

KEPLINGER LABORATORIES, INC.



A Keplinger Company

August 17, 1983

Cities Service Company
P. O. Box 3908
Tulsa, Oklahoma 74102

Attention: Mr. Jerry Walcott

Re: Overburden Pressure Tests
Well Gano B-3
Grant County, Kansas
Job Number 83-1690-00

Gentlemen:

As requested in your letter of June 22, 1983, we have tested six core plugs from the subject well to measure the effects of overburden pressure on air permeability. Results are summarized on pages 3 and 4.

Sample Nos. 1, 3, and 4 show a considerable reduction in air permeability at the higher net overburden test pressure of 2,500 psia. This is likely due to fracture healing at the higher overburden stress level. For each of these samples, initial water saturation levels are quite high, averaging 77.6 percent pore volume. It is likely that desaturation occurred primarily in the fracture network. Another possible cause of the high initial water saturations can be clay content. If these samples contain relatively large amounts of mixed layered clays, water may be bound within the clay matrix and not mobile. Sample Nos. 2 and 5 show relatively little reduction in air permeability at the higher net overburden test pressure of 2,500 psia and at reasonable initial water saturations of 36.0 and 19.9 percent pore volume, respectively. Sample No. 4 indicates an approximate 50 percent decrease in air permeability at the 2,500 psia net overburden stress level compared to the 250 psia level. This sample also showed an approximate tenfold reduction in air permeability in the presence of a near-irreducible water saturation compared to dry core air permeability.

Core plug samples 1.5-inches in diameter were drilled from the slabbed core material provided by Cities Service personnel. After drilling, core plug samples were cleaned in a Soxhlet extractor using toluene followed by alcohol and dried. Porosity, air permeability, and grain density measurements were completed on the clean and dry samples. Plugs were saturated with saturated and filtered brine containing 49.39 grams of sodium chloride per liter. Each sample was driven to a near-irreducible water saturation by using a porous plate capillary pressure cell at 200 psig. At the near-irreducible water saturation, plugs were mounted in a core holder and air permeabilities were determined at 250 psia net overburden pressure and then at 2,500 psia net overburden pressure. Results are presented in tabular form.

The conditions under which this report is presented are described immediately following the report. Please contact us if you have any questions concerning these data or if we may be of further service.

Respectfully submitted,

KEPLINGER LABORATORIES, INC.

Keplinger Laboratories, Inc.

FES:pw

KEPLINGER LABORATORIES, INC.

LAB

CORE LABORATORIES, INC.

Petroleum Reservoir Engineering

MP CITIES SERVICE COMPANY FILE NO 2402-11194
 GANO NO. B-3 DATE 3/16/92
 FORMATION SUTTON ELEV
 COUNTY GRANT STATE KANSAS CORREL FLD WATER BASE NO. CORES
 LOCATION SEC. 23-28S-36W

