



Classification

Requested by

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Subtitle

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Title

PVT analysis of
Bottom hole sample from
well 34/10 - 7.

STATOIL
EXPLORATION & PRODUCTION
LABORATORY
by
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LAB 83.61

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7/11-83

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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 3 on well 34/10-7, obtained by Flopetrol 08.07.83. A summary of the results are on page 2. Sampling details are on page 3.

The quality of the sample was checked by measuring the bubble point at ambient laboratory conditions and found to be 207 barg as compared to 203 barg measured in the field (page 4).

A portion of the sample was charged to a high pressure cell at reservoir temperature (72.8 C) where the bubble point, relative volumes and compressibility were determined. These results are on page 8.

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 by gaschromatography through C9 with decanes plus fraction. The molecular composition of the liberated oil and gas, and the corresponding calculated composition of the reservoir fluid, are given on page 6. The C6 to C9 groups consist of all components eluted after the previous n-alkane up to and including the next higher homologue. The molecular weights for these groups are calculated from the molecular composition. The molecular weight and density of the plus fraction is obtained from a TBP distillation of the stock tank oil as is also the extended composition beyond C9 given on page 7. The complete TBP distillation to C30+ is reported seperately.

The remaining sample in the cell was finally differentially liberated through a series of pressure steps with the volumetric results shown on page 10. The composition of the liberated gases and residual oil are on page 11 and 12 respectively. The gas viscosity was calculated from the gas density according to Lee at al:J.Pet.Techn.,997(1966). A separate portion of the sample was charged to a high pressure rolling ball viscosimeter for measuring the oil viscosity. The results are on page 18.

Separator tests were simulated with an SRK equation of state model. The results are on page 20. Since separator tests were not requested, a temperature equal to that of the test separator in DST nr 3 were choosen.

WELL: 34/10-7
BHS

SUMMARY

Bubble point pressure	237	Bar _g at 72.8 C
Density at bubble point	0.673	g/cm ³
Viscosity at bubble point	0.460	cP
Compressibility at bubble point	1.95×10^{-4}	1/Bar
Flash formation volume factor of bubble point oil, one-stage flash	1.498	m ³ /Sm ³ STO
Differential formation volume factor of bubble point oil	1.452	m ³ /Sm ³ Resid oi
Gas solubility of bubble point oil		
(i) One-stage flash	168.4	Sm ³ /Sm ³ STO
(ii) Differential lib at 72.8 C	155.8	Sm ³ /Sm ³ Resid oi

Standard condition gas: 1 atm (1.013 bar) and 15 C

Standard condition oil: atmospheric pressure and 15 C

*)

SAMPLING CONDITIONS

FIELD	Gullfaks
WELL	34/10-7
TEST	(DST 3)
PERFORATION	1807 - 1821 m RKB
DATE	08.07.83
SAMPLE	BHS S/N 44
DEPTH OF SAMPLER	1774 m RKB
SHIPPING BOTTLE	8151-16
BOTTOM HOLE PRESSURE	313 bar
BOTTOM HOLE TEMPERATURE	72.8 C

Well flowing on 8/64" fixed choke at 47 m³ oil per day during sampling

*)

Data from Fiopetrol Well Testing Report 83/230/30

WELL:34/10-7

BHS

(bottle # 8151-16)

BUBBLE POINT AT AMBIENT TEMPERATURE

PRESSURE	PUMP READING
Bars	cm ³
392.8	161.930
371.7	160.730
344.7	158.025
322.0	157.575
294.1	155.735
265.8	153.770
236.3	151.578
Pb = 207	
206.7	149.019
197.6	145.990
184.5	137.662
175.6	130.915

