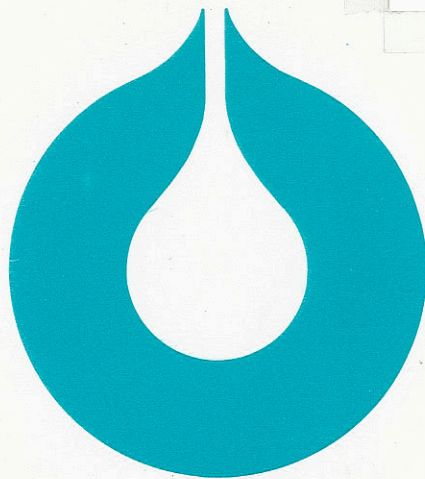


E-2.5



statoil

PVT Analysis
Bottom Hole Sample
Well 6407/1-3, DST 1

**STATOIL
EXPLORATION & PRODUCTION
LABORATORY**

by
Otto Rogne

pril-84

LAB 84.

Den norske stats oljeselskap a.s



Classification

Requested by

Empty box for requested by name.

Subtitle

Empty box for subtitle.

Co-workers

Empty box for co-workers.

B.Fjæreide, J.Grande
E.Osjord, L.Tau

Title

PVT Analysis
Bottom Hole Sample
Well 6407/1-3, DST 1

STATOIL
EXPLORATION & PRODUCTION
LABORATORY
by
Otto Rogne

April-84 LAB 84.222

Prepared

13/4-84 | *Otto Rogne*
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13/4-84 | *D. Malthe-Sørensen*
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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 1 on well 6407/1-3, as requested by STATOIL LET/B. Samples were obtained by Flopetrol 22.12.83. Sampling details are on page 2.

Two BHS (BHS # 1 and BHS # 2) were checked by measuring the bubble point at reservoir temperature which were found to be 374 and 378 barg respectively (page 3 and 6). The reservoir fluid composition was then determined for both samples by flashing a portion of the fluid through a laboratory separator at 25 C and atmospheric pressure. The flash was performed at 25 C instead of at the usual 15 C as it was observed that the stabilized oil was semisolid at the latter temperature. The reported densities at 15 C are adjusted from the measured values at 25 C (0.876 and 0.878 g/cm³ for BHS # 1 and BHS # 2 respectively) according to the PETROLEUM MEASUREMENT TABLES. 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 5 and 8. 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 9. The complete TBP distillation to C20+ is reported seperately (LAB 84.217).

Since both compositions and bubble points of the two samples were almost identical only one of the two (BHS # 2) were differentially liberated through a series of pressure steps. The volumetric results are 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.

*)

SAMPLING CONDITIONS

FIELD		TYRIHANS
WELL		6407/1-3
TEST		DST 1
PERFORATION		3697 - 3702 mRKB
DATE		22.12.83
RESERVOIR FLUID		OIL
SAMPLE, BHS # 1		Bottle 14068/64
BHS # 2		Bottle 9214/143
BOTTOM HOLE PRESSURE		
During BHS sampling		381 Bara
STATIC BOTTOM HOLE PRESSURE **		378 Bara
BOTTOM HOLE TEMPERATURE **		130 C

*)

Data from Flopetrol Well Testing Report 84/2301/1

**)

Data supplied by STATOIL, LET/B

WELL :6407/1-3

DST #: 1

BHS # 1

CONSTANT MASS EXPANSION AT 130C

PRESSURE BARG	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
562.9	0.9662	1.45E-04	
536.7	0.9699	1.56E-04	
512.8	0.9737	1.65E-04	
487.4	0.9779	1.75E-04	
458.9	0.9831	1.86E-04	
439.2	0.9867	1.94E-04	
414.7	0.9913	2.03E-04	
397.8	0.9949	2.09E-04	
386.7	0.9973	2.13E-04	
378.2	0.9991	2.16E-04	
Pb = 374.0	1.0000	2.18E-04	
372.8	1.0006		5.10
358.1	1.0104		4.28
333.6	1.0290		4.17
314.6	1.0467		4.04
291.9	1.0712		3.95
270.2	1.0997		3.85
246.8	1.1384		3.72
216.5	1.2039		3.57
189.7	1.2844		3.42
163.9	1.3922		3.27
134.8	1.5703		3.11
99.4	1.9448		2.92
60.6	2.8971		2.73