CORRELATION COREGRAPH

This graph is to be used for correlating logs of different cores from the same well.
 The logs should be plotted on the same scale and the correlation lines drawn.
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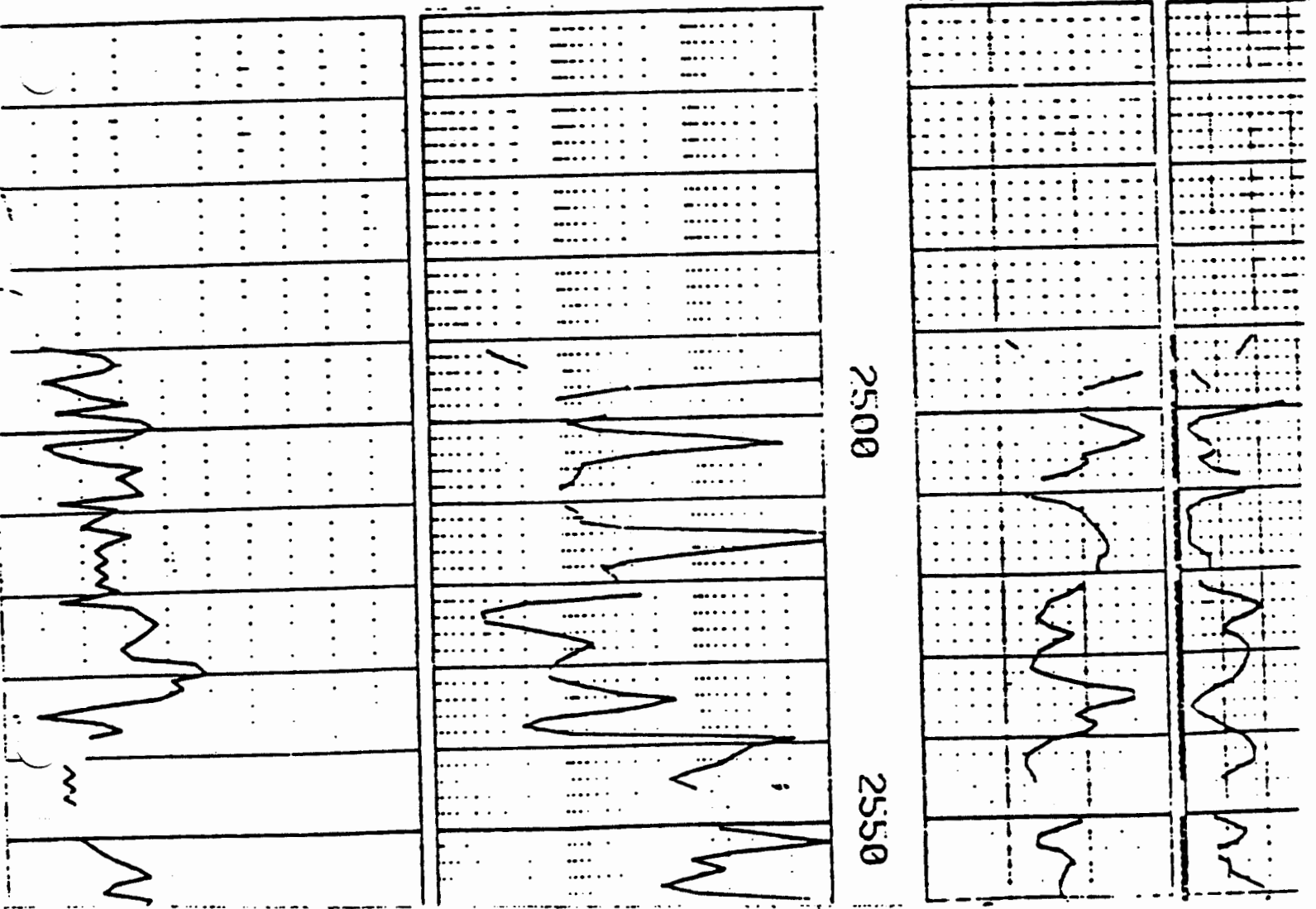
Total Water
 PERCENT PORE
 100 80 60 40

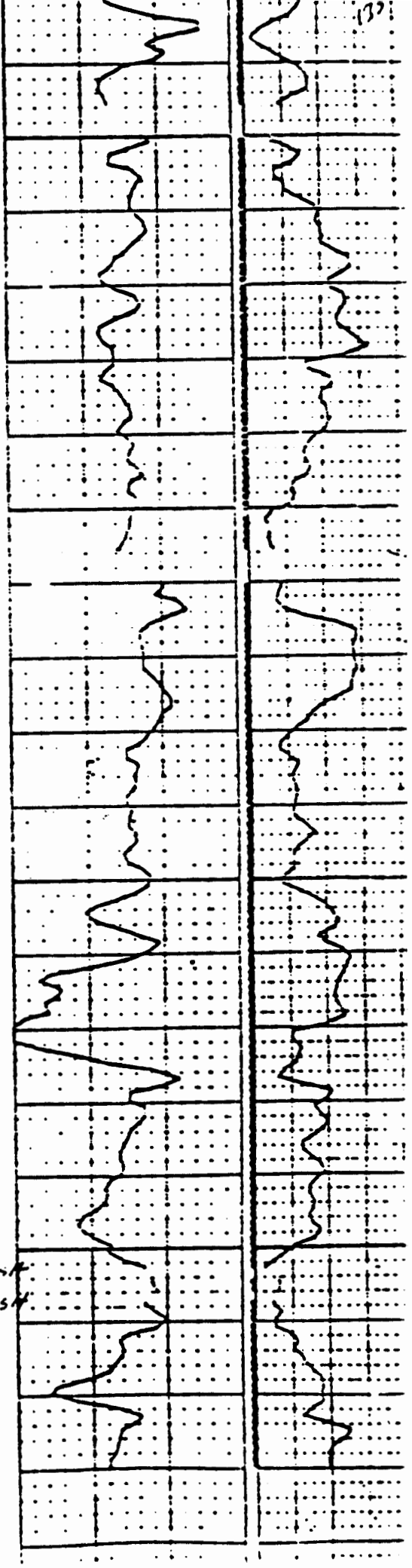
Oil Saturation
 PERCENT PORE
 0 20 40 60

