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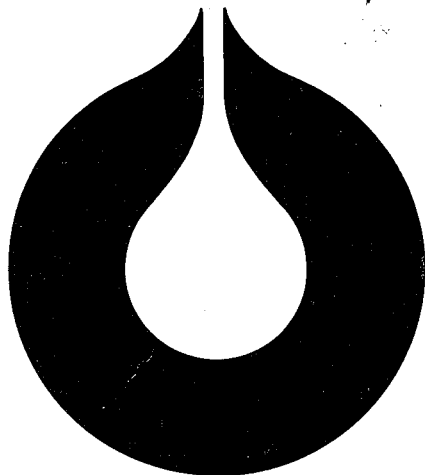


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KODE Well 31/6-5 nr.27

Returneres etter bruk



statoil

PVT Analysis

Well 31/6-5

FMT oil sample

STATOIL
EXPLORATION & PRODUCTION
LABORATORY

september 1984

LAB 84.

hared

Approved

Den norske stats oljeselskap a.s



Classification

Requested by

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Co-workers

Title

PVT Analysis
Well 31/6-5
FMT oil sample

STATOIL
EXPLORATION & PRODUCTION
LABORATORY

September 1984

LAB 84.237

Prepared

5/9-84

Otto Rogne
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Approved

5/9-84

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CONTENTS

	Page
INTRODUCTION	1
SAMPLING CONDITIONS	2
PVT ANALYSIS OF ORIGINAL OIL	
Constant mass expansion	4
Single flash	5
Composition of reservoir fluid	5
Differential depletion	
Volumetric data	6
Composition of liberated gas	7
Composition of residual oil	8
Viscosity	9
Figures	10
PVT ANALYSIS OF BUBBLE POINT ADJUSTED OIL	
Constant mass expansion	17
Single flash	18
Composition of reservoir fluid	18
Differential depletion	
Volumetric data	19
Composition of liberated gas	20
Composition of residual oil	21
Viscosity	22

INTRODUCTION

The present report gives the results of a PVT analysis of an oil sample from well 31/6-5 as requested by LET-S.

Four high pressure bottles with oil samples, which had previously been transferred from an MFT tool by SOS, were received. The bubble point at ambient temperature of all the samples were found to be identical and equal to 118 Barg. Bottle no 811418 was chosen for further study.

Since the bubble point of the sample (144 barg) at reservoir temperature was considerably lower than the reservoir pressure (158 barg), it was decided, after consulting LET-S, to perform one PVT analysis on the original sample, and one on a sample where the bubble point had been adjusted to the reservoir pressure.

The adjustment of the bubble point were accomplished by equilibrating the original oil with gas (separator gas from 31/3-1,DST 2) at 158 barg and reservoir temperature. After removing the excess gas the resulting oil had a bubble point of 159 barg. This was considered satisfactory. The PVT analysis of this sample is reported at the end of the report.

A TBP distillation of the residual stabilized oil removed from the MFT tool will be reported separately.

*)

SAMPLING CONDITIONS

FIELD		TROLL
WELL		31/6-5
TEST		MFT
PERFORATION		1571.5 mRKB
DATE		13/4/84
RESERVOIR FLUID		OIL
SAMPLE TYPE		MFT
	Oil bottle	811418
	Gas bottle	
SEPARATOR CONDITIONS		
	Pressure	N/A Bar
	Temperature	N/A C
	Gas rate	N/A Sm ³ /D
	Oil rate	N/A Sm ³ /D
	Separator GOR	N/A Sm ³ /m ³ sep oil
STATIC BOTTOM HOLE COND		
	Initial Pressure	at m 158.3 Bar
	Last Pressure	- - - N/A
	Temperature	68 C
FLOWING BOTTOM HOLE COND		
	Pressure	at m N/A Bar
	Temperature	- - - N/A C
WELL HEAD		
	Pressure	N/A Bar
	Temperature	N/A C
FIELD MEASUREMENTS		
	Gas gravity (air=1)	N/A
	Fpv	N/A
	Bubbel point in tool	104 Bar at 11 C
	Bubbel point in bottle	111 Bar at 11 C

*)

Data from SOS Sampling Report of 18th April 1984 and STATOIL LET/S.

PVT - ANALYSIS OF ORIGINAL OIL

WELL :31/6-5
 DST :
 RFT

CONSTANT MASS EXPANSION AT 68.3C

PRESSURE BARG	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
264.4	0.9888	8.91E-05	
246.4	0.9904	9.05E-05	
227.5	0.9921	9.19E-05	
209.7	0.9938	9.32E-05	
191.7	0.9954	9.46E-05	
172.6	0.9972	9.60E-05	
165.4	0.9979	9.65E-05	
156.2	0.9989	9.72E-05	
153.0	0.9993	9.74E-05	
148.4	0.9994	9.78E-05	
Pb = 144.1	1.0000	9.81E-05	
142.8	1.0020		4.65
135.4	1.0131		4.90
130.4	1.0247		4.25
125.5	1.0350		4.24
95.7	1.1306		3.87
72.3	1.2792		3.56
54.9	1.4845		3.35
50.0	1.5721		3.29

