

A. RESERVOIR FLUID STUDY

For

PETRUS OIL COMPANY
Henshaw Federal #1
Wildcat
Eddy County, New Mexico

BEFORE EXAMINER CATANACH
OIL CONSERVATION DIVISION

PETRUS EXHIBIT NO. 9

CASE NO. 9241



CORE LABORATORIES

October 19, 1987

PETRUS OIL COMPANY
12377 Merit Drive
Suite 1600
Dallas, Texas 75251

Attention: Mr. Mike Erwin

Subject: Reservoir Fluid Study
Henshaw Federal #1 Well
Wildcat
Eddy County, New Mexico
File: RFLM 87090

Gentlemen:

Samples of separator liquid and vapor were collected from the subject well on October 12, 1987 and submitted to our Midland laboratory facilities for use in a reservoir fluid study. Presented in the following report are the results of this study as requested by Petrus Oil Company.

Using the factors shown on page one, the producing gas/liquid ratio was calculated to be 13,798 cubic feet of separator gas at 15.025 psia and 60°F. per barrel of stock tank liquid at 60°F. The separator liquid shrinkage factor was determined experimentally in the laboratory and the producing ratio was found to be equivalent to 13172 standard cubic feet of separator gas per barrel of separator liquid at 38 psig and 63°F. The separator products were then physically recombined in this gas/liquid ratio and the resulting fluid was used for the entire study. The measured hydrocarbon compositions of the separator products were used in conjunction with the producing gas/liquid ratio to calculate the hydrocarbon composition of the well stream material. All of the aforementioned compositional data may be found on page two.

A small quantity of the reservoir fluid was then charged to a high pressure visual cell and thermally expanded to the reported reservoir temperature of 179° F. During a constant composition expansion at this temperature, the fluid exhibited a retrograde dew point at 3873 psig. The results of the pressure-volume measurements at 179°F. maybe found on page three, along with the deviation factor measurements at the dew point pressure and above. the deviation factor versus pressure maybe found graphically on page six.

Visual measurements of the retrograde condensate were performed at several points during a constant composition expansion and at each point during the constant volume depletion at the reservoir temperature. The maximum observed volume of retrograde condensate was 14.2 percent of the hydrocarbon pore space. A tabulation of the retrograde liquid measurements maybe found on page four: a graphical interpretation of these data is given on page five.

PETRUS OIL COMPANY
Henshaw Federal #1 Well
Mr. Mike Erwin

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Thank you for the opportunity to be of service to Petrus Oil Company. Should you have any questions or if we maybe of further assistance in any manner, please feel free to call upon us.

Very truly yours,

CORE LABORATORIES, a division of
WESTERN ATLAS INTERNATIONAL, INC.

Richard Hulme

Richard Hulme
Supervisor
Reservoir Fluid Analysis



CORE LABORATORIES

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PETRUS OIL COMPANY
Henshaw Federal #1 Well
Wildcat

October 12, 1987
Eddy County, New Mexico

FORMATION CHARACTERISTICS

Formation Name	N/A
Date First Well Completed	N/A
Original Reservoir Pressure	N/A psig at N/A ft.
Original Produced Gas/Oil Ratio	N/A SCF/Bbl
Production Rate	N/A Bbls/Day
Separator Pressure and Temperature	38 psig 63°F
Liquid Gravity at 60°F	N/A API
Datum	N/A ft. Subsea

WELL CHARACTERISTICS

Elevation	N/A ft.
Total Depth	N/A ft.
Producing Interval	N/A ft.
Tubing Size and Depth	N/A In. to N/A ft.
Open Flow Potential	N/A MMSCF/Day
Last Reservoir Pressure	4076 psig at N/A ft.
Date	N/A
Reservoir Temperature	179°F at N/A ft.
Status of Well	N/A
Pressure Gauge	N/A

