
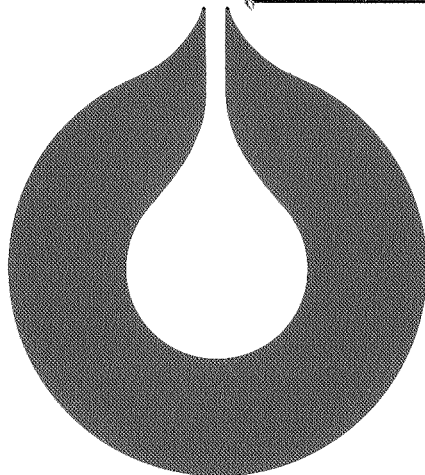


Denne rapport tilhører	 STATOIL
	99.595.274-23
L&U DOK. SENTER	
L. NR.	12483490016
KODE	Well 34/10-17 nr36
Returneres etter bruk	



statoil

PVT analysis of
bottom hole sample from
Well 34/10-17

**STATOIL
EXPLORATION & PRODUCTION
LABORATORY**

by
Otto Rogne

October-83

LAB 83

Den norske stats oljeselskap a.s



Classification

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Subtitle

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Title

PVT analysis of
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LAB 83.54

Prepared

12/10-83

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INTRODUCTION

The present report gives the experimental results of a PVT-analysis carried out on a bottom hole sample from test no. 2 on well 34/10-17, obtained by Stavanger Oilfield Services A/S on June 8, 1983. Sampling details are given on page 3.

The quality of the sample was checked by measuring the bubble point at ambient laboratory conditions and found to be 388 barg (page 4), as compared to a reported field value of 380 barg at approx. 8°C this was considered satisfactory.

A portion of the sample was charged to a high pressure cell at reservoir temperature (106 °C) where the bubble point, relative volumes and compressibility were determined. These results are on page 7.

To determine the reservoir fluid composition a portion of the fluid in the cell was flashed through a laboratory separator at 15°C and atmospheric pressure. The liberated gas and oil were collected, measured and analysed separately by gas chromatography through C₉ with decanes plus fraction. These results are on page 5.

An extended reservoir fluid composition based on the above mentioned flash up to C₉, and from C₁₀ to C₂₀₊ on a TBP distillation of stock tank oil, is given on page 6. The TBP distillation is reported separately.

The remaining sample in the cell was finally differentially liberated through a series of pressure steps with the results shown on page 8. The composition of the liberated gases are on page 9, and the composition of the gas free liquid remaining in the cell at atmospheric pressure on page 10. The gas viscosity were calculated from the gas density according to Lee et.al.

J.Pet.Techn., 997 (1966). A separate portion of the sample was charged to a high pressure rolling ball viscosimeter for viscosity measurements at 106°C. The results are on page 11.

SAMPLING CONDITIONS

Well	34/10-17
Formation	Brent
Date	08.06.1983
Test	2
Interval	2880 - 2890 m RKB

Sample no.	9
Sample bottle no.	810698
Sample type	Bottom hole
Sample depth	2831.6 m RKB

Bottom hole pressure	409 bar
Bottom hole temperature	106 °C

Well flowed for approx. 45 min., then closed in for approx. 10 min. before sample being taken.

Well: 34/10-17

BHS

BUBBLE POINT AT ROOM TEMPERATURE
(Bottle nr. 810698)