FOR P < Pb
 FOR P > Pb

$$Y = 2.490 + 1.51E-02 \times P$$

$$V/Vb = 1.01500 - 1.1003E-04 \times P + 4.1441E-08 \times P \times P$$

31/6-5
RFT

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	0.47	0.03	28.0	0.18
CARBONDIOXIDE	0.00	1.26	0.13	44.0	0.49
METHANE	0.00	84.29	3.06	16.0	32.97
ETHANE	0.13	8.64	0.60	30.1	3.46
PROPANE	0.17	2.18	0.24	44.1	0.96
i-BUTANE	0.40	1.60	0.29	58.1	0.87
n-BUTANE	0.16	0.38	0.08	58.1	0.24
i-PENTANE	0.38	0.32	0.15	72.2	0.36
n-PENTANE	0.19	0.10	0.07	72.2	0.16
HEXANES	1.45	0.31	0.48	82.7	1.00
HEPTANES	5.42	0.35	1.78	89.3	3.44
OCTANES	6.98	0.10	2.59	104.4	4.29
NONANES	4.79	0.01	2.01	119.0	2.92
DECANE PLUS	79.94	0.00	88.48	313.8	48.67
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	270.7	19.89			172.60
Gas oil ratio			=	50.7	Sm ³ /Sm ³ STO
Flash formation volume factor of bubble point liquid			=	1.134	m ³ /Sm ³ STO
Density at bubble point			=	0.835	g/cm ³
Density of STO			=	0.904	g/cm ³ at 15C
Gas gravity (air=1)			=	0.687	
Density of C10+			=	0.919	g/cm ³

WELL: 31/6-5
 DST :
 RFT

DIFFERENTIAL DEPLETION AT 68.7 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
144.1	1.152	51.6		0.820		
120.6	1.137	44.0	8.90E-03	0.826	0.903	0.0153
99.1	1.123	36.9	1.09E-02	0.831	0.908	0.0146
77.4	1.108	29.6	1.42E-02	0.838	0.927	0.0139
57.1	1.094	22.5	1.94E-02	0.844	0.943	0.0134
35.8	1.081	15.5	3.12E-02	0.850	0.959	0.0129
17.5	1.065	8.5	6.38E-02	0.856	0.985	0.0124
0	1.042			0.868		
0 *	1.000			0.904		

* 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: 31/6-5

DST :

RFT

DIFFERENTIAL DEPLETION AT 68.7 C

(Molecular composition of differentially liberated gas, mol%)

PRESSURE/BARG	120.6	99.1	77.4	57.1	35.8	17.5	0.0
NITROGEN	1.39	1.09	0.77	0.49	0.24	0.10	0.01
CARBONDIOXIDE	0.54	0.46	0.31	0.94	1.08	1.35	1.43
METHANE	93.05	93.13	93.14	91.99	90.32	85.82	68.16
ETHANE	3.72	3.97	4.38	5.02	6.35	9.49	20.57
PROPANE	0.54	0.57	0.62	0.72	0.94	1.54	4.74
i-BUTANE	0.32	0.33	0.35	0.39	0.51	0.84	2.91
n-BUTANE	0.07	0.07	0.07	0.08	0.11	0.18	0.64
i-PENTANE	0.06	0.06	0.06	0.07	0.08	0.14	0.48
n-PENTANE	0.02	0.02	0.02	0.02	0.03	0.05	0.16
HEXANES	0.08	0.08	0.08	0.08	0.10	0.15	0.43
HEPTANES	0.13	0.13	0.12	0.12	0.15	0.22	0.39
OCTANES	0.06	0.07	0.06	0.06	0.07	0.09	0.08
NONANES	0.01	0.01	0.01	0.01	0.01	0.02	0.00
DECANES+	0.01	0.01	0.01	0.01	0.01	0.01	0.00
	-----	-----	-----	-----	-----	-----	-----
	100.00	100.00	100.00	100.00	100.00	100.00	100.00

MOLE WEIGHT	17.47	17.45	17.44	17.73	18.10	19.09	23.15
GRAVITY (Air=1)	0.603	0.602	0.602	0.612	0.625	0.659	0.799

WELL: 31/6-5

DST :

RFT

DIFFERENTIAL DEPLETION AT 68.7 C
 (Molecular composition of residual oil)

COMPONENT	MOL%	
NITROGEN	0.00	
CARBONDIOXIDE	0.00	
METHANE	0.00	
ETHANE	0.15	
PROPANE	0.29	
i-BUTANE	0.58	
n-BUTANE	0.21	
i-PENTANE	0.43	
n-PENTANE	0.20	
HEXANES	1.47	
HEPTANES	5.44	
OCTANES	6.61	
NONANES	5.21	
DECANES+	79.41	

	100.00	
DENSITY AT 15 C	0.904	g/cm ³
MOLE WEIGHT	267.9	

WELL 31/6-5
RFT

VISCOSITY OF RESERVOIR FLUID AT 68.3 C

	PRESSURE (Barg)	VISCOSITY (Centipoise)
	200.0	2.748
	179.8	2.667
	159.8	2.606
Pb =	144.1	2.560
	143.0	2.601
	133.2	2.713
	123.0	2.851
	106.2	3.069
	82.2	3.457
	63.4	3.837
	44.6	4.301
	24.0	4.963
	5.9	5.731
	0.0	6.329

