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Schlumberger Reservoir Laboratories

Fluid Analysis Report

Stock tank Analysis

Well: OCS-Y-2321 Burger J 001
Well API/UWBI 55-352-00004-00
Block: Posey 6912
Lease OCS-Y-2321

For

Shell Gulf Of Mexico, Inc

Report No: 2015USPB-P004-J0001

Houston, Texas, US

24th March 2016

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Schlumberger Reservoir Laboratories
16115 Park Row, Suite 150
Houston, TX, 77084

24-Mar-2016

Shell Gulf Of Mexico, Inc

Attention: Mrs. Esra Inan Villegas

Subject: Fluid Analysis Report – Oil samples

Report No: 2015USPB-P004-J0001

Dear Mrs. Esra,

Schlumberger Reservoir Laboratories has performed laboratory analysis of stock tank oil samples as received from Core taken from OCS-Y-2321 Burger J 001 well of Posey 6912 block for Shell Gulf of Mexico, Inc. The samples were received at our lab facility on 3-Mar-2016.

Presented in the report are the results of the samples as per the scope of work agreed with Shell.

Schlumberger is very pleased to have been of service to Shell Gulf Of Mexico, Inc. Should any questions arise concerning the data presented in the report, or if may be of any assistance in any other matter, Please do not hesitate to contact us.

Sincerely,

_____

Rizwan Ahmed Khan, Project Manager
Schlumberger Reservoir Laboratories

Email: rkhan4@slb.com
Phone: +12812856381

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Quality Assurance Statement

Schlumberger Reservoir Laboratories is committed to providing unsurpassed services in reservoir fluid sampling and fluid property analyses, while maintaining high standards of safety and quality. Our objective is to deliver the most accurate and reliable sampling processes and fluid property measurements available in the industry. This objective requires persistent innovation and ongoing development of state-of-the-art technologies and equipment.

A rigorous program of quality assurance, continuous employee training and enforcement of strict safety standards maintains our compliance with Quality, Health, Safety and Environment (QHSE) requirements. Proactive integration of QHSE objectives and management goals at every level supports the communication and implementation of QHSE policies and standards.

Schlumberger requires that qualified engineering technologists perform all laboratory measurements according to specified analytical procedures designed for obtaining accurate and reliable data. Rigorous quality assurance programs and instrument calibration protocols are in place to ensure and maintain the accuracy of the procedures. Details of these programs are available upon request.

The results of all laboratory work are interpreted and reported by the Project Engineer responsible for supervision of the project. The completion of each project requires that a second Engineer/Manager/Scientist carry out an independent review of all technical data to confirm the consistency and accuracy of the report. Raw data may be adjusted within experimental error tolerances to minimize material balance error. All property measurements and calculation procedures are maintained in company archives for a period of 5 years. This information is available for review by clients upon request.

The file and laboratory records information as listed below, provide access reference to all records related to this project. For answers to any questions, please do not hesitate to contact the undersigned Project Engineer.

Data Reporting

x_____
Rizwan Khan
Project Engineer

Data Quality

x_____
Joseph Thomas Manakalathil
Data Quality Team Lead

Overall Report Quality

x_____
Joseph P
Lab Manager

1. Executive Summary

1.1 Objectives

The objective of this study is to conduct compositional analysis on the samples as obtained during Core analysis in Weatherford.

1.2 Introduction

Schlumberger Reservoir Laboratories were contacted by Esra Inan of Shell with a request to conduct compositional analysis on sample as extracted from Core samples received from Weatherford. Details of the samples received along with photographs are in Table 1 and Figure 1

1.3 Scope of Work

Below is the scope of work:

- Conduct compositional analysis on the sample received using standard GC Liquid analysis method

1.4 Sample Preparation and Analysis

DCM Samples: DCM Samples were diluted. In an effort to get valid data out of it, sample was injected by three different methods. First method was using standard GC method where data obtained was not considered representative as peaks observed in chromatogram were too small. Second method was deployed with split ratio on the GC changed from 1:120 to 1:30 so normal peaks / components are seen and are not masked due to dilution. Data obtained was deemed good quality. Third method was to concentrate sample using nitrogen blanket and then injecting the sample with split ratio as 1:30.

CS2 samples: Samples received in small vials had no flowing liquid. Sample was sticking to the walls of container. To obtain sample, small amount of CS2 was added to the vial and was then injected to standard GC for compositional analysis.

Table 1: Initial Sample Validation Results

WFT Sample ID	Client Sample ID	Shell FPC ID	Depth Ft MD	Sample Info
6123787988	MC 3	FPC_1158613	5908.9	DCM Big Vials
6123788064	MC 41	FPC_1158650	6521.3	DCM Big Vials
6123787177	MC 3	FPC_1158613	5908.9	CS2 Small Vials
6123787253	MC 41	FPC_1158650	6521.3	CS2 Small Vials

Note: CS2 extracts are in small vials whereas DCM is bigger vials.