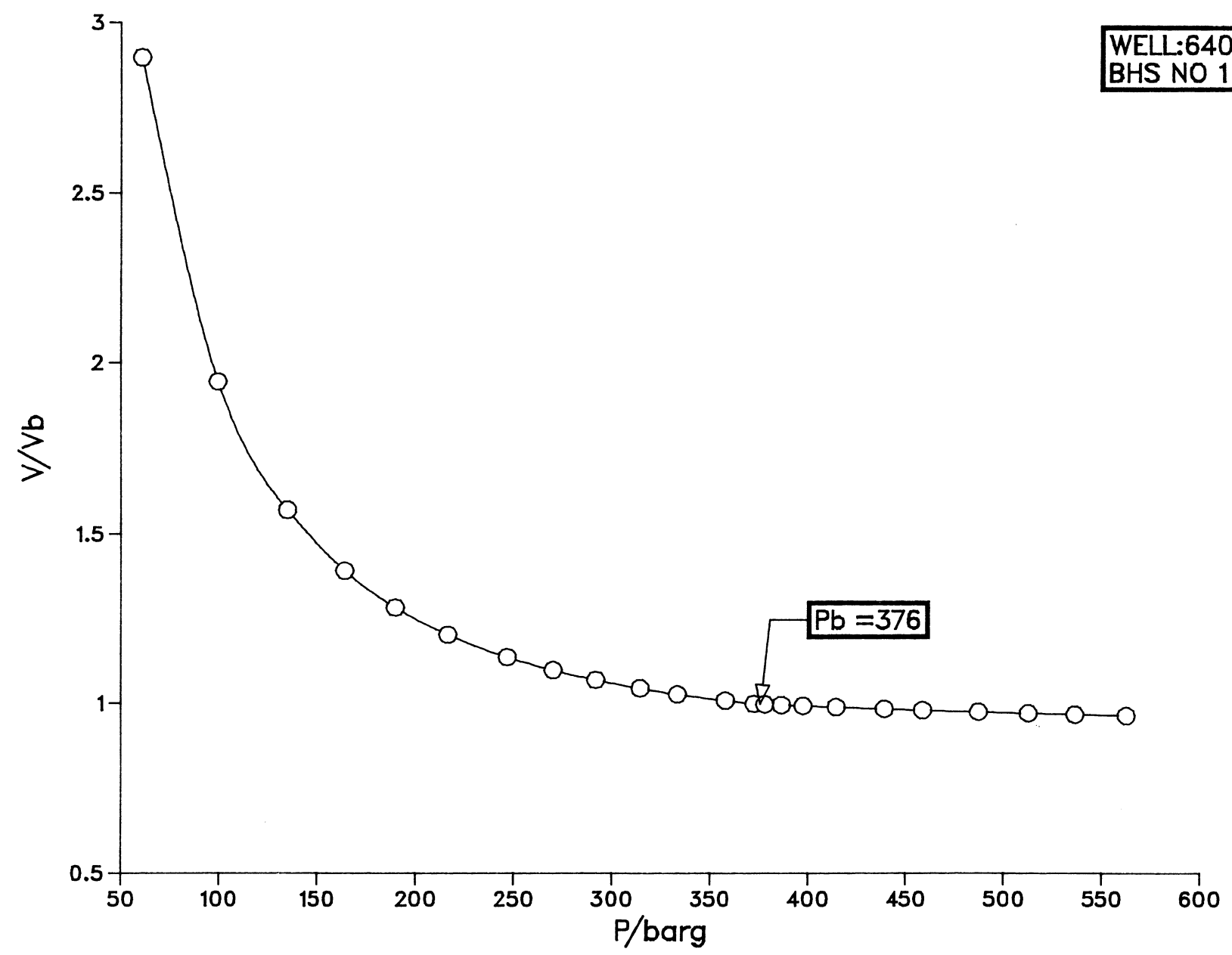
FOR P < Pb Y = 2.271 + 6.10E-03 x P

FOR P > Pb V/Vb = 1.11024 - 3.7152E-04 x P + 2.0527E-07 x P x P

FIG. 1

CONSTANT MASS EXPANSION AT 130.0 °C

WELL:6407/1-3
BHS NO 1



6407/1-3

BHS # 1

COMPOSITION OF RESERVOIR FLUID
(Single flash to stock tank conditions)

	STOCK TANK OIL	EVOLVED GAS	RECOMBINED LIQUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
NITROGEN	0.00	0.46	0.10	28.0	0.32
CARBONDIOXIDE	0.00	2.81	0.93	44.0	1.97
METHANE	0.00	80.90	9.81	16.0	56.75
ETHANE	0.04	6.32	1.44	30.1	4.44
PROPANE	0.29	4.33	1.48	44.1	3.12
i-BUTANE	0.17	0.73	0.35	58.1	0.56
n-BUTANE	0.63	1.73	0.87	58.1	1.40
i-PENTANE	0.52	0.54	0.41	72.2	0.53
n-PENTANE	0.96	0.68	0.59	72.2	0.76
HEXANES	2.24	0.57	0.97	84.5	1.07
HEPTANES	5.70	0.62	2.05	90.5	2.14
OCTANES	7.04	0.25	2.51	104.0	2.28
NONANES	5.51	0.05	2.12	118.9	1.68
DECANE PLUS	76.90	0.01	76.37	314.0	22.98
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	264.1	21.82			94.20

Gas oil ratio = 189.0 Sm³/Sm³ STO
Flash formation volume factor
of bubble point liquid = 1.618 m³/Sm³ STO
Density at bubble point = 0.654 g/cm³
Density of STO = 0.883 g/cm³ at 15C
Gas gravity (air=1) = 0.753
Density of C10+ = 0.891 g/cm³

