



PVT WATER ANALYSIS REPORT

WELL LIR-GT01

FOR GEOTHERMIE DE LIER

AUGUST 12TH, 2014

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1 PVT Analysis of Water Samples

1.1 Bottomhole Sampling

The bottomhole sampling took place on July 6, 2014 at De Lier, well LIR-GT01.

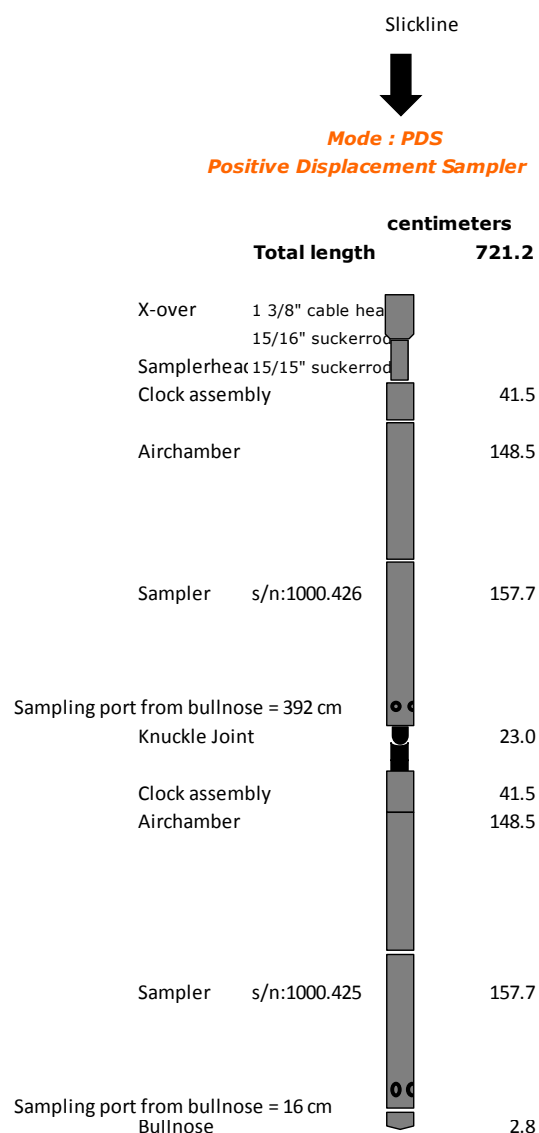


Figure 1 - Bottomhole Sampler

The bottomhole samplers were connected to a slickline unit and run in tandem to a depth of 2300 and respectively 2350 meters, where they were filled with sample by displacement, and then retrieved to surface. The samples were then pressurized up to 5000 psi on the transfer bench, where the samples were transferred from the bottomhole samplers into floating piston (transport) bottles.

Once transfer was completed the transport-bottle was sealed from top, pressure reduced to 1000 psi at bottom of bottle to ensure gas the cap, to follow up by sealing the bottom part of the bottle.

The transport bottles were picked-up by PanTerra on location at De Lier on July 7, 2014.

Casedhole Data Sheet

Field pvt

Company: Agro AdviesBuro
Job No: July-14

Field: Westland
Well: LIR-GT-01

Installation: KCA/Deutag T49
Date: 8-Jul-2014

General Information

Sample No:	<u>1</u>	Sample Nature:	<u>Bottomhole water with gas</u>
Test No:	<u>Run#1</u>	Flow Period:	<u>static</u>
Cylinder No:	<u>10/0337</u>	Sampler Type:	<u>PDS</u>
Sampling Date:	<u>6-Jul-14 02:17</u>	Conveyed By:	<u>Slickline</u>
Sampling Point:	<u>2299.84 meters</u>	Sampler Serial No:	<u>PDS Leutert 1000.425</u>
Perforations :	<u>n/a</u>		

Transfers Conditions

Sample Bottle Type:	<u>Cylinder type 600</u>	Gas Cap Created:	<u>Pressure reduced from 4800 to 1150 psi</u>
Sample Bottle Volume:	<u>700cc</u>	2cc Opening Pressure	<u>2500 psi</u>
Sample Volume:	<u>600cc</u>	Final Pressure:	<u>1150 psi at ambient temperature</u>

