

AMSTUTZ AND YATES, INC.

Petroleum Engineers and Geologists

406 KFH BUILDING

WICHITA 2, KANSAS

March 16, 1953

Harry Gore
Brown Building
Wichita, Kansas

Re: Electric Log Analysis of, and
Recommendations for Recompletion of,
Harry Gore - Frank Law No. 1
NW NW SW Section 2-T10S-R23W
Graham County, Kansas

Gentlemen:

In answer to your request, we have made a study of the electric log recorded in the subject well, for the purpose of locating thereon any and all porous breaks which from their electrical characteristics appear to deserve testing when the well is recompleted above the "Marmaton Sand", from which it has been producing. You kindly furnished us with copies of the electric log and Mr. James I. Daniel's geological report on the subject well, also copies of electric logs on some wells of the Law Pool. Electric logs on other wells of the pool were supplied from our files. All logs were examined and compared with one another with a view to evaluate more accurately the potentialities of the various breaks present.

The results of our study of the electric log in the subject well are presented on the following pages. The porous breaks and the zones in which they occur are listed and interpreted in the order of decreasing depths.

The depth measurements of the electric log on the subject well were taken from the kelly bushing, the elevation of which is reported to have been 2439 feet above sea level.

MARMATON CONGLOMERATE 4040-4082'

This formation appears to have a very heterogeneous lithological character throughout its extent and to present marked changes in porosity-permeability development from one foot to the next. In the porous intervals, the porosity was found to vary between extreme limits of 8.5 and 19 per cent, and the water saturation between extreme limits of 47 and 85 per

cent. Several shaly streaks are present. These characteristics, the apparent absence of shows in the samples, and the fact that the well is relatively low on structure, all tend to indicate that this formation offers little prospect of producing water-free oil or gas in commercial amounts. It has definitely poorer electrical features and poorer reservoir characteristics than the "Marmaton Sand" now about to be abandoned. It therefore does not appear to deserve testing. If verification of this conclusion is desired however, the intervals most likely to produce some oil and/or gas are from 4049 to 4053, and from 4040 to 4045 feet. These intervals should preferably be tested separately, starting with the lower one.

LANSING-KANSAS CITY GROUP

Several of the limestone beds or "zones" which are found in this group contain potentially oil and/or gas-bearing porous breaks. Comparison of the log in the subject well with the logs in the other wells of the Law Pool shows that the zones preserve substantially the same gross thicknesses throughout the pool and are present in all the wells, while the porosity-permeability development of the porous break or breaks in any one zone varies markedly from well to well. This of course is quite typical of Lansing-Kansas City limes. For the sake of discussion and future reference, the main limestone beds or "zones" have been identified by capital letters. (It should be noted that these capital letters do not necessarily correspond to the capital letters used by John V. Morgan in his paper "Correlation of Radioactive Logs of the Lansing and Kansas City Groups in Central Kansas"). The zones are reviewed herebelow in order of decreasing depths.

Zone L 3932-3944'

A fairly continuous break is present, extending from 3935 to 3939 feet. The net porous-permeable section is $3\frac{1}{2}$ feet. The two-foot interval from 3936 to 3938 feet has a porosity in the 18 to 20 per cent range, and a water saturation in the 34 to 39 per cent range, and appears to have a chance of producing some water-free oil and/or gas, at least initially. The one-foot interval from 3938 to 3939 feet has a porosity ranging from 14.5 to 16 per cent and a water saturation varying from 42 to 46 per cent and may also produce some oil and/or gas, probably with some water. It might be best to limit the perforations to the interval from 3935 to 3938 feet, to retard as much as possible the production of water, but there is

no impervious, acid-resistant barrier between this interval and the lower foot of the porous break, so that perforation and acidization are almost certain to result in the production of some water, along with the oil and/or gas, from the start. This being so, the entire break could be perforated at once, from 3935 to 3939 feet, in order to open the zone more fully.