WELL :6407/1-3

DST #: 1

BHS # 2

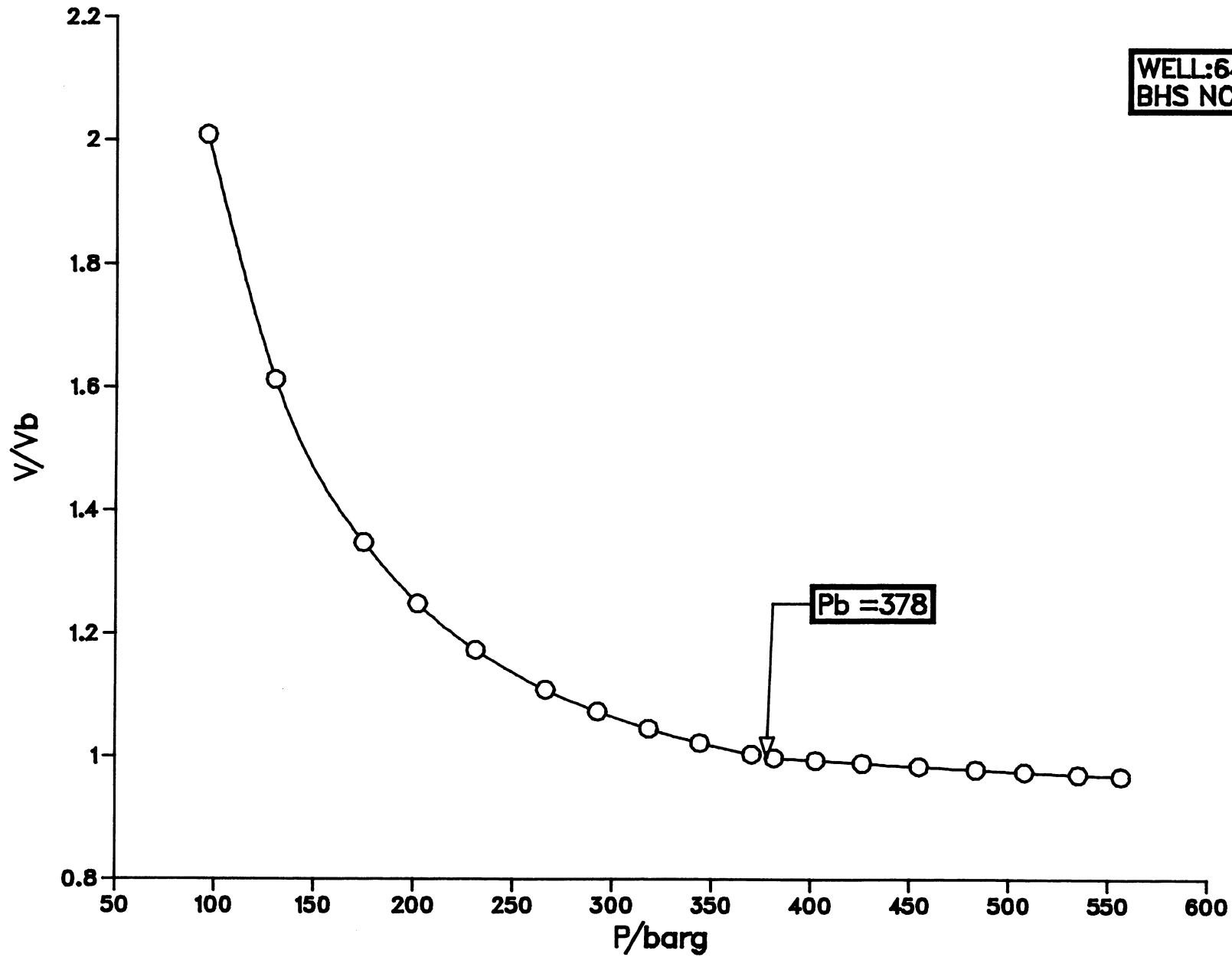
CONSTANT MASS EXPANSION AT 130C

PRESSURE BARG	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
556.9	0.9682	1.50E-04	
535.2	0.9716	1.57E-04	
508.1	0.9757	1.67E-04	
483.6	0.9798	1.75E-04	
454.6	0.9850	1.85E-04	
426.2	0.9903	1.94E-04	
402.8	0.9949	2.02E-04	
381.7	0.9992	2.09E-04	
Pb = 378.0	1.0000	2.10E-04	
370.5	1.0048		4.24
344.3	1.0233		4.19
318.5	1.0460		4.06
292.7	1.0737		3.96
266.5	1.1089		3.84
231.3	1.1733		3.66
202.3	1.2485		3.49
174.8	1.3472		3.35
130.1	1.6121		3.11
95.9	2.0085		2.92

FOR P < Pb Y = 2.481 + 4.95E-03 x P

FOR P > Pb V/Vb = 1.10544 - 3.4780E-04 x P + 1.8220E-07 x P x P

CONSTANT MASS EXPANSION AT 130.0 °C



WELL:6407/1-3
BHS NO 2

Pb = 378

6407/1-3

BHS # 2

COMPOSITION OF RESERVOIR FLUID
(Single flash to stock tank conditions)

	STOCK TANK OIL	EVOLVED GAS	RECOMBINED LIQUID		
	MOL%	MOL%	WEIGHT%	MOL WT	MOL%
NITROGEN	0.00	0.43	0.09	28.0	0.30
CARBONDIOXIDE	0.00	2.83	0.94	44.0	1.99
METHANE	0.00	81.16	9.82	16.0	57.09
ETHANE	0.04	6.28	1.43	30.1	4.43
PROPANE	0.27	4.23	1.44	44.1	3.06
i-BUTANE	0.16	0.71	0.34	58.1	0.55
n-BUTANE	0.61	1.69	0.85	58.1	1.37
i-PENTANE	0.51	0.53	0.40	72.1	0.52
n-PENTANE	0.94	0.67	0.58	72.1	0.75
HEXANES	2.21	0.57	0.95	84.5	1.05
HEPTANES	5.62	0.59	2.01	90.4	2.08
OCTANES	7.12	0.25	2.54	104.0	2.29
NONANES	5.68	0.05	2.19	119.1	1.72
DECANE PLUS	76.84	0.01	76.42	314.0	22.80
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	264.1	21.72			93.60

