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Alan

CORE LABORATORIES

Reservoir Fluid Study
for

University of Kansas

Shield Oil Producers - Letsch #7
Hall-Gurney
27-14-13W, C W2 E2 S1

RFL 990108
28-Sep-1999

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Core Laboratories, Inc.

CORELAB

September 29, 1999

University of Kansas
4008 Learned Hall
Lawrence, KS 66045

Subject: Reservoir Fluid Study
Well: Shields Oil Producers – Letsch #7
RFL No. 990108

Attention: Mr. Richard Pancake

Dear Mr. Pancake,

Samples of separator liquid were collected from the subject well on August 2, 1999 and were submitted to our Carrollton, Texas laboratory facilities for use in a Reservoir Fluid Study. Presented in the following report are the results of this study. Should any questions arise or if we may be of further service in anyway, please contact me at 972-323-3940. Thank you.

Sincerely,

Tom Coleman

Thomas R. Coleman
Reservoir Fluid Laboratory-Carrollton, Texas

Core Laboratories, Inc.
1875 Monetary Lane, Carrollton, Texas 75006-7012, (972) 466-2673, fax (972)323-3930, e-mail @corelabusa.com

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LABORATORY PROCEDURES

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PRELIMINARY QUALITY CHECKS OF SEPARATOR SAMPLES

As a quality check, the room temperature bubblepoint pressure of the separator liquid samples were measured. This information, summarized on page three of the report, indicated that the samples received in the laboratory closely represent reported field separator conditions.

SEPARATOR SAMPLE COMPOSITIONS

The composition of the separator liquid was measured to a triacontanes plus fraction using the low temperature distillation technique. This resulted in the composition listed on page four.

PRESSURE-VOLUME RELATIONS

A portion of the reservoir fluid was charged to a high-pressure visual cell and thermally expanded to the reported reservoir temperature of 105°F. After establishing thermal equilibrium, the fluid sample was subjected to a constant composition expansion at this temperature. The fluid was found to have a saturation pressure of 23 psig. Other data derived from the pressure-volume relations measurements, including relative volumes and average single-phase compressibilities, may be found on pages five and six.

MULTI-PRESSURE VISCOSITY

The viscosity of the reservoir fluid was measured over a wide range of pressures at 105°F. in a rolling ball viscosimeter. The viscosity of the fluid was found to vary from a minimum of 3.91 centipoise at the saturation pressure to a maximum of 6.10 centipoise at 5000 psig. Results may be found on page seven.

SHRINKAGE TEST

A shrinkage was test performed on the reservoir fluid to determine the gas/oil ratio, stock tank oil gravity and formation volume factor. Results may be found on page eight.

GRAPHICAL REPRESENTATIONS

This report includes graphical representations and analytical expressions. The statistical summaries represent an objective estimate of non-systematic error using a preset live of confidence. Confidence intervals are calculated using the Student "t" density distribution tables.

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Shield Oil Producers - Letsch #7
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General Well Information

Company	**University of Kansas**	
Well Name	**Shield Oil Producers - Letsch #7**	
API Well Number		
File Number	**RFL 990108**	
Date Sample Collected	**2-Aug-1999**	
Sample Type	**Separator**	
Geographical Location	**27-14-13W, C W2 E2 S1**	
Field	**Hall-Gurney**	

Well Description

Formation	**Lansing/Kansas City**	
Pool (or Zone)	**C& D Intervals**	
Date Completed	*	
Elevation	*	ft
Producing Interval	**2856-76**	ft
Total Depth	**2877**	ft
Tubing Size	*	in
Tubing Depth	*	ft
Casing Size	**7**	in
Casing Depth	**2844**	ft

Pressure Survey Data

Data from Original Discovery Well

Date	*	
Reservoir Pressure	*	psig

Data at Sample Collection

Date	**2-Aug-1999**	
Reservoir Pressure	**+/- 600**	psig
Reservoir Temperature	**105**	°F
Pressure Tool	*	
Flowing Bottom-Hole Pressure	*	psig
Flowing Tubing Pressure	*	psig

* Data not forwarded to Core Laboratories.

