Core Lab™

RESERVOIR OPTIMIZATION

Reservoir Fluid Study

for

3D Oil

Wardie-1

AFL 20080029

CORE LABORATORIES AUSTRALIA PTY LTD

Reservoir Fluids Group

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30th September 2008

3D Oil Limited
Level 5,
164 Flinders Lane,
Melbourne
VIC 3000

Attention: Jon Keall

Dear Jon,

Subject: Reservoir Fluid Study: Well: Wardie-1; Our file: AFL 20080029

Two sub-surface oil and one sub-surface water sample were forwarded to our Perth laboratory on 19th June 2008 for initial validation and compositional analysis. Presented in the following report are the results of the requested analyses.

Core Laboratories Australia Pty Ltd are very pleased to have been of service to 3D Oil Limited in this work. Should any questions arise concerning the data presented in this report, or if we may be of assistance in any other matter, please do not hesitate to contact us.

Yours Faithfully,
For CORE LABORATORIES AUSTRALIA PTY LTD

Murray Macleod
Laboratory Supervisor

Table of Contents

Section A - Summary of Analysis Methods

Summary of Analysis Methods

Sample Validation

The opening pressures of the three sub-surface oil samples were recorded at ambient temperature. They were then stabilised at 5000 psig and heated to 100°C for 24 hours. The samples were agitated thoroughly to ensure they were completely single phase and homogenous. A check for free water was made and the sample volume determined.

Compositional Analysis (BHS Oil)

The fluid composition of each oil sample was determined using a combination of flash separation and gas chromatography techniques. Each fluid was flashed at a controlled temperature (50°C) and separated into oil and gas phases.

The gas was analysed using extended gas chromatography with compositions determined by a GPA 2286 method using a multi-column gas chromatograph system. A temperature programme was utilised to obtain optimum detection and separation of dodecanes plus components.

The flashed oil was analysed by temperature programmed high resolution capillary gas chromatography. The two analyses were then mathematically recombined to the flash gas-oil ratio.

Compositional Analysis (BHS water)

After separation of the emulsion which involved heat treatment to 94°C for 5 weeks, the pressurised water sample was subjected to an atmospheric (zero) flash analysis whereby the fluids were flashed from working pressure of 5000 psig and 94°C to atmospheric pressure and ambient temperature, and separated into gas and water phases. The gas-water ratio and the evolved gas composition are the data obtained from this test. A 12-ion analysis was not performed on the flashed water due to insufficient sample. The gas-water ratio was calculated from the volume of gas and weight of water obtained during the flash and density of flashed water.

Compositional Analysis Databases

For all compositions reported in this study, the properties used, eg Molecular Weight and Density of the individual components are tabulated in Section E of the Appendix.

Section B - Summary of Samples Received and Validation Data

Reported Well and Sampling Information - MDTs

Reservoir and Well Information

Field	
Well	Wardie-1
Reservoir Fluid	Oil
Formation	
Reservoir Pressure	1983.3 psig
Reservoir Temperature	54.7 °C
Installation	West Triton
Test	
Perforations	

Sampling Information

Date sampled	20-May-08
Time sampled	02:00-02:35, 05:10-05:35 hrs
Type of samples	MDT
Sampling company	Schlumberger
Sampling point	
Sampling Depth	1582.4 mMDRT
Choke	
Status of well	
Bottomhole pressure	1983.3 psig
Bottomhole temperature	54.7 °C
Wellhead flowing pressure	
Wellhead flowing temperature	
Separator pressure	
Separator temperature	
Pressure base	14.696 psia
Temperature base	15.6°C
Water flowrate	
Gas gravity (Air = 1)	
H2S	
CO2	
BS&W	
Oil gravity at 60°F	

Comments: Sampling information for samples T.01 and T.03

Summary of MDT Samples Received and Validation Data

MDT Samples

Sample Number	Cylinder Number	ex-Chamber Number	Sample Depth (m MDRT)	Sample Type	Sampling :- Pressure (psig)	Sampling :- Temp. (°C)	Laboratory opening :- Pressure (psig)	Laboratory opening :- Temp. (°C)	Water Volume (cm^3)	Sample Volume (cm^3)
T.01	PT-2162	3349	1582.4	Oil	1983	54.7	876	17.5	4*	300
T.02	PT-1147	3454	1593.7	Water	1983	54.7	439	15.2	**	325
T.03	PT-2173	3300	1582.4	Oil	1983	54.7	938	15.4	50*	325

Notes:

Sampling pressure and temperature information obtained from Expro sampling sheets.