Bubble point lab = 207 Bars

Bubble point field = 203 Bars

WELL: 34/10-7
DST NO 3, BHS
Bottle nr. 8151-16

BUBBLE POINT AT AMBIENT TEMPERATURE

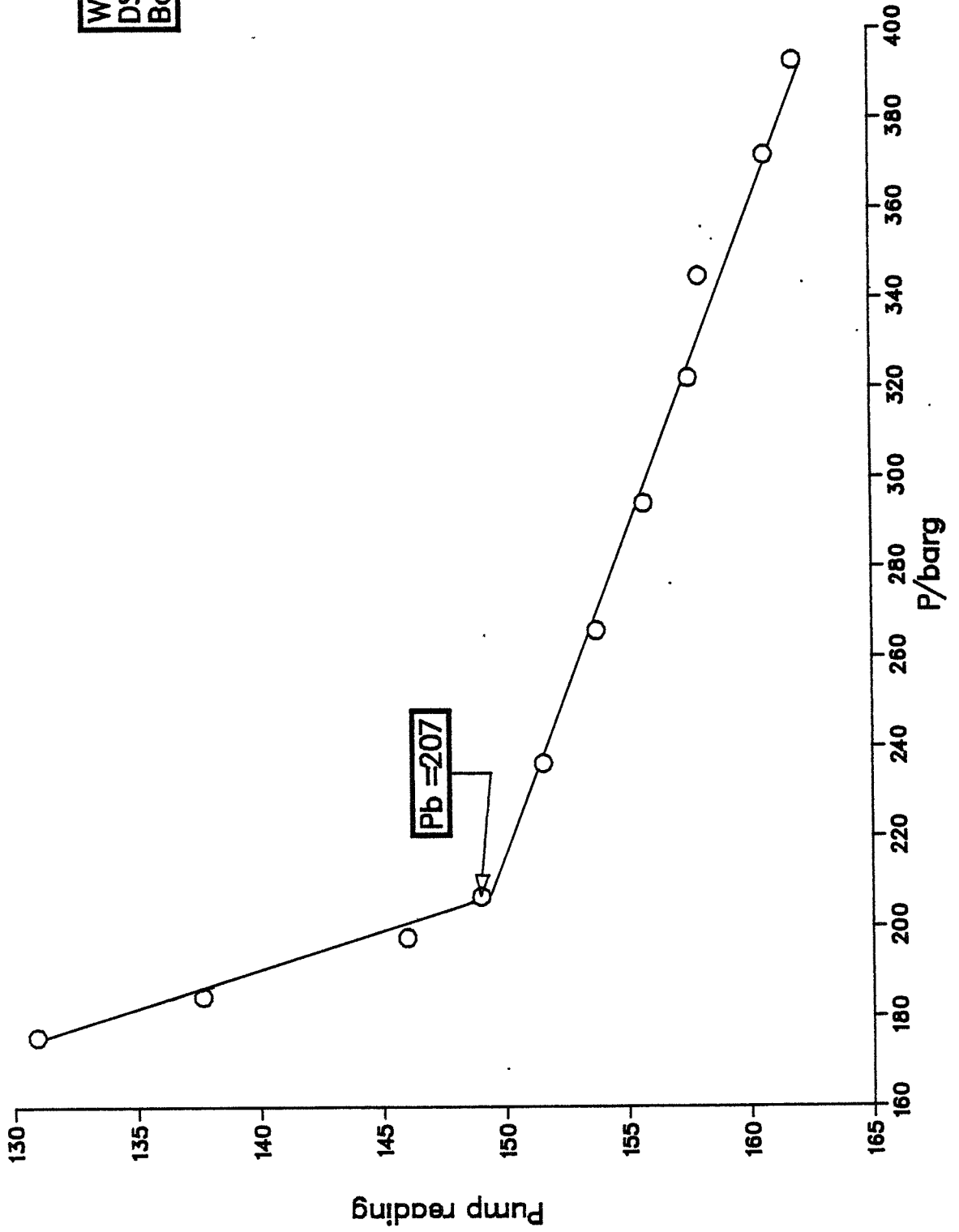


FIG. 1

34/10-7

BHS

SINGLE FLASH TO STOCK TANK CONDITIONS

	STOCK TANK OIL	EVOLVED GAS	RECOMBINED LIQUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
NITROGEN	0.00	1.09	0.22	28.0	0.69
CARBONDIOXIDE	0.00	0.19	0.06	44.0	0.12
METHANE	0.00	74.66	8.46	16.0	47.06
ETHANE	0.05	9.00	1.92	30.1	5.69
PROPANE	0.44	6.70	2.17	44.1	4.39
i-BUTANE	0.32	1.31	0.62	58.1	0.95
n-BUTANE	1.31	3.07	1.57	58.1	2.42
i-PENTANE	1.27	1.01	0.89	72.2	1.11
n-PENTANE	2.04	1.13	1.18	72.2	1.46
HEXANES	4.64	0.86	2.15	85.0	2.26
HEPTANES	9.47	0.68	4.05	91.9	3.93
OCTANES	11.79	0.26	5.33	105.2	4.52
NONANES	8.67	0.04	4.37	121.0	3.23
DECANE PLUS	60.00	0.00	67.01	269.7	22.18
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	201.0	23.77			89.26

GAS OIL RATIO	=	168.4	Sm ³ /m ³
FORM VOL FACTOR(B ₀)	=	1.498	m ³ /Sm ³
DENSITY AT BUBBLE P	=	0.673	g/cm ³
DENSITY OF STO	=	0.839	g/cm ³
GAS GRAVITY(air=1)	=	0.821	
DENSITY OF C10+	=	0.868	g/cm ³

34/10-7

BHS

1)

EXTENDED RESERVOIR FLUID COMPOSITION

COMPONENT	WEIGHT%	MOL WEIGHT	MOL%	DENSITY g/cm ³ at 15C
N2	0.22	28.0	0.69	0.000
CO2	0.06	44.0	0.12	0.000
C1	8.46	16.0	47.06	0.000
C2	1.92	30.1	5.69	0.000
C3	2.17	44.1	4.39	0.000
iC4	0.62	58.1	0.95	0.000
nC4	1.57	58.1	2.42	0.000
iC5	0.89	72.2	1.11	0.000
nC5	1.18	72.2	1.46	0.000
C6	2.15	85.0	2.26	0.668
C7	4.05	91.9	3.93	0.735
C8	5.33	105.2	4.52	0.745
C9	4.37	121.0	3.23	0.784
C10	3.45	134.7	2.30	0.789
C11	3.39	150.3	2.03	0.794
C12	3.48	166.4	1.88	0.806
C13	3.26	181.0	1.62	0.819
C14	3.79	194.0	1.76	0.832
C15	3.23	209.4	1.39	0.834
C16	2.54	222.4	1.03	0.844
C17	3.26	240.9	1.22	0.841
C18	2.41	256.0	0.85	0.847
C19	2.88	268.2	0.97	0.860
C20+	35.32	447.0	7.12	0.906
	-----		-----	
	100.00		99.99	

1)