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Production Data

Data from Original discovery Well

Location	*	
Date	*	
Oil Gravity @ STP	*	°API
Separator Pressure	*	psig
Separator Temperature	*	°F
Production Rates		
Gas	*	Mscf/D
Liquid	*	STbbl/D
Gas/Liquid Ratio	*	scf/bbl

Separator Conditions

Primary Separator Pressure	18	psig
Primary Separator Temperature	78	°F
Secondary Separator Pressure	na	psig
Secondary Separator Temperature	na	°F
Primary Separator Gas Production Rate	none	Mscf/D

Gas Factors -

Field Values:		
Pressure Base	14.73	psia
Temperature Base	60	°F
Compressibility Factor (Fpv)	*	
Gas Gravity Factor (Fg)	*	
Laboratory Values:		
Pressure Base	14.73	psia
Temperature Base	60	°F
Compressibility Factor (Fpv)	na	
Gas Gravity Factor (Fg)	na	

Primary Separator Liquid Rate	*	bbl/D	at	°F
Stock Tank Liquid Rate	*	bbl/D	at	°F
Separator Gas / Separator Liquid Ratio	*	scf/bbl		
Separator Gas / Stock Tank Liquid Ratio	*	scf/bbl		
Stock Tank Liquid / Separator Gas Ratio	*	bbl/Mscf		
Separator Liquid / Stock Tank Liquid Ratio	*	bbl/bbl	at	°F

* Data not forwarded to Core Laboratories.

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PRELIMINARY CHECKS OF SAMPLE QUALITY
AND SUMMARY OF SAMPLES RECEIVED

Separator Gas**					
Cylinder Number	Sampling Conditions		Laboratory Opening Conditions		
	psig	°F	psig	°F	Air Content (mol %)

Separator Liquid					
Cylinder Number	Sampling Conditions		Laboratory Bubblepoint		Water Recovered (cc)
	psig	°F	psig	°F	
*323040C	4	78	7	72	0
376483D	8	78	9	70	0

*This sample was selected for further analysis
** No separator gas was collected

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Composition of Reservoir Fluid Sample
(by Low Temperature Distillation)

Component Name	Mol %	Wt %	Density (gm/cc)	MW
Hydrogen Sulfide	0.04	0.01	0.8006	34.08
Carbon Dioxide	0.18	0.04	0.8172	44.01
Nitrogen	0.00	0.00	0.8086	28.013
Methane	0.08	0.01	0.2997	16.043
Ethane	0.37	0.06	0.3562	30.07
Propane	1.54	0.35	0.5070	44.097
iso-Butane	0.65	0.20	0.5629	58.123
n-Butane	2.03	0.61	0.5840	58.123
Iso-Pentane	1.94	0.73	0.6244	72.15
n-Pentane	3.75	1.41	0.6311	72.15
Hexanes	10.58	4.63	0.6850	84
Heptanes	10.20	5.10	0.7220	96
Octanes	11.89	6.61	0.7450	107
Nonanes	8.07	5.08	0.7640	121
Decanes	6.85	4.78	0.7780	134
Undecanes	5.30	4.05	0.7890	147
Dodecanes	4.27	3.58	0.8000	161
Tridecanes	4.17	3.80	0.8110	175
Tetradecanes	3.45	3.41	0.8220	190
Pentadecanes	3.14	3.37	0.8320	206
Hexadecanes	2.42	2.80	0.8390	222
Heptadecanes	2.21	2.73	0.8470	237
Octadecanes	1.94	2.54	0.8520	251
Nonadecanes	1.70	2.32	0.8570	263
Eicosanes	1.36	1.95	0.8620	275
Heneicosanes	1.15	1.75	0.8670	291
Docosanes	1.00	1.59	0.8720	305
Tricosanes	0.87	1.44	0.8770	318
Tetracosanes	0.71	1.23	0.8810	331
Pentacosanes	0.69	1.24	0.8850	345
Hexacosanes	0.52	0.97	0.8890	359
Heptacosanes	0.50	0.96	0.8930	374
Octacosanes	0.45	0.90	0.8960	388
Nonacosanes	0.41	0.87	0.8990	402
Triacontanes plus	5.57	28.88	1.0302	996
Totals	100.00	100.00		

Total Sample Properties

Molecular Weight	192.10
Theoretical Liquid Density, gm/scc	0.8425

ALPHA 1.

