

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

RF

Reservoir Fluid Study
for
STATOIL

Well 15/9 - 1

DST No 1.

Field: Wildcat

WELLFILE

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

December 8, 1977.

Statoil,
Largardsveien 78,
P.O. Box 300,
4001, Stavanger,
Norway.

Attention: Mr. Per Thomassan.

Subject: Reservoir Fluid Study,
Well 15/9-1
DST No 1.
Our File Number: RFLA 77002

Gentlemen:

On June 3, 1977, four subsurface reservoir fluid samples were collected from the subject well and forwarded to our Aberdeen laboratory for use in a reservoir fluid study. Presented in the following report are the results of this study as requested by Statoil.

Cylinder number 1436 (transferred from Flopetrol Sampler Number 139 - 1st run, bottom sample) was used throughout the entire study as requested by your telex reference number 5420/77-A.

The hydrocarbon composition of the subsurface fluid was determined by low temperature fractional distillation. The results of this test in terms of mol per cent and weight per cent are presented on page two. At this time, the extended analysis through pentadecanes plus fractions has not been determined. However, upon completion of these test procedures, a supplementary report will be issued.

A sample of the reservoir fluid was charged to a high-pressure windowed cell and thermally expanded to the reservoir temperature of 244°F. At this temperature, a constant composition expansion was conducted during which the reservoir fluid exhibited a bubble point pressure of 6125 psig. When subjected to differential pressure depletion at the reservoir temperature, the fluid evolved a total of 1101 cubic feet of gas at 14.73 psia and 60°F per barrel of residual oil at 60°F. The resulting relative volume factor was 1.561 barrels of saturated fluid per barrel of residual oil. Further determinations measured at each point during the differential pressure depletion include oil density, and the properties of the evolved gas. A tabulation of the data from the foregoing test procedures is presented on pages three, four, and five. The viscosity of the reservoir fluid was measured over a wide range of pressures at 244°F. in a rolling ball viscosimeter. The viscosity of the fluid was found to vary from a minimum of 0.683 centipoise at the saturation pressure to a maximum of 3.156 centipoise at atmospheric pressure. The results of the viscosity measurements are tabulated on page six.

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Statoil
Well 15/9-1

Page Two

One single-stage separator test was performed at 110°F to determine the effect of separator pressure upon gas-oil ratio, stock tank oil gravity, and formation volume factor. The result of this test is given on page seven. The separator gas analysis is given on page eight.

It has been a pleasure to be of service to Statoil. If you have any questions concerning the report or if we may be of further assistance in any way, please do not hesitate to contact us.

Very truly yours,

Core Laboratories U.K. Limited
Reservoir Fluid Analysis.



JDO/rmb
7cc - Addressee

J.D.Owen
Supervising Engineer.

Company STATOIL Date Sampled _____
 Well 15/9 - 1 DST No.1. County _____
 Field WILDCAT State NORTH SEA.

FORMATION CHARACTERISTICS

Formation Name _____
 Date First Well Completed _____, 19____
 Original Reservoir Pressure _____ PSIG @ _____ Ft.
 Original Produced Gas-Oil Ratio _____ SCF/Bbl
 Production Rate _____ Bbl/Day
 Separator Pressure and Temperature _____ PSIG, _____ °F.
 Oil Gravity at 60° F. _____ °API
 Datum _____ Ft. Subsea
 Original Gas Cap _____

WELL CHARACTERISTICS

Elevation _____ Ft.
 Total Depth _____ Ft.
 Producing Interval _____ Ft.
 Tubing Size and Depth _____ In. to _____ Ft.
 Productivity Index _____ Bbl/D/PSI @ _____ Bbl/Day
 Last Reservoir Pressure _____ PSIG @ _____ Ft.
 Date _____, 19____
 Reservoir Temperature 244 °F. @ _____ Ft.
 Status of Well _____
 Pressure Gauge _____
 Normal Production Rate _____ Bbl/Day
 Gas-Oil Ratio _____ SCF/Bbl
 Separator Pressure and Temperature _____ PSIG, _____ °F.
 Base Pressure _____ PSIA
 Well Making Water _____ % Cut

SAMPLING CONDITIONS

Sampled at _____ Ft.
 Status of Well Shut in 20 hours.
 Gas-Oil Ratio 1053 SCF/Bbl STB
 Separator Pressure and Temperature 230 PSIG, 110 °F.
 Tubing Pressure _____ PSIG
 Casing Pressure _____ PSIG
 Core Laboratories Engineer _____
 Type Sampler Flopetrol.