Shipping Conditions

Initial Pressure:	<u>5000 psi</u>	Transport pressure	<u>1150 psi</u>
Transfer Pressure:	<u>4800 psi</u>	App. Bubble Point:	<u>n/a</u>

Figure 2 - Sampling Sheet Bottomhole Sample 10/0337

Casedhole Data Sheet

Field pvt

Company: **Agro AdviesBuro**
Job No: **July-14**

Field: **Westland**
Well: **LIR-GT-01**

Installation: **KCA/Deutag T49**
Date: **8-Jul-2014**

General Information

Sample No: <u>2</u>	Sample Nature: <u>Bottomhole water with g</u>
Test No: <u>Run#1</u>	Flow Period: <u>static</u>
Cylinder No <u>07/1002</u>	Sampler Type: <u>PDS</u>
Sampling D <u>6-Jul-14 02:17</u>	Conveyed By: <u>Slickline</u>
Sampling P <u>2296.08 meters</u>	Sampler Serial No: <u>PDS Leutert 1000.426</u>
Perforation <u>n/a</u>	

Transfers Conditions

Sample Botl <u>Cylinder type 600</u>	Gas Cap Created: <u>Pressure reduced from 4800 to 1000 psi</u>
Sample Botl <u>700cc</u>	2cc Opening Pressure <u>2100 psi</u>
Sample Vol <u>600cc</u>	Final Pressure: <u>1150 psi at ambient temperature</u>

Shipping Conditions

Initial Pres: <u>5000 psi</u>	Transport pressure <u>1000 psi</u>
Transfer Pr <u>4800 psi</u>	App. Bubble Point: <u>n/a</u>

Figure 3 - Sampling Sheet Bottomhole Sample 07/1002

Casedhole Data Sheet

Field pvt

Company: Agro AdviesBuro
Job No: July-14

Field: Westland
Well: LIR-GT-01

Installation: KCA/Deutag T49
Date: 8-Jul-2014

General Information

Sample No:	<u>3</u>	Sample Nature:	<u>Bottomhole water with g</u>
Test No:	<u>Run#2</u>	Flow Period:	<u>static</u>
Cylinder No:	<u>07/1007</u>	Sampler Type:	<u>PDS</u>
Sampling Date:	<u>6-Jul-14 07:20</u>	Conveyed By:	<u>Slickline</u>
Sampling Point:	<u>2349.84 meters</u>	Sampler Serial No:	<u>PDS Leutert 1000.425</u>
Perforations :	<u>n/a</u>		

Transfers Conditions

Sample Bottle Type:	<u>Cylinder type 600</u>	Gas Cap Created:	<u>Pressure reduced from 4400 to 1000 psi</u>
Sample Bottle Volume:	<u>700cc</u>	2cc Opening Pressure	<u>2200 psi</u>
Sample Volume:	<u>600cc</u>	Final Pressure:	<u>1000 psi at ambient temperature</u>

Shipping Conditions

Initial Pressure:	<u>5000 psi</u>	Transport pressure	<u>1000 psi</u>
Transfer Pressure:	<u>4400 psi</u>	App. Bubble Point:	<u>n/a</u>

Figure 4 - Sampling Sheet Bottomhole Sample 07/1007

Casedhole Data Sheet

Field pvt

Company: Agro AdviesBuro
Job No: July-14

Field: Westland
Well: LIR-GT-01

Installation: KCA/Deutag T49
Date: 8-Jul-2014

General Information

Sample No:	<u>4</u>	Sample Nature:	<u>Bottomhole water with g</u>
Test No:	<u>Run#2</u>	Flow Period:	<u>static</u>
Cylinder No:	<u>2007/10</u>	Sampler Type:	<u>PDS</u>
Sampling Date:	<u>6-Jul-14 07:20</u>	Conveyed By:	<u>Slickline</u>
Sampling Point:	<u>2346.08 meters</u>	Sampler Serial No:	<u>PDS Leutert 1000.426</u>
Perforations :	<u>n/a</u>		