↓

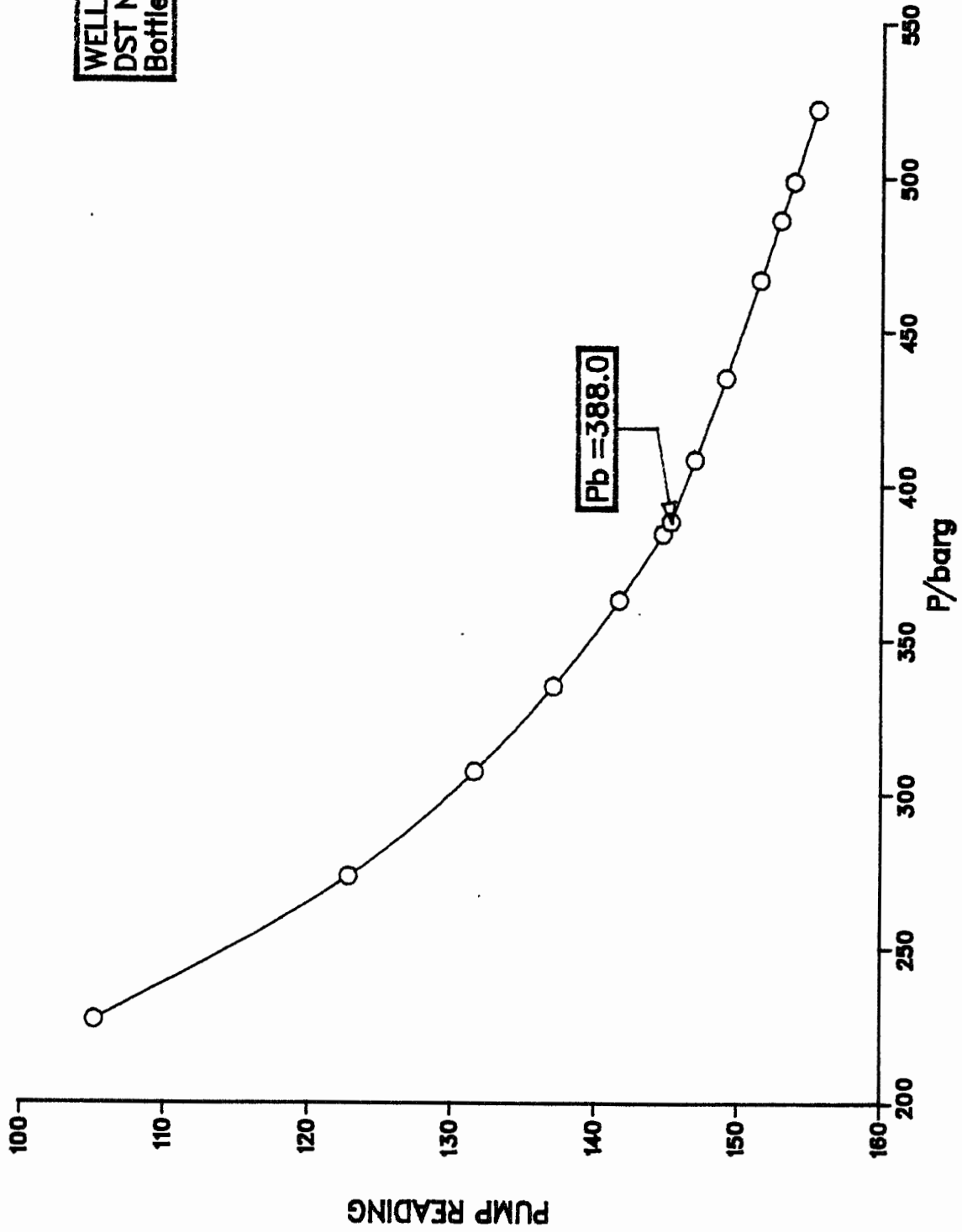
	<u>Pressure</u> <u>Barg</u>	<u>Pump reading</u> <u>cm³</u>
	521.8	155.459
	498.4	153.825
	485.9	152.825
	466.4	151.910
	434.6	149.109
	408.0	146.949
$P_b =$	388	
	384.0	144.750
	362.5	141.693
	334.6	137.159
	307.0	131.661
	237.0	122.906
	226.6	105.205

Bubble point lab (19°C) = 388 barg

Bubble point field (8°C) = 380 barg

FIG. 1

BUBBLE POINT AT ROOM TEMPERATURE



WELL: 34/10-17
DST NR. 2, BHS
Bottle nr. 810698

Well: 34/10-17

BHS

FLASH OF RESERVOIR FLUID TO STOCK TANK CONDITIONS
(Molecular Composition)

Component	Stock tank	Evolved	Reservoirfluid	
	oil mol %	gas mol %	mol %	weight %
Nitrogen	-	1.10	0.87	0.37
Carbondioxide	-	0.96	0.76	0.51
Methane	-	71.82	57.00	13.84
Ethane	-	11.69	9.28	4.22
Propane	0.67	7.15	5.82	3.88
i- Butane	0.42	1.39	1.19	1.04
n- Butane	1.20	2.45	2.19	1.93
i- Pentane	1.34	0.90	0.99	1.08
n- Pentane	1.82	0.88	1.07	1.17
Hexanes	4.54	0.77	1.52	1.96
Heptanes	9.20	0.60	2.38	3.31
Octanes	12.11	0.28	2.72	4.28
Nonanes	8.21	0.03	1.72	3.13
Decanes plus	<u>60.49</u>	<u>0.01</u>	<u>12.49</u>	<u>59.28</u>
	100.00	100.00	100.00	100.00

Molecular weight 229. 23.9 66.3

GOR	:	339	Sm^3/m^3
Formation vol. factor	:	2.00	m^3/m^3
Density at bubble point	:	0.599	g/cm^3
Density of STO at 15°C	:	0.853	g/cm^3
Gas gravity (air =1)	:	0.827	
Molecular weight of C ₁₀₊	:	316	
Density of C ₁₀₊ at 15 C	:	0.881	g/cm^3

Well: 34/10-17

BHS

EXTENDED RESERVOIR FLUID COMPOSITION

Component	mol %	mol weight	Density at 15 C g/cm ³
N ₂	0.87		
CO ₂	0.96		
C ₁	57.00		
C ₂	9.28		
C ₃	5.82		
i-C ₄	1.19		
n-C ₄	2.19		
i-C ₅	0.99		
n-C ₅	1.07		
C ₆	1.52	85	0.677
C ₇	2.38	92	0.734
C ₈	2.72	104	0.756
C ₉	1.72	119	0.775
C ₁₀	0.92	134	0.788
C ₁₁	0.86	148	0.791
C ₁₂	0.94	162	0.801
C ₁₃	0.81	177	0.818
C ₁₄	0.67	188	0.830
C ₁₅	0.75	201	0.836
C ₁₆	0.48	215	0.841
C ₁₇	0.55	234	0.839
C ₁₈	0.52	250	0.843
C ₁₉	0.46	264	0.852
C ₂₀ ⁺	<u>5.53</u>	496	0.913
	100.00		

CONSTANT MASS EXPANSION AT 106°C.