REMARKS:

Sample used in this analysis was transferred from Flopetrol tool number 139 (1st Run, bottom sample) to Core Laboratory cylinder number 1436

Company STATOIL Formation _____
 Well 15/9-1 DST No. 1. County _____
 Field WILDCAT State NORTH SEA

HYDROCARBON ANALYSIS OF Reservoir Fluid SAMPLE

COMPONENT	MOL PER CENT	WEIGHT PER CENT	DENSITY @ 60° F. GRAMS PER CUBIC CENTIMETER	° API @ 60° F.	MOLECULAR WEIGHT
Hydrogen Sulfide	Nil	Nil			
Carbon Dioxide	3.18	1.47			
Nitrogen	0.39	0.11			
Methane	55.06	9.27			
Ethane	6.98	2.20			
Propane	4.89	2.26			
iso-Butane	0.51	0.31			
n-Butane	1.55	0.94			
iso-Pentane	0.52	0.39			
n-Pentane	0.55	0.42			
Hexanes	2.02	1.82			
Heptanes plus	24.35	80.81	0.9079	24.2	316
	<u>100.00</u>	<u>100.00</u>			

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 profitableness of any oil, gas or other mineral well or sand in connection with which such report is used or relied upon.

VOLUMETRIC DATA OF Reservoir Fluid SAMPLE

1. Saturation pressure (bubble-point pressure) 6125 PSIG @ 244 °F.
2. Specific volume at saturation pressure: ft³/lb 0.02256 @ 244 °F.
3. Thermal expansion of saturated oil @ 6800 PSI = $\frac{V @ 244 \text{ °F}}{V @ 65 \text{ °F}} = \underline{1.101905}$
4. Compressibility of saturated oil @ reservoir temperature: Vol/Vol/PSI:

$$\text{From } \underline{6800} \text{ PSI to } \underline{6610} \text{ PSI} = \underline{12.15 \times 10^{-6}}$$

$$\text{From } \underline{6610} \text{ PSI to } \underline{6420} \text{ PSI} = \underline{13.05 \times 10^{-6}}$$

$$\text{From } \underline{6420} \text{ PSI to } \underline{6280} \text{ PSI} = \underline{13.46 \times 10^{-6}}$$

$$\text{From } \underline{6280} \text{ PSI to } \underline{6125} \text{ PSI} = \underline{14.21 \times 10^{-6}}$$

Pressure-Volume Relations at 224 °F.

<u>Pressure</u> <u>PSIG</u>	<u>Relative</u> <u>Volume (1)</u>	<u>Y</u> <u>Function (2)</u>
6800	0.9912	
6700	0.9923	
6610	0.9934	
6515	0.9947	
6420	0.9959	
6335	0.9970	
6280	0.9978	
6210	0.9987	
6130	0.9997	
<u>6125</u>	1.0000	
6065	1.0019	
5935	1.0059	
5715	1.0140	
5335	1.0285	5.176
4930	1.0483	5.008
4480	1.0744	4.918
4120	1.1020	4.756
3740	1.1379	4.606
3370	1.1830	4.447
2990	1.2455	4.250
2605	1.3333	4.031
2220	1.4597	3.801
1870	1.6375	3.541
1601	1.8270	3.385
1358	2.0710	3.242
1168	2.3322	3.145
1018	2.6064	3.078
905	2.8820	3.015
813	3.1595	2.971
738	3.4574	2.911
671	3.7547	2.886

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

$$(2) Y \text{ Function} = \frac{(P_{sat} - P)}{(P_{abs}) (V/V_{sat} - 1)}$$

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Differential Vaporization at 244 °F.