* Samples appear to form emulsions readily. T.01 and T.03 were heat-treated until water-in oil fell below 0.1% for analysis.

** Water sample T.02 contained oil in emulsified form. After 1 week on heat, a small separated oil sample collected from the top of PT-1147 still contained >10% water (Karl Fischer titration timed out). This fluid does not pour at room temperature. After 5 weeks with periodic checks, 260cc of oil was collected leaving 60cc of water for flash analysis.

Sample Volumes at 5000 psig and 94°C

Section C - Compositional Analysis Data (Bottom Hole Oil Samples)

Compositional Analysis of Sample T.01, cylinder PT-2162 to C36 plus

	Component	Mole %	Weight %
H_2	Hydrogen	0.00	0.00
H_2S	Hydrogen Sulphide	0.00	0.00
CO_2	Carbon Dioxide	0.87	0.28
N_2	Nitrogen	0.23	0.05
C_1	Methane	26.23	3.12
C_2	Ethane	0.63	0.14
C_3	Propane	0.77	0.25
iC_4	i-Butane	0.85	0.36
nC_4	n-Butane	0.68	0.29
C_5	Neo-Pentane	0.04	0.02
iC_5	i-Pentane	1.26	0.67
nC_5	n-Pentane	0.71	0.38
C_6	Hexanes	3.18	2.03
	M-C-Pentane	0.70	0.44
	Benzene	0.01	0.00
	Cyclohexane	0.47	0.29
C_7	Heptanes	4.35	3.23
	M-C-Hexane	2.48	1.81
	Toluene	0.03	0.02
C_8	Octanes	6.41	5.43
	E-Benzene	0.15	0.12
	M/P-Xylene	0.37	0.29
	O-Xylene	0.07	0.06
C_9	Nonanes	5.39	5.13
	1,2,4-TMB	0.21	0.19
C_{10}	Decanes	5.83	6.15
C_{11}	Undecanes	4.65	5.07
C_{12}	Dodecanes	3.51	4.19
C_{13}	Tridecanes	3.57	4.63
C_{14}	Tetradecanes	3.13	4.41
C_{15}	Pentadecanes	3.33	5.08
C_{16}	Hexadecanes	2.64	4.34
C_{17}	Heptdecanes	2.38	4.18
C_{18}	Octadecanes	2.41	4.49
C_{19}	Nonadecanes	1.82	3.55
C_{20}	Eicosanes	1.56	3.18
C_{21}	Heneicosanes	1.28	2.77
C_{22}	Docosanes	1.09	2.48
C_{23}	Tricosanes	0.94	2.21
C_{24}	Tetracosanes	0.78	1.92
C_{25}	Pentacosanes	0.66	1.70
C_{26}	Hexacosanes	0.52	1.38
C_{27}	Heptacosanes	0.45	1.24
C_{28}	Octacosanes	0.35	1.01
C_{29}	Nonacosanes	0.32	0.96
C_{30}	Triacontanes	0.25	0.79
C_{31}	Hentriacontanes	0.23	0.75
C_{32}	Dotriacontanes	0.17	0.55
C_{33}	Tritriacontanes	0.14	0.48
C_{34}	Tetratriacontanes	0.11	0.40
C_{35}	Pentatriacontanes	0.09	0.31
$C_{36}+$	Hexatriacontanes Plus	1.70	7.18
	Totals :	100.00	100.00

Note: 0.00 means less than 0.005.

Compositional Analysis of Sample T.01, cylinder PT-2162 to C36 plus

Calculated Residue Properties		
C_7 plus	Mole%	64.55
	Molecular Weight (g mol-1)	193
	Density at 15.6°C (g cm-3)	0.8168
C_{11} plus	Mole%	38.08
	Molecular Weight (g mol-1)	245
	Density at 15.6°C (g cm-3)	0.8530
C_{20} plus	Mole%	10.64
	Molecular Weight (g mol-1)	371
	Density at 15.6°C (g cm-3)	0.8931
C_{36} plus	Mole %	1.70
	Molecular Weight (g mol-1)	568
	Density at 15.6°C (g cm-3)	0.9298

Calculated Whole Sample Properties		
	Average mole weight (g mol-1)	135
	GOR from Flash* (scf/bbl)	280

