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**CORE LABORATORIES, INC.**  
*Petroleum Reservoir Engineering*  
**DALLAS, TEXAS**

December 17, 1953

**RESERVOIR FLUID DIVISION**  
**T. L. KENNERLY, Manager**

Imperial Oil Limited  
Redwater, Alberta, Canada

Attention: Mr. Edward Cutlan

Subject: Reservoir Fluid Study  
Imperial Virden No. 8-28-10-26 Well  
Virden (Roselea) Field  
Manitoba, Canada

Gentlemen:

Presented in this report are the results of laboratory studies performed on subsurface samples collected from the subject well on November 14, 1953.

The saturation pressure was determined to be 140 psig at the reservoir temperature of 87° F. Comparison of this value with the measured reservoir pressure of 961 psig makes apparent the conclusion that the reservoir exists in an undersaturated condition. Prior to further discussion, attention is directed to the reservoir fluid composition reported on page six. The fluid is quite unusual in that methane is almost completely absent while the intermediate materials are present in appreciable quantity. This distribution of components is responsible for much of the somewhat different behavior noted in subsequent studies.

Differential vaporization of the fluid at reservoir temperature resulted in the liberation of 83 standard cubic feet of vapor, measured at 14.7 psia and 60° F., per barrel of residual liquid measured at 60° F. The corresponding formation volume factor was found to be 1.062 barrels of saturated fluid per barrel of residual liquid. The effect of the unusual composition is seen in the graphical data. Approximately 66 per cent of the gas evolution was achieved below 30 psig with a corresponding majority of the shrinkage occurring over the same range. The liquid phase viscosity varied from a value of 3.35 centipoises at saturation

pressure to a maximum of 4.88 centipoises at zero pressure. Again, the major portion of the increase occurred in the final pressure depletion step.

Separator tests were performed at various operating pressures to determine the effect of separation conditions upon the produced fluid. Graphical analysis of these data again indicates the unusual composition. The major changes in all properties have occurred when the separator pressure has increased to 20 psig. Maximum stock tank gravity and yield, per unit of reservoir fluid, occur between 20 and 30 psig. The abrupt change in separator gas-oil ratio with increased pressures is quite apparent.

It has been a sincere pleasure to perform this study for you. If we may prove of assistance in any manner, we would appreciate the opportunity to serve you.

Very truly yours,

Core Laboratories, Inc.

A handwritten signature in dark ink, appearing to read "F. O. Reudelhuber", with a horizontal line extending to the right.

F. O. Reudelhuber,  
Division Engineer

FOR:ma

**CORE LABORATORIES, INC.**  
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**DALLAS, TEXAS**

Page 1 of 10File RFL 249Company Imperial Oil Limited Date Sampled November 14, 1953Well Imperial Virden No. 8-28-10-26 County \_\_\_\_\_Field Virden (Roselea) State Manitoba, Canada**FORMATION CHARACTERISTICS**

Formation Name	<u>Mississippian</u>
Date First Well Completed	<u>August 5</u> , 19 <u>53</u>
Original Reservoir Pressure	_____ PSI @ _____ ft.
Original Produced Gas-Oil Ratio	_____ cu. ft./bbl.
Production Rate	_____ bbl./d.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Oil Gravity at 60° F.	<u>34.8</u> ° API
Datum	<u>630</u> ft. subsea
Original Gas Cap	_____

**WELL CHARACTERISTICS**

Elevation	<u>1464 Ft. K.B., 1453 Ft. C.F.</u>
Total Depth	<u>2105 K.B.</u> ft.
Completion Depth	_____ ft.
Tubing Size and Depth	<u>2.5</u> in. to <u>2079 K.B.</u> ft.
Productivity Index	<u>31</u> bbl./d./PSI @ <u>124</u> bbl./d.
Last Reservoir Pressure	<u>961</u> PSI @ <u>2035 C.F.</u> ft.
Date	<u>November 14</u> , 19 <u>53</u>
Reservoir Temperature	<u>87</u> ° F. @ <u>2035 C.F.</u> ft.
Status of Well	<u>Shut-In 48 Hours</u>
Pressure Gauge	<u>Amerada (CLI)</u>
Normal Production Rate	_____ bbl./d.
Gas-Oil Ratio	_____ cu. ft./bbl.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Base Pressure	_____ PSI Abs.
Well Making Water	_____ % Cut

**SAMPLING CONDITIONS**

Sampled at	<u>2035 Feet C.F.</u>
Status of Well	<u>Shut-In 50 Hours*</u>
Gas-Oil Ratio	_____ cu. ft./bbl.
Separator Pressure and Temperature	_____ PSI, _____ ° F.
Tubing Pressure	<u>230</u> PSI
Casing Pressure	<u>235</u> PSI
Core Laboratories Engineer	<u>N. J. C.</u>
Type Sampler	<u>Perco</u>

**REMARKS:**

\* Well flowed five minutes immediately prior to sampling to bring fresh oil into well bore.