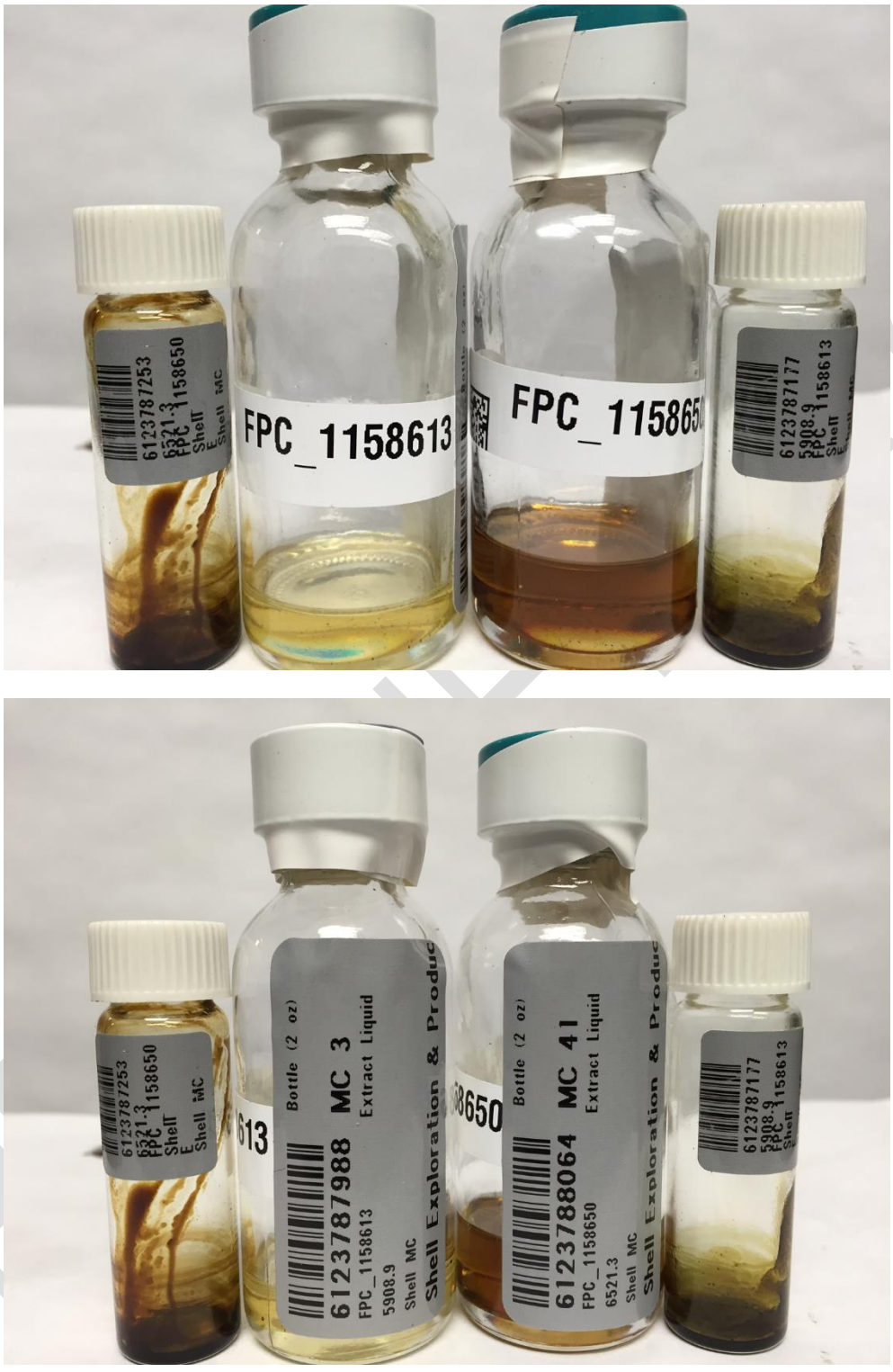


Figure 1 : Samples as received for analysis (From L to R: 6123787253, 6123787988, 6123788064, 6123787177)