* Reservoir fluid flashed from 5000 psig at 94°C to atmospheric pressure at 50°C

Fingerprint Analysis of flashed oil, Sample T.01, cylinder PT-2162

Chromatogram

Wardie-1 S/F (1,1)
Acquired Monday, 14 July 2008 4:27:14 PM

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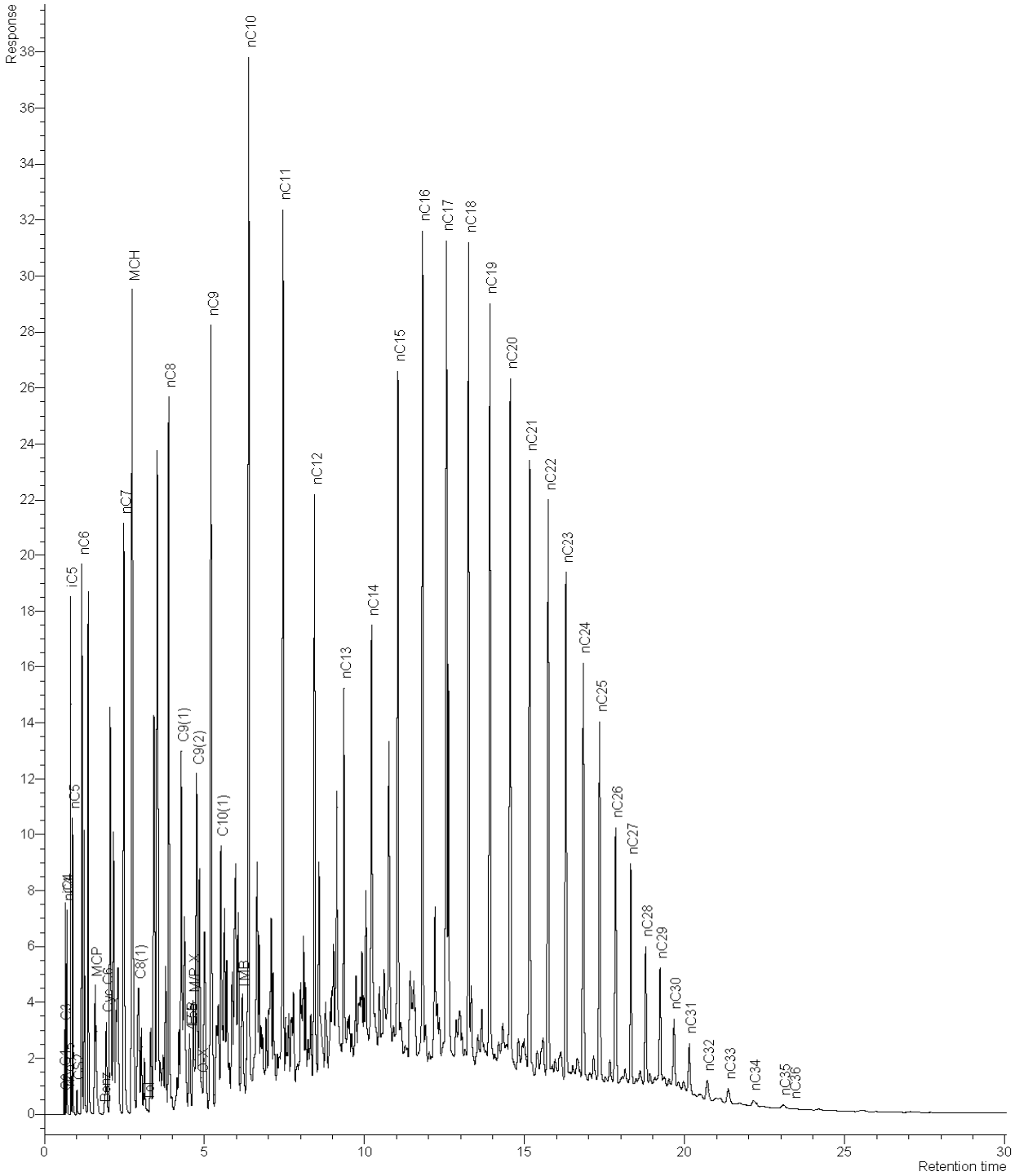