FIG.1

CONSTANT MASS EXPANSION AT 68.3 °C

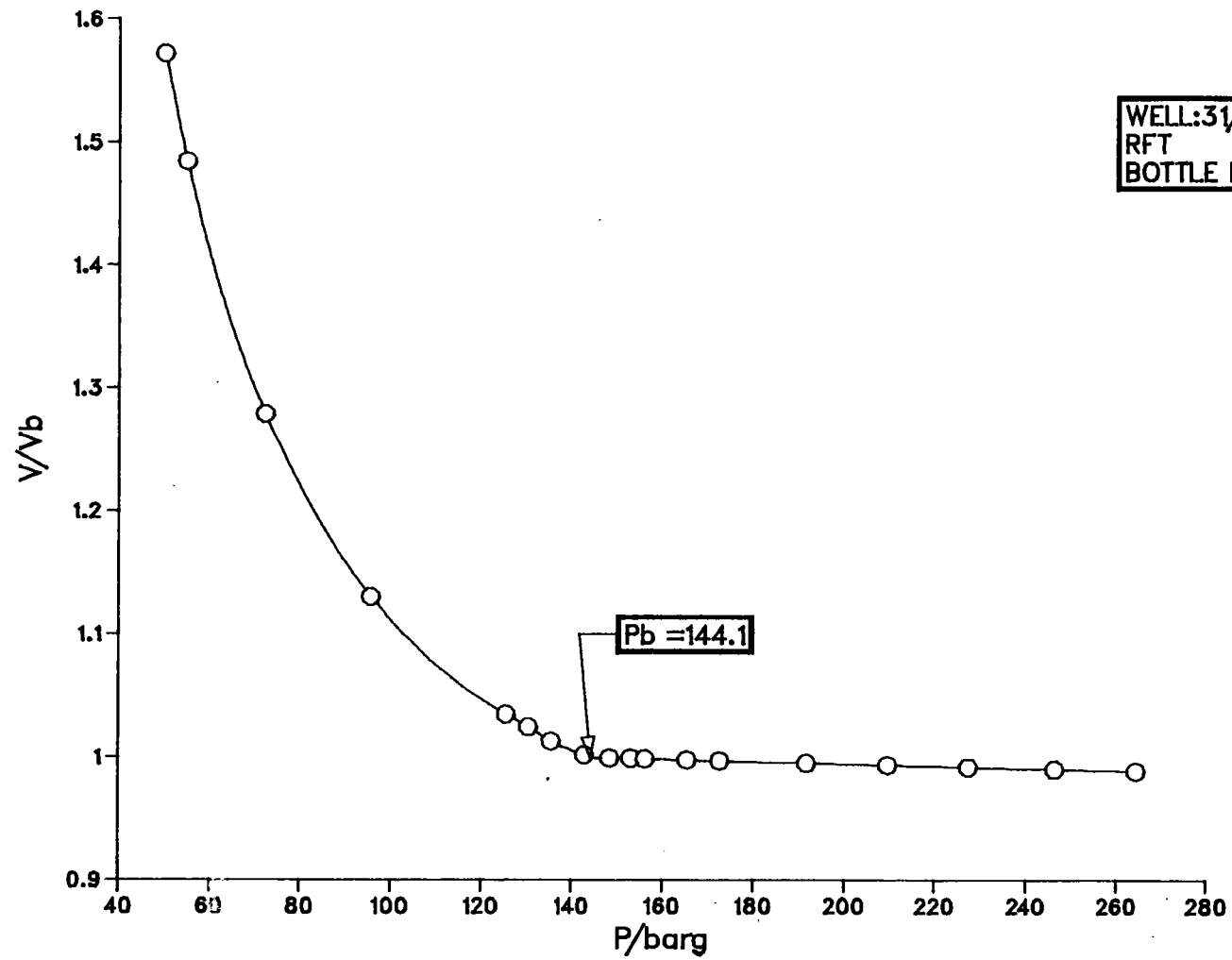


FIG. 2

DIFFERENTIAL DEPLETION AT 68.3 °C
COMPRESSIBILITY FACTOR