1. Fluid Analysis Results of Sample 6123787988

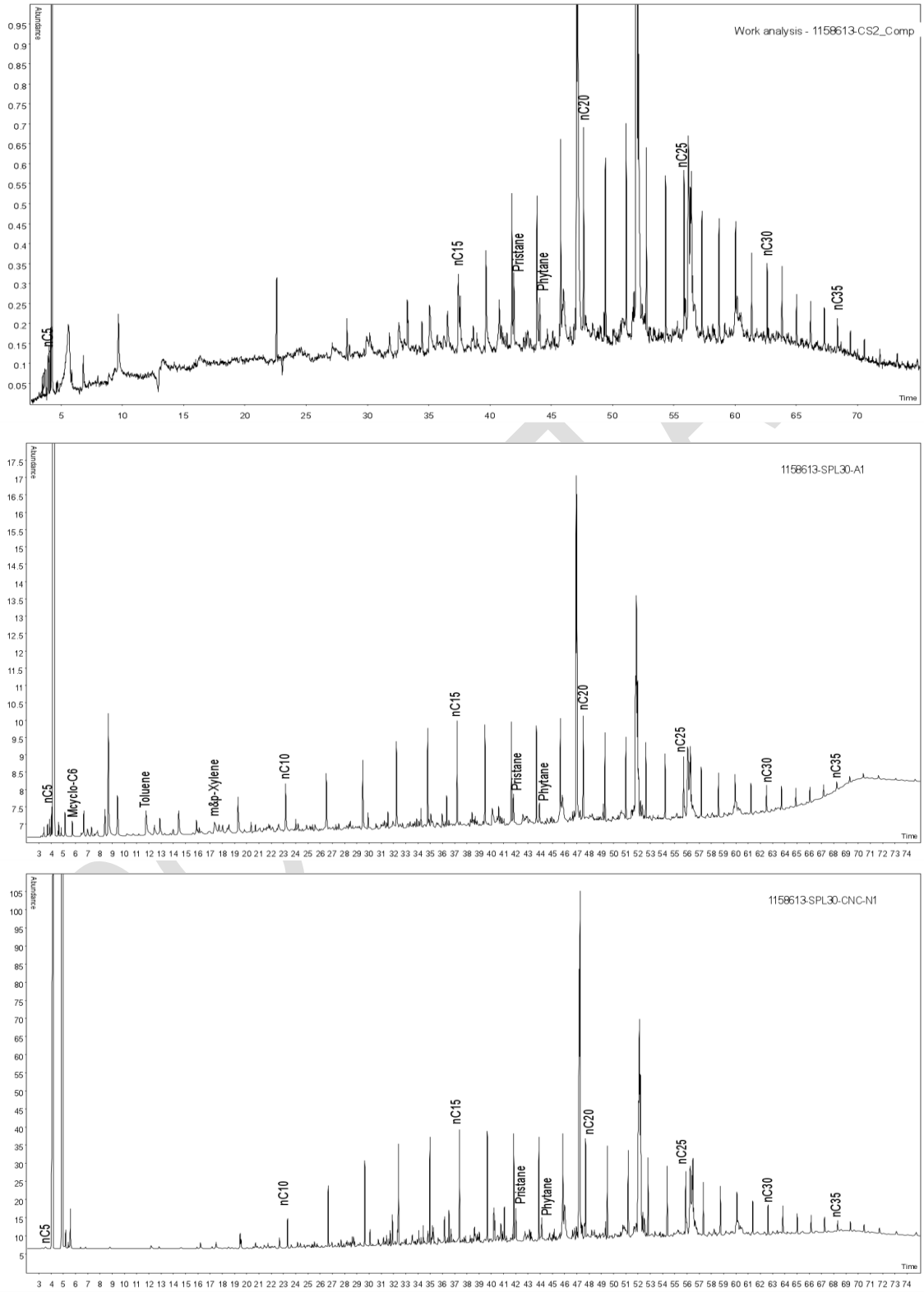
1.1 Compositional Analysis of Sample 6123787988