Compositional Analysis of Sample T.03, cylinder PT-2173 to C36 plus

	Component	Mole %	Weight %
H_2	Hydrogen	0.00	0.00
H_2S	Hydrogen Sulphide	0.00	0.00
CO_2	Carbon Dioxide	0.84	0.28
N_2	Nitrogen	0.26	0.05
C_1	Methane	26.83	3.20
C_2	Ethane	0.62	0.14
C_3	Propane	0.74	0.24
iC_4	i-Butane	0.85	0.37
nC_4	n-Butane	0.65	0.28
C_5	Neo-Pentane	0.04	0.02
iC_5	i-Pentane	1.20	0.64
nC_5	n-Pentane	0.67	0.36
C_6	Hexanes	3.05	1.95
	M-C-Pentane	0.68	0.42
	Benzene	0.00	0.00
	Cyclohexane	0.46	0.29
C_7	Heptanes	4.26	3.17
	M-C-Hexane	2.44	1.79
	Toluene	0.02	0.02
C_8	Octanes	6.33	5.38
	E-Benzene	0.16	0.12
	M/P-Xylene	0.36	0.28
	O-Xylene	0.08	0.06
C_9	Nonanes	5.32	5.08
	1,2,4-TMB	0.20	0.18
C_{10}	Decanes	5.83	6.17
C_{11}	Undecanes	4.64	5.08
C_{12}	Dodecanes	3.52	4.22
C_{13}	Tridecanes	3.55	4.62
C_{14}	Tetradecanes	3.13	4.42
C_{15}	Pentadecanes	3.32	5.09
C_{16}	Hexadecanes	2.62	4.33
C_{17}	Heptdecanes	2.38	4.20
C_{18}	Octadecanes	2.42	4.53
C_{19}	Nonadecanes	1.82	3.57
C_{20}	Eicosanes	1.57	3.22
C_{21}	Heneicosanes	1.29	2.80
C_{22}	Docosanes	1.10	2.51
C_{23}	Tricosanes	0.95	2.24
C_{24}	Tetracosanes	0.80	1.96
C_{25}	Pentacosanes	0.67	1.72
C_{26}	Hexacosanes	0.52	1.39
C_{27}	Heptacosanes	0.45	1.26
C_{28}	Octacosanes	0.36	1.04
C_{29}	Nonacosanes	0.33	0.97
C_{30}	Triacontanes	0.26	0.81
C_{31}	Hentriacontanes	0.24	0.77
C_{32}	Dotriacontanes	0.17	0.56
C_{33}	Tritriacontanes	0.14	0.49
C_{34}	Tetratriacontanes	0.12	0.41
C_{35}	Pentatriacontanes	0.10	0.35
$C_{36}+$	Hexatriacontanes Plus	1.64	6.95
	Totals :	100.00	100.00

Note: 0.00 means less than 0.005.

Compositional Analysis of Sample T.03, cylinder PT-2173 to C36 plus

Calculated Residue Properties		
C_7 plus	Mole%	64.25
	Molecular Weight (g mol-1)	193
	Density at 15.6°C (g cm-3)	0.8170
C_{11} plus	Mole%	38.11
	Molecular Weight (g mol-1)	245
	Density at 15.6°C (g cm-3)	0.8529
C_{20} plus	Mole%	10.71
	Molecular Weight (g mol-1)	369
	Density at 15.6°C (g cm-3)	0.8928
C_{36} plus	Mole %	1.64
	Molecular Weight (g mol-1)	568
	Density at 15.6°C (g cm-3)	0.9299

Calculated Whole Sample Properties		
	Average mole weight (g mol-1)	134
	GOR from Flash* (scf/bbl)	286