Data to C9 based on single flash,
remaining on TBP distillation

WELL:34/10-7

BHS

CONSTANT MASS EXPANSION AT 72.8 C

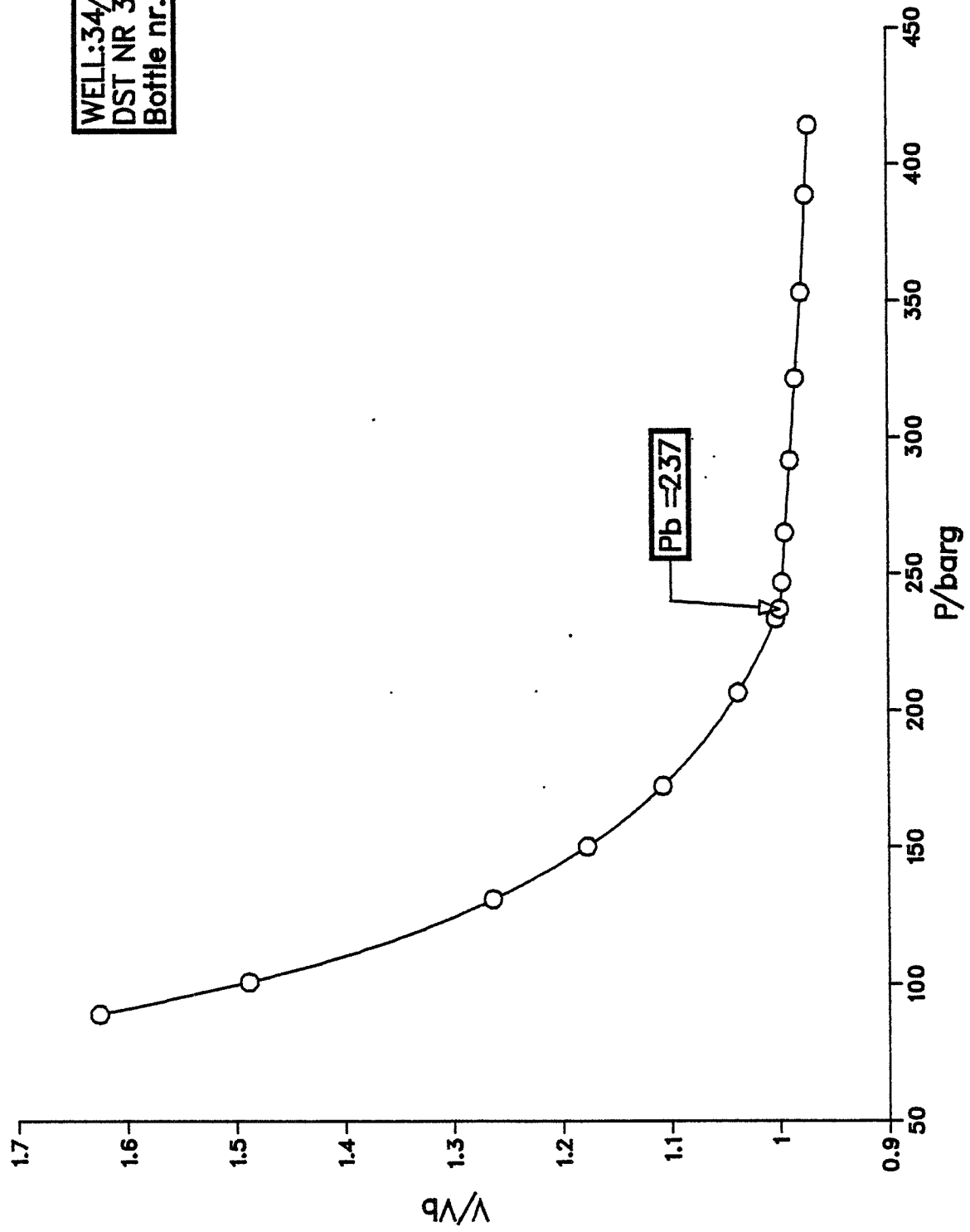
PRESSURE BARG	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
414.4	0.9722	1.24E-04	
388.8	0.9753	1.34E-04	
353.0	0.9797	1.49E-04	
321.5	0.9852	1.62E-04	
291.4	0.9902	1.74E-04	
265.0	0.9951	1.84E-04	
246.8	0.9977	1.91E-04	
Pb = 237.0	1.0000	1.95E-04	
233.5	1.0036		4.11
206.4	1.0384		3.86
172.3	1.1077		3.49
150.2	1.1774		3.26
131.1	1.2641		3.06
100.8	1.4884		2.77
89.0	1.6256		2.66

FOR P < Pb Y = 1.739 + 1.02E-02 x P

FOR P > Pb V/Vb = 1.05803 - 2.9476E-04 x P + 2.1061E-07 x P x P

FIG. 2

CONSTANT MASS EXPANSION AT 72.8 DEG. C.



WELL: 34/10-7
DST NR 3,BHS
Bottle nr. 8151-16

WELL: 34/10-7

BHS

DIFFERENTIAL DEPLETION AT 72.8 C

PRESSURE	OIL FORM VOL FACT	SOLUTION GOR	GAS FORM VOL FACT	RES OIL DENSITY	COMPR FACTOR	GAS VISCOSITY
BARG	Bod	Rsd	Bg	g/cm ³	Z	cP
237.0	1.452	155.8		0.676		
211.0	1.408	137.1	4.99E-03	0.686	0.873	0.0210
181.5	1.361	117.5	5.72E-03	0.698	0.860	0.0190
144.4	1.309	94.9	7.24E-03	0.711	0.868	0.0168
111.3	1.263	75.0	9.49E-03	0.724	0.879	0.0153
81.2	1.224	57.8	1.33E-02	0.736	0.903	0.0141
51.0	1.184	40.8	2.16E-02	0.749	0.926	0.0132
10.6	1.112	14.0	1.03E-01	0.771	0.989	0.0117
0	1.052			0.794		
0 *	1.000			0.835		

* AT 15 C

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

Rsd : Standard m³ gas per m³ residual oil
at 15 C and atm P

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

WELL: 34/10-7

BHS

DIFFERENTIAL DEPLETION AT 72.8 C

(Molecular composition of differentially liberated gas, mol%)