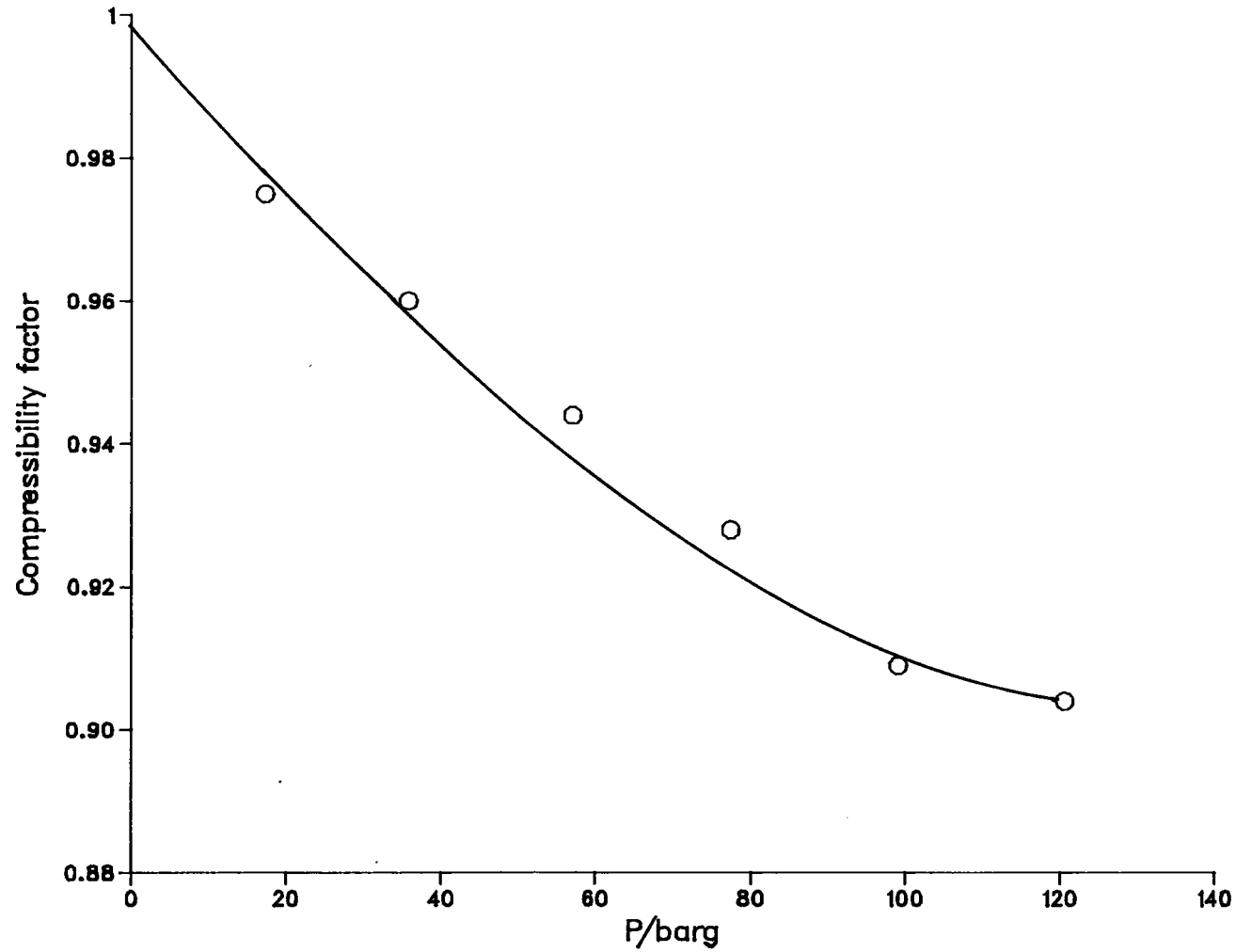


FIG. 3

DIFFERENTIAL DEPLETION AT 68.3 °C
GAS FORMATION VOLUME FACTOR