Table 2: Compositional Analysis of Sample 6123787988

Component	MW[1]	Method 1 Standard Method (Split Ratio 120)		Method 2 Split Ratio 30		Method 3 Concentrated and Split Ratio 30	
	g/mol	wt %	mole %	wt %	mole %	wt %	mole %
CO2	44.01	0.00	0.00	0.00	0.00	0.00	0.00
H2S	34.08	0.00	0.00	0.00	0.00	0.00	0.00
N2	28.01	0.00	0.00	0.00	0.00	0.00	0.00
C1	16.04	0.00	0.00	0.00	0.00	0.00	0.00
C2	30.07	0.00	0.00	0.00	0.00	0.00	0.00
C3	44.10	0.01	0.09	0.01	0.08	0.00	0.02
i-C4	58.12	0.02	0.08	0.01	0.07	0.00	0.00
n-C4	58.12	0.03	0.16	0.04	0.18	0.00	0.01
i-C5	72.15	0.03	0.12	0.05	0.19	0.00	0.01
n-C5	72.15	0.04	0.18	0.08	0.33	0.01	0.03
C6	84.00	0.00	0.00	0.39	1.32	0.02	0.07
Mcyclo-C5	84.16	0.00	0.00	0.09	0.29	0.14	0.66
Benzene	78.11	0.00	0.00	0.04	0.16	0.01	0.05
Cyclo-C6	84.16	0.00	0.00	0.17	0.58	0.01	0.05
C7	100.21	0.00	0.00	0.49	1.39	0.13	0.49
Mcyclo-C6	98.19	0.00	0.00	0.40	1.17	0.00	0.02
Toluene	92.14	0.00	0.00	0.30	0.93	0.01	0.03
C8	114.23	0.00	0.00	1.92	4.77	0.08	0.28
C2-Benzene	106.17	0.00	0.00	0.03	0.08	0.01	0.03
m&p-Xylene	106.17	0.00	0.00	0.26	0.70	0.04	0.16
o-Xylene	106.17	0.00	0.00	0.06	0.16	0.02	0.07
C9	128.26	0.00	0.00	0.93	2.07	0.22	0.67
C10	134.00	4.42	9.56	1.39	2.93	0.57	1.66
C11	147.00	4.16	8.21	1.47	2.83	0.79	2.08
C12	161.00	4.01	7.22	2.03	3.58	1.22	2.96
C13	175.00	3.80	6.29	2.24	3.64	1.67	3.72
C14	190.00	3.89	5.93	2.57	3.84	1.87	3.82
C15	206.00	3.25	4.57	3.34	4.60	2.28	4.31
C16	222.00	3.49	4.56	2.88	3.68	2.09	3.65
C17	237.00	3.22	3.94	3.26	3.91	2.63	4.32
C18	251.00	3.34	3.86	3.00	3.40	2.27	3.52
C19	263.00	3.06	3.37	3.18	3.43	2.53	3.75
C20	275.00	5.68	5.99	8.86	9.14	6.20	8.77
C21	291.00	3.25	3.23	3.61	3.52	2.35	3.14
C22	305.00	3.15	2.99	3.56	3.31	2.43	3.10
C23	318.00	5.69	5.19	8.71	7.78	6.28	7.68
C24	331.00	2.78	2.43	3.10	2.66	2.08	2.45
C25	345.00	2.60	2.18	3.01	2.47	2.10	2.37
C26	359.00	4.15	3.35	6.00	4.75	3.90	4.23
C27	374.00	2.48	1.92	2.77	2.11	1.87	1.95
C28	388.00	2.25	1.68	2.80	2.05	1.86	1.86
C29	402.00	2.53	1.82	5.22	3.69	2.02	1.95
C30+	750.00	28.67	11.08	21.73	8.21	50.29	26.06
Calculated MW		289.82		283.84		388.93	

[1]Katz and Firoozabadi MW data used; MWs of nC7,nC8 and nC9 are used for C7,C8 and C9

Figure 2: Gas Chromatogram of Sample 1158613--(Top to Bottom: Standard Method, Split 30, Concentrated with Split 30)



2. Fluid Analysis Results of Sample 6123788064

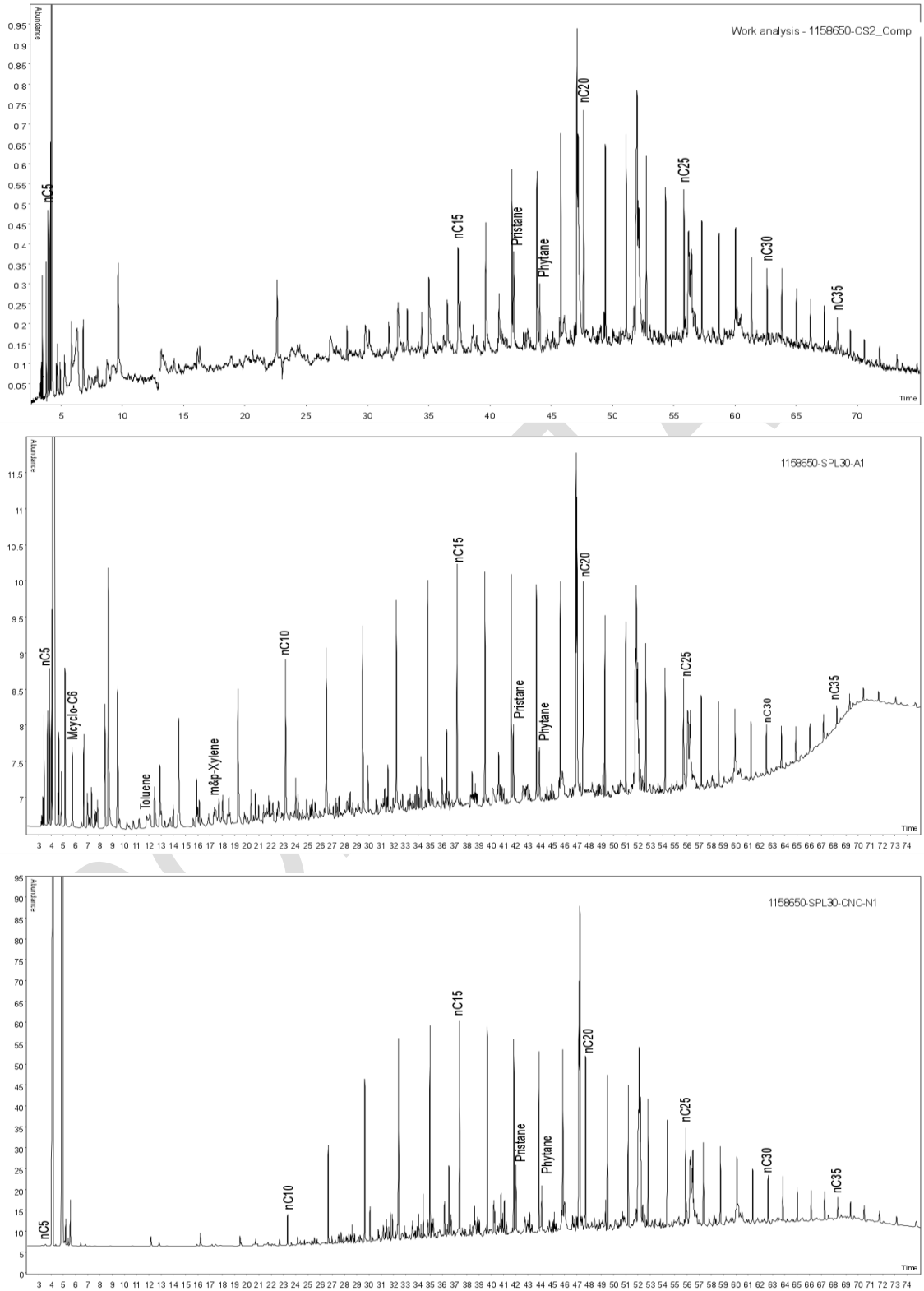
2.1 Compositional Analysis of Sample 6123788064