Gas oil ratio = 188.6 Sm³/Sm³ STO
Flash formation volume factor
of bubble point liquid = 1.630 m³/Sm³ STO
Density at bubble point = 0.649 g/cm³
Density of STO = 0.885 g/cm³ at 15C
Gas gravity (air=1) = 0.750
Density of C10+ = 0.891 g/cm³

6407/1-3

BHS # 2

1)

EXTENDED RESERVOIR FLUID COMPOSITION

COMPONENT	WEIGHT%	MOL WEIGHT	MOL%	DENSITY g/cm ³ at 15C
N2	0.09	28.0	0.30	
CO2	0.94	44.0	1.99	
C1	9.82	16.0	57.09	
C2	1.43	30.1	4.43	
C3	1.44	44.1	3.06	
iC4	0.34	58.1	0.55	
nC4	0.85	58.1	1.37	
iC5	0.40	72.1	0.52	
nC5	0.58	72.1	0.75	
C6	0.95	84.5	1.05	0.701
C7	2.01	90.4	2.08	0.741
C8	2.54	104.0	2.29	0.762
C9	2.19	119.1	1.72	0.780
C10	1.53	134.0	1.06	0.784
C11	2.41	149.0	1.51	0.793
C12	1.95	164.0	1.11	0.803
C13	2.64	176.0	1.40	0.818
C14	2.51	188.0	1.25	0.822
C15	3.15	203.0	1.45	0.830
C16	2.08	214.0	0.91	0.837
C17	2.89	232.0	1.16	0.834
C18	2.64	248.0	1.00	0.836
C19	3.29	259.0	1.19	0.846
C20+	51.33	446.0	10.75	0.871
	-----		-----	
	100.00		99.99	

1)

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

WELL: 6407/1-3

DST : 1

BHS # 2

DIFFERENTIAL DEPLETION AT 130 C

PRESSURE	OIL FORM	SOLUTION	GAS FORM	RES OIL	COMPR	GAS
BARG	VOL FACT	GOR	VOL FACT	DENSITY	FACTOR	VISCOSITY
	Bod	Rsd	Bg	g/cm ³	Z	cP
378.0	1.580	180.5		0.665		
358.4	1.532	166.7	4.18E-03	0.677	1.064	0.0283
333.2	1.491	151.0	4.32E-03	0.686	1.022	0.0273
300.5	1.449	133.7	4.71E-03	0.695	1.005	0.0250
246.0	1.377	105.0	5.57E-03	0.714	0.973	0.0219
181.8	1.309	76.7	7.28E-03	0.732	0.941	0.0191
122.4	1.250	52.3	1.08E-02	0.750	0.947	0.0168
61.8	1.192	28.4	2.17E-02	0.769	0.965	0.0149
19.6	1.140	11.1	6.77E-02	0.788	0.988	0.0135
0	1.096			0.802		
0 *	1.000			0.879		

* 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: 6407/1-3

DST : 1

BHS # 2

DIFFERENTIAL DEPLETION AT 130 C

(Molecular composition of differentially liberated gas, mol%)

PRESSURE/BARG	358.4	333.2	300.5	246.0	181.8	122.4	61.8	19.6	0.0
NITROGEN	0.45	0.53	0.63	0.60	0.51	0.36	0.21	0.09	0.00
CARBONDIOXIDE	2.40	2.85	2.56	2.51	2.60	2.81	3.19	3.75	3.51
METHANE	85.47	85.29	85.56	86.01	86.00	85.13	81.79	70.18	42.74
ETHANE	4.48	4.46	4.52	4.62	4.85	5.36	6.77	10.30	15.07
PROPANE	2.51	2.47	2.49	2.49	2.56	2.83	3.77	7.07	16.05
i-BUTANE	0.40	0.39	0.39	0.38	0.38	0.41	0.54	1.08	3.00
n-BUTANE	0.89	0.87	0.86	0.84	0.83	0.88	1.16	2.43	6.97
i-PENTANE	0.30	0.28	0.28	0.26	0.25	0.26	0.33	0.67	1.97
n-PENTANE	0.39	0.37	0.37	0.34	0.32	0.33	0.41	0.86	2.16
HEXANES	0.43	0.41	0.42	0.37	0.34	0.32	0.39	0.79	1.27
HEPTANES	0.64	0.54	0.62	0.51	0.45	0.42	0.48	0.96	0.72
OCTANES	0.46	0.42	0.47	0.38	0.33	0.29	0.30	0.54	0.66
NONANES	0.27	0.24	0.25	0.20	0.18	0.15	0.15	0.30	0.96
DECANES+	0.91	0.88	0.59	0.51	0.42	0.48	0.51	0.98	4.91
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
MOLE WEIGHT	21.86	21.69	21.22	20.34	20.15	20.22	21.16	24.90	40.69
GRAVITY (Air=1)	0.755	0.749	0.733	0.702	0.696	0.698	0.731	0.860	1.405