Transfers Conditions

Sample Bottle Type:	<u>Cylinder type 600</u>	Gas Cap Created:	<u>Pressure reduced from 4350 to 1000 psi</u>
Sample Bottle Volume:	<u>700cc</u>	2cc Opening Pressure	<u>2300 psi</u>
Sample Volume:	<u>600cc</u>	Final Pressure:	<u>1000 psi at ambient temperature</u>

Shipping Conditions

Initial Pressure:	<u>5000 psi</u>	Transport pressure	<u>1000 psi</u>
Transfer Pressure:	<u>4350 psi</u>	App. Bubble Point:	<u>n/a</u>

Figure 5 - Sampling Sheet Bottomhole Sample 2007/10

Table 1 - Bottomhole Samples Summary

Sample ID	Sample Date	Sample Time	Sample Nature	Sample point (meters below rotary table)	Cylinder ID
Run#1 bottom	06-Jul-14	02:17	Water & Gas	2300-0.16=2299.84	10/0337
Run#1 top	06-Jul-14	02:17	Water & Gas	2300-3.92=2296.08	07/1002
Run#2 bottom	06-Jul-14	07:20	Water & Gas	2350-0.16=2349.84	07/1007
Run#2 top	06-Jul-14	07:20	Water & Gas	2350-3.92=2346.08	2007/10

1.2 Surface Sampling

Four water samples were collected at the wellhead of the well LIR-GT01 on July 3, 2014. Three “live” (i.e. with gas still dissolved inside) of which 1 back-up sample were collected with the wellhead pressure 8 bar respectively. The samples were collected using the displacement procedure into piston cylinders.

One “dead” (no gas dissolved) water sample was collected from the wellhead into a jerry can.