Plus Fractions	Mol %	Wt %	Density	MW
Heptanes plus	78.84	91.95	0.8659	224
Undecanes plus	41.83	70.38	0.9087	323
Pentadecanes plus	24.64	55.54	0.9412	433
Eicosanes plus	13.23	41.78	0.9781	607
Pentacosanes plus	8.14	33.82	1.0073	799
Triacontanes plus	5.57	28.88	1.0302	996

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VOLUMETRIC DATA

(at 105 °F)

Saturation Pressure (Psat)	23 psig
Density at Psat	0.8221 gm/cc
Thermal Exp @ 1800 psig	1.01856 V at 105 °F / V at 60 °F

AVERAGE SINGLE-PHASE COMPRESSIBILITIES

Pressure Range psig			Single-Phase Compressibility v/v/psi
5000	to	4000	5.63 E -6
4000	to	3000	5.63 E -6
3000	to	1800	5.71 E -6
1800	to	200	6.38 E -6
200	to	23	9.53 E -6

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PRESSURE-VOLUME RELATIONS

(at 105 °F)

Pressure psig	Relative Volume (A)	Density gm/cc
5000	0.9706	0.8469
4000	0.9760	0.8425
3000	0.9815	0.8374
2000	0.9871	0.8328
1800	0.9882	0.8318
1000	0.9929	0.8278
500	0.9961	0.8253
400	0.9968	0.8247
300	0.9975	0.8241
200	0.9983	0.8236
100	0.9992	0.8227
50	0.9997	0.8222
b»23	1.0000	0.8221

(A) Relative Volume: V/Vsat or volume at indicated pressure per volume at saturation pressure.

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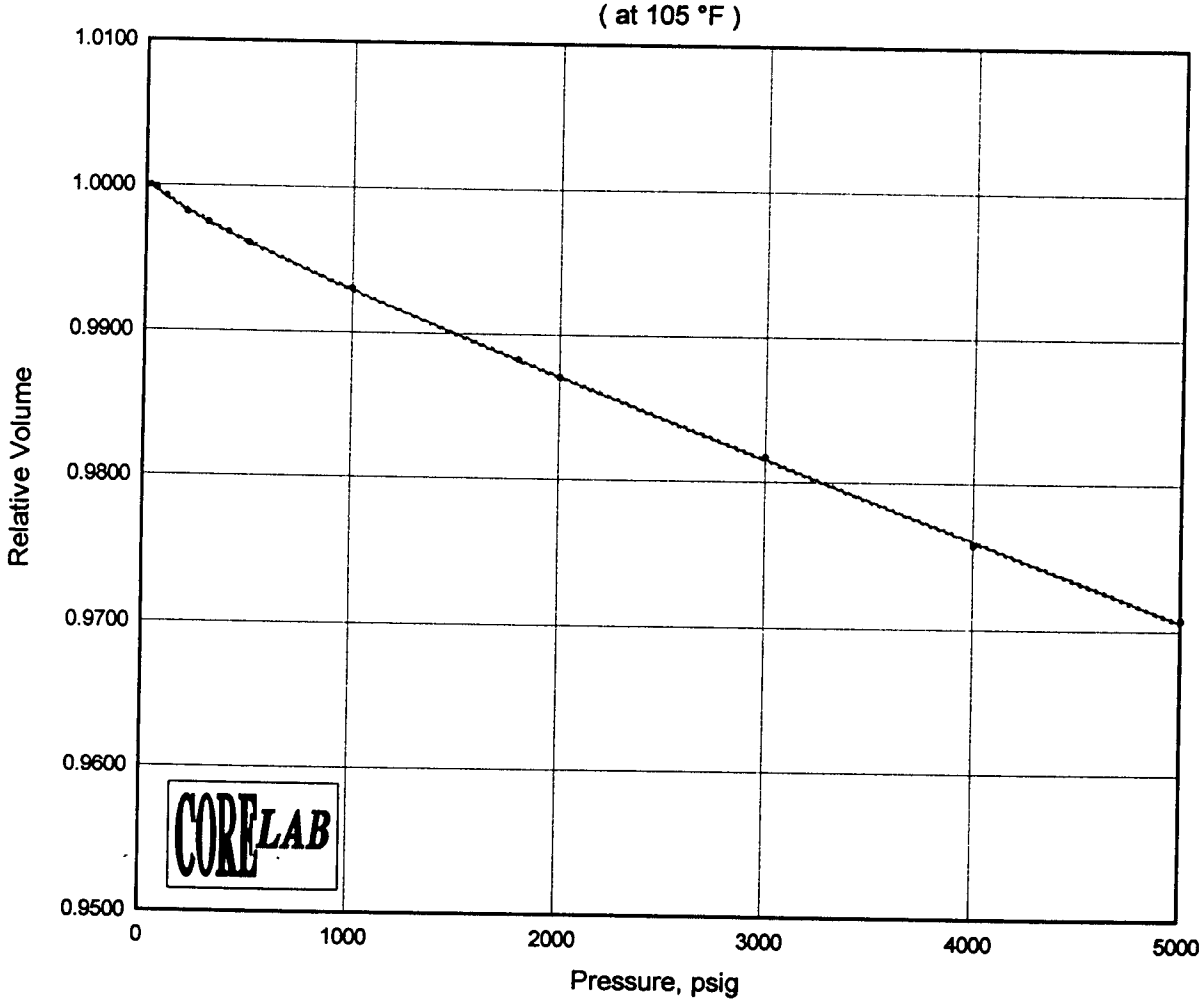
RELATIVE VOLUME