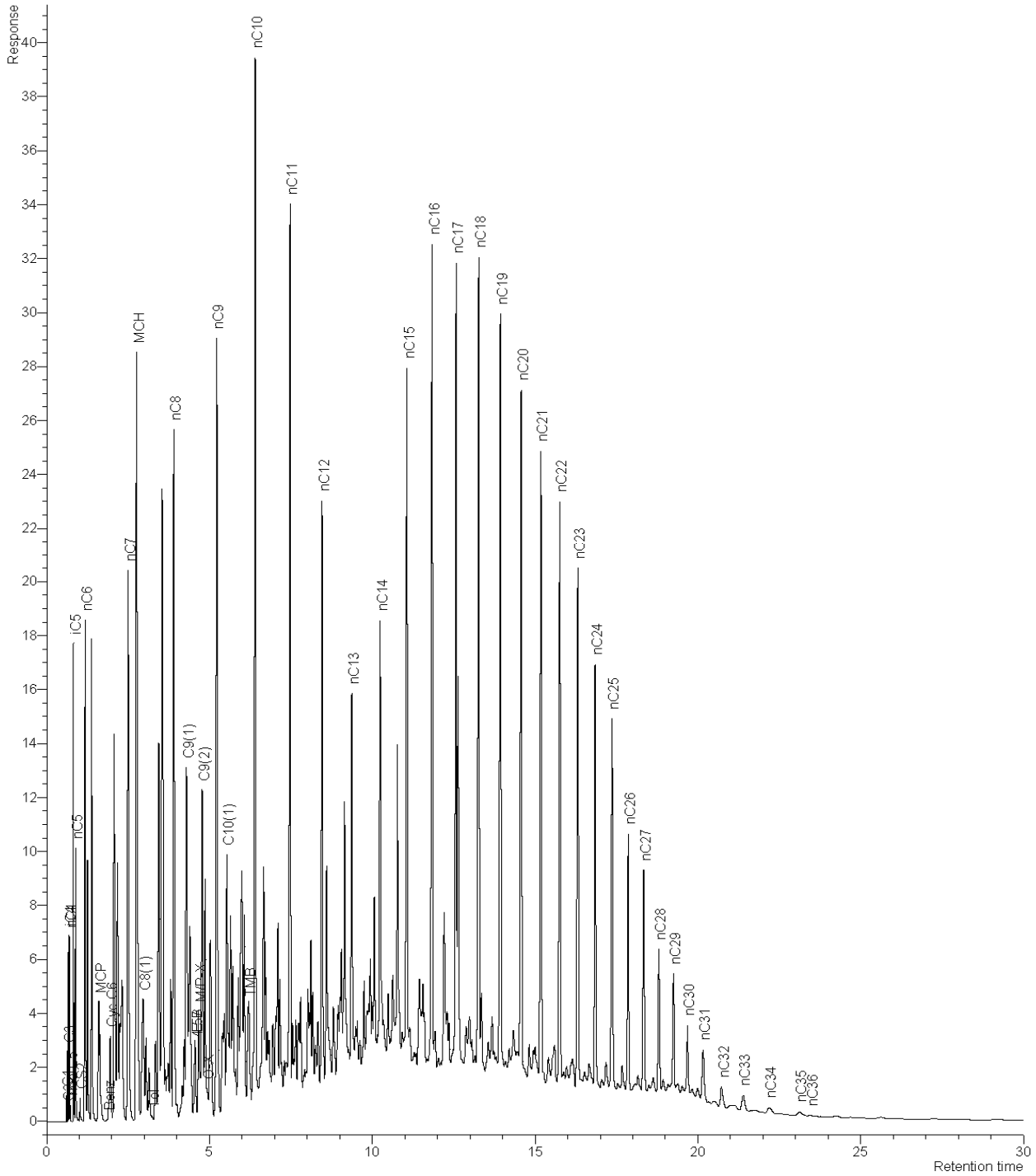
* Reservoir fluid flashed from 5000 psig at 94°C to atmospheric pressure at 50°C

Fingerprint Analysis of flashed oil sample T.03, cylinder PT-2173

Chromatogram

Wardie-1 S/F (1,1)
Acquired Friday, 11 July 2008 3:46:05 PM

wb06072008,as_1.2201,1,1,1



Section D - Compositional Analysis Data - Bottom Hole Water Sample

Compositional Analysis of Flashed Gas from Sample T.02, Cylinder PT-1147 to C12+

	Component	Mole %	Weight %
H_2	Hydrogen	0.00	0.00
H_2S	Hydrogen Sulphide	0.00	0.00
CO_2	Carbon Dioxide	6.13	10.32
N_2	Nitrogen	1.22	1.31
C_1	Methane	77.31	47.48
C_2	Ethane	3.33	3.83
C_3	Propane	1.15	1.94
iC_4	i-Butane	0.74	1.64
nC_4	n-Butane	0.56	1.23
C_5	Neo-Pentane	0.06	0.17
iC_5	i-Pentane	1.31	3.63
nC_5	n-Pentane	0.94	2.58
C_6	Hexanes	3.20	10.45
	M-C-Pentane	0.33	1.06
	Benzene	0.00	0.00
	Cyclohexane	0.59	1.89
C_7	Heptanes	1.59	6.06
	M-C-Hexane	0.61	2.29
	Toluene	0.03	0.09
C_8	Octanes	0.70	3.07
	E-Benzene	0.01	0.04
	M/P-Xylene	0.00	0.00
	O-Xylene	0.00	0.00
C_9	Nonanes	0.17	0.81
	1,2,4-TMB	0.02	0.11
C_{10}	Decanes	0.00	0.00
C_{11}	Undecanes	0.00	0.00
$C_{12}+$	Dodecanes Plus	0.00	0.00
	Totals :	100.00	100.00