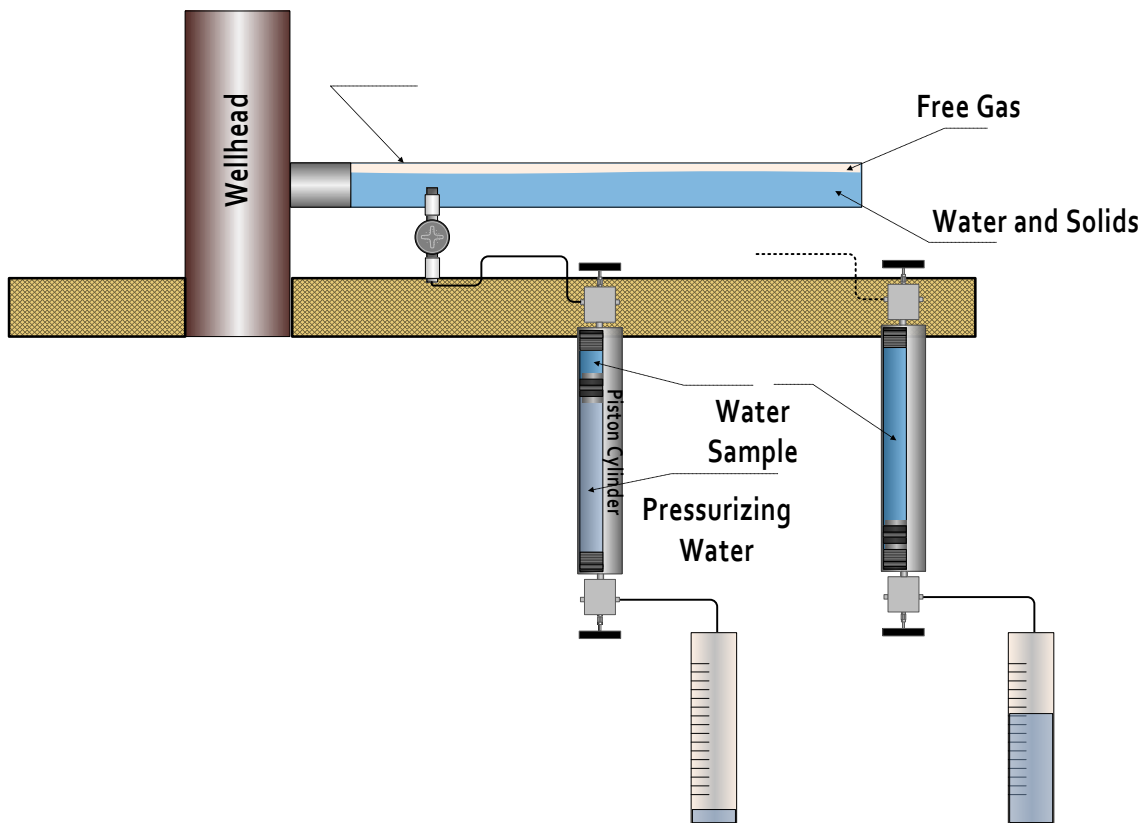


Figure 6 - Surface Sampling Layout

Table 2 - Surface Sampling Summary

Sample no.	Sampling Point Temperature	Sampling Point Pressure	Wellhead Flow Rate	Date taken
	⁰ Celsius	bar	m3/h	
Sample1	87	8	255	3-7-2014
Sample 2	87	8	255	3-7-2014
Sample 3 (back-up)	87	8	255	3-7-2014

1.3 Samples Quality Control

Visual Inspection upon Receiving the Samples

Upon receipt, the samples were visually inspected for any obvious faults, i.e. leaks, bent valves or any other mechanical problems. The sample cylinders were found to be in good condition.

Opening Pressure Measurement

The pressurized sample cylinders at room temperature were connected at the pressurizing water end to a high pressure pump, the opening pressure was read at the pump display.

Sample Volume Measurement

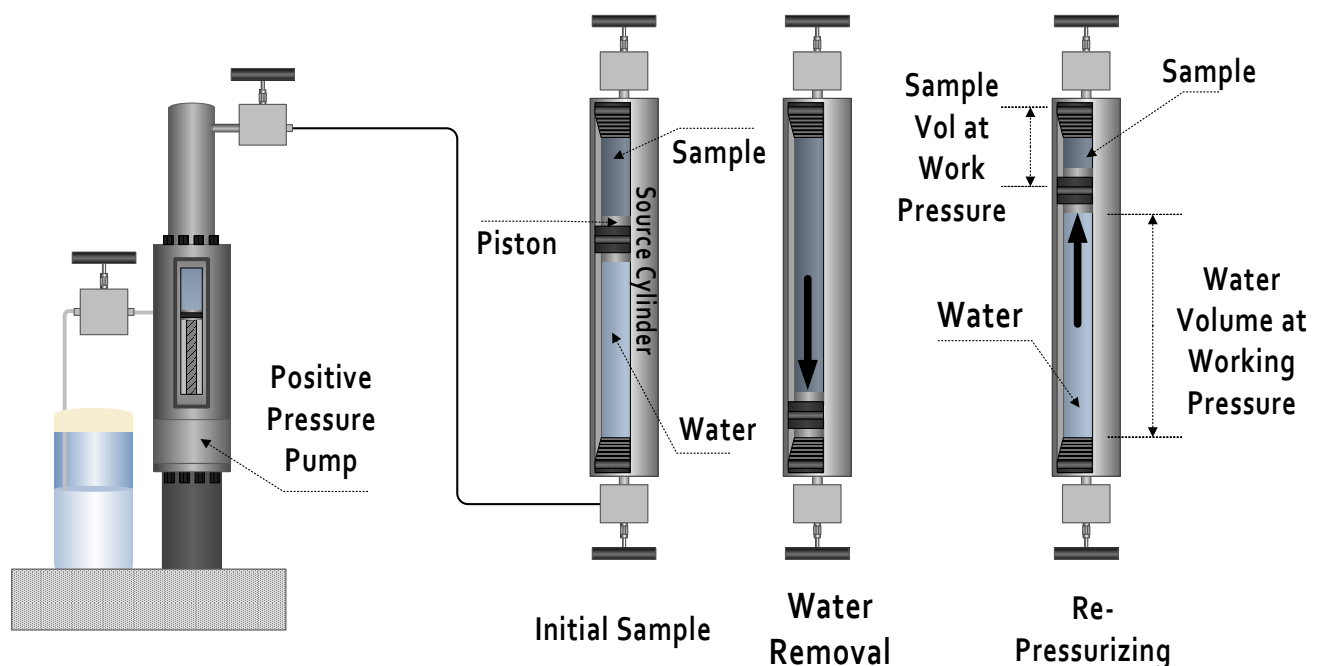


Figure 7 - Samples Volume Measurement Layout

The pressurizing fluid (water) was drained from the sample water end.