PRESSURE/BARG	211.0	181.5	144.4	111.3	81.2	51.0	10.6	0.0
NITROGEN	2.21	2.02	1.67	1.32	0.94	0.56	0.21	0.04
CARBONDIOXIDE	0.16	0.15	0.17	0.17	0.19	0.27	0.36	0.23
METHANE	85.54	86.49	86.98	87.10	86.38	84.10	77.43	29.82
ETHANE	5.45	5.42	5.65	6.03	6.80	8.33	11.36	22.31
PROPANE	2.85	2.73	2.73	2.81	3.12	3.85	1.71	23.58
i-BUTANE	0.48	0.45	0.43	0.42	0.45	0.53	1.71	4.48
n-BUTANE	1.03	0.95	0.89	0.86	0.91	1.08	3.48	9.64
i-PENTANE	0.36	0.32	0.28	0.25	0.25	0.29	0.91	2.70
n-PENTANE	0.42	0.37	0.32	0.29	0.29	0.32	0.99	2.80
HEXANES	0.46	0.38	0.31	0.27	0.25	0.26	0.76	2.02
HEPTANES	0.60	0.40	0.32	0.27	0.24	0.24	0.66	1.53
OCTANES	0.33	0.25	0.19	0.16	0.13	0.13	0.33	0.68
NONANES	0.09	0.06	0.05	0.04	0.04	0.03	0.07	0.13
DECANES+	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.04
	-----	-----	-----	-----	-----	-----	-----	-----
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
MOLE WEIGHT	20.17	19.69	19.43	19.30	19.42	19.96	25.05	38.22
GRAVITY (Air=1)	0.696	0.680	0.671	0.666	0.670	0.689	0.865	1.319

WELL: 34/10-7

BHS

DIFFERENTIAL DEPLETION AT 72.8 C
(Molecular composition of residual oil)

COMPONENT	MOL%	
NITROGEN	0.00	
CARBONDIOXIDE	0.00	
METHANE	0.00	
ETHANE	0.04	
PROPANE	0.68	
i-BUTANE	0.51	
n-BUTANE	1.85	
i-PENTANE	1.52	
n-PENTANE	2.36	
HEXANES	4.74	
HEPTANES	9.25	
OCTANES	11.30	
NONANES	8.50	
DECANES+	59.25	