Table 3: Compositional Analysis of Sample 6123788064

Component	MW[1]	Method 1 Standard Method (Split Ratio 120)		Method 2 Split Ratio 30		Method 3 Concentrated and Split Ratio 30	
	g/mol	wt %	mole %	wt %	mole %	wt %	mole %
CO2	44.01	0.00	0.00	0.00	0.00	0.00	0.00
H2S	34.08	0.00	0.00	0.00	0.00	0.00	0.00
N2	28.01	0.00	0.00	0.00	0.00	0.00	0.00
C1	16.04	0.00	0.00	0.00	0.00	0.00	0.00
C2	30.07	0.00	0.00	0.00	0.00	0.00	0.00
C3	44.10	0.02	0.15	0.03	0.19	0.00	0.01
i-C4	58.12	0.03	0.15	0.05	0.21	0.00	0.00
n-C4	58.12	0.10	0.49	0.19	0.81	0.00	0.01
i-C5	72.15	0.11	0.43	0.21	0.75	0.00	0.01
n-C5	72.15	0.16	0.64	0.33	1.17	0.00	0.02
C6	84.00	0.00	0.00	1.15	3.50	0.02	0.08
Mcyclo-C5	84.16	0.00	0.00	0.21	0.64	0.09	0.45
Benzene	78.11	0.00	0.00	0.02	0.08	0.01	0.04
Cyclo-C6	84.16	0.00	0.00	0.28	0.85	0.01	0.04
C7	100.21	0.00	0.00	1.03	2.61	0.09	0.37
Mcyclo-C6	98.19	0.00	0.00	0.62	1.62	0.00	0.00
Toluene	92.14	0.00	0.00	0.10	0.28	0.00	0.00
C8	114.23	0.00	0.00	2.76	6.17	0.06	0.21
C2-Benzene	106.17	0.00	0.00	0.05	0.12	0.00	0.01
m&p-Xylene	106.17	0.00	0.00	0.19	0.45	0.01	0.04
o-Xylene	106.17	0.00	0.00	0.05	0.12	0.00	0.01
C9	128.26	0.00	0.00	1.45	2.89	0.12	0.38
C10	134.00	4.63	9.74	2.17	4.12	0.26	0.82
C11	147.00	4.26	8.17	2.20	3.82	0.61	1.74
C12	161.00	4.79	8.40	2.86	4.53	1.17	3.05
C13	175.00	3.80	6.12	2.93	4.28	1.76	4.23
C14	190.00	3.65	5.42	3.29	4.42	1.98	4.38
C15	206.00	3.83	5.24	3.84	4.75	2.32	4.72
C16	222.00	3.77	4.79	3.01	3.46	2.11	3.98
C17	237.00	3.50	4.16	3.63	3.91	2.42	4.28
C18	251.00	3.51	3.95	2.98	3.02	2.25	3.76
C19	263.00	3.45	3.70	3.42	3.32	2.36	3.77
C20	275.00	4.75	4.87	6.27	5.82	4.06	6.19
C21	291.00	3.34	3.24	3.56	3.12	2.15	3.11
C22	305.00	3.05	2.82	3.22	2.70	2.12	2.91
C23	318.00	4.56	4.04	5.84	4.69	3.88	5.12
C24	331.00	2.78	2.37	2.96	2.28	1.85	2.35
C25	345.00	2.73	2.23	3.10	2.29	1.88	2.29
C26	359.00	3.63	2.85	4.83	3.43	2.81	3.29
C27	374.00	2.52	1.90	2.98	2.04	1.71	1.92
C28	388.00	2.43	1.77	2.99	1.97	1.73	1.87
C29	402.00	2.62	1.84	3.45	2.19	1.86	1.94
C30+	750.00	27.98	10.52	21.75	7.38	58.30	32.60
Calculated MW		281.97		255.13		419.54	
Mole Ratio							