The samples were shaken until stable at working pressure and the amount of pressurizing water was recorded.

The sample volumes were the difference between the total volume of the cylinders and the pressurizing fluid.

Samples Restoration

While connected to a positive displacement pump, the samples were homogenized by shaking for 24 hours prior to any removal of sample.

Table 3 - Samples Quality Check Results

Sample no.	Type	Opening Pressure	Opening Temp	Sample Volume	H ₂ S (y/n)	Valve Checked (y/n)	
		bar	^o Celsius			top	bot
Sample1	Surface	3.51	24	650	n	y	y
Sample 2	Surface	4.82	24	650	n	y	y
07/1002	BHS	92.62	25	580	n	y	y
07/1007	BHS	86.48	25	560	n	y	y

1.4 Flash Separation

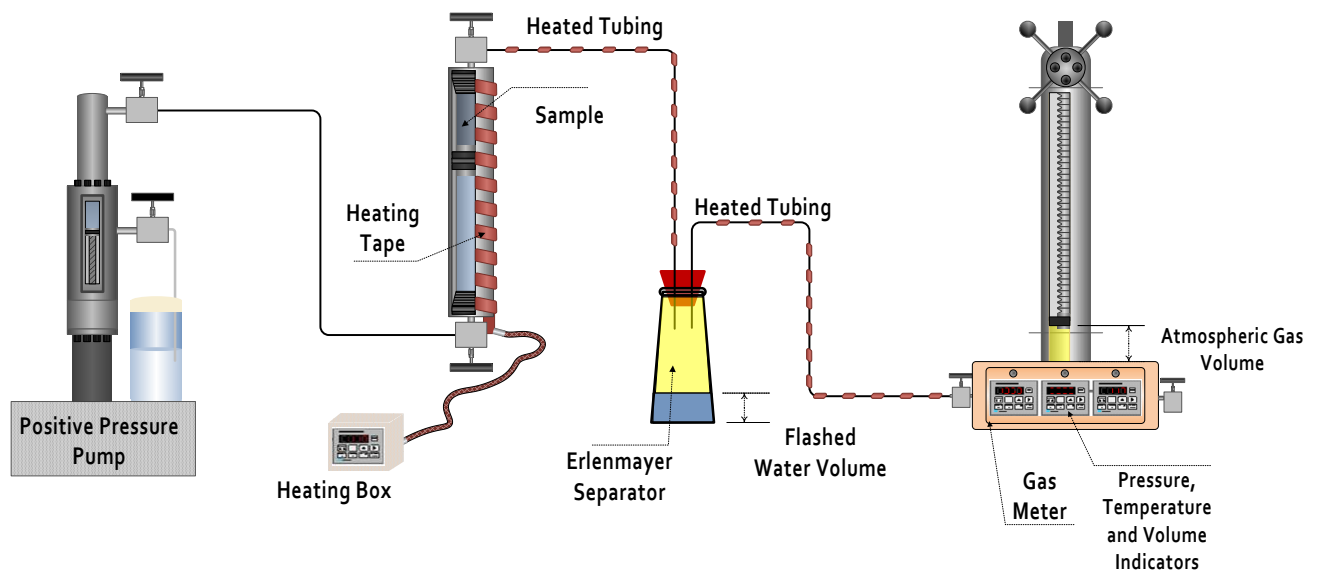


Figure 8 - Flash Separation Layout

A volume of single-phase water was pumped from the sample cylinder into a trap connected to a gas meter at atmospheric conditions of pressure and temperature.

The flashed water and gas volumes, separation temperatures and atmospheric pressures were accurately recorded.

The composition of gas was subsequently measured using the procedure described below. The flash GWR (gas water ratio) was calculated as the ratio between the flashed water and the collected gas.

1.5 Water and Gas Physical Properties Measurement

Water Density Measurement

The density of the flashed water was measured using a digital u-tube handheld densitometer, model Anton Paar DMA 35.

A sample causes a change in the oscillation frequency of a vibrating glass U tube. The change is directly proportional to the density of the sample.

The embedded software allows for temperature correction when the ambient temperature is different than standard.



