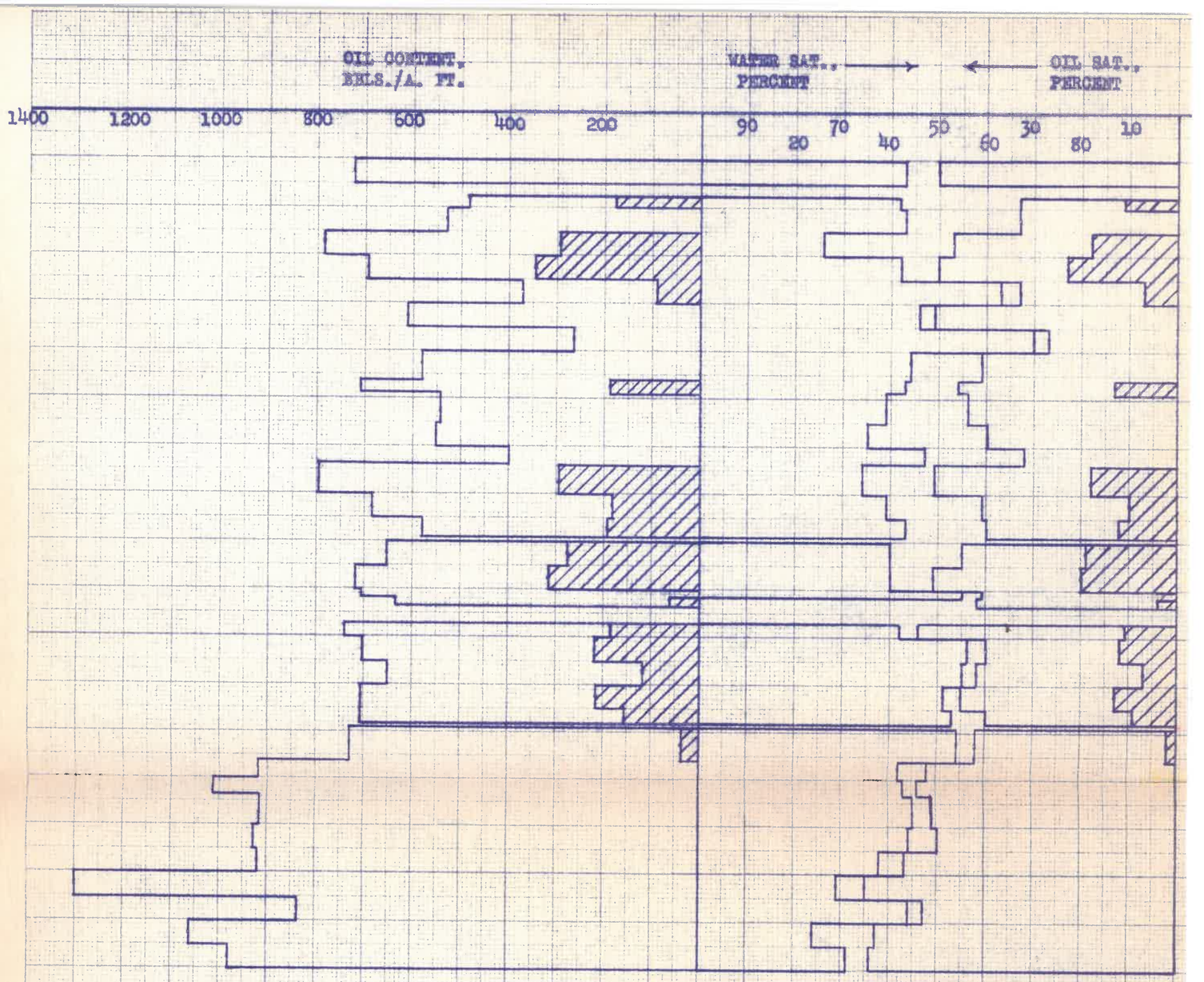
SUMMARY OF LABORATORY FLOODING TESTS

TABLE V

Company Glenn Caldwell Lease North Unit Well No. 23

Depth Interval, Feet	719.0 - 731.7	731.7 - 744.2	719.0 - 744.2
Feet of Core Analyzed	4.0	12.1	16.1
Average Percent Porosity	19.2	19.9	19.7
Average Percent Original Oil Saturation	42.0	40.9	41.1
Average Percent Oil Recovery	15.0	10.8	11.8
Average Percent Residual Oil Saturation	27.0	30.1	29.3
Average Percent Residual Water Saturation	67.1	60.0	61.8
Average Percent Total Residual Fluid Saturation	94.1	90.1	91.1
Average Original Oil Content, Bbls./A. Ft.	630.	702.	684.
Average Oil Recovery, Bbls./A. Ft.	228.	195.	203.
Average Residual Oil Content, Bbls./A. Ft.	402.	507.	481.
Total Original Oil Content, Bbls./Acre	2,522.	8,484.	11,006.
Total Oil Recovery, Bbls./Acre	912.	2,354.	3,266.
Total Residual Oil Content, Bbls./Acre	1,610.	6,130.	7,740.
Average Effective Permeability, Millidarcys	0.94	7.96	6.22
Average Initial Fluid Production Pressure, p.s.i.	16.9	13.2	14.1