Pressure Barg	Rel vol V/Vb	Compressibility 1/Bar	Y-factor
503.0	0.9724	2.41E-04	
485.7	0.9771	2.51E-04	
465.1	0.9828	2.64E-04	
443.2	0.9882	2.77E-04	
427.1	0.9926	2.86E-04	
412.1	0.9969	2.95E-04	
Pb = 402.0	1.0000	3.01E-04	
392.1	1.0054		4.70
382.0	1.0112		4.66
363.9	1.0234		4.47
343.6	1.0405		4.20
310.2	1.0719		4.12
269.7	1.1275		3.85
219.9	1.2391		3.46
168.6	1.4538		3.05
132.8	1.7335		2.76
121.6	1.8627		2.67

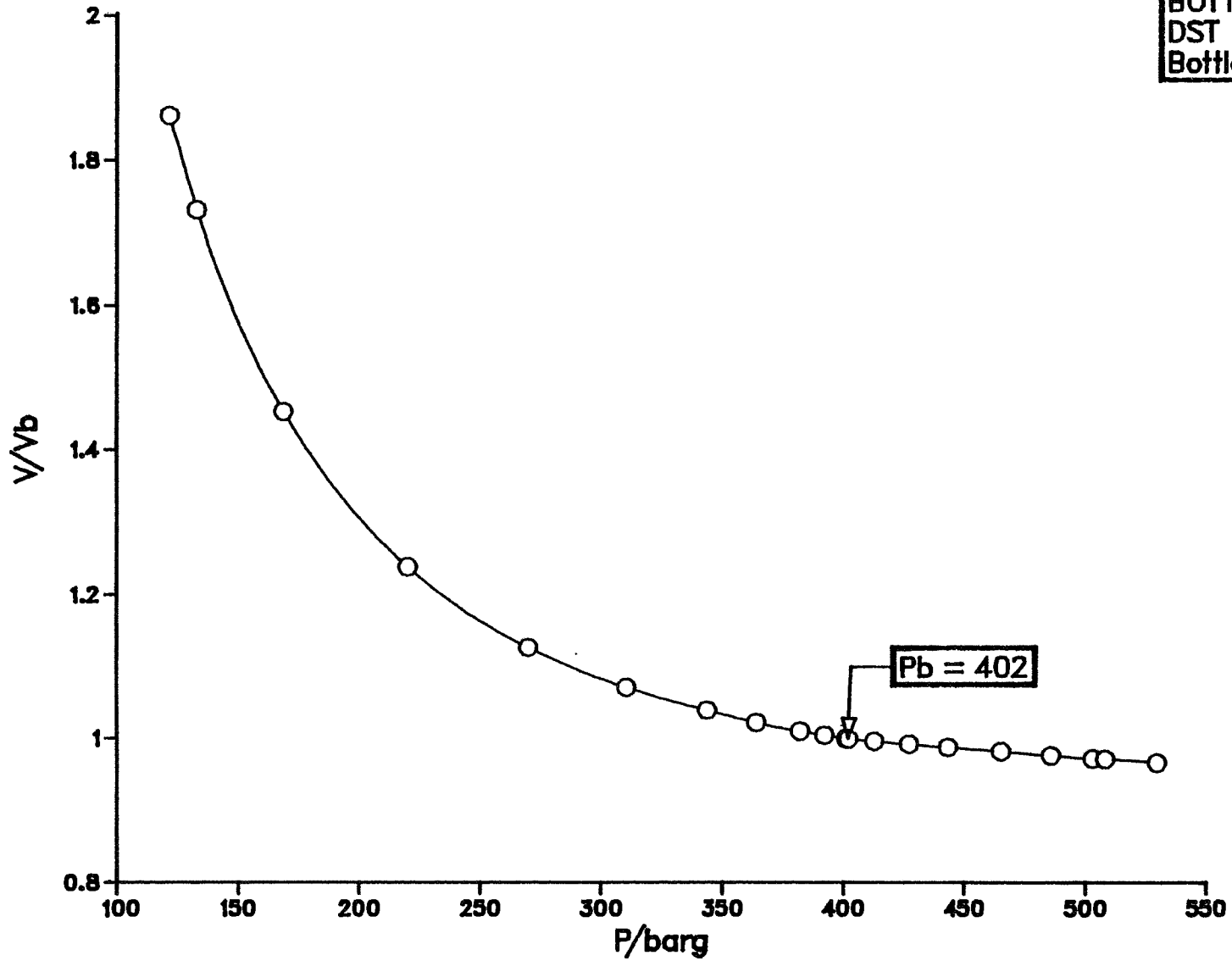
For $P < P_b$ $Y = 1.803 + 7.36E-03 \times P$

