

Al Froetschner
Sec. 18-21s-17w
Pawnee Co., Ks

Hollibart
Lab
Report

NORTHERN NATURAL GAS COMPANY
and
ASPEN DRILLING COMPANY

Proctschner No. 1

1' Sample Krider 2074-84

75-1' " s Winfield 2104-07
(3) 2110-20
2132-42

6" Sample Hydro (X)
2112-13 FEET

Copy Data

Robert Klein

May

DATA FOR F11-NO35-73

CHEMICAL RESEARCH AND DEVELOPMENT DEPARTMENT

HALLIBURTON SERVICES
DUNCAN, OKLAHOMA

F. H. C.

LABORATORY REPORT

No. F11-N035-73

Mr. M. L. Klein

Date November 16, 1973

Halliburton Services

Wichita, Kansas

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We give below results of our examination of five sacks of formation core pieces which were
from full diameter cores with an approximate total length of two feet.

Submitted by Core Laboratories, Inc. for Northern Natural Gas Company
and Aspen Drilling Company

Marked Well: Froetschner No. 1 (Wildcat Gas Well)

Location: Pawnee County, Kansas
NE, SW, NW, Sec. 18 T21 S-R17W

Depth: 2075-76 feet Krider Formation
2104-13 feet Winfield Formation

BHT Range: 75-80°F

Purpose

Formation core pieces from the two formations in the above described well were submitted for laboratory evaluation from the Fracturing Section. Also, tests were requested with acid base fluids from the Chemical Services Section. The results of the test with acid base fluids will be reported under number S30-A055-73.

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Discussion

Fracture Flow Capacity Tests indicated higher capacity than that recorded for medium hard cores used for basic fracture design data.

The piece of core selected from the 2110 to 2111 foot zone indicated higher air permeability values than for the adjacent piece used by Core Laboratories, Inc. This is to be expected since the lithology changes in the submitted cores are abrupt and erratic.

Acid Solubility values were high and the Immersion Tests indicated acid was detrimental. This was indicated by the noted partial disintegration of the cores in 7 1/2 percent MCA after overnight saturation.

The sodium chloride content of all five cores measured extremely high. The usual range is 150 to 250 mg. salt per 100 grams of core.

The Fluid Flow Tests indicated no reduction in permeability after the flow of two percent potassium chloride water, fresh water or ALCOGEL 320 base fluid.

There is a possibility that the apparent increase in flow of all three test fluids after 24 hours is due to the desolving of sodium chloride from the matrix of the rock. Water sensitive mixed layer clay was detected in all five cores but its presence did not appear to reduce the matrix fluid conductivity values. One possibility is that the clays are in isolated areas of the rock matrix and are not contacted by the injected fluid.

DataCore Analysis

No.	Depth feet	Porosity %	Air Permeability		Solubility* %	Salt Content, mg. Salt/100 gm. Core
			Horizontal, md Initial	Final		
1	2075-76	-	-	-	92.0	1550
2A	2105-06	-	0.02	-	49.5	780
2B	2105-06	7.7	0.03	-	-	-
2C	2105-06	-	0.03	-	-	-
3A	2110-11	-	17.4	21.9	62.0	2250
3B	2110-11	-	40.2	-	-	-
3C	2110-11	30.0	14.7	35.6	-	-
3D	2110-11	-	21.9	35.7	-	-
4A	2112-13	-	2.0	-	76.5	2720
4B	2112-13	Test Plug Fractured		-	-	-
4C	2112-13	3.5	0.19	-	-	-
4D	2112-13	-	0.01	-	-	-
5	2141-42	-	-	-	69.5	2210

NOTE: Final permeability values were determined after Fluid Flow Tests and 16 hour drying time in laboratory oven at 130°F.

* This is solubility in 15% hydrochloric acid as calcium carbonate only.