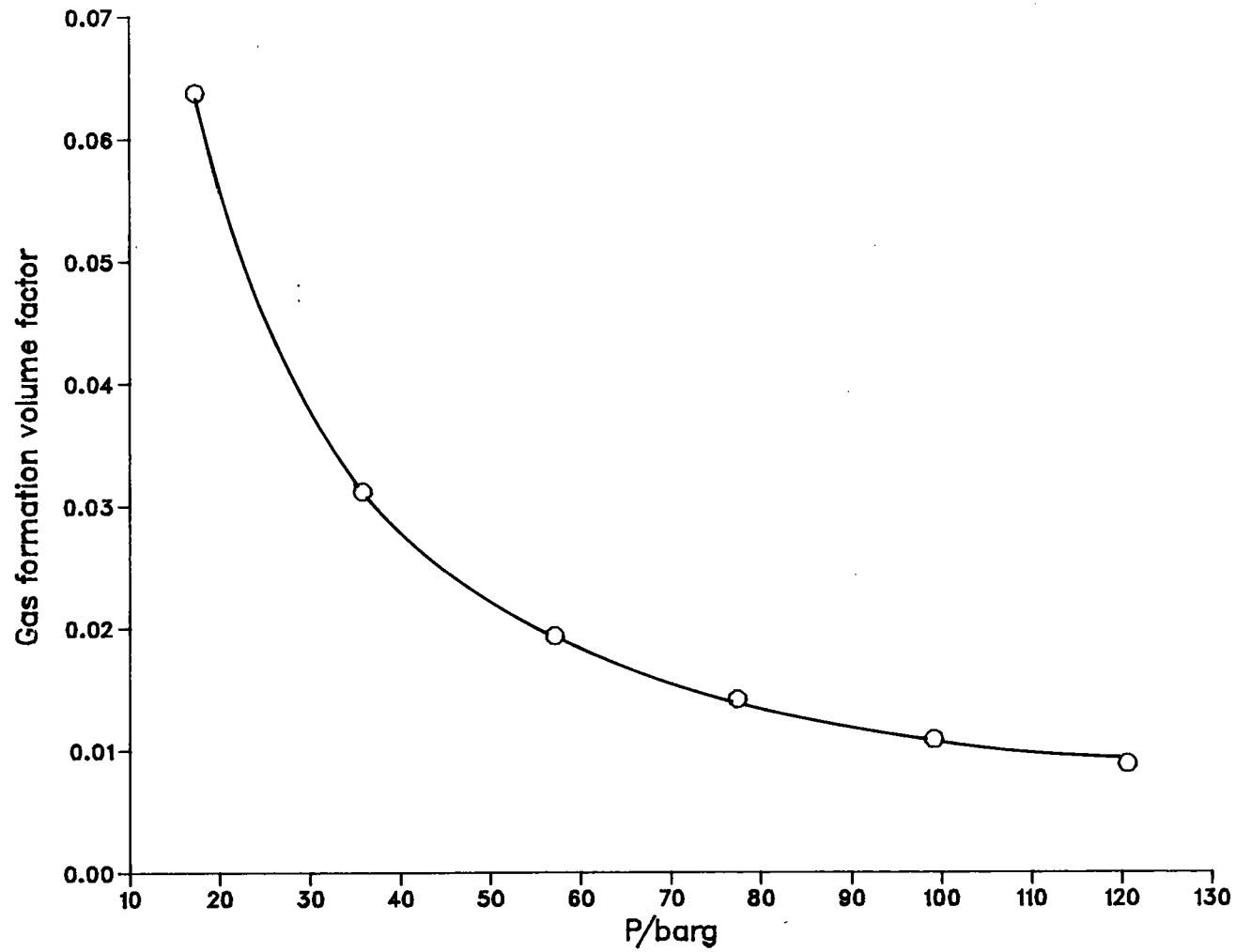


FIG. 4

DIFFERENTIAL DEPLETION AT 68.3 °C
OIL FORMATION VOLUME FACTOR

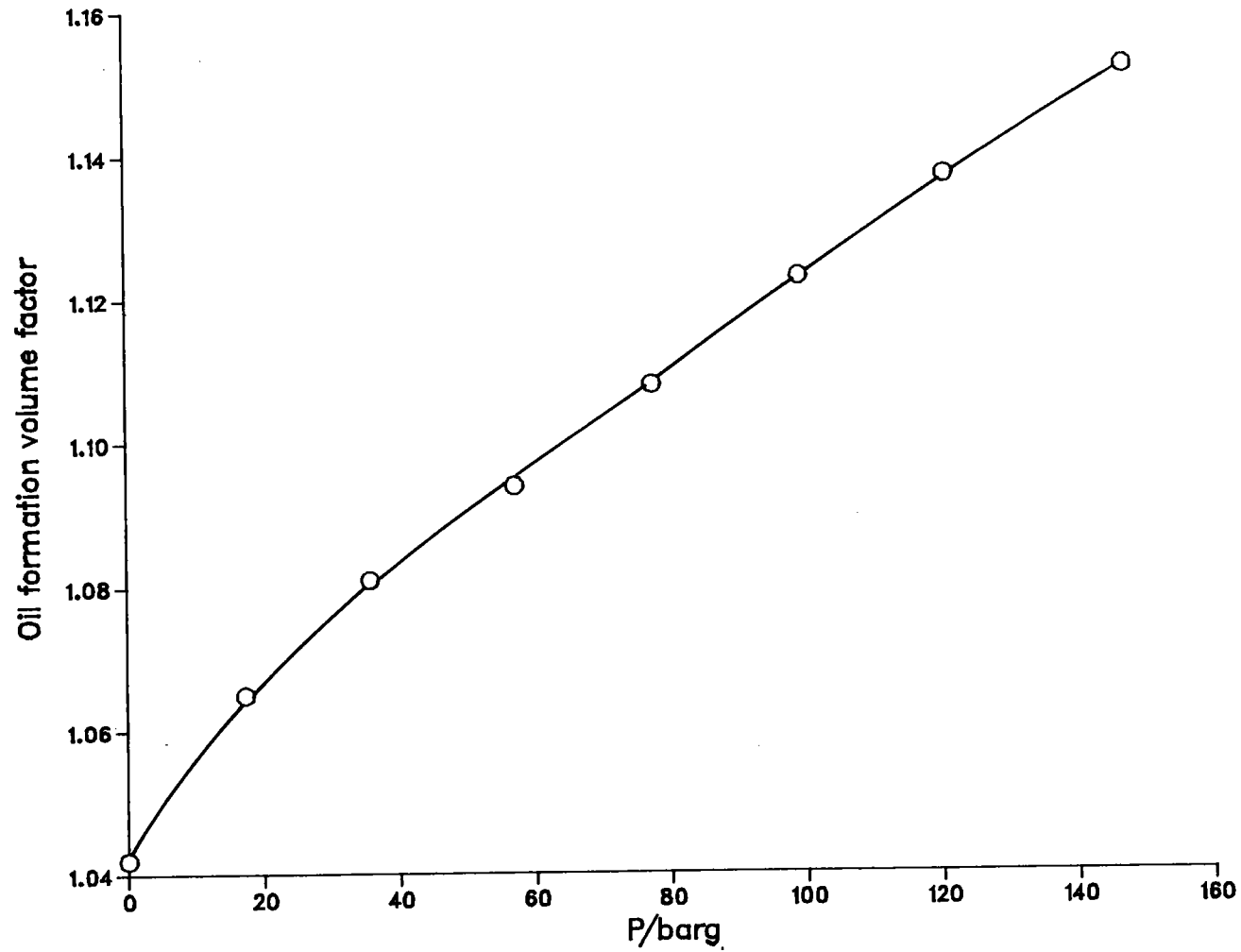


FIG. 5