(at 105 °F)



Relative Volume Expression:	LEGEND
y= a + b (Xd)^i + c (Xd)^j	
where:	• Laboratory Data
a= 1.00040e+ 00 i= 0.744	..... Confidence Limits
b= -3.98682e- 04 j= 1.381	——— Analytical Expression
c= -4.73289e- 06	Saturation Pressure: 23 psig
Note: Xd (dimensionless 'X') = Pi / Psat, psig	Current Reservoir Pressure: 600 psig
Confidence level: 99 %	**Pressure-Volume Relations**
Confidence interval: +/- 0.00013	**Figure A-1**
'r squared': .999771	

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RESERVOIR FLUID VISCOSITY
(at 105 °F)

Pressure psig	Oil Viscosity cp
5000	6.10
4500	5.86
4000	5.62
3500	5.38
3000	5.15
2500	4.92
2000	4.70
1500	4.48
1000	4.27
500	4.07
100	3.93
50	3.92
b>>23	3.91
0	3.93

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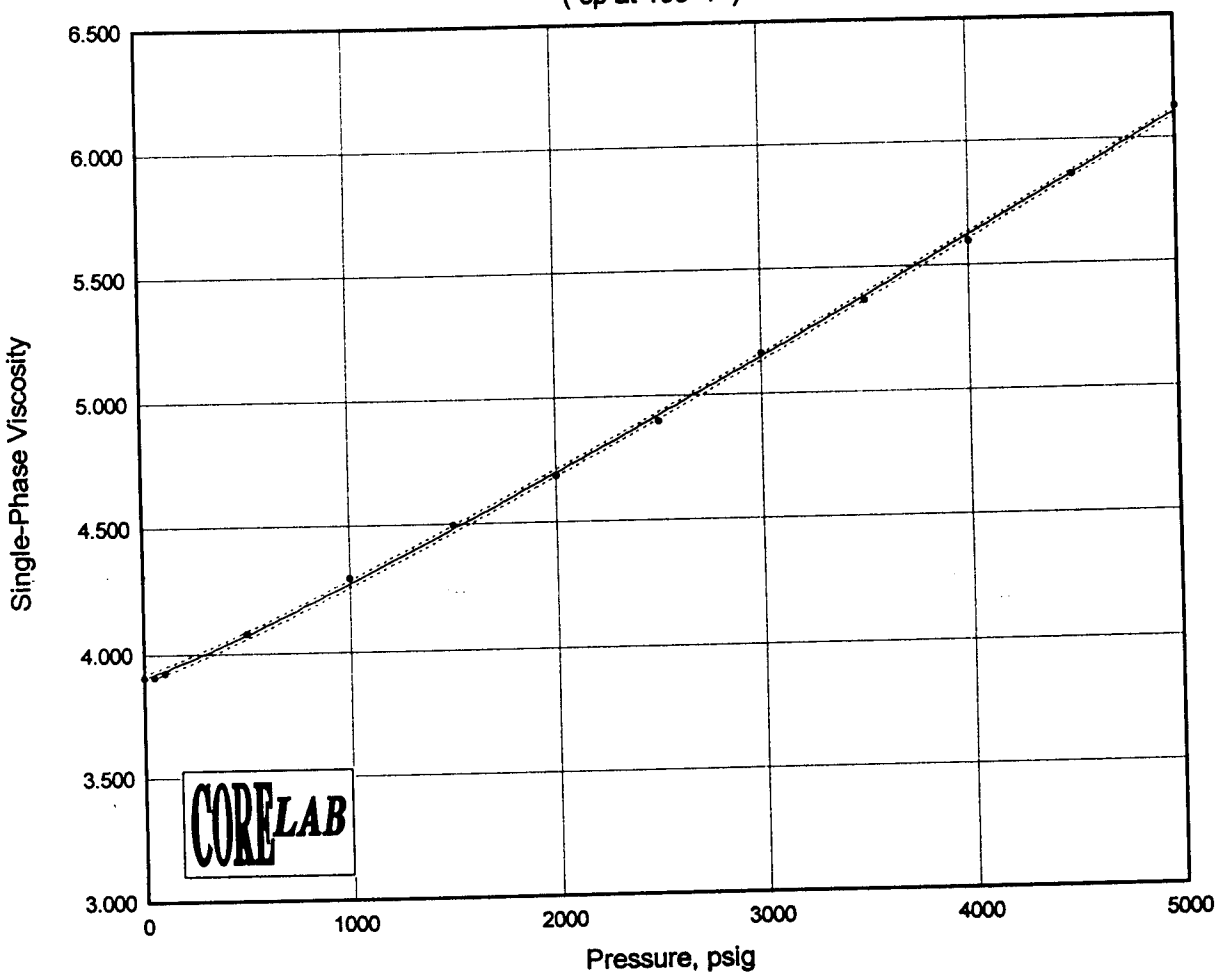
SINGLE-PHASE FLUID VISCOSITY