For $P > P_b$ $V/V_b = 1.17434 - 5.6650E-04 \times P + 3.3039E-07 \times P \times P$

FIG. 2

Relative volume

WELL:34/10-17
BOTTOM HOLE SAMPLE
DST NR 2
Bottle nr. 810698



DIFFERENTIAL DEPLETION AT 106^o C

Pressure barg	Oil form vol fact Bod	Solution gor Rs	Gas form vol fact Bg	Res oil density g/cm ³	Compr factor Z	Gas viscosity cP
402.0	2.230	392.1		0.590		
380.2	2.071	341.5	3.72E-03	0.603	1.067	0.0484
351.4	1.912	289.3	3.77E-03	0.619	1.000	0.0430
301.8	1.734	226.8	4.07E-03	0.642	0.926	0.0338
245.0	1.594	175.6	4.76E-03	0.666	0.881	0.0254
175.7	1.464	125.3	6.50E-03	0.693	0.865	0.0197
100.7	1.343	78.6	1.15E-02	0.724	0.881	0.0157
29.2	1.218	33.2	4.14E-02	0.758	0.941	0.0131
2.9	1.098	3.8	3.32E-01	0.791	0.973	0.0105
0	1.075			0.799		
0 *	1.000			0.859		

* at 15 C

Bod : Volume of oil at P and T per volume of residual oil
at 15 C and atm P.

Rs : Standard m³ gas per m³ residual oil at 15 C

Bg : m³ gas at T and P per standard m³ gas

DIFFERENTIAL DEPLETION AT 106°C

(Molecular composition of differentially liberated gas, mol%)

PRESSURE/BARG	380.2	351.4	301.8	254.0	175.7	100.7	29.2	2.9	0.0
NITROGEN	1.24	1.29	1.40	1.38	1.12	0.83	0.29	0.06	0.02
CARBONDIOXIDE	0.84	0.90	0.89	0.90	0.94	1.03	1.20	0.72	0.20
METHANE	70.12	71.84	74.05	76.52	78.08	77.27	65.78	23.41	6.47
ETHANE	9.44	9.50	9.40	9.65	9.92	11.21	16.53	19.12	13.55
PROPANE	5.36	5.31	5.06	5.02	4.87	5.35	9.31	22.26	25.15
i-BUTANE	1.06	1.02	0.95	0.91	0.84	0.86	1.53	5.56	7.86
n-BUTANE	1.83	1.76	1.62	1.54	1.37	1.40	2.49	10.92	15.64
i-PENTANE	1.02	0.90	0.67	0.59	0.49	0.46	0.77	4.26	7.03
n-PENTANE	0.99	0.76	0.68	0.61	0.49	0.44	0.55	4.13	6.75
HEXANES	1.09	0.97	0.81	0.68	0.51	0.41	0.62	3.51	6.27
HEPTANES	1.39	1.20	1.08	0.80	0.58	0.40	0.55	3.12	5.88
OCTANES	1.99	1.39	1.16	0.70	0.43	0.27	0.31	1.92	3.76
NONANES	0.75	0.72	0.66	0.30	0.14	0.06	0.05	0.63	1.00
DECANES+	<u>2.87</u>	<u>2.46</u>	<u>1.57</u>	<u>0.40</u>	<u>0.21</u>	<u>0.01</u>	<u>0.00</u>	<u>0.40</u>	<u>0.44</u>
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.0
MOLE WEIGHT	31.20	29.38	26.58	23.47	22.22	21.84	25.04	44.62	56.67
GRAVITY (air = 1)	1.077	1.014	0.918	0.810	0.767	0.754	0.865	1.541	1.957

DIFFERENTIAL DEPLETION AT 106° C
(Molecular composition of residual oil)

COMPONENT	MOL%
NITROGEN	0.00
CARBONDIOXIDE	0.00
METHANE	0.00
ETHANE	0.00
PROPANE	0.43
i-BUTANE	0.34
n-BUTANE	1.07
i-PENTANE	1.14
n-PENTANE	1.50
HEXANES	3.54
HEPTANES	7.46
OCTANES	10.45
NONANES	7.32
DECANES	<u>66.75</u>
	100.00
DENSITY AT 15 C	0.859 g/cm ³
MOLE WEIGHT	247.7