WELL: 6407/1-3

DST : 1

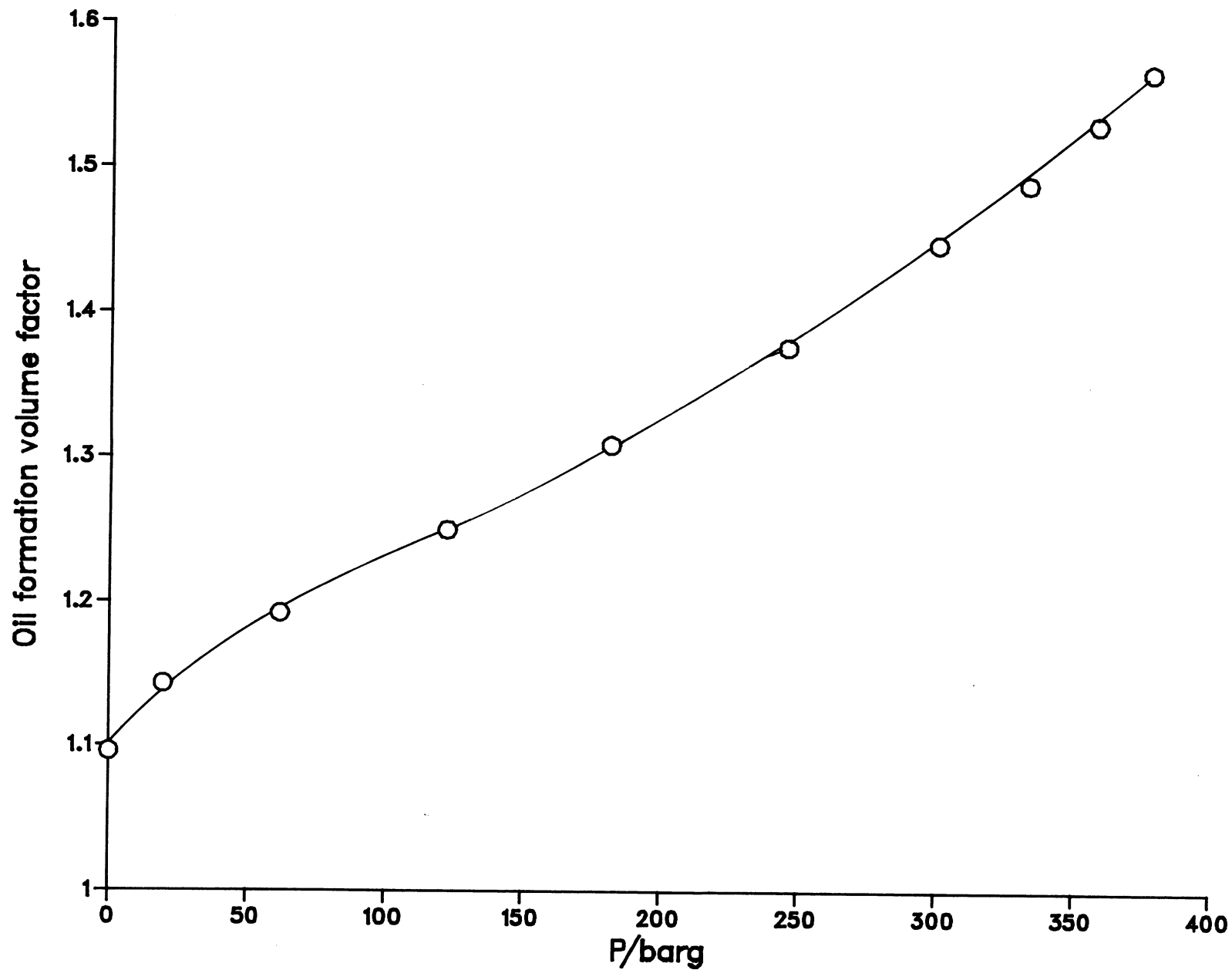
BHS # 2

DIFFERENTIAL DEPLETION AT 130 C
 (Molecular composition of residual oil)