(cp at 105 °F)



Single-Phase Viscosity Expression: y= a + b (dX)^i		LEGEND
where: a= 3.91347e+ 00 b= 1.64024e- 04	i= 1.116	• Laboratory Data ..... Confidence Limits ——— Analytical Expression
Note: dX (delta 'X') = | Psat - Pi |, psig		Saturation Pressure: 23 psig
Confidence level: 99 % Confidence interval: +/- 0.0152 cp 'r squared': .999508		**Rolling-Ball Viscosity** **Figure B-1**

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SEPARATOR FLASH ANALYSIS

Flash Conditions		Gas/Oil Ratio (scf/bbl)	Gas/Oil Ratio (scf/STbbl)	Stock Tank Oil Gravity at 60 °F	Formation Volume Factor	Separator Volume Factor	Specific Gravity of Flashed Gas	Oil Phase Density (gm/cc)
psig	°F	(A)	(B)	(°API)	Bofb (C)	(D)	(Air=1.000)	
23	105							0.8221
0	72	5	5	35.5	1.031	1.006	0.805	0.8418
		Rsfb =	5					

(A) Cubic Feet of gas at 14.73 psia and 60 °F per Barrel of oil at indicated pressure and temperature.
(B) Cubic Feet of gas at 14.73 psia and 60 °F per Barrel of Stock Tank Oil at 60 °F.
(C) Barrels of saturated oil at 23 psig and 105 °F per Barrel of Stock Tank Oil at 60 °F.
(D) Barrels of oil at indicated pressure and temperature per Barrel of Stock Tank Oil at 60 °F.

EXTENSIONS TO ANALYTICAL EQUATIONS
Appendix A

Average Single-Phase Compressibility -

$$\bar{c}_o = -\frac{1}{v}\cdot\left(\frac{\partial v}{\partial P}\right) \Rightarrow -\frac{1}{rv_i}\cdot\left(\frac{rv_i - rv_{i-1}}{P_i - P_{i-1}}\right) \qquad \text{for } P_b < P_{i-1} < P_i \le P_w \qquad \text{(a1.1)}$$