FIG. 3

DIFFERENTIAL DEPLETION AT 106 DEG.C COMPRESSIBILITY FACTOR

WELL 34/10-17
DST NR 2, BHS
Bottle nr 810698

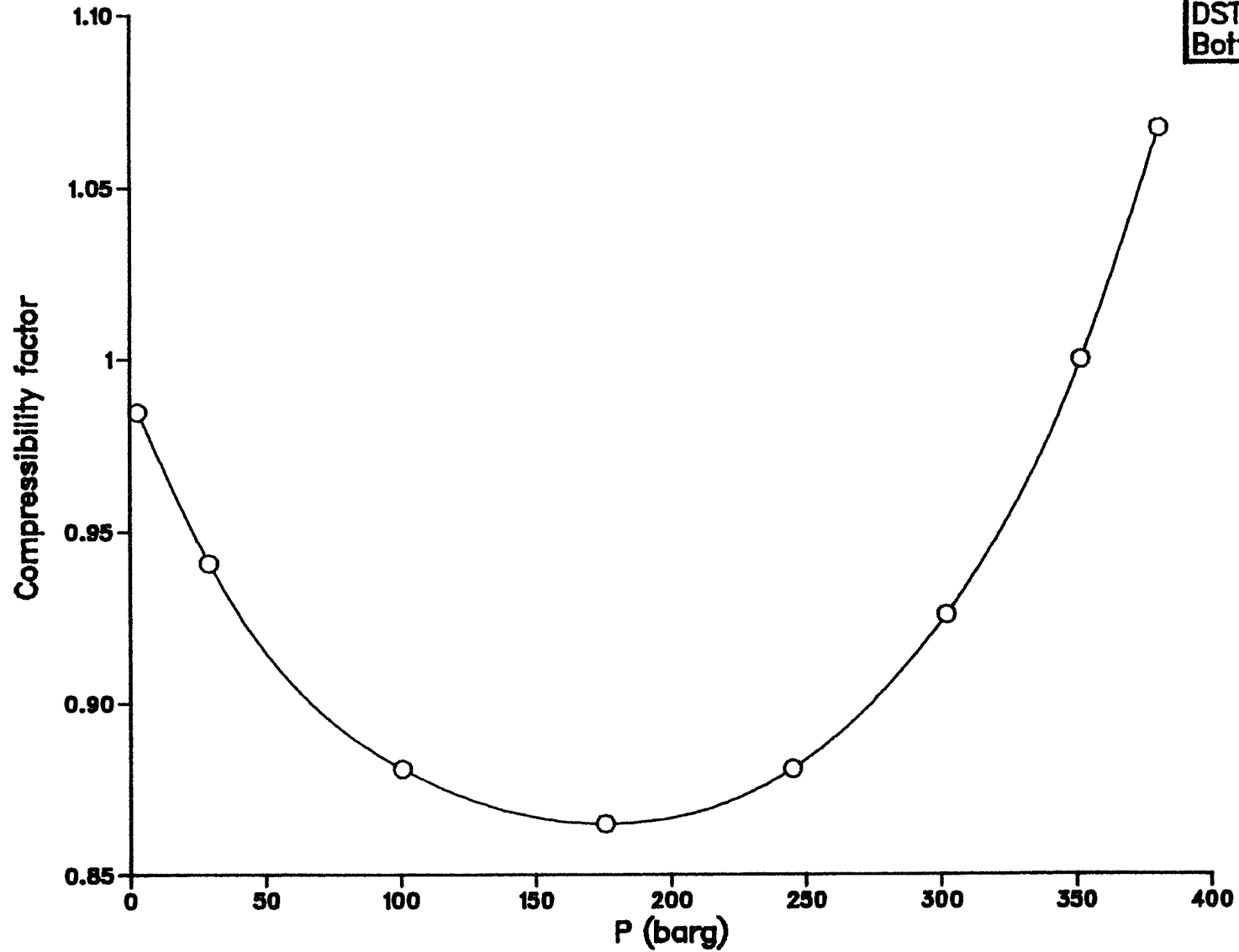


FIG. 4

DIFFERENTIAL DEPLETION AT 106 DEG.C RESERVOIR OIL DENSITY

WELL 34/10-17
DST NR 2,BHS