[1]Katz and Firoozabadi MW data used; MWs of nC7,nC8 and nC9 are used for C7,C8 and C9

Figure 3: Gas Chromatogram of Sample 1158650--(Top to Bottom: Standard Method, Split 30, Concentrated with Split 30)



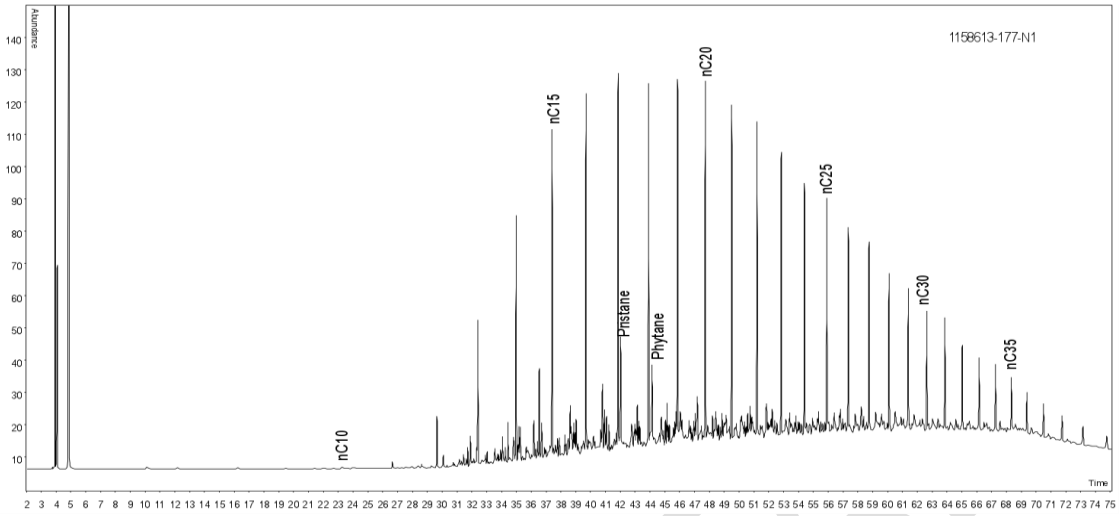
3. Fluid Analysis Results of Sample 6123787177

3.1 Compositional Analysis of Sample 6123787177

Table 4: Compositional Analysis of Sample 6123787177

Component	MW[1]	Direct Injection (Split Ratio 120)	
	g/mol	wt %	mole %
CO2	44.01	0.00	0.00
H2S	34.08	0.00	0.00
N2	28.01	0.00	0.00
C1	16.04	0.00	0.00
C2	30.07	0.00	0.00
C3	44.10	0.00	0.01
i-C4	58.12	0.00	0.00
n-C4	58.12	0.00	0.00
i-C5	72.15	0.00	0.00
n-C5	72.15	0.00	0.03
C6	84.00	0.01	0.03
Mcyclo-C5	84.16	0.00	0.00
Benzene	78.11	0.00	0.00
Cyclo-C6	84.16	0.00	0.00
C7	100.21	0.00	0.01
Mcyclo-C6	98.19	0.00	0.00
Toluene	92.14	0.00	0.00
C8	114.23	0.01	0.05
C2-Benzene	106.17	0.00	0.00
m&p-Xylene	106.17	0.00	0.00
o-Xylene	106.17	0.00	0.00
C9	128.26	0.01	0.03
C10	134.00	0.02	0.07
C11	147.00	0.07	0.20
C12	161.00	0.27	0.67
C13	175.00	0.89	2.05
C14	190.00	1.64	3.50
C15	206.00	2.54	4.98
C16	222.00	2.94	5.35
C17	237.00	3.30	5.64
C18	251.00	3.53	5.69
C19	263.00	3.83	5.88
C20	275.00	3.74	5.50
C21	291.00	3.63	5.04
C22	305.00	3.54	4.70
C23	318.00	3.44	4.38
C24	331.00	3.24	3.96
C25	345.00	3.17	3.72
C26	359.00	3.08	3.47
C27	374.00	2.96	3.20
C28	388.00	2.84	2.96
C29	402.00	2.71	2.72
C30+	750.00	48.59	26.16
Calculated MW		404.23	