Zone K 3914-3926'

This zone presents two thin porous breaks with very broken porosity-permeability development from 3916½ to 3918½, and from 3920 to 3923 feet. Both breaks are probably argillaceous to some extent, the shaly material being present both in dispersed form and in very thin streaks. The upper break has an average porosity of 15 per cent, with a water saturation on the order of 40 per cent. The lower break has a porosity of only 8 to 9 per cent with a high water saturation, from 55 to 61 per cent, in its upper two feet (3920-3922 feet), and is probably argillaceous in its lower foot. It is recommended that only the upper break, from 3916½ to 3918½ feet, be exposed through perforations, and acidized. Because of the rather poor characteristics and the argillaceous content of this break, commercial production is doubtful. This conclusion appears confirmed by the results of the drill stem test covering Zone K and the lower part of Zone J. This test, where the tool was opened for one hour, recovered only 10 feet of slightly oil-cut mud and the shut-in bottom hole pressure recorded was zero p.s.i.g. It is believed that the little oil recovered came from the upper break of Zone K.

Zone J 3895-3907'

This zone is mostly composed of dense lime and has very poor porosity-permeability development. It does not deserve testing.

Zone I 3879-3888'

Two thin breaks are present, from 3880 to 3881 and from 3882 to 3884 feet, and have approximately the same porosity, in the 12 to 13.5 per cent range, and the same water saturation, in the 35 to 39 per cent range. Both breaks could be opened together. The remainder of the zone is composed of dense lime. Commercial production from these breaks is questionable.

Zone H 3858-3872'

This zone is mostly composed of dense lime with a few very thin streaks of submarginal porosity. It does not deserve testing.

AMSTUTZ AND YATES, INC.

- 4 -

Zone G 3848-3852 $\frac{1}{2}$ '

This zone is composed of dense lime and does not deserve testing.

Zone F 3818-3847'

The lithology of this zone is complex and is best discussed through the following breakdown:

- 3818-3819 1' Dense lime.
- 3819-3822 3' Lime, probably oolitic, porosity increases from some 15 per cent in the top foot to 20-25 per cent in the lower two feet. Water saturation in excess of 50 per cent. This interval would produce oil and/or gas with considerable amounts of water.
- 3822-3824 2' Lime with poor porosity, predominantly water-bearing.
- 3824-3826 2' Dense lime.
- 3826-3828 2' Argillaceous lime, poor porosity.
- 3828-3833 5' Dense lime with very thin shale streaks.
- 3833-3845 12' Probably chalky lime, with very fine, submarginal porosity. In spite of the deceptively promising MicroLog readings, it is believed that this interval has little chance of producing fluids in commercial amounts, because of its probable chalky character. It might deserve testing however, because of its thickness. It would definitely require an acid treatment.
- 3845-3847 2' Dense lime.

Zone E 3805-3816'

This zone presents fair to good porosity, probably oolitic and/or vugular in nature, from 3805 to 3813 feet. The interval from 3805 to 3809 feet has porosity grading from less than 12 per cent at the top to 22 per cent at the base, and has a water saturation increasing from approximately

40 per cent at the top to 50 per cent or more at the base. These figures indicate that this interval (3805-3809 feet) would produce oil and/or gas, plus water. The interval from 3809 to 3813 feet has an average porosity of 24 per cent and a water saturation in the 60 to 65 per cent range. This interval would produce predominantly water. Since there is no impervious, acid-resistant barrier between the two intervals, there is little chance of limiting water production by perforating the top interval from 3805 to 3809 feet, only. The zone was covered by a drill stem test. The tool was open one hour, and 540 feet of slightly muddy salt water were recovered. Good bottom hole pressure (1150 p.s.i.g.) and flowing pressure (150 p.s.i.g.) were observed. It would appear that this test and the electrical characteristics condemn the zone for commercial production.