Bottle nr 810698

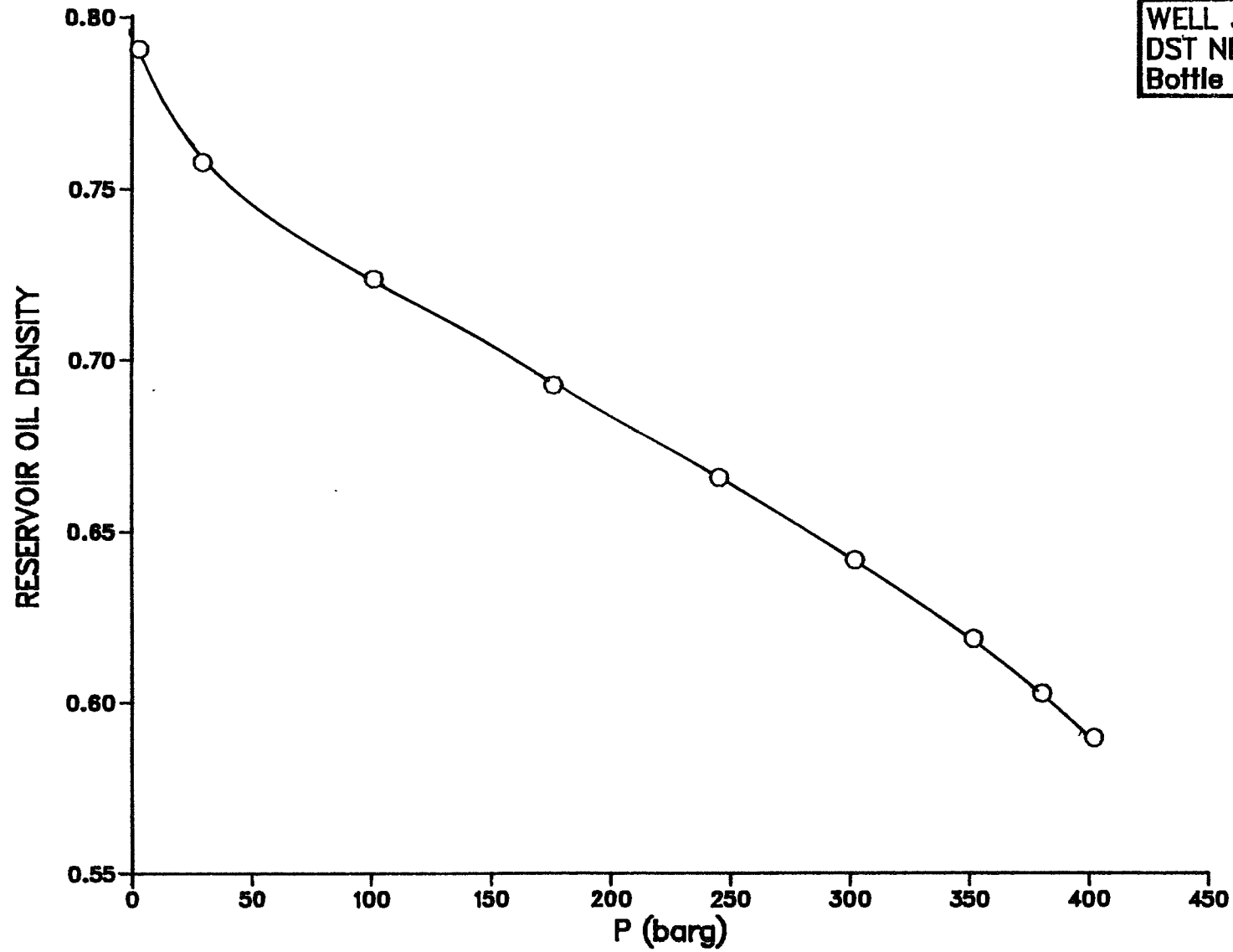


FIG. 5

DIFFERENTIAL DEPLETION Gas formation volume factor

WELL 34/10-17
DST NR 2, BHS
Bottle nr 810698

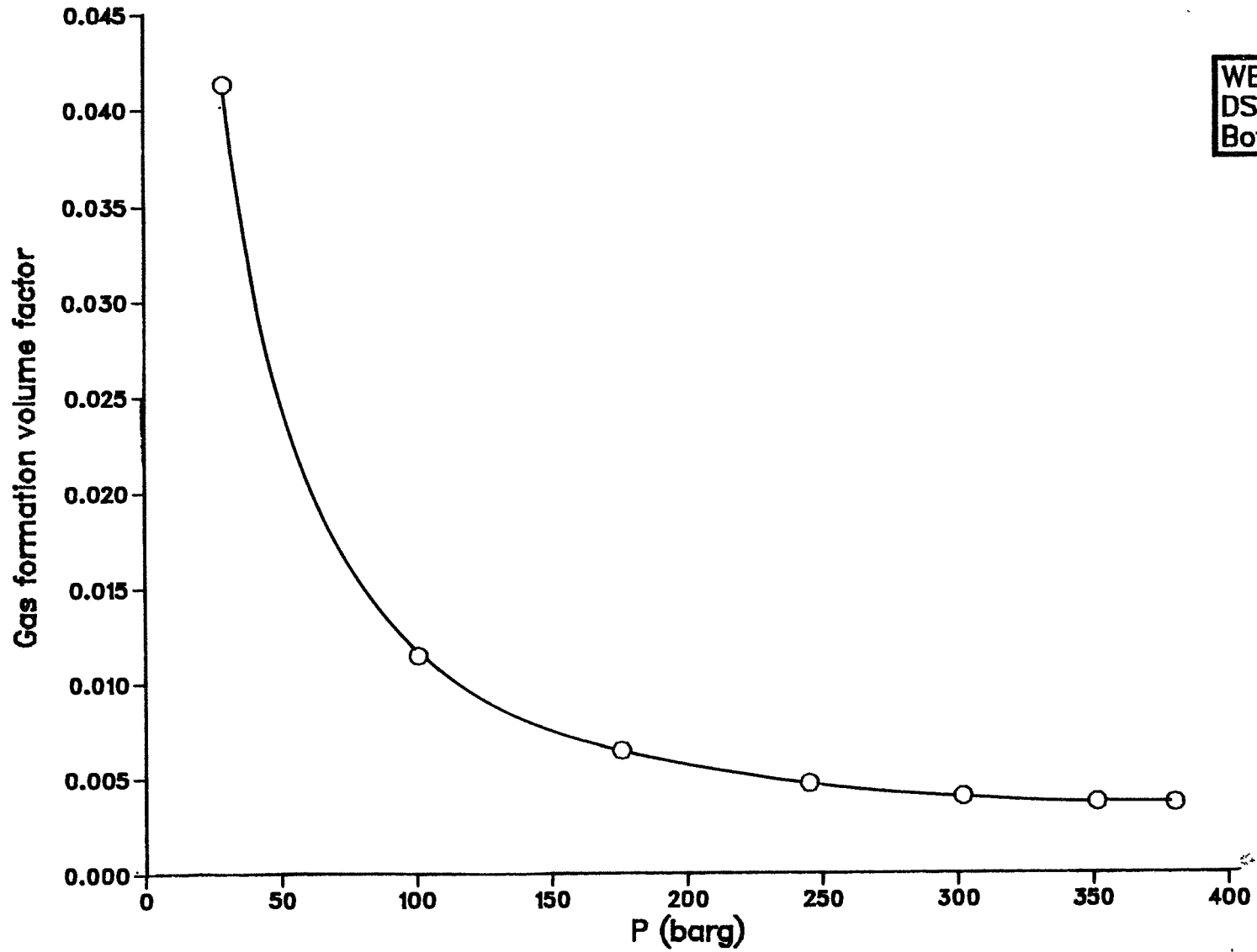


FIG. 6

DIFFERENTIAL DEPLETION AT 106 DEG.C SOLUTION GOR