	100.00	
DENSITY AT 15 C	0.835	g/cm ³
MOLE WEIGHT	200.5	

FIG.3

DIFFERENTIAL DEPLETION AT 72.8 DEG.C OIL FORMATION VOLUME FACTOR

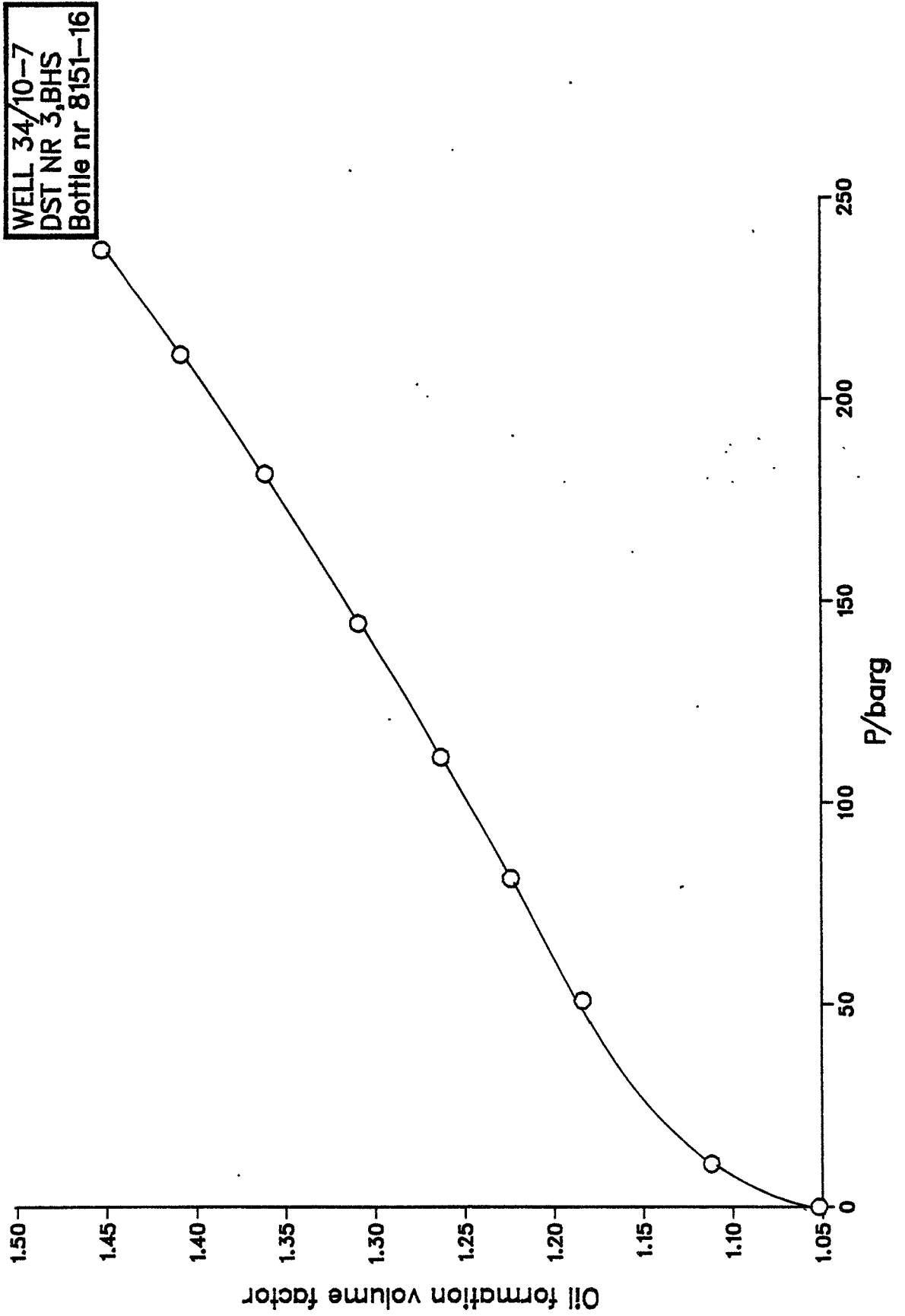
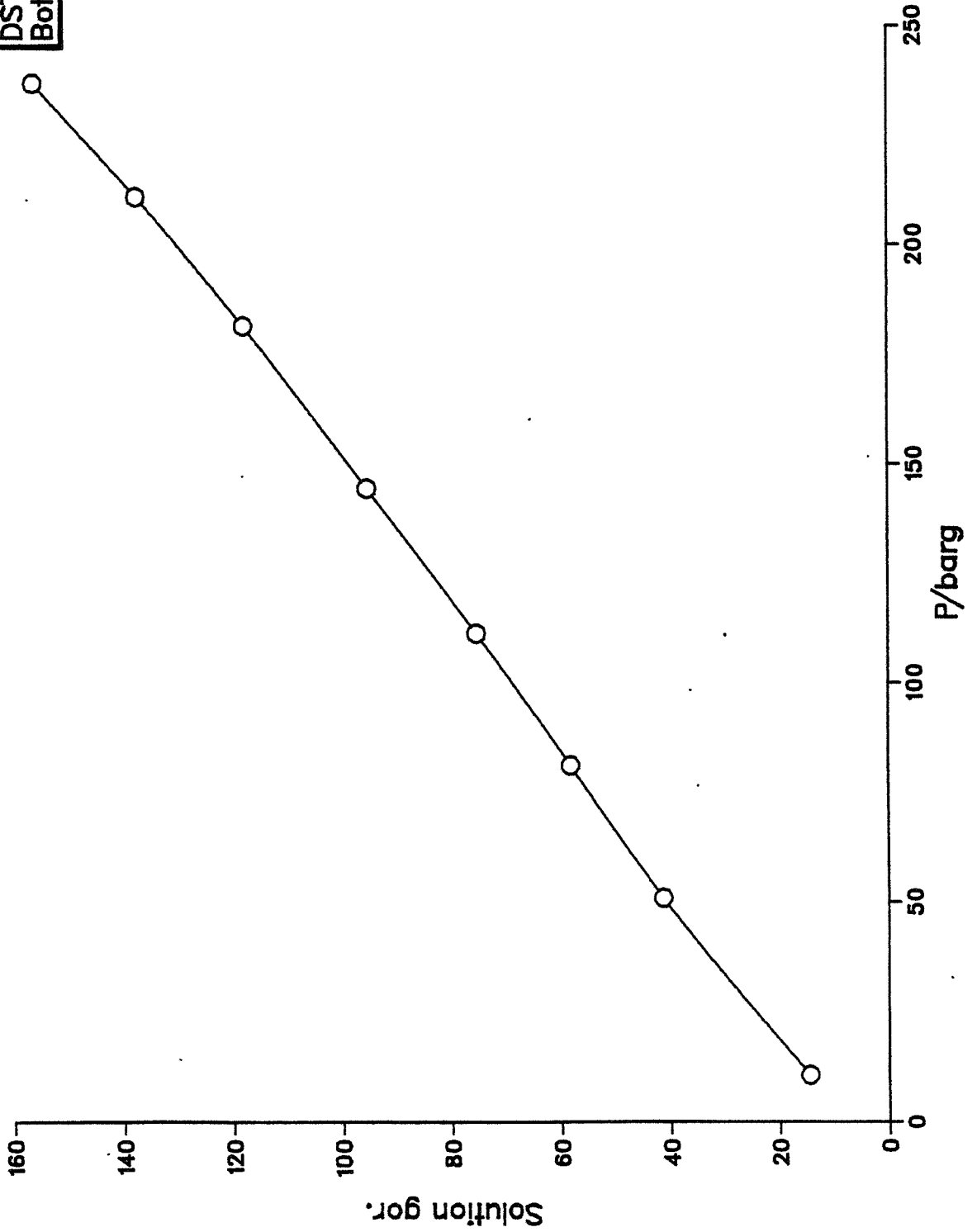


FIG.4

DIFFERENTIAL DEPLETION AT 72.8 DEG.C SOLUTION GOR

WELL 34/10-7
DST NR 3,BHS
Bottle nr 8151-16



Solution gor.