Note: 0.00 means less than 0.005.

Calculated Properties	
C_7+	
Mole%	4.05
Molecular Weight (g mol-1)	99.6
Density at 15.6°C (g cm-3)	0.7317

Calculated Whole Gas Properties	
Molecular Weight (g mol-1)	26.14
Real Relative Density (Air=1 at 14.696 psia and 15.6°C)	0.9075

Gas-Water Ratio	
Gas Water Ratio (scf/bbl) from flash at 19.6°C	19.7

Note:
Reservoir fluid was flashed from 5000 psig and 94°C to atmospheric pressure and 19.6°C

Detailed Flashed Water Analysis from Sample T.02, Cylinder PT-1147

Dissolved Constituent	Units	Results
Ions		
Calcium, Ca	mg/L	
Magnesium, Mg	mg/L	
Iron, Fe (soluble)	mg/L	
Sodium, Na	mg/L	
Potassium, K	mg/L	
Strontium, Sr	mg/L	
Barium, Ba	mg/L	
Manganese, Mn	mg/L	
Chloride, Cl	mg/L	
Sulphate, SO4	mg/L	
Bicarbonate, HCO3	mg/L	
Carbonate, CO3	mg/L	
Hydroxide, OH	mg/L	
Basic Properties		
pH	pH units	7.7
Resistivity, @ 25°C	ohm-m	
Total Dissolved Solids (calculated)	mg/L	
Total Dissolved Solids (by evaporation at 110°C)	mg/L	
Total Dissolved Solids (by evaporation at 180°C)	mg/L	
Density, @ 20°C	gm/cc	1.0425

Notes:

1. During validation checks, sample T.02 (PT-1147) was found to be a tight margarine-like emulsion.
2. The sample was left upright and standing on heat at 5000 psig and 94°C.
3. Sample status was checked periodically over 5 weeks.
4. 260cc of free oil was removed (and stored) leaving 60cc of water available for flash analysis.
5. The volume of water collected was insufficient and quality inadequate for detailed water analysis and resistivity.

Section E - Appendix

Data Used in Gas Compositional Calculations

Component		Mole Weight (g mol-1)	Density (g cm-3 at 60°F)	Component		Mole Weight (g mol-1)	Density (g cm-3 at 60°F)
Hydrogen	*	2.016	N/A	33DMC5	*	100.20	0.6954
Oxygen/(Argon)	**	31.999	1.1410	Cyclohexane	*	84.16	0.7827
Nitrogen (Corrected)	**	28.013	0.8086	2MC6/23DMC5	*	100.20	0.6917
Methane	**	16.043	0.2997	11DMCYC5/3MC6	*	99.20	0.7253
Carbon Dioxide	**	44.010	0.8172	t13DMCYC5	*	98.19	0.7528
Ethane	**	30.070	0.3558	c13DMCYC5/3EC5	*	99.20	0.7262
Hydrogen Sulphide	**	34.080	0.8006	t12DMCYC5	*	98.19	0.7554
Propane	**	44.097	0.5065	Heptanes (nC7)	*	100.20	0.6875
i-Butane	**	58.123	0.5623	22DMC6	*	114.23	0.6994
n-Butane	**	58.123	0.5834	MCYC6	*	98.19	0.7740
Neo-Pentane	*	72.15	0.5968	ECYC5	*	98.19	0.7704
i-Pentane	**	72.150	0.6238	223TMC5/24&25DMC6	*	114.23	0.7060
n-Pentane	**	72.150	0.6305	ctc124TMCYC5	*	112.21	0.7511
22DMC4	*	86.18	0.6529	ctc123TMCYC5	*	112.21	0.7574
23DMC4/CYC5	*	78.16	0.7129	Toluene	*	92.14	0.8734
2MC5	*	86.18	0.6572	Octanes (nC8)	*	114.23	0.7063
3MC5	*	86.18	0.6682	E-Benzene	*	106.17	0.8735
Hexanes (nC6)	*	86.18	0.6631	M/P-Xylene	*	106.17	0.8671
22DMC5	*	100.20	0.6814	O-Xylene	*	106.17	0.8840
M-C-Pentane	*	84.16	0.7533	Nonanes (nC9)	*	128.26	0.7212
24DMC5	*	100.20	0.6757	Decanes	***	134	0.778
223TMC4	*	100.20	0.6947	Undecanes	***	147	0.789
Benzene	*	78.11	0.8820	Dodecanes	***	161	0.800