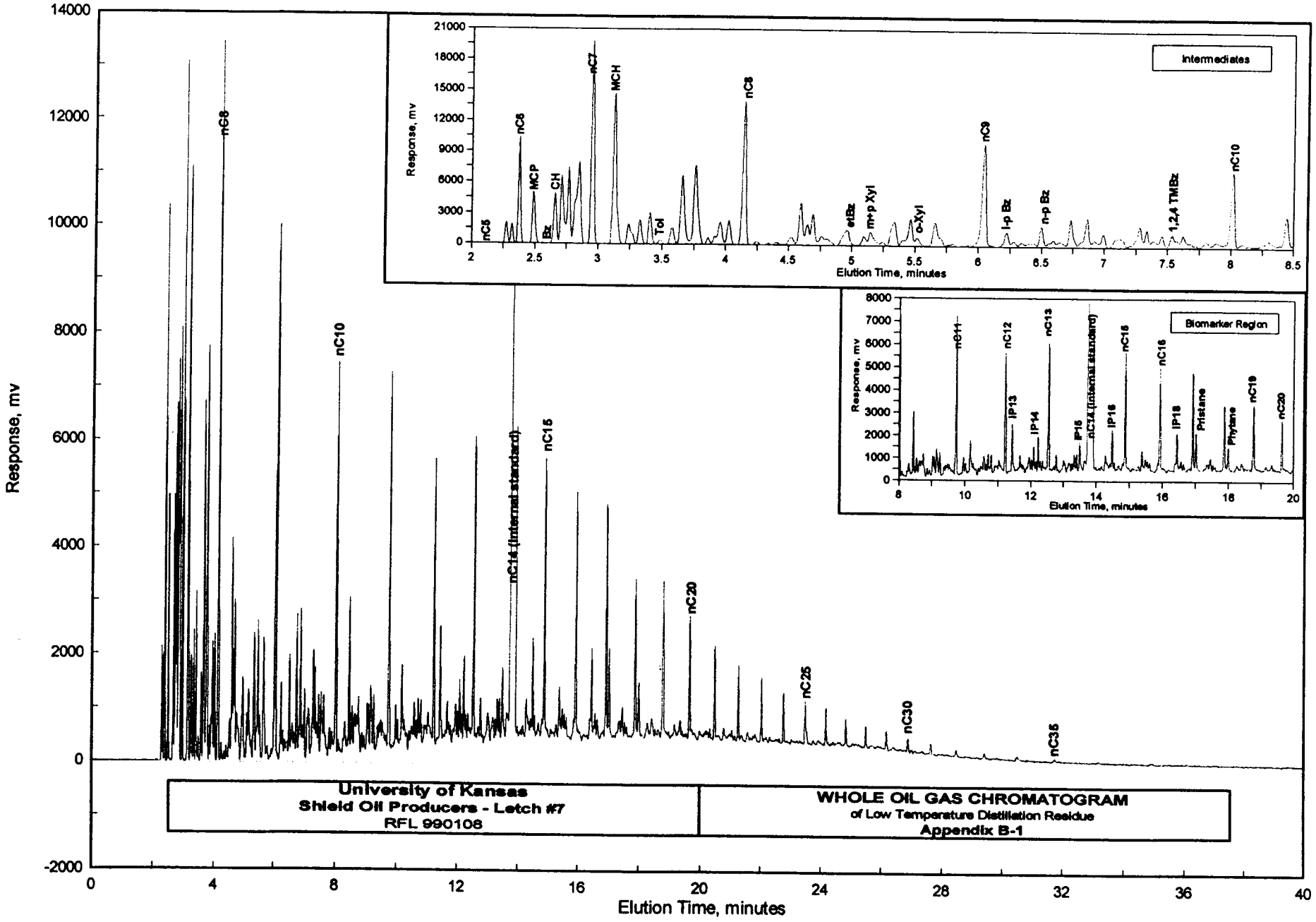
DEFINITION OF TERMS

Definition of Variables -

c	Coefficient of Isothermal Compressibility
v	Volume
P	Pressure
rv	Relative Volume (from constant mass expansion)

Definition of Subscripts -

b	at bubble point pressure
i	any discreet point
o	single-phase oil
w	at working conditions


Response, mv
Elution Time, minutes
nC8
nC10
nC14 (internal standard)
nC15
nC20
nC25
nC30
nC35
Intermediates
nC5
nC6
MCP
Bz
CH
nC7
MCH
Tol
nC8
etBz
m+p Xyl
o-Xyl
nC9
i-p Bz
n-p Bz
1,2,4 TMBz
nC10
Biomarker Region
nC11
nC12
IP13
IP14
nC13
IP15
nC14 (internal standard)
IP16
nC15
nC16
IP18
Pristane
Phytane
nC19
nC20
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WHOLE OIL GAS CHROMATOGRAM
of Low Temperature Distillation Residue
Appendix B-1