P/barg

WELL 34/10-7
DST NR 3,BHS
Bottle nr 8151-16

DIFFERENTIAL DEPLETION AT 72.8 DEG.C GAS FORMATION VOLUME FACTOR

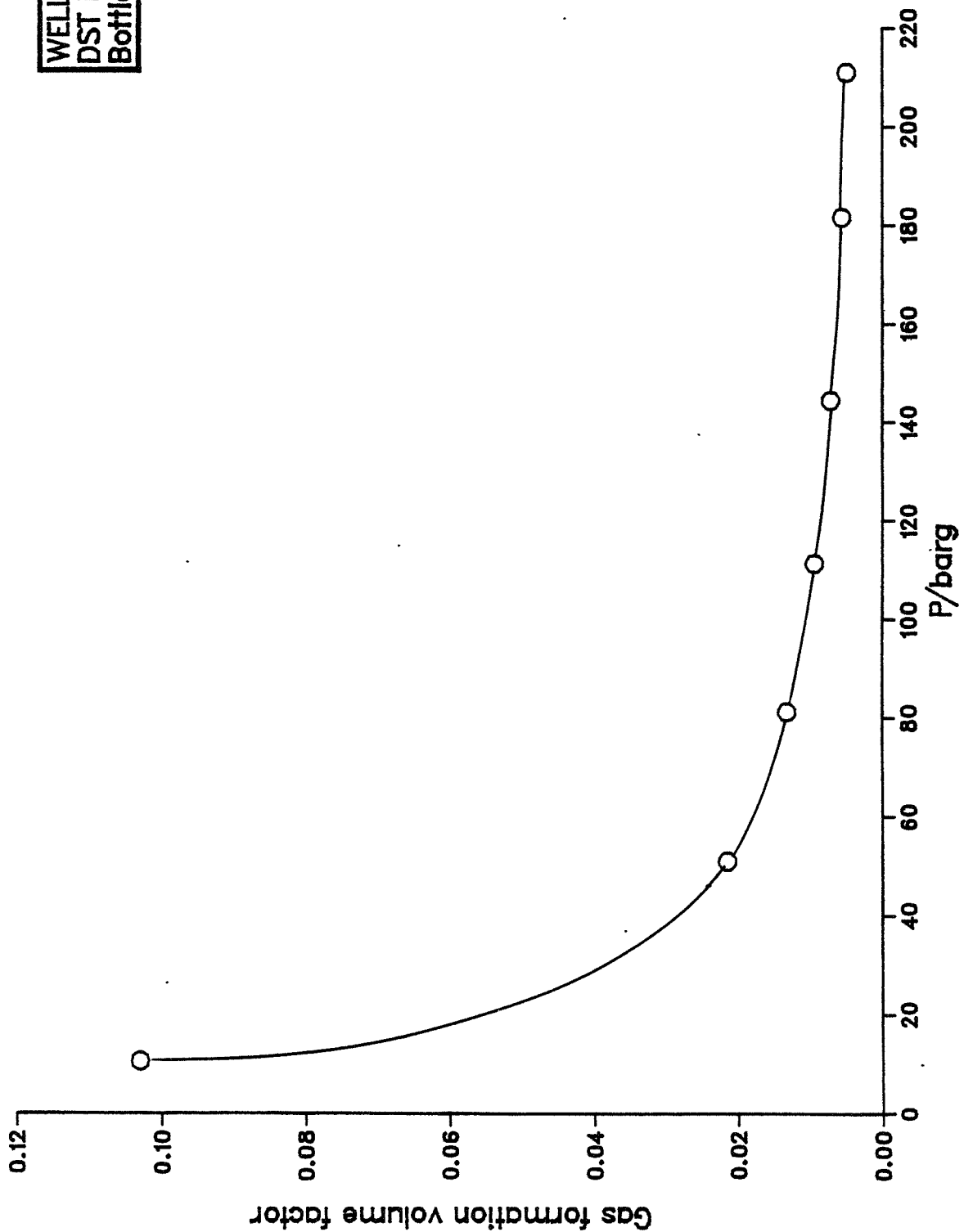


FIG. 5

WELL 34/10-7