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**VOLUMETRIC DATA OF Reservoir Fluid SAMPLE**

1. Saturation pressure (bubble-point pressure) 140 PSI @ 87 ° F.
2. Thermal expansion of saturated oil @ 5000 PSI =  $\frac{V @ 87^\circ \text{F.}}{V @ 76^\circ \text{F.}} = \underline{1.00550}$
3. Compressibility of saturated oil @ reservoir temperature: Vol./Vol./PSI:
 

From 5000 PSI to 3200 PSI =  $4.77 \times 10^{-6}$   
 From 3200 PSI to 1400 PSI =  $5.35 \times 10^{-6}$   
 From 1400 PSI to 140 PSI =  $6.94 \times 10^{-6}$
4. Specific volume at saturation pressure: cu. ft./# 0.01938 @ 87 ° F.

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**Reservoir Fluid SAMPLE TABULAR DATA**

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION ● 87 ° F., RELATIVE VOLUME OF OIL AND GAS, V/V <sub>SAT.</sub>	VISCOSITY OF OIL ● 87 ° F., CENTIPOISES	DIFFERENTIAL LIBERATION ● 87 ° F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/V <sub>R</sub>
5000	0.9733				1.034
4400	0.9759				1.036
3800	0.9787				1.039
3200	0.9817				1.043
2600	0.9848				1.046
2025		4.00			
2000	0.9880				1.049
1475		3.80			
1400	0.9913				1.053
1100	0.9930				1.055
910		3.61			
900	0.9942				1.056
700	0.9955				1.057
550		3.49			
500	0.9969				1.059
300	0.9984				1.060
280		3.41			
200	0.9994				1.061
140	1.0000	3.35	0	83	1.062
135	1.0011				
129	1.0043				
122	1.0103				
117	1.0195				
110		3.36			
106	1.0429				
96	1.0783				
79	1.1606		8	75	1.061
65	1.2841				
60		3.41			
52	1.5817				
50			15	68	1.060
40	2.0595	3.57			
30			28	55	1.055

V = Volume at given pressure

V<sub>SAT.</sub> = Volume at saturation pressure at the specified temperature.V<sub>R</sub> = Residual Oil Volume at 14.7 PSI absolute and 60° F.

These analyses, opinions or interpretations are based on observations and material supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representations as to the productivity, proper operation, or profitability of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

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Reservoir Fluid **SAMPLE TABULAR DATA**

PRESSURE PSI GAUGE	PRESSURE-VOLUME RELATION ● 87 ° F., RELATIVE VOLUME OF OIL AND GAS, V/V <sub>SAT</sub> .	VISCOSITY OF OIL ● 87 ° F., CENTIPOISES	DIFFERENTIAL LIBERATION ● 87 ° F.		
			GAS/OIL RATIO LIBERATED PER BARREL OF RESIDUAL OIL	GAS/OIL RATIO IN SOLUTION PER BARREL OF RESIDUAL OIL	RELATIVE OIL VOLUME, V/V <sub>R</sub>

27	3.1661				
20		3.83			
0		4.88	83	0	1.014

@ 60° F. = 1.000

Gravity of Residual Oil =

34.9° API @ 60° F.

v = Volume at given pressure

v<sub>SAT</sub> = Volume at saturation pressure at the specified temperature.

v<sub>R</sub> = Residual Oil Volume at 14.7 PSI absolute and 60° F.

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**SEPARATOR TESTS OF Reservoir Fluid SAMPLE**

SEPARATOR PRESSURE, PSI GAUGE	SEPARATOR TEMPERATURE, ° F.	SEPARATOR GAS/OIL RATIO <i>See Foot Note (1)</i>	STOCK TANK GAS/OIL RATIO <i>See Foot Note (1)</i>	STOCK TANK GRAVITY, ° API @ 60° F.	SHRINKAGE FACTOR, V <sub>R</sub> /V <sub>SAT.</sub> <i>See Foot Note (2)</i>	FORMATION VOLUME FACTOR, V <sub>SAT.</sub> /V <sub>R</sub> <i>See Foot Note (3)</i>	SPECIFIC GRAVITY OF FLASHED GAS
0	76	85		34.7	0.9346	1.070	1.4954
10	76	44	22	35.3	0.9515	1.051	
20	70	30	32	35.4	0.9542	1.048	
50	74	9	57	35.1	0.9524	1.050	