Zones D and D' 3792-3794' and 3796-3801'

These are two dense lime stringers.

Zone C 3770-3790'

This zone appears on the electric log as a dense lime with numerous breaks of sub-marginal porosity and several argillaceous streaks. The interval from 3770 to 3775 feet (derrick floor measurements), corresponding to the interval 3772 to 3777 feet on the electric log, was described as consisting of light limestone with a few oil stained crevices. The presence of crevices would explain, at least partly, the poor electrical characteristics of this interval. In spite of these poor characteristics, this interval appears to deserve testing.

Zone B 3759-3766'

This zone appears argillaceous and dense throughout most of its thickness, but has some limited porosity-permeability development in the interval from 3760 to 3762 feet. This interval has a porosity of 9 to 10 per cent, and a water saturation of approximately 45 to 50 per cent. The interval deserves testing in spite of its very limited thickness. It will require an acid treatment. Production will probably be oil and/or gas, plus water.

This zone was drill stem tested in the west offset to the subject well, the Magnolia - Klenk No. 1, NE NE SE of Section 3-T10S-R23W. This well is 6 feet lower structurally on the Lansing-Kansas City than the subject well. The tool was open one hour, and 330 feet of heavily gas and

AMSTUTZ AND YATES, INC.

- 6 -

slightly oil-cut mud, and 330 feet of heavily oil and gas-cut mud were recovered. The bottom hole pressure was 700 p.s.i.g. The fluids recovered in the test came from a two-foot break with a porosity-permeability development slightly superior to the corresponding break in the subject well.

Zone A 3724-3750'

- 3824-3827 3' Argillaceous lime with poor, unsatisfactory porosity-permeability development. Might produce a very small amount of oil and/or gas.
- 3827-3830 3' Essentially dense lime.
- 3830-3832 2' Lime, with marginal porosity. Might produce a very small amount of oil and/or gas, plus water.
- 3832-3850 18' Lime, probably chalky, with numerous argillaceous streaks. Electrical characteristics essentially unsatisfactory for fluid production.

TOPEKA

That section of the Topeka over which the log can be analyzed, from 3590 to 3688 feet, contains several porous breaks which appear predominantly, if not exclusively, water-bearing.

CONCLUDING REMARKS

- 1- The electric log analysis reveals the presence of a number of porous breaks containing some oil and/or gas, with variable water saturations. It is improbable that any of these breaks could produce water-free oil or gas for very long. Most breaks will produce some water from the start. This conclusion is further borne out by the relatively low position of the well on structure.
- 2- Most porous breaks are thin or very thin, and have a broken porosity-permeability development. It is doubtful therefore that any one break can make a commercial well, but it is probable that several of the best breaks can make a small, commercial well.

AMSTUTZ AND YATES, INC.

- 7 -

- 3- Decision as to how many breaks should be exposed through perforations and acidized depends somewhat on the extent to which the operator wishes to go in testing the potentialities of this particular well, and of the area immediately surrounding it.
- 4- Assuming that the operator's desire is more to obtain a small commercial well than to test thoroughly every break present, we would recommend that the following intervals in the Lansing-Kansas City group be opened first, as offering the best chances of production. (All measurements are from the kelly bushing).

<u>Zone</u>	<u>Interval</u>	<u>Probable Production</u>
L	3935-3938	Oil and/or gas, possibly water-free.
	3938-3939	Oil and/or gas, plus water.
		Note: These two breaks cannot be separated.
K	3916-3918	Oil and/or gas, plus water.
I	3880-3884	Oil and/or gas, possibly water-free.
C	3770-3773	Possibly oil and/or gas, plus water.
B	3760-3762	Oil and/or gas, plus water.

We appreciated this opportunity to be of service to you. Kindly let us know if we may be of any further assistance in this matter.

Very truly yours,

AMSTUTZ AND YATES, INC.

L. G. Chombart

L. G. Chombart

LGC:gl