Figure 4: Gas Chromatogram of Sample 6123787177



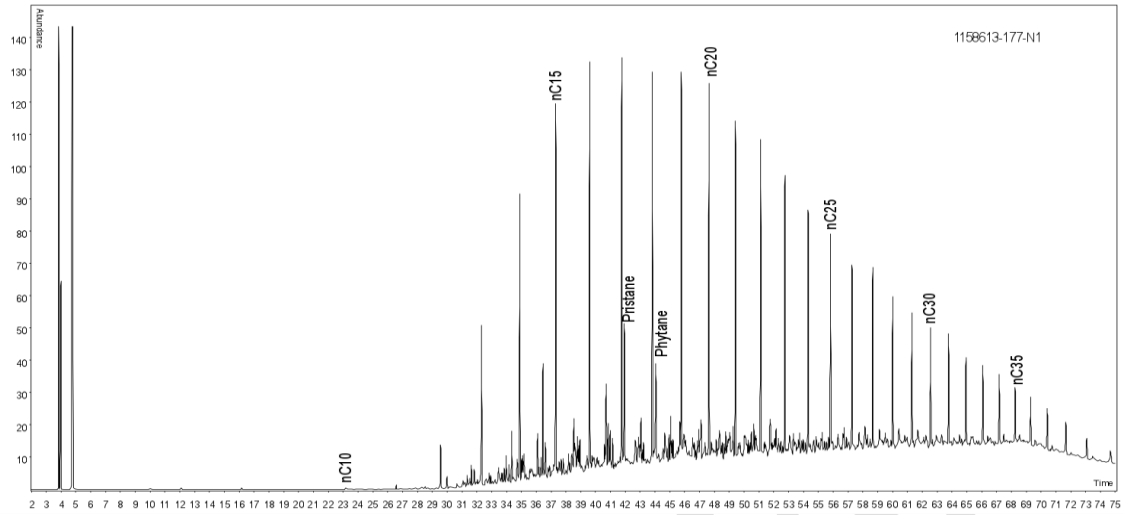
4. Fluid Analysis Results of Sample 6123787253

4.1 Compositional Analysis of Sample 6123787253

Table 5: Compositional Analysis of Sample 6123787253

Component	MW[1]	Direct Injection (Split Ratio 120)	
	g/mol	wt %	mole %
CO2	44.01	0.00	0.00
H2S	34.08	0.00	0.00
N2	28.01	0.00	0.00
C1	16.04	0.00	0.00
C2	30.07	0.00	0.00
C3	44.10	0.00	0.00
i-C4	58.12	0.00	0.00
n-C4	58.12	0.00	0.00
i-C5	72.15	0.00	0.00
n-C5	72.15	0.00	0.02
C6	84.00	0.00	0.01
Mcyclo-C5	84.16	0.00	0.00
Benzene	78.11	0.00	0.00
Cyclo-C6	84.16	0.00	0.00
C7	100.21	0.00	0.01
Mcyclo-C6	98.19	0.00	0.00
Toluene	92.14	0.00	0.00
C8	114.23	0.01	0.04
C2-Benzene	106.17	0.00	0.00
m&p-Xylene	106.17	0.00	0.00
o-Xylene	106.17	0.00	0.00
C9	128.26	0.01	0.04
C10	134.00	0.02	0.05
C11	147.00	0.03	0.09
C12	161.00	0.19	0.49
C13	175.00	0.79	1.86
C14	190.00	1.65	3.57
C15	206.00	2.59	5.17
C16	222.00	2.97	5.49
C17	237.00	3.35	5.81
C18	251.00	3.57	5.85
C19	263.00	3.79	5.91
C20	275.00	3.61	5.38
C21	291.00	3.48	4.91
C22	305.00	3.36	4.52
C23	318.00	3.21	4.14
C24	331.00	3.01	3.73
C25	345.00	2.94	3.49
C26	359.00	2.84	3.25
C27	374.00	2.79	3.06
C28	388.00	2.68	2.84
C29	402.00	2.58	2.64
C30+	750.00	50.53	27.63
Calculated MW		410.40	

Figure 5: Gas Chromatogram of Sample 6123787253



Appendix A: Nomenclature and Definitions

API Gravity	American Petroleum Institute Gravity
Bg	Gas Formation Volume Factor
Bo	Oil Formation Volume Factor
CCE	Constant Composition Expansion
CGR	Condensate Gas Ratio
CVD	Constant Volume Depletion
DL	Differential Liberation
FS & W	Free Sediment & Water
BS&W	Base Sediment & Water
FVF	Formation Volume Factor
GOR	Gas Oil Ratio
n	Number of Moles
OBM	Oil Based Mud
P	Absolute Pressure
Psat	Bubble Point Pressure
PV	Pressure-Volume Method
Pres	Initial Reservoir Pressure
R	Universal Gas Constant
RF	Reservoir Fluid
Rs	Solution Gas Oil Ratio
T	Temperature
V	Volume
Vr	Relative Volume
SBM	Synthetic Oil Based Mud
STL	Stock Tank Liquid
STO	Stock Tank Oil
WBM	Water Based Mud
Z	Gas Deviation Factor, Gas Compressibility Factor

Dry Gross Heating Value is the total energy transferred as heat in an ideal combustion reaction at a standard temperature and pressure in which all water formed appears as liquid.