DIFFERENTIAL DEPLETION AT 68.3 °C
RESERVOIR OIL DENSITY

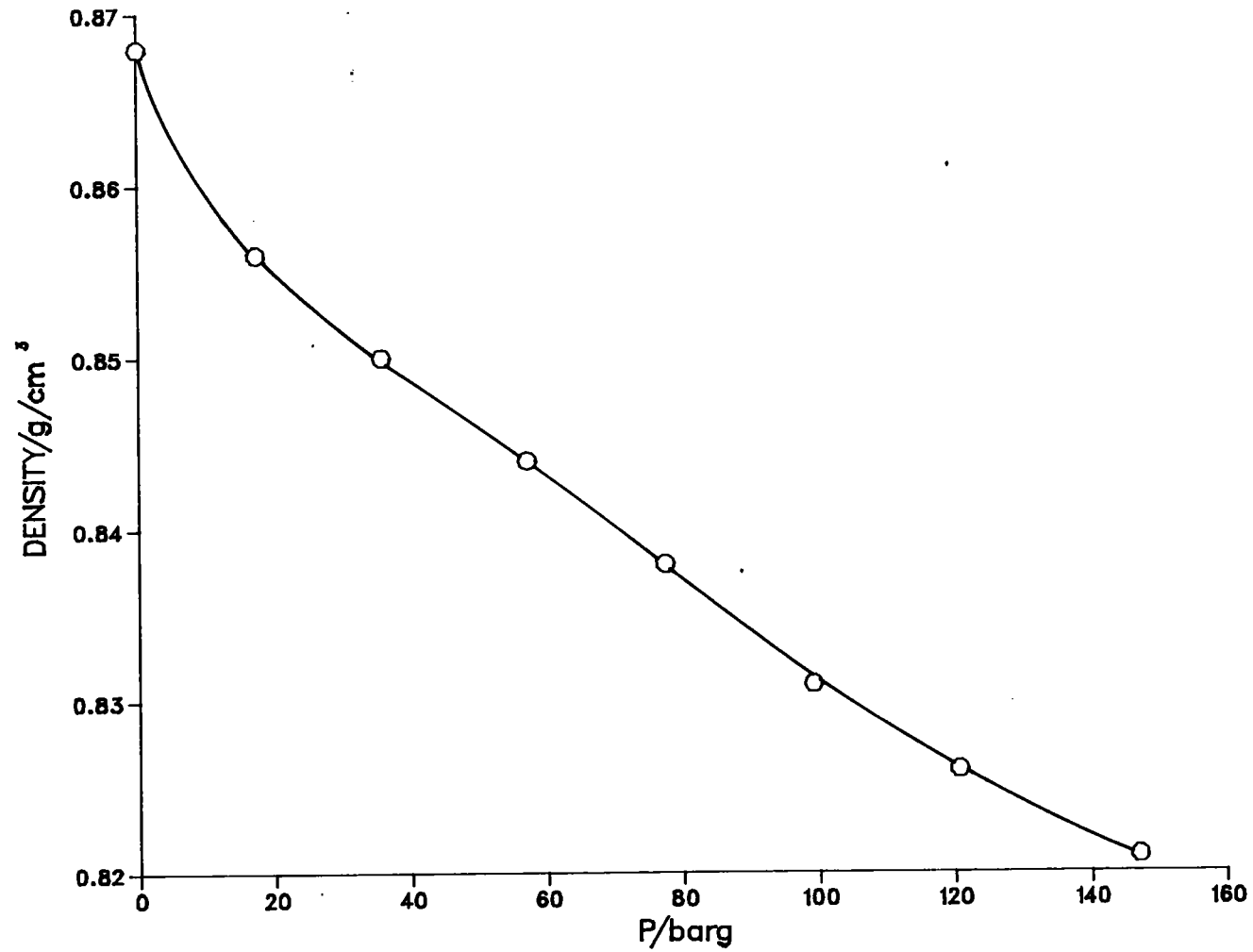
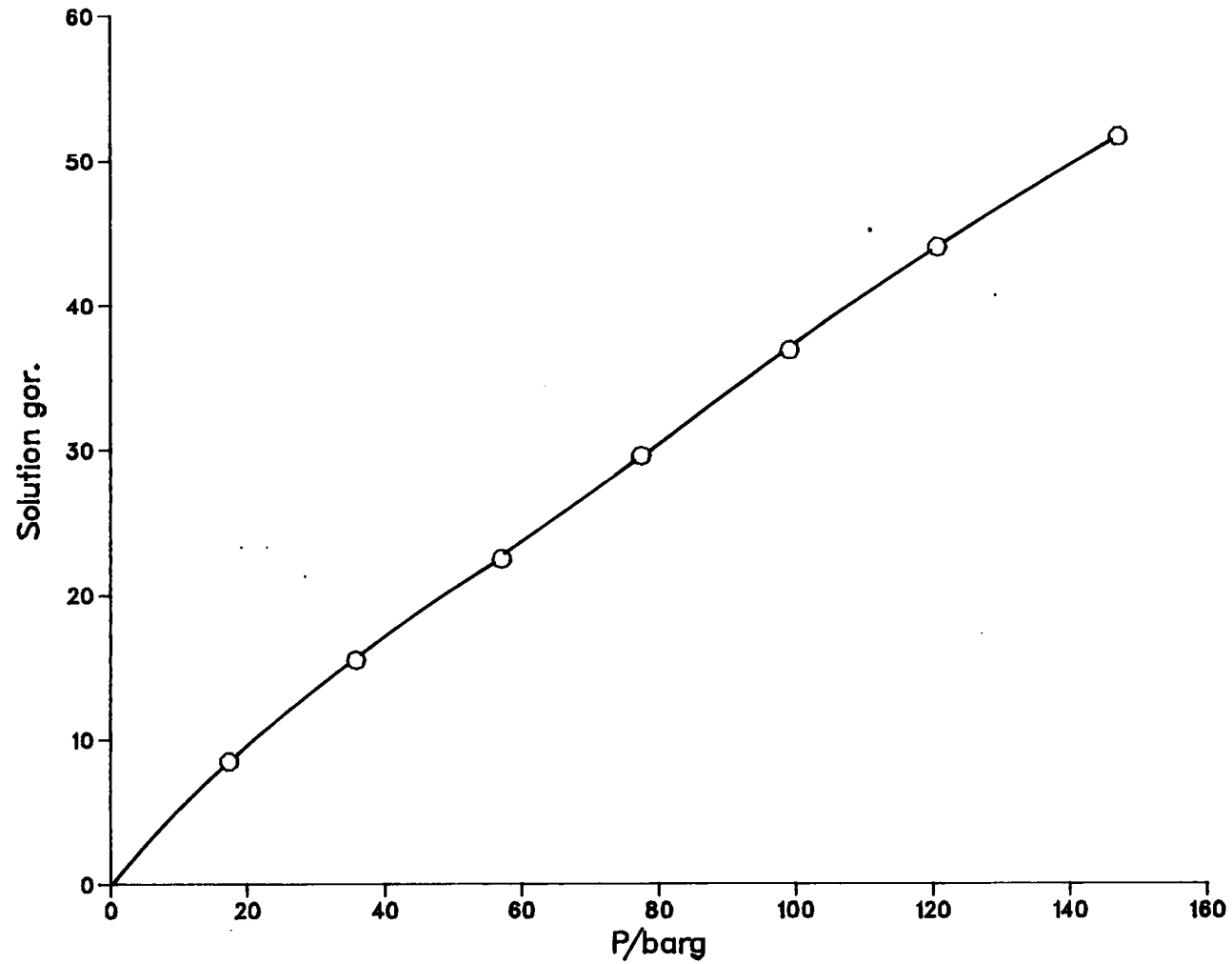