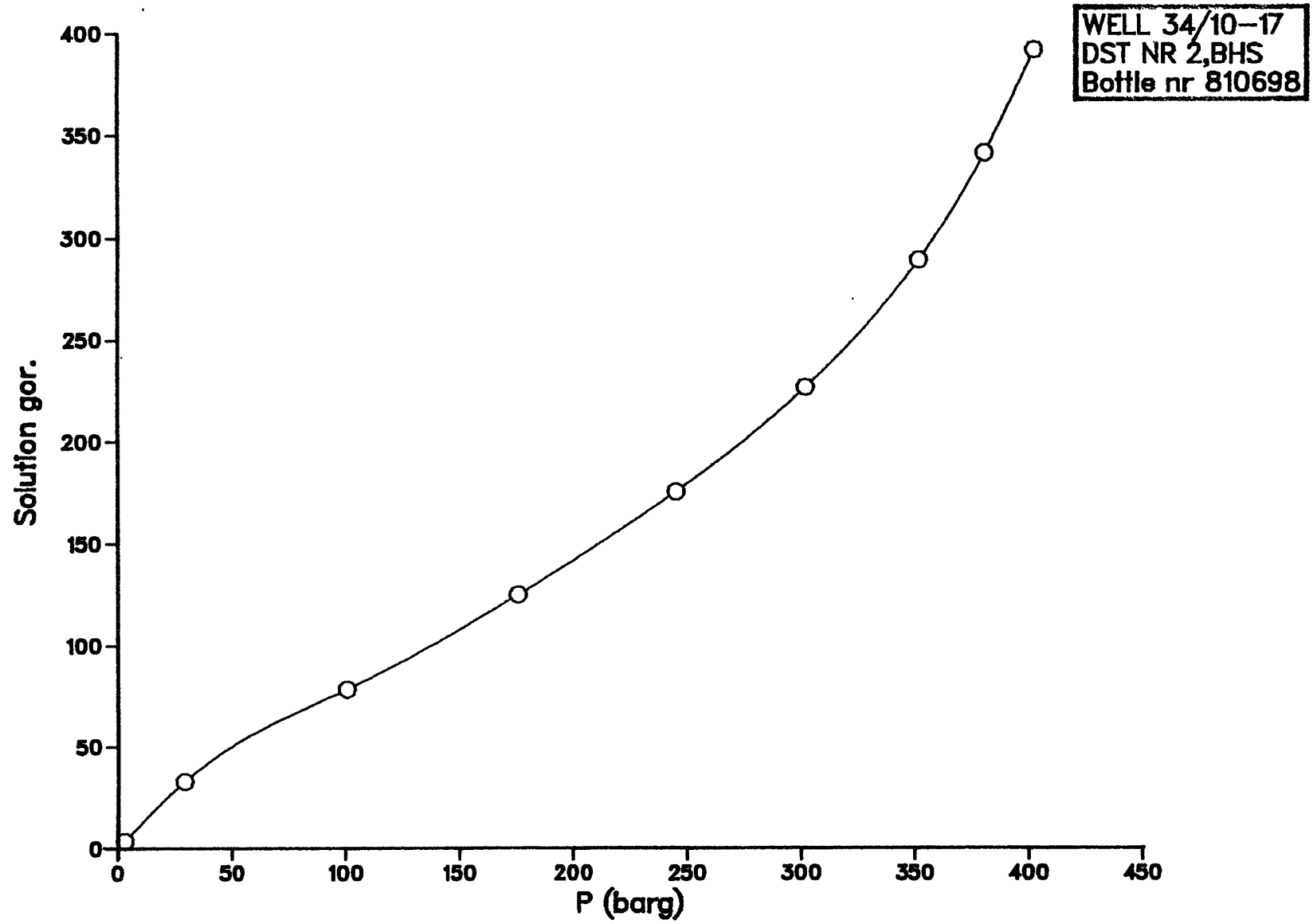
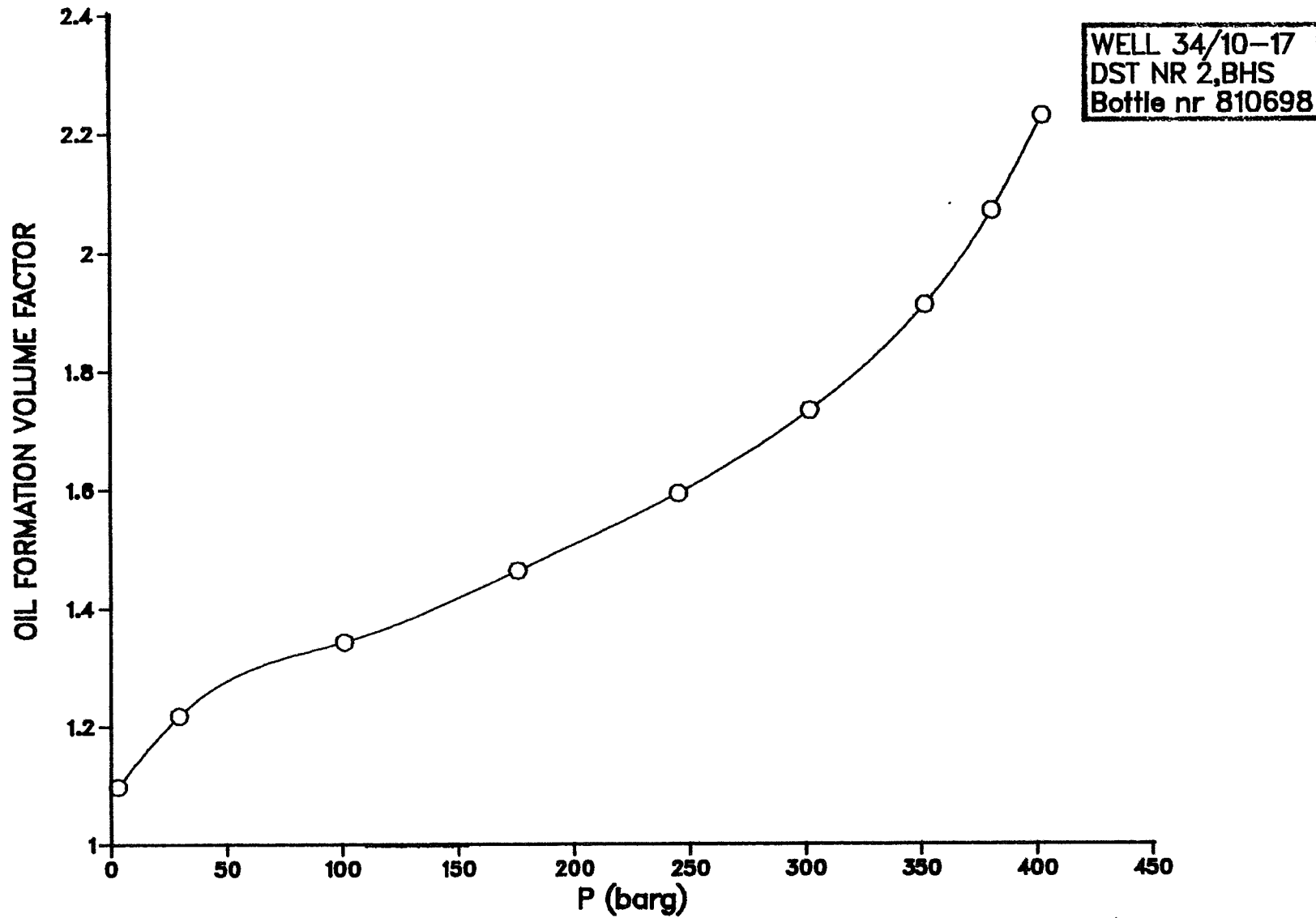


FIG. 7

DIFFERENTIAL DEPLETION AT 106 DEG.C OIL FORMATION VOLUME FACTOR



VISCOSITY OF RESERVOIR FLUID AT 106°C

Pressure (barg)	Viscosity (centipoise)
500.0	0.308
475.0	0.295
450.0	0.287
425.0	0.274
$p_b =$ 402.0	0.268
390.2	0.272
360.7	0.290
329.7	0.315
300.3	0.345
251.0	0.417
199.7	0.517
150.0	0.635
97.8	0.797
51.9	0.992
0	1.677

FIG. 8

VISCOSITY OF RESERVOIR FLUID AT 106 DEG. C.