Gamma Ray
 RADIATION INCREASE

Permeability
 MILLIDARIES
 1000 100 10

Porosity
 PERCENT
 30 20 10 0



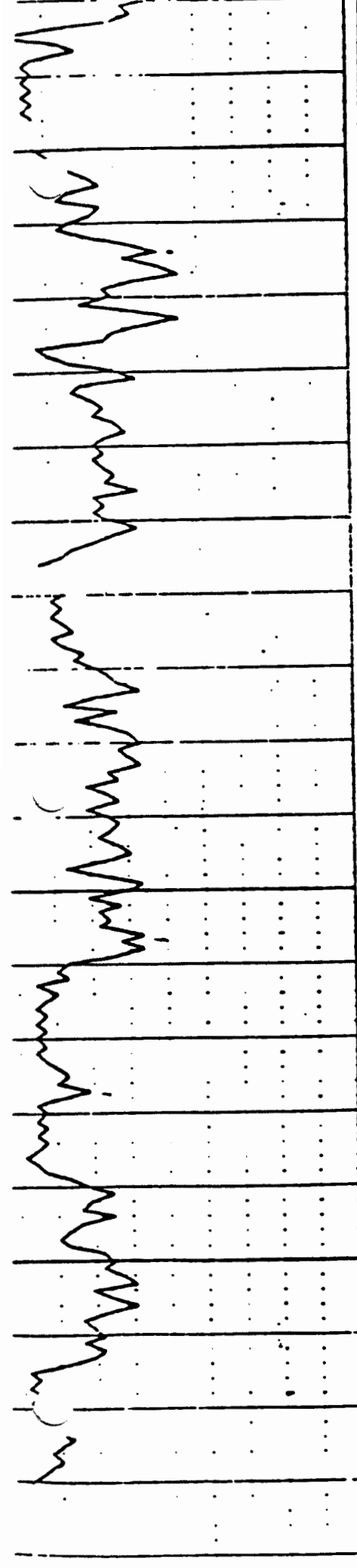
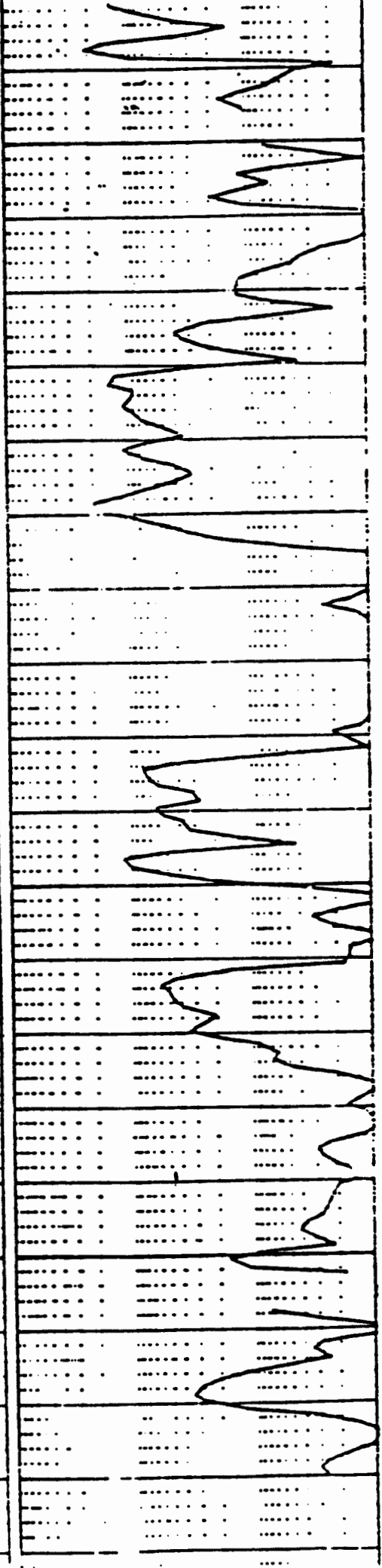