FIG. 6

DIFFERENTIAL DEPLETION AT 68.3 °C
SOLUTION GOR



PVT - ANALYSIS OF ORIGINAL OIL
with
ADJUSTED BUBBLE POINT

WELL : 31/6-5-2
 DST #:
 RFT

CONSTANT MASS EXPANSION AT 68.8C

	PRESSURE BARG	REL VOL V/Vb	COMPRESSIBILITY 1/BAR	Y-FACTOR
	288.8	0.9872	9.71E-05	
	266.3	0.9895	9.78E-05	
	245.5	0.9915	9.84E-05	
	226.7	0.9933	9.89E-05	
	206.3	0.9952	9.95E-05	
	186.8	0.9972	1.00E-04	
	174.3	0.9986	1.00E-04	
	165.2	0.9994	1.01E-04	
	161.2	0.9998	1.01E-04	
Pb =	159.0	1.0000	1.01E-04	
	152.1	1.0105		4.55
	134.7	1.0420		4.37
	115.5	1.0924		4.11
	95.7	1.1718		3.87
	68.1	1.3806		3.52
	56.4	1.5397		3.38
	46.9	1.7300		3.29
	39.2	1.9615		3.19

FOR P < Pb Y = 2.703 + 1.22E-02 x P
 FOR P > Pb V/Vb = 1.01658 - 1.0716E-04 x P + 1.9599E-08 x P x P