SAMPLING CONDITIONS

Flowing Tubing Pressure	N/A psig
Flowing Bottom Hole Pressure	N/A psig
Primary Separator Pressure	38 psig
Primary Separator Temperature	63°F
Secondary Separator Pressure	No 2° Sep. psig
Secondary Separator Temperature	No 2° Sep. °F
Field Stock Tank Liquid Gravity	59°API at 60°F
Primary Separator Gas Production Rate	1007.3 MSCF/Day
Pressure Base	15.025 psia
Temperature Base	60°F
Compressibility Factor (Fpv)	1.0073
Gas Gravity (Assumed)	0.810
Gas Gravity Factor (Fg)	1.1111
Stock Tank Liquid Production Rate @ 60°F	73 Bbls/Day
Primary Separator Gas/ Stock Tank Liquid Ratio	13798 SCF/Bbl
	or
	72.474 Bbls/MMSCF
Sampled By	Core Laboratories
Remarks:	

HYDROCARBON ANALYSES OF SEPARATOR PRODUCTS AND CALCULATED WELL STREAM

Component	Separator Liquid,		Separator Gas		Well Stream,	
	Mol Percent	Mol %	GPM	Mol Percent	GPM	
Hydrogen Sulfide	0.00	0.00		0.00		
Carbon Dioxide	0.00	0.21		0.20		
Nitrogen	0.01	2.06		1.94		
Methane	1.13	72.84		68.62		
Ethane	0.89	11.41	3.112	10.79	2.879	
Propane	1.96	6.68	1.877	6.40	1.759	
iso-Butane	1.00	1.06	0.354	1.06	0.346	
n-Butane	3.38	2.47	0.794	2.52	0.793	
iso-Pentane	2.73	0.80	0.299	0.91	0.332	
n-Pentane	4.31	0.87	0.321	1.07	0.387	
Hexanes	9.17	0.71	0.281	1.21	0.469	
Heptanes	16.72	0.73	0.313	1.67	0.701	
Octanes	19.71	0.11	0.051	1.27	0.576	
Nonanes	10.49	0.03	0.015	0.65	0.325	
Decanes	6.88	0.01	0.006	0.41	0.223	
Undecanes plus	21.62	0.01	0.006	1.28	0.813	
	100.00	100.00	7.429	100.00	9.603	

Properties of Heptanes plus

API gravity @ 60°F.	50.0		
Density, gm/cc @ 60°F.	0.7788		0.773
Molecular weight	135	98.9	129

Calculated separator gas gravity (air = 1.000) = 0.810

Calculated gross heating value for separator gas = 1399 BTU

per cubic foot of dry gas @ 15.025 psia and 60°F.

Primary separator gas collected @ 38 psig and 63°F.

Primary separator liquid collected @ 38 psig and 63°F.

Primary separator gas/separator liquid ratio = 13172 SCF/Bbl @ 63°F.

Primary separator liquid/stock tank liquid ratio = 1.0475 Bbls @ 63°F./Bbl @ 60°F.