DST NR 3,BHS
Boffle nr 8151-16

DIFFERENTIAL DEPLETION AT 72.8 DEG.C RESERVOIR OIL DENSITY

FIG.6

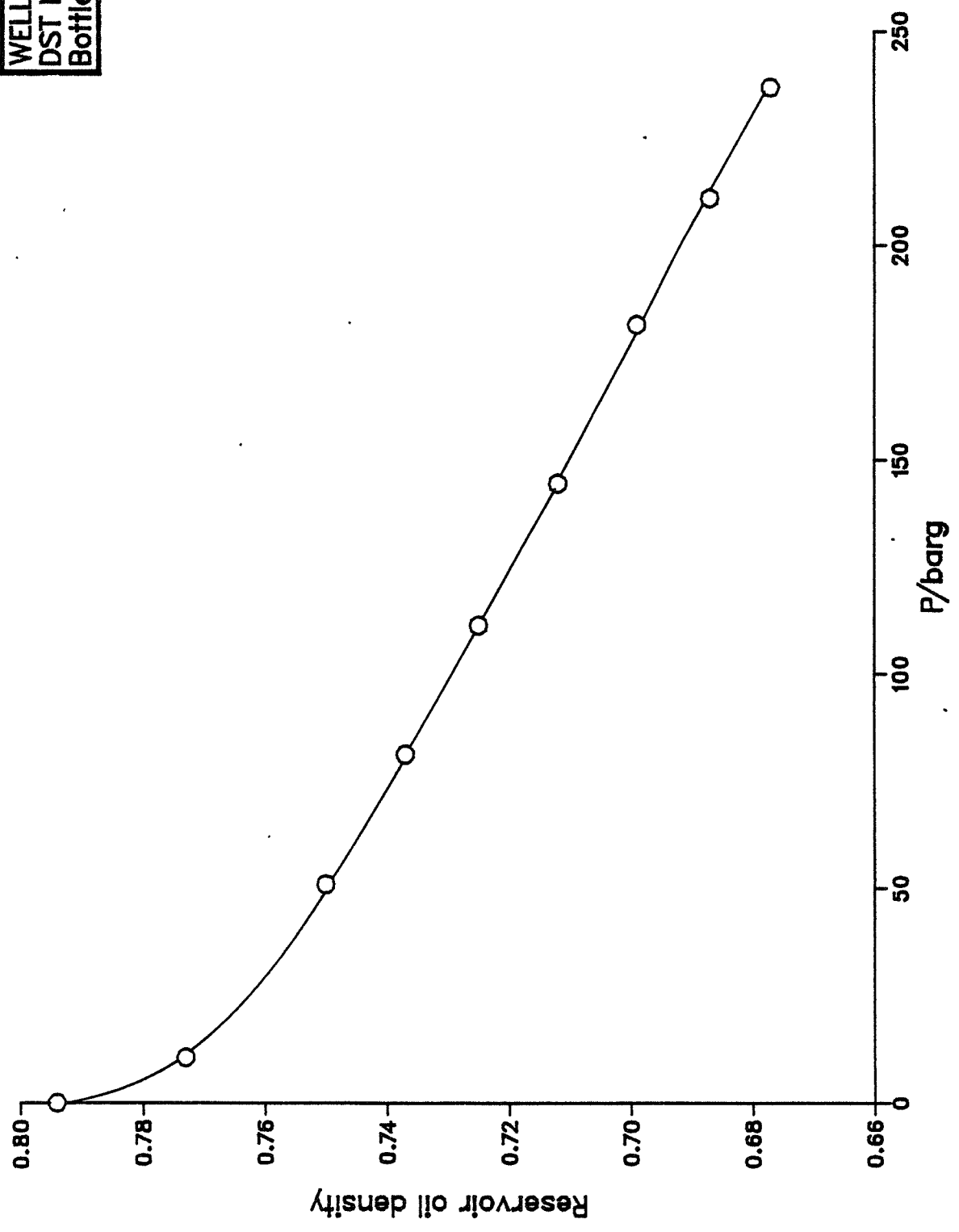
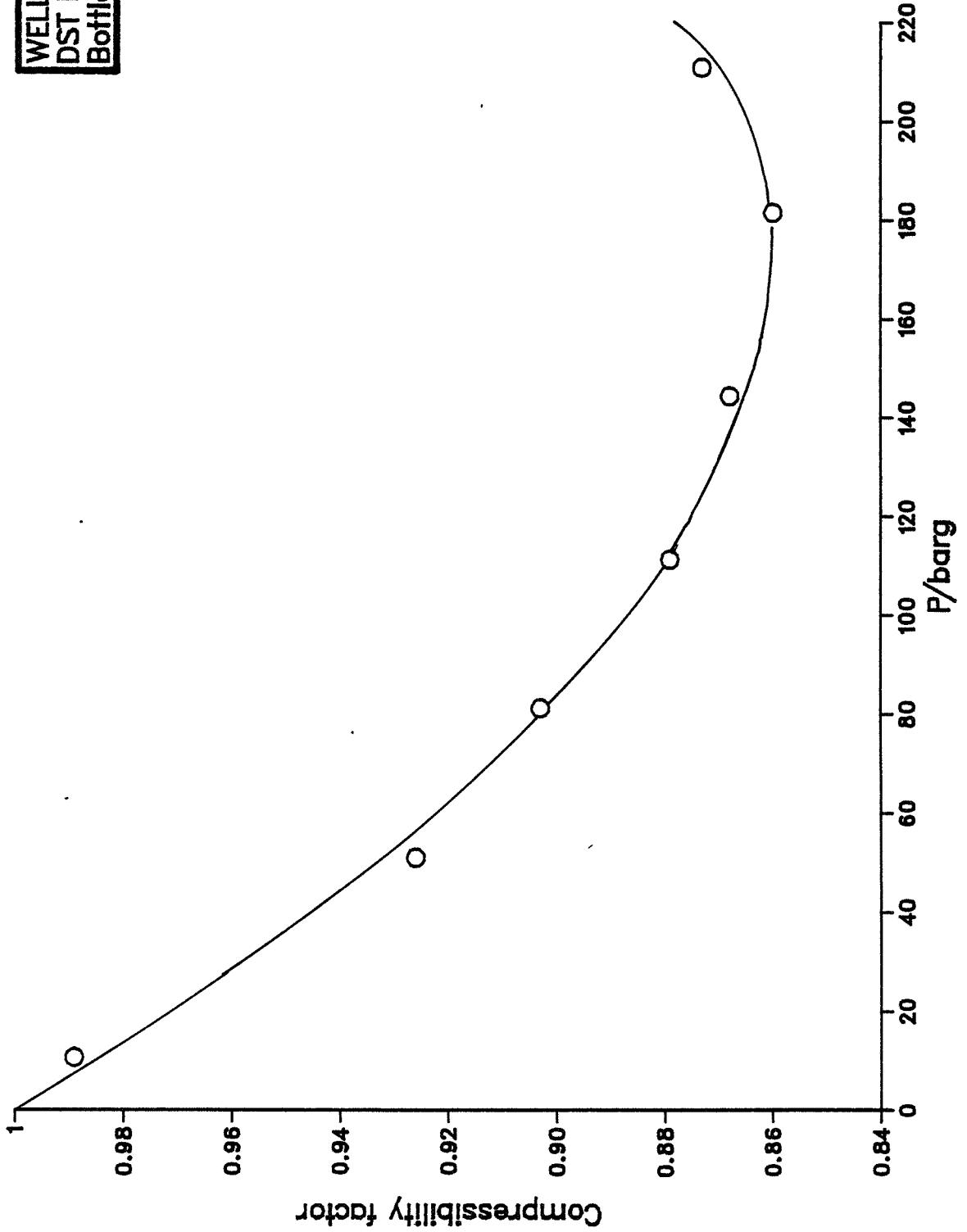