Figure 9 - DMA 35 Densitometer

Water pH Measurement

The pH meter used is an Orion 370 pH meter. Before any measurement, a 3-point calibration measurement is run for the standard buffers that will correspond with the selected calibration pH mode (pH 4/7/10).

After calibration, the pH electrodes are rinsed with deionized (D.I.) H₂O and blot dry.

For the actual measurement, the bottom part of the electrode is immersed in the sample, and when the “ready” light comes up a stable pH value is obtained and frozen and the display can be read.

For each new sample, the step above is repeated and the electrode is rinsed every time in deionized water.

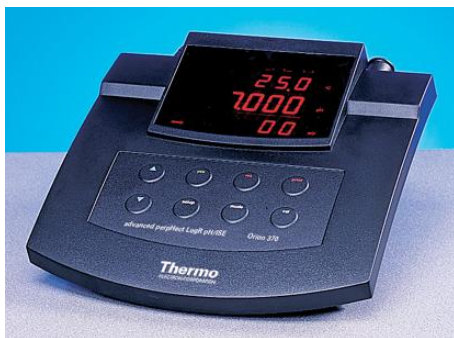


Figure 10 - Orion 370 pH meter

Water Particle Size Analysis

The particle size distribution in water is measured by a particle sizer. A sample is thoroughly homogenized and then directly dispersed uniformly in an ultrasonic bath.

The sample is diluted with demineralized water in order to achieve optimal obscuration of the laser beam.

The scattering of a laser beam by the suspended particles is measured and the data analyzed to give the particle size distribution of the sample.

The obscuration value from the LPSA analysis represents a coefficient describing how obscure is the sample. Ideal is between 10-30%.



Figure 11 - Particle Sizer

Gas Composition

The resulted gas fraction from the flash was analyzed using the gas chromatography procedure.

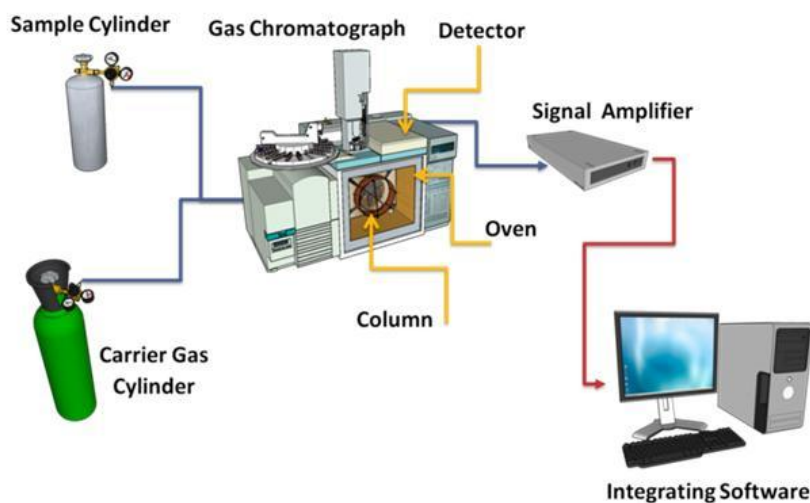


Figure 12 - General Chromatographic Procedure Layout

Compositions up to C_{11+} were measured. Components: porous polymer and mole sieve columns, TCD detector (for C_1 - C_3 , permanent gases), capillary column and FID detector (for C_4 to C_{11+}).