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



KEY:

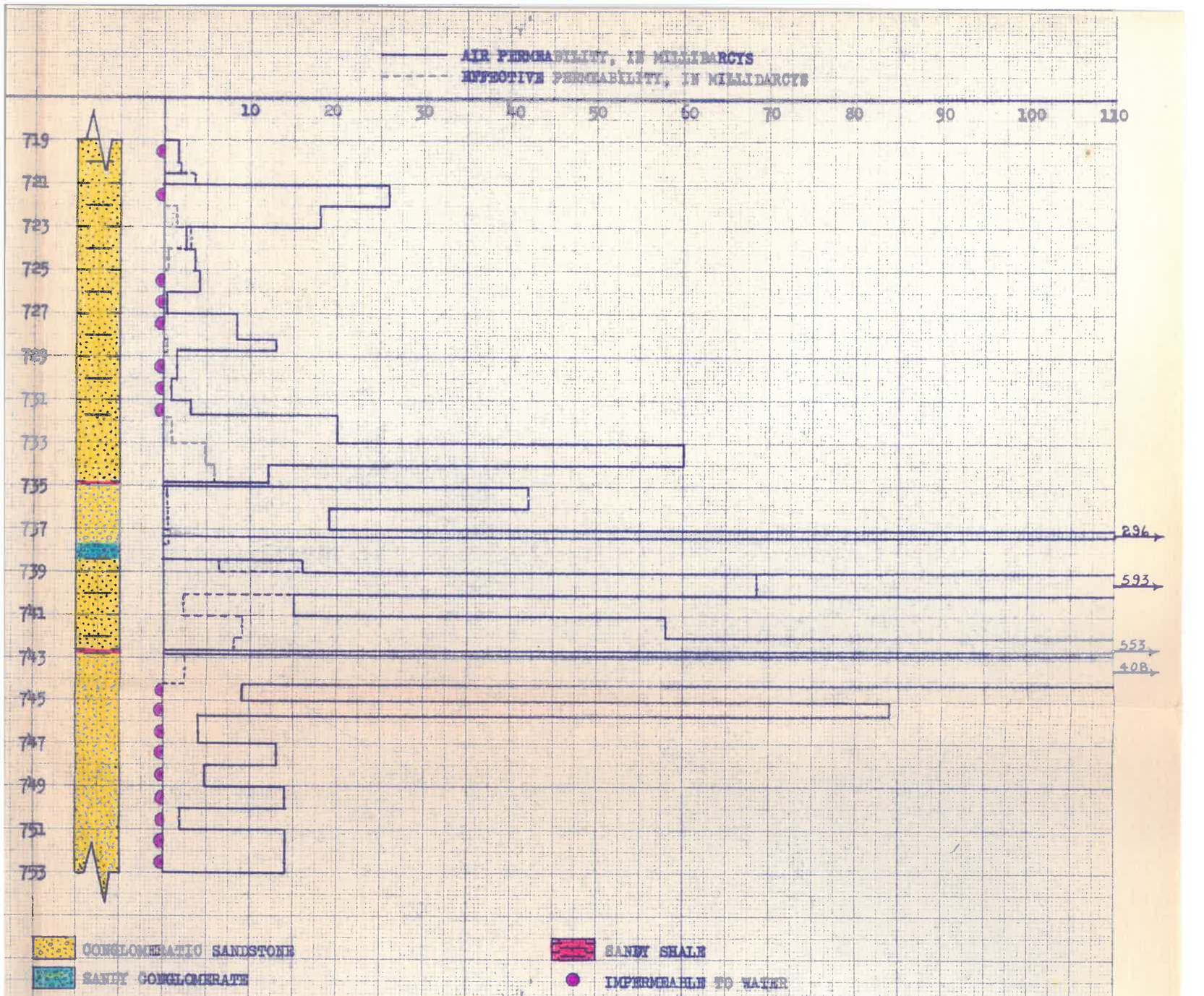
- FLOOD POT RECOVERY
- SANDSTONE
- SHALY SANDSTONE
- CARBONACEOUS SANDSTONE

GLENN

NORTH UNIT LEASE

ANDERS

DEPTH INTERVAL, FEET	FEET OF CORE ANALYZED	AVERAGE PERCENT POROSITY	AVG. OIL SATURATION PERCENT
719.0 - 731.7	12.2	17.4	40.9
731.7 - 744.2	11.4	20.4	44.4
744.2 - 753.0	8.8	22.5	56.6
719.0 - 753.0	32.4	19.9	46.4



CALDWELL

WELL NO. 23

ON COUNTY, KANSAS

AVG. WATER SATURATION PERCENT	AVG. OIL CONTENT BBLS./A.FT.	TOTAL OIL CONTENT BBLS./ACRE	AVG. AIR PERMEABILITY, MILLIDARCYS	CALCULATED OIL RECOVERY BBLS./ACRE
44.8	559	6,817	6.6	
44.7	700	7,984	165.9	
37.7	985	8,670	22.6	
42.8	724	23,471	65.7	

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CHANUTE, KANSAS
MAY, 1977.