Pressure PSIG	Solution Gas/Oil Ratio (1)	Relative Oil Volume (2)	Relative Total Volume (3)	Oil Density gm/cc	Deviation Factor Z	Gas Formation Volume Factor (4)	Incremental Gas Gravity
	BAR						
6125	422.3	1101	1.561	0.7100			
5935	409.2	1050	1.540	0.7151	1.056	0.00354	0.826
5450	375.8	942	1.495	0.7241	1.002	0.00365	0.804
4975	343.0	844	1.454	0.7326	0.966	0.00386	0.789
4490	309.6	753	1.417	0.7413	0.936	0.00414	0.767
4010	276.5	668	1.382	0.7497	0.915	0.00453	0.756
3525	243.0	588	1.350	0.7580	0.898	0.00506	0.745
3050	210.3	512	1.319	0.7666	0.890	0.00579	0.735
2570	177.2	437	1.288	0.7758	0.888	0.00685	0.729
2085	143.8	363	1.258	0.7849	0.894	0.00849	0.733
1600	110.3	290	1.228	0.7942	0.908	0.01121	0.740
1100	75.8	217	1.199	0.8034	0.928	0.01660	0.761
600	41.4	142	1.166	0.8144	0.956	0.03101	0.814
200		72	1.133	0.8253	0.984	0.09138	0.966
0		0	1.080	0.8418			1.652

@ 60°F = 1.000

Gravity of Residual Oil = 24.0 API at 60°F.

- (1) Cubic feet of gas at 14.73 psia and 60°F. per barrel of residual oil at 60°F.
- (2) Barrels of oil at indicated pressure and temperature per barrel of residual oil at 60°F.
- (3) Barrels of oil plus liberated gas at indicated pressure and temperature per barrel of residual oil at 60°F.
- (4) Cubic feet of gas at indicated pressure and temperature per cubic foot at 14.73 psia and 60°F.

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Viscosity Data at 244 °F.

<u>Pressure PSIG</u>	<u>Oil Viscosity Centipoise</u>	<u>Calculated Gas Viscosity Centipoise</u>	<u>Oil/Gas Viscosity Ratio</u>
6800	0.748		
6600	0.730		
6400	0.714		
6200	0.691		
6125	0.683		
5935	0.686	0.0354	19.38
5450	0.700	0.0331	21.15
4975	0.749	0.0305	24.56
4490	0.803	0.0278	28.88
4010	0.874	0.0254	34.41
3525	0.951	0.0232	40.99
3050	1.058	0.0212	49.91
2570	1.169	0.0194	60.26
2085	1.314	0.0178	73.82
1600	1.506	0.0164	91.83
1100	1.742	0.0152	114.61
600	2.045	0.0141	145.04
200	2.528	0.0129	195.97
0	3.156	0.0103	306.41

SEPARATOR TESTS OF Reservoir Fluid SAMPLE

Separator Pressure PSI Gauge	Separator Temperature °F	Gas/Oil Ratio (1)	Gas/Oil Ratio (2)	Stock Tank Gravity API @ 60°F	Formation Volume Factor (3)	Separator Volume Factor (4)	Specific Gravity of Flashed Gas
230	110	910	977			1.073	0.713 *
to							
0.	110	77	78	23.8	1.526	1.020	1.130

* Collected in the laboratory and analyzed for hydrocarbons.

- (1) Gas/Oil Ratio in cubic feet of gas @ 60°F. and 14.73 PSI absolute per barrel of oil @ indicated pressure and temperature.
- (2) Gas/Oil Ratio in cubic feet of gas @ 60°F and 14.73 PSI absolute per barrel of stock tank oil @ 60°F.
- (3) Formation Volume Factor is barrels of saturated oil @ 6125 PSI gauge and 244°F. per barrel of stock tank oil @ 60°F.
- (4) Separator Volume Factor is barrels of oil @ indicated pressure and temperature per barrel of stock tank oil @ 60°F.

Company STATOIL Formation _____
 Well 15/9 - 1 DST No.1 County _____
 Field WILDCAT State NORTH SEA

HYDROCARBON ANALYSIS OF Separator GAS SAMPLE

COMPONENT	MOL PER CENT	G P M
Hydrogen Sulfide	Nil	
Carbon Dioxide	4.46	
Nitrogen	0.51	
Methane	79.89	
Ethane	9.36	
Propane	4.04	1.111
iso-Butane	0.45	0.147
n-Butane	0.74	0.233
iso-Pentane	0.18	0.066
n-Pentane	0.19	0.069
Hexanes	0.09	0.037
Heptanes plus	0.09	0.041
	<u>100.00</u>	<u>1.704</u>

Calculated gas gravity (air = 1.000) = 0.713

Calculated gross heating value = 1140 BTU per
 cubic foot of dry gas at 14.73 psia at 60°F.