- (1) Separator and stock tank Gas/Oil Ratio in cubic feet of gas @ 60° F. and 14.7 PSI absolute per barrel of stock tank oil @ 60° F.
- (2) Shrinkage Factor:  $V_R/V_{SAT.}$  is barrels of stock tank oil @ 60° F. per barrel of saturated oil @ 140 PSI gauge and 87° F.
- (3) Formation Volume Factor:  $V_{SAT.}/V_R$  is barrels of saturated oil @ 140 PSI gauge and 87° F. per barrel of stock tank oil @ 60° F.

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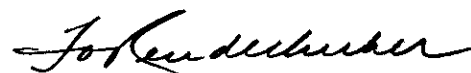
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Company Imperial Oil Limited Formation Mississippian  
 Well Imperial Virden No. 8-28-10-26 County \_\_\_\_\_  
 Field Virden (Roselea) State Manitoba, Canada

**HYDROCARBON ANALYSIS OF Reservoir Fluid SAMPLE**

COMPONENT	WEIGHT %	MOL %	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Methane & Lighter	0.06	0.65			
Ethane	0.88	5.21			
Propane	1.82	7.34			
Iso-butane	0.64	1.96			
N-butane	2.00	6.12			
Iso-pentane	1.33	3.28			
N-pentane	1.22	3.02			
Hexanes	2.90	6.00			
Heavier	89.04	65.84	0.8771	29.7	241
Hydrogen Sulfide	0.11	0.58			
	100.00	100.00			

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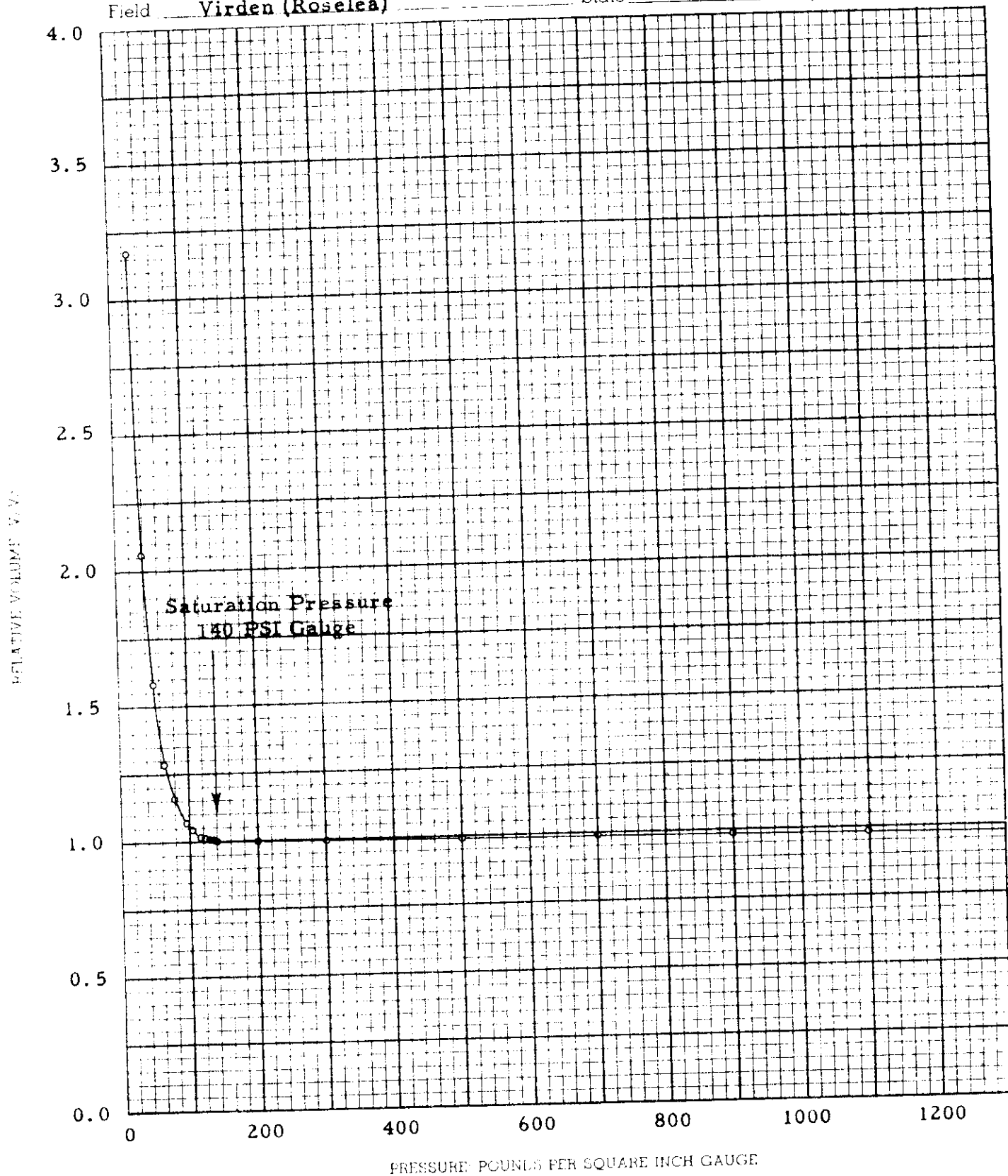