Primary separator gas/well stream ratio = 941.05 MSCF/MMSCF

Stock tank liquid/well stream ratio = 68.20 BBLs/MMSCF

**PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID AT 179°F
(Constant Composition Expansion)**

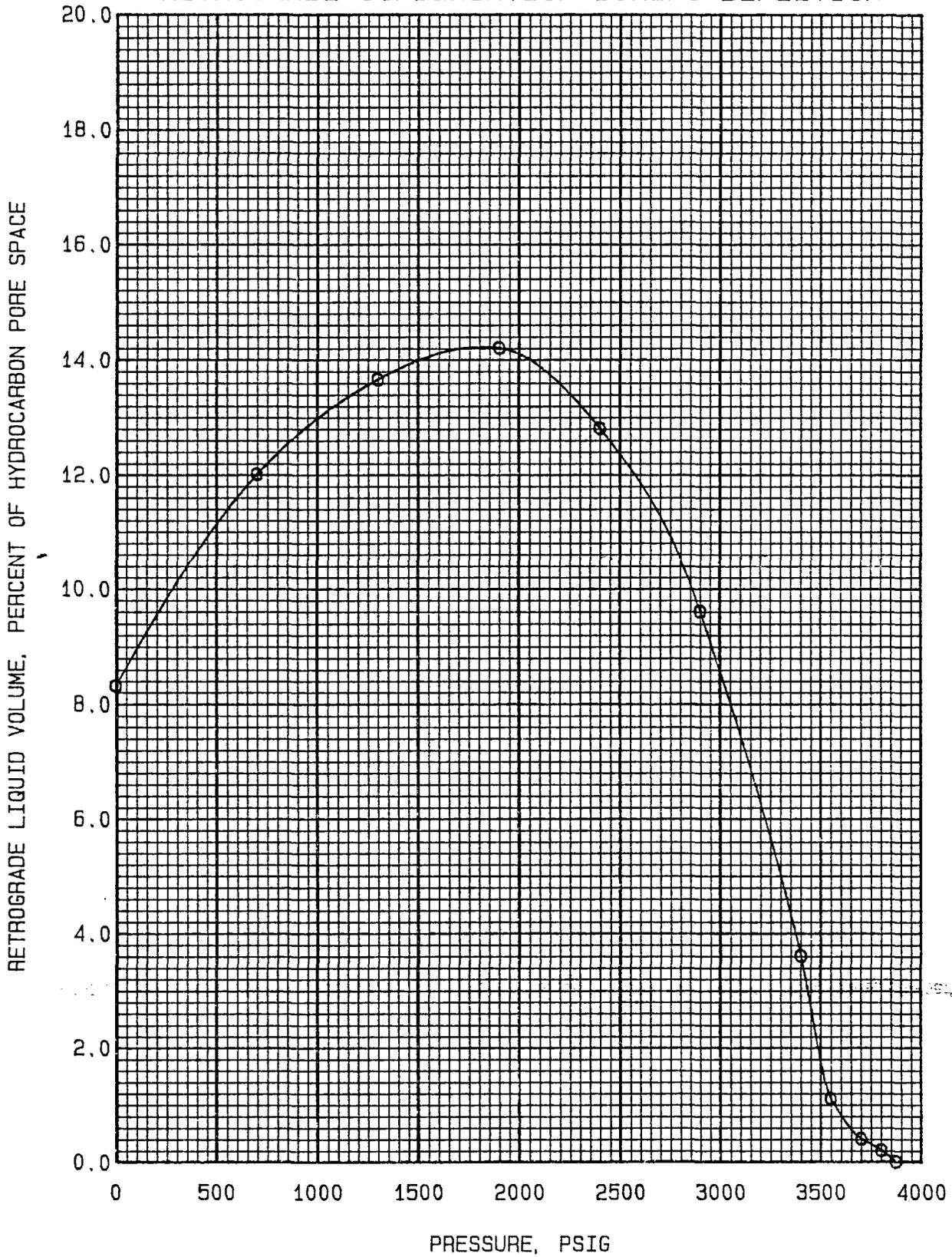
<u>Pressure psig</u>	<u>Relative Volume(1)</u>	<u>Z Factor</u>
5000	0.9002	1.049
4500	0.9357	0.965
4300	0.9536	0.932
4200	0.9635	0.917
4100	0.9733	0.900
4000	0.9844	0.885
3900	0.9963	0.870
3873 Dew Point Pressure	1.0000	0.866
3850	1.0023	
3800	1.0092	
3700	1.0237	
3550	1.0484	
3350	1.0875	
3100	1.1495	
2800	1.2474	
2500	1.3827	
2200	1.5688	
2012	1.7223	
1900	1.8372	
1600	2.2165	
1420	2.5292	
1247	2.9283	
1112	3.3275	

(1) Relative Volume: V/V_{sat} is barrels at indicated pressure per barrel at saturation pressure.

RETROGRADE CONDENSATION DURING GAS DEPLETION AT 179°F

<u>Pressure,</u> <u>PSIG</u>	<u>Retrograde Liquid Volume</u> <u>Percent of Hydrocarbon Pore Space</u>
3873 Dew Point Pressure	0.0
3800	0.2
3700	0.4
3550	1.1
3400 First Depletion Pressure	3.6
2900	9.6
2400	12.8
1900	14.2
1300	13.6
700	12.0
0	8.3

RETROGRADE CONDENSATION DURING DEPLETION



DEVIATION FACTOR Z OF WELL STREAM
DURING DEPLETION AT 179 F.