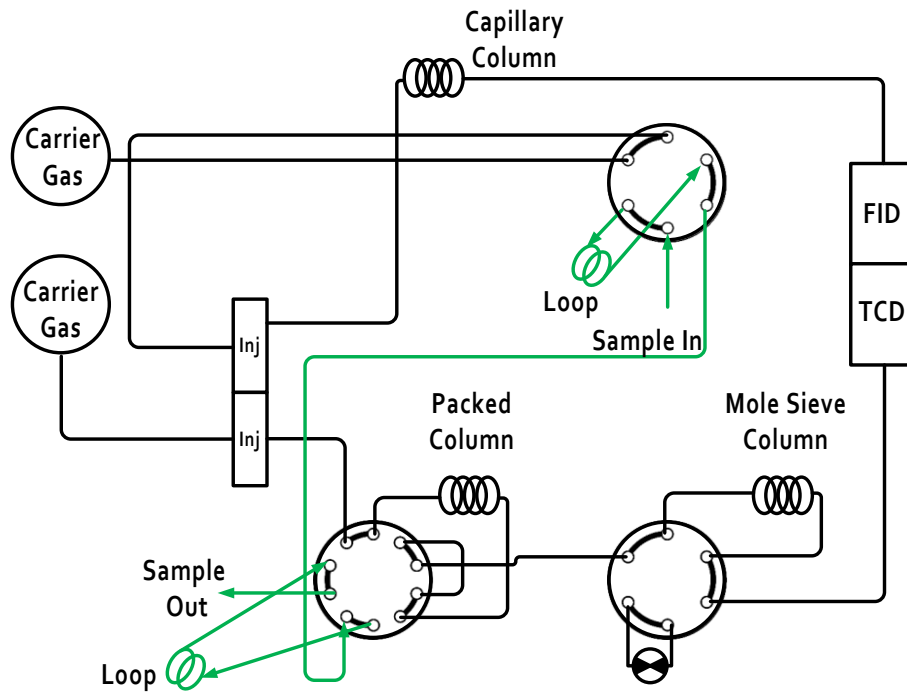


Figure 13 - Gas Chromatograph Layout

Table 4 - Composition of Flashed Gas from Surface Sample 1

Component		Mole%	Weight%
H ₂	Hydrogen	0.000	0.000
H ₂ S	Hydrogen Sulphide	0.000	0.000
CO ₂	Carbon Dioxide	56.717	75.576
N ₂	Nitrogen	0.415	0.352
C1	Methane	39.344	19.111
C2	Ethane	2.088	1.901
C3	Propane	0.505	0.675
C4	i-Butane	0.058	0.102
C4	n-Butane	0.124	0.218
C5	i-Pentane	0.066	0.145
C5	n-Pentane	0.158	0.345
C6	Hexanes	0.071	0.180
	MC Pentane	0.010	0.025
	Benzene	0.160	0.378
	Cyclohexane	0.011	0.029
C7	Heptanes	0.058	0.170
	MC Hexane	0.017	0.051
	Toluene	0.051	0.143
C8	Octanes	0.027	0.088
	E-Benzene	0.001	0.002
	M/P Xylene	0.000	0.001
	O-Xylene	0.001	0.003
C9	Nonanes	0.010	0.035
	1,2,4 TMB	0.000	0.002
C10	Decanes	0.011	0.046
C11+	Undecanes +	0.095	0.422
	Total	100.000	100.000

Calculated Gas Properties	
Gas Density (kg m ⁻³ @ 15°C)	1.475
Gas Mole Weight (g mol ⁻¹)	33.028
Real Relative (to air) Density of Gas	1.141
Mole weight of Heptanes Plus (g mol ⁻¹)	101.675
Density of Heptanes plus (g cm ⁻³ at 60°F)	0.806
Mole Weight of Undecanes plus (g mol ⁻¹)	147.000
Density of Undecanes plus (g cm ⁻³ at 60°F)	0.789
Calorific Value (MJ m ⁻³)	19.061

Table 5 - Composition of Flashed Gas from Surface Sample 2

Component		Mole%	Weight%
H ₂	Hydrogen	0.000	0.000
H ₂ S	Hydrogen Sulphide	0.000	0.000
CO ₂	Carbon Dioxide	40.402	62.454
N ₂	Nitrogen*	0.598	0.589
C1	Methane	54.658	30.800
C2	Ethane	3.034	3.205
C3	Propane	0.604	0.935
C4	i-Butane	0.063	0.129
C4	n-Butane	0.076	0.155
C5	i-Pentane	0.165	0.417
C5	n-Pentane	0.063	0.160
C6	Hexanes	0.022	0.064
	MC Pentane	0.003	0.008
	Benzene	0.119	0.325
	Cyclohexane	0.004	0.011
C7	Heptanes	0.019	0.063
	MC Hexane	0.005	0.018
	Toluene	0.081	0.263
C8	Octanes	0.014	0.053
	E-Benzene	0.000	0.002
	M/P Xylene	0.001	0.003
	O-Xylene	0.001	0.003
C9	Nonanes	0.004	0.017
	1,2,4 TMB	0.000	0.002
C10	Decanes	0.009	0.041
C11+	Undecanes +	0.055	0.283
	Total	100.000	100.000