Immersion Tests

Effects of immersion under vacuum at 85°F for one hour in the following:

No.	Depth feet	Fresh Water	10% NaCl	2% KCl	2% Clay-Fix	7 1/2% MCA	6% HF	Kero- sene	Mix- ture*
2	2105-06	V-SAF	NFR	NFR	NFR	MAF	V-SAF	NFR	NFR
3	2110-11	SAF	SAF	SAF	SAF	MAF	SAF	NFR	V-SAF
4	2112-13	SAF	SAF	SAF	SAF	MAF	SAF	NFR	V-SAF

Additional damage from 7 1/2% MCA was noted after immersion overnight. This damage (shown below) is partly due to the solubility in HCl acid.

2	2105-06	PD
3	2110-11	PD
4	2112-13	PD

NFR = No fines released.

V-SAF = Very small amount fines.

SAF = Small amount fines.

MAF = Moderate amount fines.

PD = Partially disintegrated.

* Mixture: 30% Methanol-70% (2%) Potassium Chloride Water.

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Data (Cont'd)X-Ray Diffraction Analysis

Depth, feet Sample Number	2075-76 1	2105-06 2*	2110-11 3	2112-13 4	2141-42 5
	<u>Quantitative, percent</u>				
Quartz	3.0	36.0	18.0	14.0	8.0
Feldspar	-	-	5.0	3.0	-
Calcite	-	38.0	-	-	7.0
Dolomite	92.0	12.0	56.0	78.0	62.0
Illite	2.0	4.0	-	-	7.0
Mixed Layer Clay	3.0	10.0	21.0	5.0	16.0

* This is analysis of bulk sample, however, a white material in the natural fractures was evaluated and identified as quartz and sodium chloride.

Fracture Flow Capacity Tests

Core depth: 2141-42 feet
 Core marked: 5
 Closure pressure: 1500 psig (assumed)

<u>Mesh Size</u>	<u>Type Propping Agent</u>	<u>Fracture Concentration (lb/sq. ft.)</u>	<u>Calculated Flow Capacity (md-ft)</u>
20-40	Brady Sand	1.00	2,141
20-40	Brady Sand	2.50	5,634
20-40	Brady Sand	4.00	7,585
10-20	Brady Sand	1.00	7,546
10-20	Brady Sand	2.50	13,275
10-20	Brady Sand	4.00	20,100

Data (Cont'd)Fluid Flow Tests

Core area: 4.337 cm²
 Core length: 2.54 cm
 Core depth: No. 3 - 2104-13 feet
 Test temperature: 85°F
 Test pressure: 20 psig

Core No.	Fluid Flowed	Average Flow Rate (ml/min)	
		Initial	Final
3A	2% Potassium Chloride Water	1.67	1.85
3C	Fresh Water	1.59	1.90
3D	ALCOGEL 320 (Base Fluid)	1.58	2.72

Prior to the initial flow period, the core plugs were saturated in the test fluid for 90 minutes under vacuum at room temperature. The plugs were then immersed in their respective fluids for 24 hours before the final (reverse) flow rate.

Remarks

The data in this report was given to Mr. M. L. Klein by Mr. John Morgan during a telephone conversation on November 14, 1973.

Data Book Reference

The data presented in this report are recorded in Fracturing Book No. 2324, pages 5 & 8; Fracturing Book No. 2254, page 75; Fracturing Book No. 2277, pages 26-27; Fracturing Book No. 2303, pages 26-27; and Analytical Book No. 2297, pages 63 and 67.

The remaining cores from this project were shipped to M. L. Klein as he requested November 14, 1973.

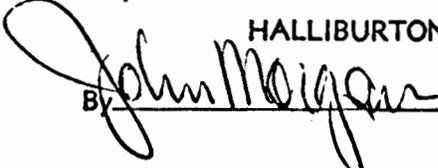
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Respectfully submitted,

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HALLIBURTON SERVICES

By 

CONCLUSIONS CONT'D

The cores as submitted appeared homogeneous with the exception of some anhydrite nodules in the core. Generally, formations of this solubility range will not produce adequate fracture flow capacity. If the insoluble fines stay on the fracture face, they effectively reduce much further reaction. If they are removed from the fracture face by turbulence, they are then present in the fracture as massive amounts of fines.