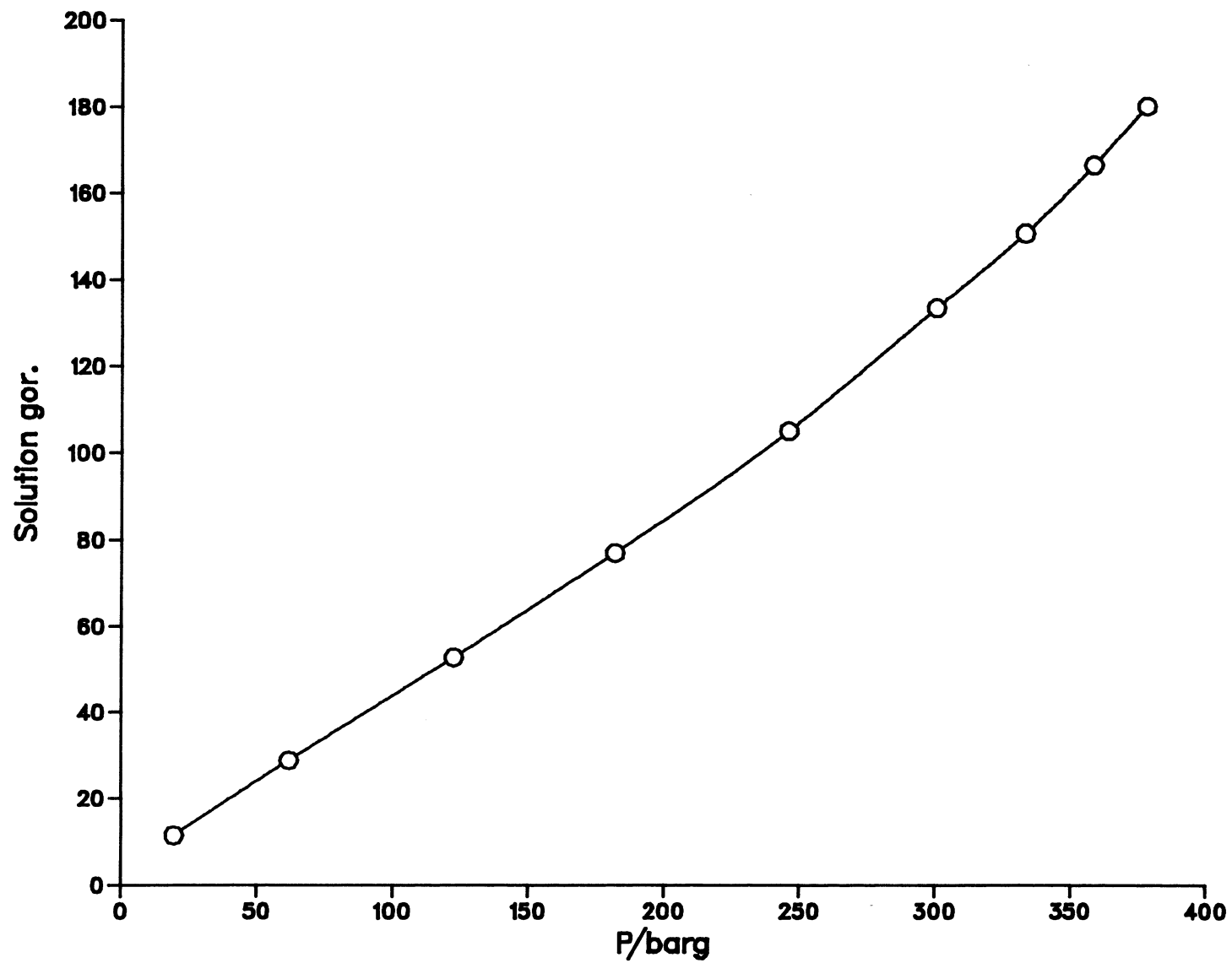
COMPONENT	MOL%	
NITROGEN	0.00	
CARBONDIOXIDE	0.00	
METHANE	0.00	
ETHANE	0.04	
PROPANE	0.35	
i-BUTANE	0.19	
n-BUTANE	0.74	
i-PENTANE	0.52	
n-PENTANE	0.92	
HEXANES	1.91	
HEPTANES	4.85	
OCTANES	6.16	
NONANES	5.04	
DECANES+	79.28	

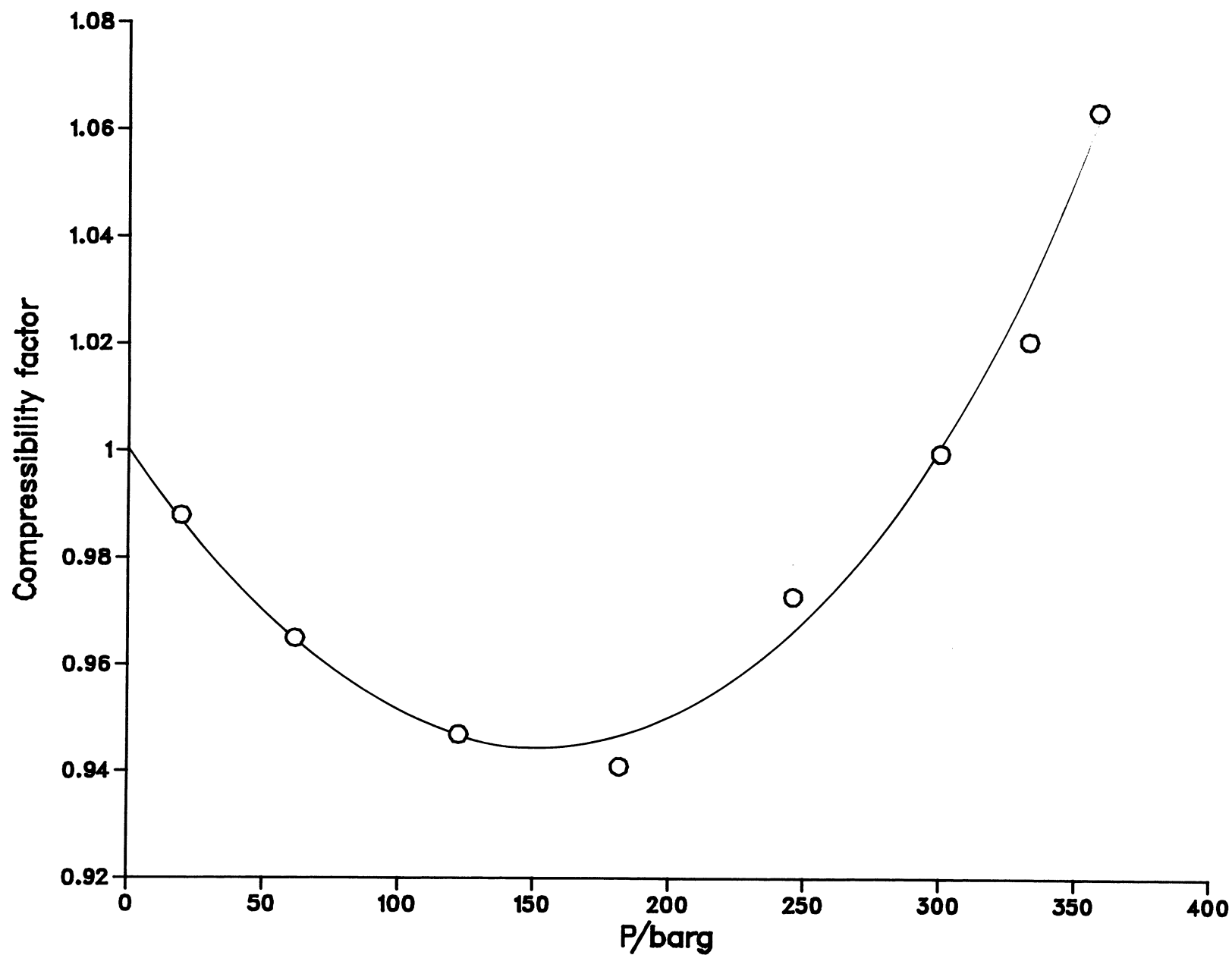
	100.00	
DENSITY AT 15 C	0.879	g/cm ³
MOLE WEIGHT	265.3	