FIG.7

DIFFERENTIAL DEPLETION AT 72.8 DEG.C COMPRESSIBILITY FACTOR

WELL 34/10-7
DST NR 3,BHS
Bottle nr 8151-16



WELL: 34/10-7

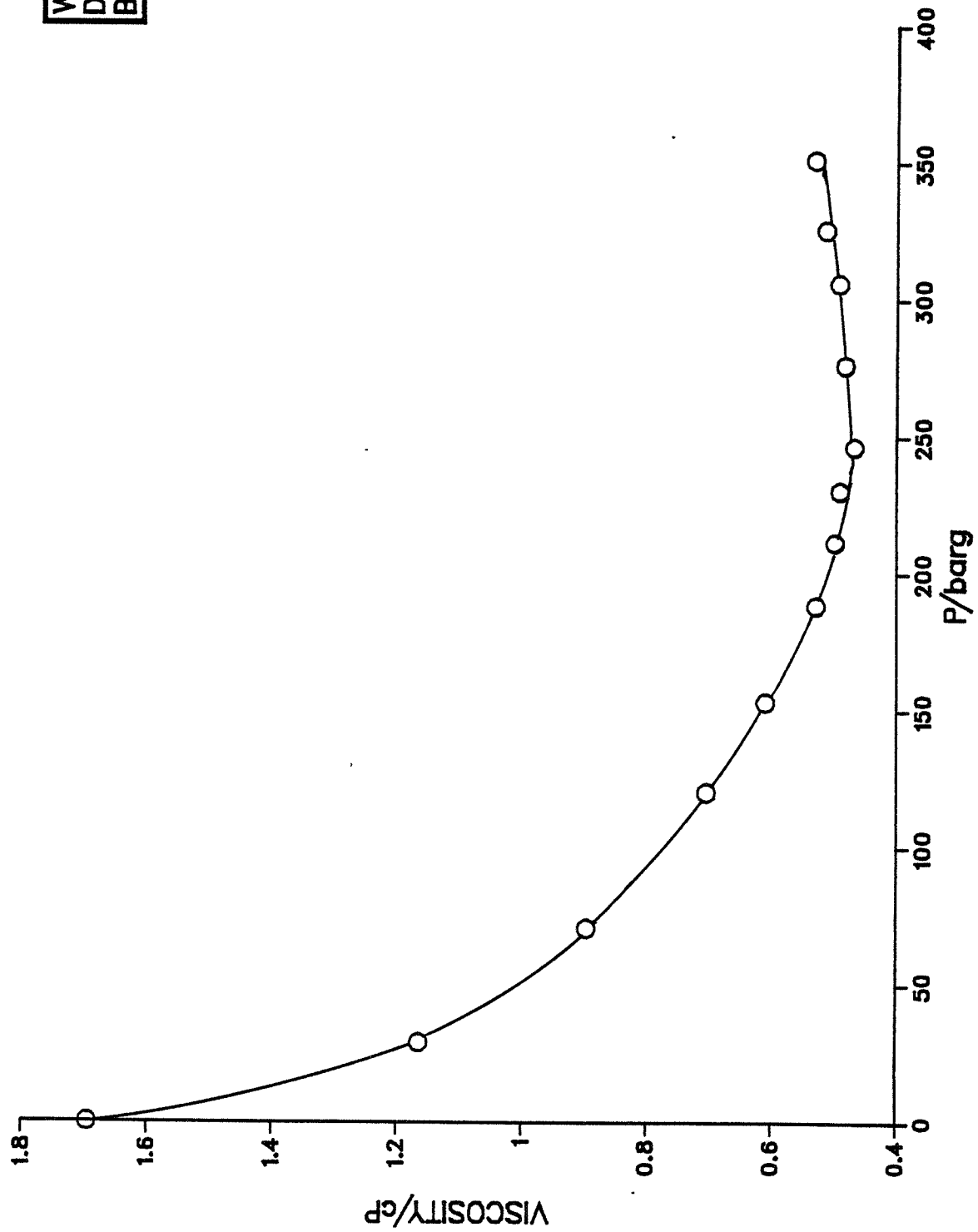
BHS

VISCOSITY OF RESERVOIR FLUID AT 72.8 C

PRESSURE (Barg)	VISCOSITY (Centipoise)
351.3	0.531
325.6	0.514
306.1	0.493
276.2	0.483
246.4	0.468
Pb = 237.0	0.460
230.3	0.491
211.5	0.499
188.4	0.529
153.2	0.610
120.3	0.704
70.7	0.896
29.1	1.164
0	1.694

fig. 8

VISCOSITY OF RESERVOIR FLUID AT 72.8 DEG. C



WELL: 34/10-7
DST NR. 3, BHS
Bottle nr. 8151-16

WELL: 34/10-7

BHS

SEPARATOR TESTS OF RESERVOIR FLUID
 (Calculated values from EOS simulation)

SEPARATOR		GAS-OIL RATIO		FORM VOL	DENSITY	GAS
PRESSURE	TEMP	(Sm ³ /m ³)		FACTOR	STO	GRAVITY
(Barg)	(C)	Separator	Stock tank	Bof	(g/cm ³)	(air=1)
0*	15	168.4		1.498	0.839	0.821
9.0	42	145	7	1.45	0.836	0.732
26.5	42	127	24	1.44	0.835	0.725
49.0	42	110	43	1.45	0.837	0.739
75.0	42	92	64	1.46	0.838	0.756
100.0	42	74	84	1.47	0.840	0.767

* From single flash, page 6

GOR : Std m³ gas per m³ STO at 15 C

Bof : m³ bubble point oil per m³ STO at 15 C

Gas gravity: average value of total gas