The suspending additive, HC-2, generally is not effective in removing fines of these quantities.

It is recommended that treatments with suitable fracturing fluids (non-acid) containing proppants be considered in fracturing treatment of these wells. Refer to Halliburton Services Fracturing Services Report F11-N035-73 for additional core information and fracturing recommendations.

DATA

Quantitative X-ray Analysis (Percent)

	<u>#1 (20)</u> <u>2075-76'</u>	<u>#2 (35)</u> <u>2105-06'</u>	<u>#3 (40)</u> <u>2110-11'</u>
Quartz	3	36	18
Feldspar	--	--	5
Calcite	--	38	--
Dolomite	92	12	56
Illite	2	4	--
Mixed Layer Clays	3	10	21
Solubility*	92%	49.5%	62%
	<u>#4 (42)</u> <u>2112-13'</u>	<u>#5 (61)</u> <u>2141-42'</u>	
Quartz	14	8	
Feldspar	3	--	
Calcite	--	7	
Dolomite	78	62	
Illite	--	7	
Mixed Layer Clays	5	16	
Solubility*	76.5%	69.5%	

*Solubility by weight loss in 15% HCl after 2 hours at 78°F.

DATA CONT'D

Released Fines Test with Excess Core

Large chunks of cores were immersed in 15% HCl using excess core. After the acid was spent and/or until all reaction had stopped. The excess fines were washed off the core chunks with water. The solids were then weighed to determine the amount of fines released.

Conditions:

Temperature-----78°F
 Acid Volume-----150 ml
 Contact Time-----60 minutes

Results:

<u>Core Number and Depth</u>	<u>Fines Released (lbs/1000 gal. acid)</u>
1 (20) 2075-76'	640
2 (35) 2105-06'	440
3 (40) 2110-11'	860
4 (42) 2112-13'	1120
5 (61) 2141-42'	55*

*The acid on Core #5 was not completely spent. It appeared to reach a stable condition with no further reaction noted.

Data contained in Book #2231, page 48 and Book #2297, page 63.

cc: Mr. W. T. Malone
 Mr. R. M. Lasater
 Mr. F. N. Harris
 Mr. J. B. McCalla, Jr. ✓
 Mr. R. P. Thompson

Respectfully submitted,

Laboratory Analyst

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By *S. E. Fredrickson*

S. E. Fredrickson

CHEMICAL RESEARCH AND DEVELOPMENT DEPARTMENT

HALLIBURTON SERVICES
DUNCAN, OKLAHOMA

Acid base

LABORATORY REPORT

No. S30-A055-73

Mr. Marvin Klein

Date November 15, 1973

Halliburton Services

Wichita, Kansas

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Give below results of our examination of the submitted cores.

Submitted by Mr. Marvin Klein for Aspen Drilling Co.

Worked _____

Aspen Drilling Co.
Froetschner No. 1
Herington-Krider Formation Wildcat
Pawnee Co., Kansas

<u>Core No.</u>	<u>Depth</u>
1 (20)	2075-76'
2 (35)	2105-06'
3 (40)	2110-11'
4 (42)	2112-13'
5 (61)	2141-42'

PURPOSE

These cores were submitted for analysis and an acid treatment recommendation.

CONCLUSIONS

X-ray analysis indicated that Cores #1, 3-5 were major dolomite with Core #2 being primarily calcite with a large amount of quartz. HCl solubility varied from 92% in Core #1 to 49.5% in Core #2, with the average overall solubility approximately 70%.

The released fines test indicated that a very large amount of fines would be present in a fracture after treatment. These fines could effectively reduce the fracture flow capacity developed by the acid.

*→ Fracture acid
(M.R. Klein)*

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