DIFFERENTIAL DEPLETION AT 130.0 °C
OIL FORMATION VOLUME FACTOR

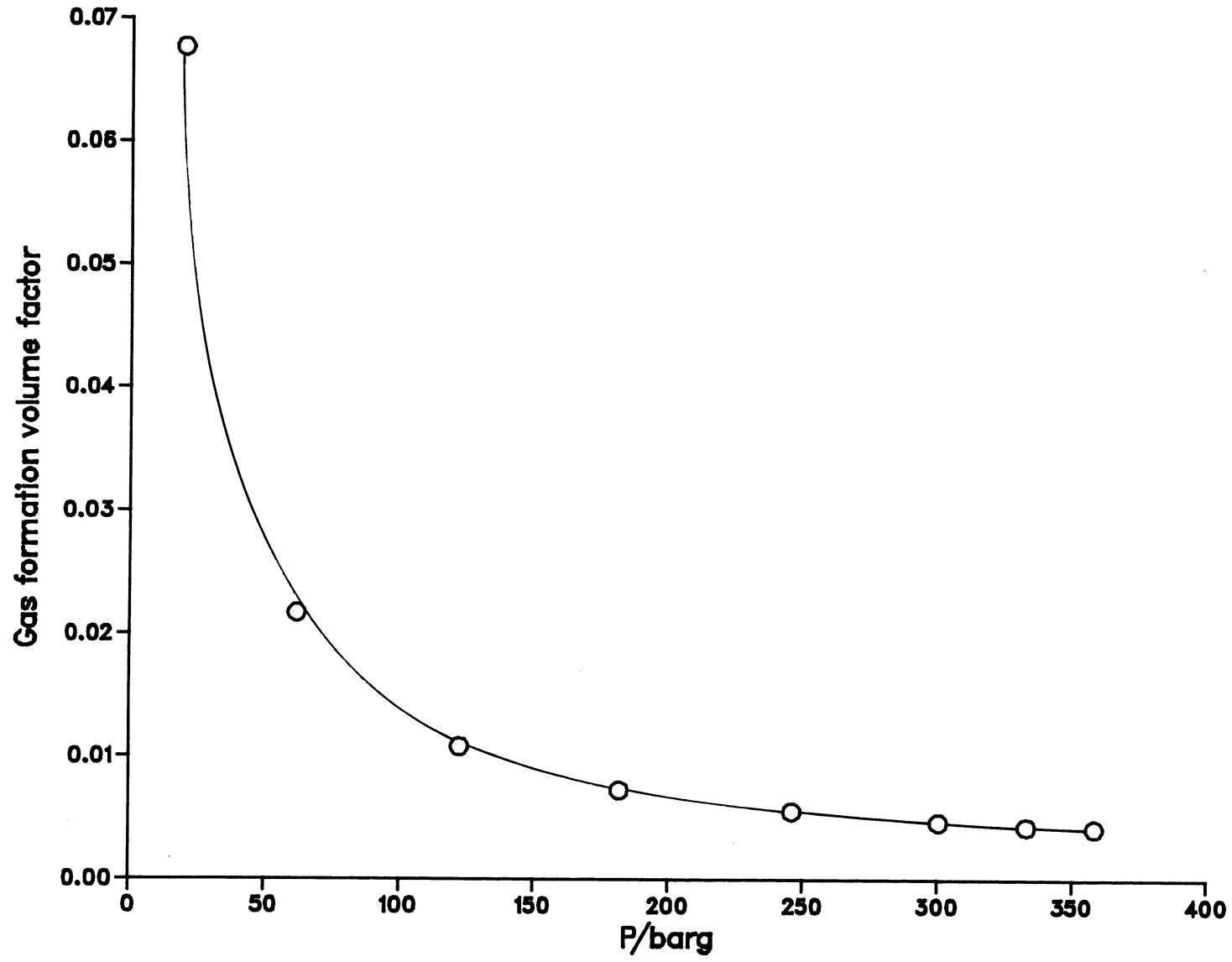


DIFFERENTIAL DEPLETION AT 130.0 °C SOLUTION GOR

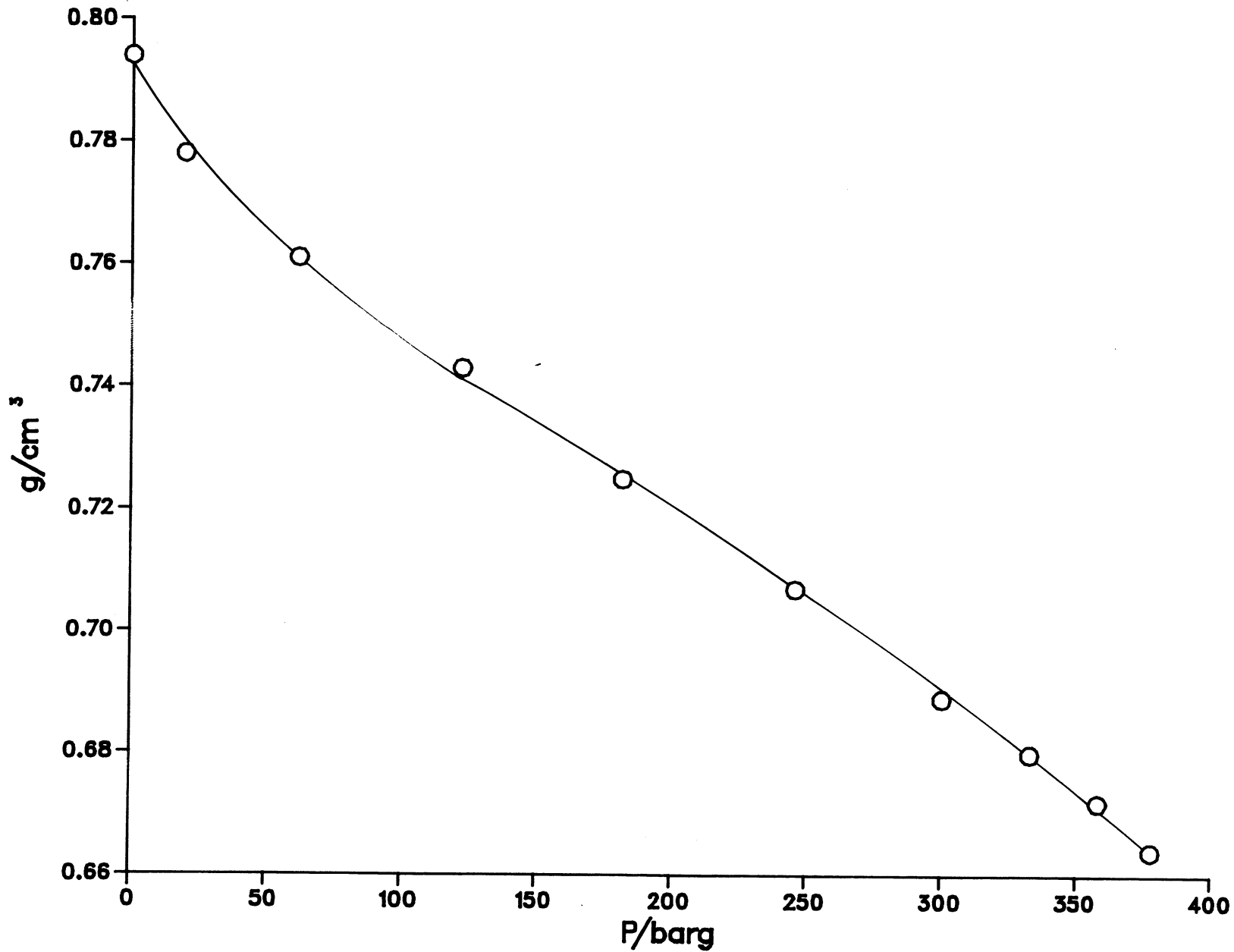


DIFFERENTIAL DEPLETION AT 130.0 °C
COMPRESSIBILITY FACTOR

DIFFERENTIAL DEPLETION AT 130.0 °C
GAS FORMATION VOLUME FACTOR



DIFFERENTIAL DEPLETION AT 130.0 °C
RESERVOIR OIL DENSITY



WELL 6407/1-3

DST # 1

BHS # 2

VISCOSITY OF RESERVOIR FLUID AT 130.0 C

	PRESSURE (Barg)	VISCOSITY (Centipoise)
	500.0	0.503
	475.5	0.499
	450.6	0.497
	419.4	0.495
	404.3	0.492
P _b =	378.0	0.490
	370.0	0.498
	354.5	0.519
	321.5	0.556
	294.2	0.591
	271.4	0.623
	228.7	0.698
	196.3	0.759
	166.0	0.823
	133.9	0.909
	99.7	1.008
	75.9	1.082
	41.1	1.235
	0	1.685

VISCOSITY OF RESERVOIR FLUID AT 130.0 °C