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2600

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ROUTINE CORE ANALYSIS RESULTSCITIES SERVICE COMPANY
WELL GANO B-3
GRANT COUNTY, KANSAS

<u>Sample Number</u>	<u>Depth, Feet</u>	<u>Air Permeability, md</u>	<u>Porosity, Percent</u>	<u>Grain Density, gm/cc</u>	<u>Remarks</u>
1	2,519.4	19.5	5.8	2.74	ls., lt. gry., hi. frac. <i>Wichita</i>
2	2,542.3	8.84	20.0	2.81	Ss., tan., v.f. grn. to <i>Ballwin</i> silty., v. calc.
3	2,545.7	17.9	10.4	2.78	Sltst., dk. gry., silty. <i>Ballwin</i> calc., lam., frac.
4	2,562.7	0.0753	9.9	2.86	ls., dk. gry., vug. gyp. <i>Krida</i>
5	2,566.8	2.01	16.8	2.84	ls., med. gry. vug. gyp. <i>Krida</i>
6	2,588	0.0077	9.2	2.67	Ss., rdsh. brn., v.f. grn. <i>Cd.</i> calc., frac.

OVERBURDEN PRESSURE EFFECTS ON PERMEABILITY

CITIES SERVICE COMPANY
WELL GANO B-3
GRANT COUNTY, KANSAS

Sample Number	Depth, Feet	Dry Core Air Permeability, md	Initial Water Saturation, Percent	Air Permeability at S_{wi} , md	
				250 psig Overburden	2,500 psig Overburden
1	2,519.4	19.5	80.8*	3.90	0.00091
2	2,542.3	8.84	30.0	5.32	5.17
3	2,543.7	17.9	76.2*	2.36	0.00011
4	2,562.7	0.0753	47.3	0.00748	0.00341
5	2,566.8	2.01	19.9	1.20	1.09
6	2,588	0.00769	75.7*	0.000094	0.000031

*These samples were fractured. Saturation measurements probably reflect saturation change mainly in the fracture porosity.

CONDITIONS AND QUALIFICATIONS

Keplinger Laboratories, Inc. will endeavor to provide accurate and reliable laboratory measurements of the cores provided by the client. The results of any core analysis are necessarily affected by the condition in which the core is received and the selection of the samples to be analyzed. In the absence of direction by the client, Keplinger Laboratories, Inc. will utilize their best geological and engineering judgment in selecting the samples to be analyzed. It should be recognized that most cores do not have uniform properties and that selection of truly representative samples is rarely possible. Unless otherwise directed, the samples will normally be selected from the highest quality segments. Thus, use of the properties measured in this report in reservoir calculations could result in an overestimation in reservoir volume and/or deliverability. Keplinger Laboratories, Inc. assumes no responsibility nor offers any guarantee of the productivity or performance of any oil or gas well or hydrocarbon recovery process based upon the data presented in this report.

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KEPLINGER LABORATORIES, INC.

CITIES SERVICE
INTEROFFICE LETTER

July 18, 1983

TO: J. Vairogs
FROM: E. M. Withjack *EW*
SUBJECT: Special-Flow Tests for Gano B-3, Grant Co., Kansas

The objectives of the special-flow tests for Gano B-3 were to provide permeability measurements for three plug samples (two carbonate and one siltstone) under the following conditions: 1) minimum confining pressure (conventional air permeability), 2) air permeability at a low confining pressure with immobile water present, and 3) air permeability at a confining pressure of 2500 psi with immobile water present. These objectives were not completely satisfied because of either sample breakage during testing or the low permeability of the rock.

Table 1 shows the results from the samples which were able to undergo testing. Sample No. 2 is the only sample which was successfully tested for all three objectives. A fracture along the entire length of Sample No. 8 contributed to its high permeability. The plug split during saturation, thus no data were taken with immobile water present. The low permeability of Sample No. 3 did not permit measuring the air permeability, in a reasonable period of time, at a low confining pressure with immobile water present.

ch

Attachment

cc: J. C. Lockett
C. J. Mundis
V. W. Rhoades