Data Source Refs :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas, GPA 2145-96.

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behaviour of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The gas mole % compositions were calculated from the measured weight % compositions using the most detailed analysis results, involving as many of the above components as were identified. The reported component mole % compositions were then sub-grouped into the generic carbon number components.

Data Used in Liquid Compositional Calculations

Component		Mole Weight (g mol-1)	Density (g cm-3 at 60°F)	Component		Mole Weight (g mol-1)	Density (g cm-3 at 60°F)
Hydrogen	*	2.016	N/A	Undecanes	***	147	0.789
Hyd. sulphide	**	34.080	0.8006	Dodecanes	***	161	0.800
Carbon Dioxide	**	44.010	0.8172	Tridecanes	***	175	0.811
Nitrogen	**	28.013	0.8086	Tetradecanes	***	190	0.822
Methane	**	16.043	0.2997	Pentadecanes	***	206	0.832
Ethane	**	30.070	0.3558	Hexadecanes	***	222	0.839
Propane	**	44.097	0.5065	Heptadecanes	***	237	0.847
i-Butane	**	58.123	0.5623	Octadecanes	***	251	0.852
n-Butane	**	58.123	0.5834	Nonadecanes	***	263	0.857
i-Pentane	**	72.150	0.6238	Eicosanes	***	275	0.862
n-Pentane	**	72.150	0.6305	Heneicosanes	***	291	0.867
Hexanes	**	86.177	0.6634	Docosanes	***	305	0.872
Me-cyclo-pentane	*	84.16	0.7533	Tricosanes	***	318	0.877
Benzene	*	78.11	0.8820	Tetracosanes	***	331	0.881
Cyclo-hexane	*	84.16	0.7827	Pentacosanes	***	345	0.885
Heptanes	**	100.204	0.6874	Hexacosanes	***	359	0.889
Me-cyclo-hexane	*	98.19	0.7740	Heptacosanes	***	374	0.893
Toluene	*	92.14	0.8734	Octacosanes	***	388	0.896
Octanes	**	114.231	0.7061	Nonacosanes	***	402	0.899
Ethyl-benzene	*	106.17	0.8735	Triacontanes	***	416	0.902
Meta/Para-xylene	*	106.17	0.8671	Hentriacontanes	***	430	0.906
Ortho-xylene	*	106.17	0.8840	Dotriacontanes	***	444	0.909
Nonanes	**	128.258	0.7212	Tritriacontanes	***	458	0.912
1-2-4-T-M-benzene	*	120.19	0.8797	Tetratriacontanes	***	472	0.914
Decanes	**	142.285	0.7334	Pentatriacontanes	***	486	0.917

Data Source Refs :

* ASTM Data Series Publication DS 4B (1991) - Physical Constants of Hydrocarbon and Non-Hydrocarbon Compounds.

** GPA Table of Physical Constants of Paraffin Hydrocarbons and Other Components of Natural Gas GPA 2145-96.

*** Journal of Petroleum Technology, Nov 1978, Pages 1649-1655.
Predicting Phase Behaviour of Condensate/Crude Oil Systems Using Methane Interaction Coefficients - D.L. Katz & A. Firoozabadi.

Note :
The residue mole weight and density values (eg heptanes plus, undecanes plus, eicosanes plus) are calculated so that the calculated average mole weights and densities correspond with the measured values. This can lead to anomalous residue mole weights and densities where the Katz and Firoozabadi values may not be suitable for the isomer groups detected.

Report prepared by	**Report approved by**
Damien Gerard **Senior Reservoir Fluids Analyst**	**Murray Macleod** **Laboratory Supervisor**