Wet Gross Heating Value is the total energy transferred as heat in an ideal combustion reaction of water saturated gas at a standard temperature and pressure in which all water formed appears as liquid.

Molar masses, densities and critical values of pure components are from CRC handbook of Chemistry and Physics and those of pseudo components are based on corrected MW values proposed by Curtis Whitson in the SPE Journal paper # 12233 of August 1983

Compressibility in constant mass study is obtained from mathematical derivation of relative volume.

Gas gravity is calculated from composition using the perfect gas equation (Gas deviation factor, Z=1)

Appendix B: Molecular Weight Data

Table 6: Molecular Weight Data of Katz and Whitson

No	Component	Katz	Whitson	Different
		g/mol	g/mol	
1	CO2	44.0	44.0	
2	H2S	34.1	34.1	
3	N2	28.0	28.0	
4	C1	16.0	16.0	
5	C2	30.1	30.1	
6	C3	44.1	44.1	
7	i-C4	58.1	58.1	
8	n-C4	58.1	58.1	
9	i-C5	72.2	72.2	
10	n-C5	72.2	72.2	
11	C6	84.0	84.0	
12	Mcyclo-C5	84.2	84.2	
13	Benzene	78.1	78.1	
14	Cyclo-C6	84.2	84.2	
15	C7	96.0	96.0	
16	Mcyclo-C6	98.2	98.2	
17	Toluene	92.1	92.1	
18	C8	107.0	107.0	
19	C2-Benzene	106.2	106.2	
20	m&p-Xylene	106.2	106.2	
21	o-Xylene	106.2	106.2	
22	C9	121.0	121.0	
23	C10	134.0	134.0	
24	C11	147.0	147.0	
25	C12	161.0	161.0	
26	C13	175.0	175.0	
27	C14	190.0	190.0	
28	C15	206.0	206.0	
29	C16	222.0	222.0	
30	C17	237.0	237.0	
31	C18	251.0	251.0	
32	C19	263.0	263.0	
33	C20	275.0	275.0	
34	C21	291.0	291.0	
35	C22	305.0	300.0	*
36	C23	318.0	312.0	*
37	C24	331.0	324.0	*
38	C25	345.0	337.0	*
39	C26	359.0	349.0	*
40	C27	374.0	360.0	*
41	C28	388.0	372.0	*
42	C29	402.0	382.0	*
43	C30+	750.0	750.0	

*MW values for C30+ are industry average which do not reflect the actual MW values of C30+ measured in this study.

Appendix C: Procedure for Sample Restoration and Standard PVT Analyses

Compositional Analyses

The compositional analysis of liquid samples is performed on a temperature programmed GC equipped with a different capillary column, an FID detector and uses helium as a carrier gas. The temperature programming is also non-isothermal (ramping to over 572.0 °F), and the detection range covers C3 to C29 and a lumped C36+. The analysis includes the associated common isomers. Identification and quantification of C2 is hampered with the co-elution of C1 and ethylene therefore cannot be guaranteed and is therefore omitted.

The liquid GC utilizes a proprietary technology to determine hydrocarbon liquid carbon number distribution. For low C36+ fraction concentration (< 5 wt %), the GC is calibrated against ASTM D2887 Reference Gas Oil #2. The tuning parameter for this calibration is the C36+ fraction weight percent. A mean value of 2.5 wt % within a deviation of ± 0.4 wt % is considered acceptable as a control limit. A warning limit is set at 2.5 ± 0.6 wt %, and the GC is completely overhauled and returned to proper operation if the measured ASTM standard C36+ concentration is registered outside these limits.

In much the same way, an internal standard reference crude is used for calibration in the high C36+ region. This standard has a mean C36+ weight percent of 32 wt% and a deviation of 1.8 wt % is considered an acceptable control limit. The warning limit for the reference crude is ± 2.7 wt %. All of the aforementioned standards are run on a regular basis and detailed records of the GC performance and overhauls are maintained and are provided to clients upon request. Similarly for heavier crude in the region of 52 wt% C36+ there is an additional internal 'heavy crude oil reference'. All compositional details C31 to C35 and C36+ are not controlled quantitatively but C30+ is.

Although the GC is calibrated with "real" crude oils, it cannot differentiate between n-alkanes and other paraffin groups for C6+ components. Only n-alkane peaks are identified and components between these peaks are lumped together into an overall carbon number grouping.