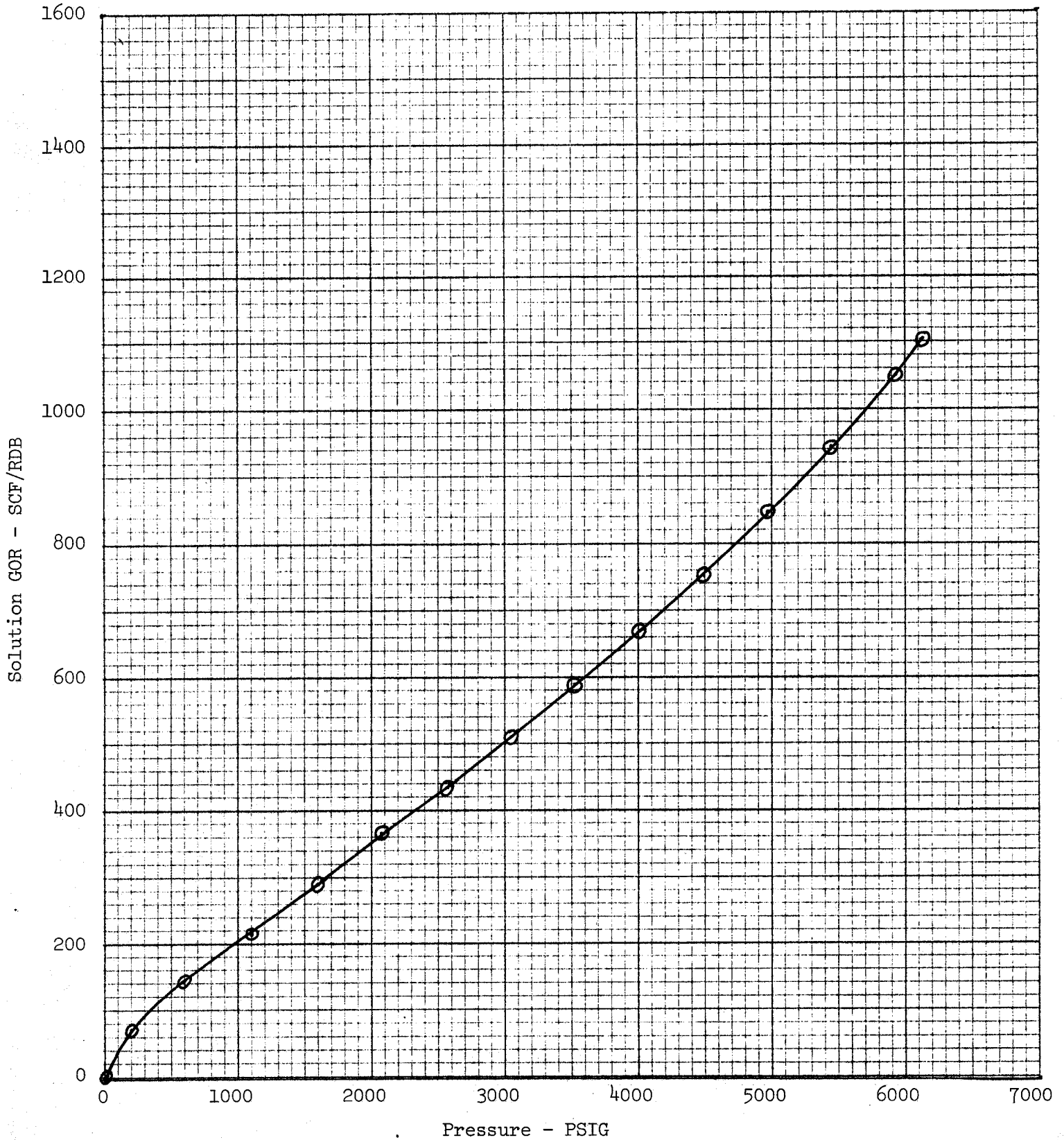
Collected at 230 psig and 100°F in the laboratory.