F. O. Reudelhuber



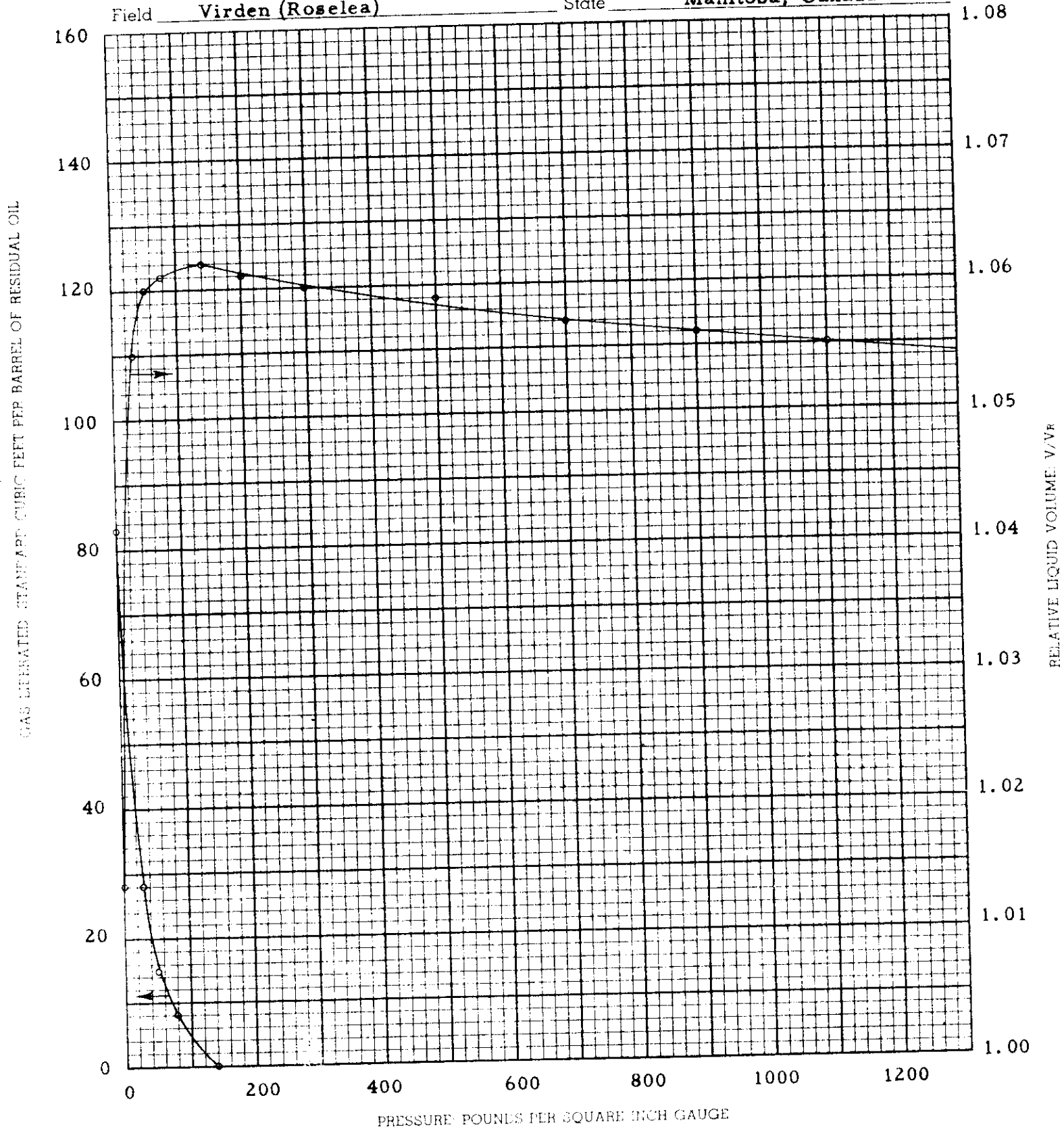
PRESSURE-VOLUME RELATIONS OF RESERVOIR FLUID

Company Imperial Oil Limited Formation Mississippian  
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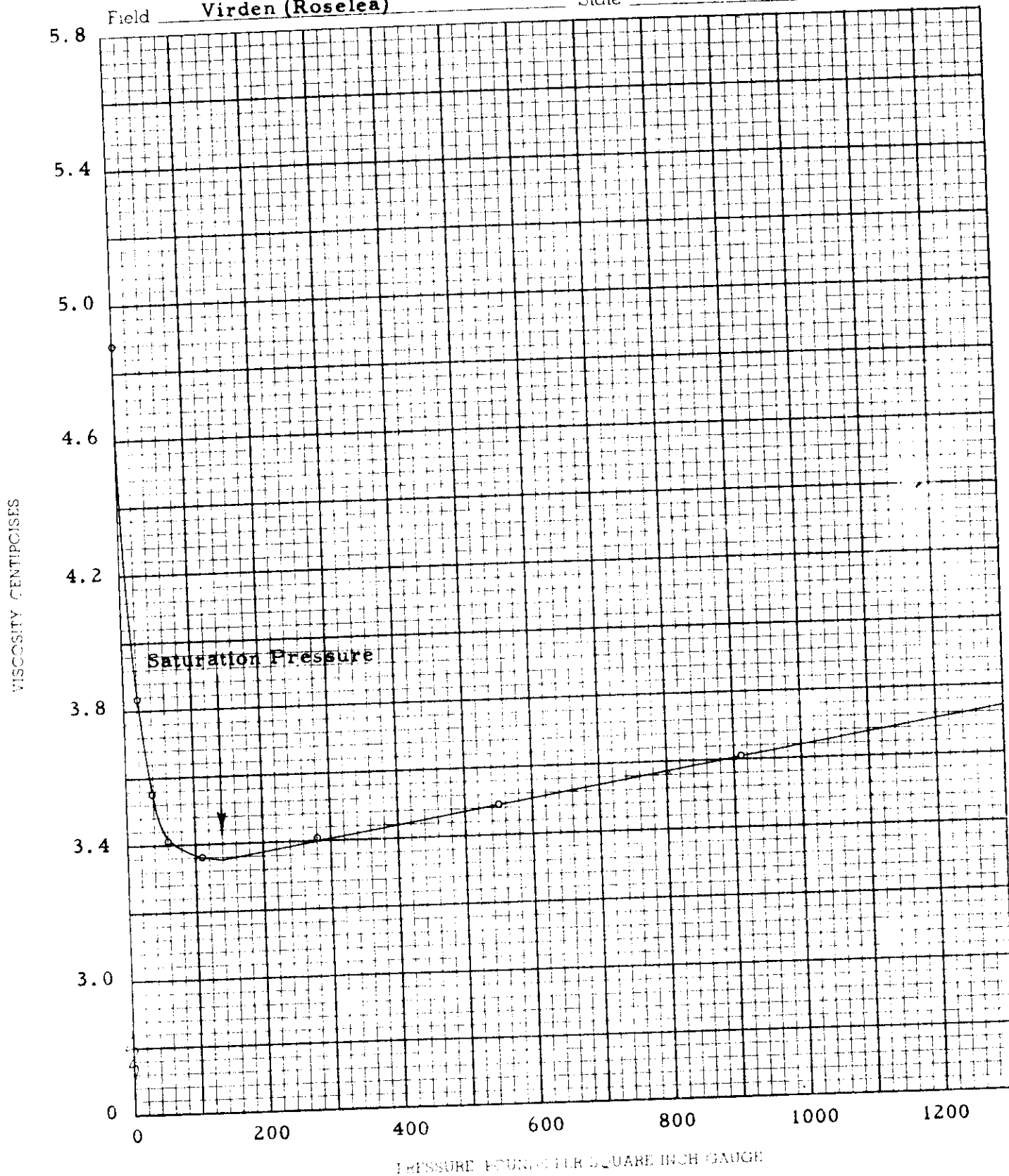
DIFFERENTIAL VAPORIZATION OF RESERVOIR FLUID

Company Imperial Oil Limited Formation Mississippian  
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VISCOSITY OF RESERVOIR FLUID

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