31/6-5-2
RFT

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	0.51	0.03	28.0	0.21
CARBONDIOXIDE	0.00	0.85	0.09	44.0	0.35
METHANE	0.00	85.03	3.31	16.0	34.87
ETHANE	0.08	8.28	0.61	30.1	3.44
PROPANE	0.07	2.09	0.23	44.1	0.90
i-BUTANE	0.19	1.55	0.26	58.1	0.75
n-BUTANE	0.08	0.38	0.07	58.1	0.20
i-PENTANE	0.22	0.30	0.11	72.1	0.26
n-PENTANE	0.17	0.11	0.06	72.1	0.15
HEXANES	1.36	0.33	0.46	82.7	0.94
HEPTANES	5.32	0.42	1.75	89.2	3.31
OCTANES	6.87	0.14	2.53	104.2	4.11
NONANES	4.74	0.01	1.96	118.5	2.80
DECANE PLUS	80.89	0.00	88.53	314.0	47.71
	-----	-----	-----		-----
	100.00	100.00	100.00		100.00
MOL WEIGHT	273.1	19.79			169.23

Gas oil ratio	=	54.3	Sm ³ /Sm ³ STO
Flash formation volume factor of bubble point liquid	=	1.159	m ³ /Sm ³ STO
Density at bubble point	=	0.818	g/cm ³
Density of STO	=	0.903	g/cm ³ at 15C
Gas gravity (air=1)	=	0.683	
Density of C10+	=	0.919	g/cm ³

WELL: 31/6-5-2
 DST :
 RFT

DIFFERENTIAL DEPLETION AT 68.8 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
159.0	1.162	54.3		0.815		
142.2	1.152	49.3	7.60E-03	0.819	0.908	0.0161
126.2	1.142	44.4	8.54E-03	0.823	0.907	0.0155
100.6	1.124	36.0	1.09E-02	0.830	0.921	0.0146
74.2	1.107	27.3	1.49E-02	0.838	0.937	0.0138
49.2	1.089	19.0	2.27E-02	0.845	0.952	0.0132
30.7	1.075	12.6	3.69E-02	0.852	0.977	0.0128
17.4	1.066	8.0	6.44E-02	0.856	0.989	0.0124
0	1.040			0.869		
0 *	1.000			0.904		

* 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: 31/6-5-2

DST :

RFT

DIFFERENTIAL DEPLETION AT 68.8 C

(Molecular composition of differentially liberated gas, mol%)

PRESSURE/BARG	142.2	126.2	100.6	74.2	49.2	30.7	17.4	0.0
NITROGEN	1.53	1.34	1.06	0.68	0.41	0.18	0.04	0.05
CARBONDIOXIDE	1.17	1.30	1.07	0.79	1.00	0.99	1.36	1.37
METHANE	92.23	92.23	92.69	92.38	91.55	89.16	84.67	65.66
ETHANE	3.75	3.82	3.92	4.70	5.40	7.39	10.48	22.25
PROPANE	0.56	0.56	0.56	0.67	0.78	1.11	1.70	5.12
i-BUTANE	0.34	0.33	0.32	0.37	0.42	0.60	0.92	3.21
n-BUTANE	0.07	0.07	0.07	0.08	0.09	0.13	0.19	0.70
i-PENTANE	0.06	0.06	0.06	0.06	0.07	0.09	0.15	0.54
n-PENTANE	0.02	0.02	0.02	0.02	0.02	0.03	0.05	0.17
HEXANES	0.08	0.08	0.07	0.08	0.08	0.10	0.15	0.47
HEPTANES	0.13	0.12	0.11	0.11	0.12	0.15	0.21	0.39
OCTANES	0.06	0.07	0.05	0.06	0.06	0.07	0.08	0.06
NONANES	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DECANES+	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
MOLE WEIGHT	17.67	17.68	17.56	17.62	17.81	18.30	19.29	24.50
GRAVITY (Air=1)	0.610	0.610	0.606	0.608	0.615	0.632	0.666	0.846

WELL: 31/6-5-2

DST :

RFT

DIFFERENTIAL DEPLETION AT 68.8 C
(Molecular composition of residual oil)

COMPONENT	MOL%
NITROGEN	0.00
CARBONDIOXIDE	0.00
METHANE	0.00
ETHANE	0.19
PROPANE	0.36
i-BUTANE	0.65
n-BUTANE	0.23
i-PENTANE	0.45
n-PENTANE	0.21
HEXANES	1.48
HEPTANES	5.44
OCTANES	7.12
NONANES	5.03
DECANES+	78.84

	100.00

DENSITY AT 15 C	0.904	g/cm ³
MOLE WEIGHT	267.3	

WELL 31/6-5
RFT

VISCOSITY OF RESERVOIR FLUID AT 68.8 C

PRESSURE (Barg)	VISCOSITY (Centipoise)
250.0	2.992
224.8	2.890
200.2	2.780
175.3	2.690
162.2	2.628
Pb = 159.0	2.610
143.2	2.683
130.0	2.815
105.0	3.094
79.5	3.484
56.6	3.996
30.2	4.693
10.9	5.453
0.0	6.105