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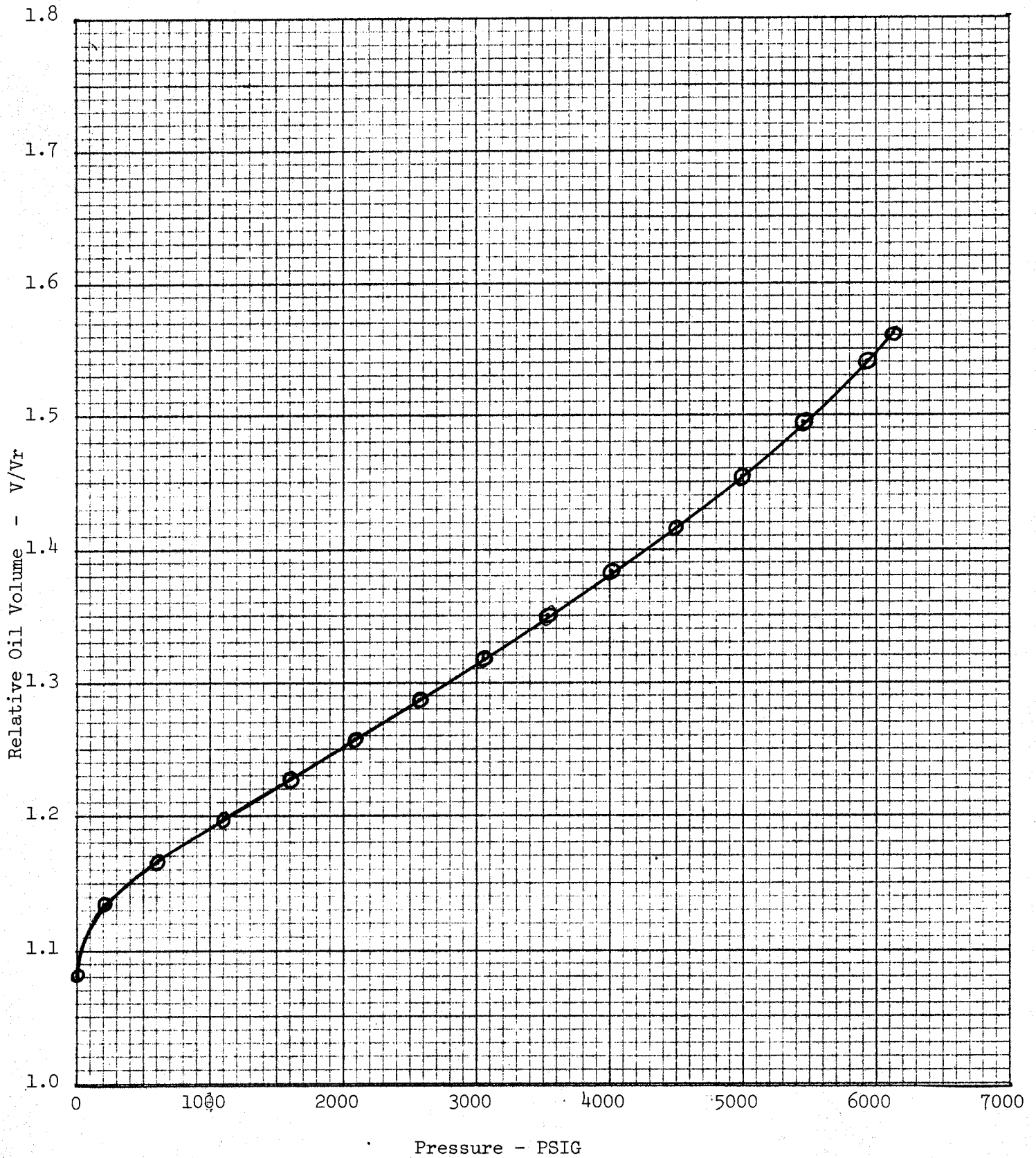
John D. Owen

Supervising Engineer
 Reservoir Fluid Analysis

Solution Gas/Oil Ratio During Differential Vaporization.



Relative Oil Volume During Differential Vaporization.



Viscosity of Reservoir Fluid at 244°F.