Calculated Gas Properties	
Gas Density (kg m ⁻³ @ 15°C)	1.272
Gas Mole Weight (g mol ⁻¹)	28.471
Real Relative (to air) Density of Gas	0.984
Mole weight of Heptanes Plus (g mol ⁻¹)	98.919
Density of Heptanes plus (g cm ⁻³ at 60°F)	0.826
Mole Weight of Undecanes plus (g mol ⁻¹)	147.000
Density of Undecanes plus (g cm ⁻³ at 60°F)	0.789
Calorific Value (MJ m ⁻³)	25.576

* very high air contamination

Table 6 - Composition of Flashed Gas from Bottomhole Sample 07/1002

Component		Mole%	Weight%
H ₂	Hydrogen	0.000	0.000
H ₂ S	Hydrogen Sulphide	0.000	0.000
CO ₂	Carbon Dioxide	20.337	38.173
N ₂	Nitrogen	3.275	3.913
C1	Methane	70.843	48.474
C2	Ethane	4.287	5.498
C3	Propane	0.401	0.754
C4	i-Butane	0.053	0.131
C4	n-Butane	0.060	0.150
C5	i-Pentane	0.042	0.128
C5	n-Pentane	0.006	0.019
C6	Hexanes	0.056	0.200
	MC Pentane	0.022	0.078
	Benzene	0.052	0.172
	Cyclohexane	0.059	0.213
C7	Heptanes	0.441	1.804
	MC Hexane	0.042	0.178
	Toluene	0.003	0.011
C8	Octanes	0.017	0.078
	E-Benzene	0.000	0.000
	M/P Xylene	0.000	0.000
	O-Xylene	0.000	0.000
C9	Nonanes	0.001	0.006
	1,2,4 TMB	0.000	0.000
C10	Decanes	0.002	0.012
C11+	Undecanes +	0.001	0.008
	Total	100.000	100.000

Calculated Gas Properties	
Gas Density (kg m ⁻³ @ 15°C)	1.050
Gas Mole Weight (g mol ⁻¹)	23.446
Real Relative (to air) Density of Gas	0.812
Mole weight of Heptanes Plus (g mol ⁻¹)	93.759
Density of Heptanes plus (g cm ⁻³ at 60°F)	0.742
Mole Weight of Undecanes plus (g mol ⁻¹)	147.000
Density of Undecanes plus (g cm ⁻³ at 60°F)	0.789
Calorific Value (MJ m ⁻³)	33.294

Table 7 - Composition of Flashed Gas from Bottomhole Sample 07/1007

Component		Mole%	Weight%
H ₂	Hydrogen	0.000	0.000
H ₂ S	Hydrogen Sulphide	0.000	0.000
CO ₂	Carbon Dioxide	13.227	27.711
N ₂	Nitrogen	3.571	4.762
C1	Methane	78.822	60.197
C2	Ethane	3.678	5.265
C3	Propane	0.372	0.781
C4	i-Butane	0.055	0.151
C4	n-Butane	0.064	0.178
C5	i-Pentane	0.011	0.036
C5	n-Pentane	0.007	0.023
C6	Hexanes	0.011	0.045
	MC Pentane	0.003	0.014
	Benzene	0.063	0.234
	Cyclohexane	0.009	0.038
C7	Heptanes	0.058	0.263
	MC Hexane	0.006	0.029
	Toluene	0.004	0.017
C8	Octanes	0.004	0.022
	E-Benzene	0.000	0.000
	M/P Xylene	0.000	0.000
	O-Xylene	0.000	0.001
C9	Nonanes	0.002	0.009
	1,2,4 TMB	0.000	0.001
C10	Decanes	0.008	0.052
C11+	Undecanes +	0.025	0.172
	Total	100.000	100.000

Calculated Gas Properties	
Gas Density (kg m ⁻³ @ 15°C)	0.938
Gas Mole Weight (g mol ⁻¹)	21.007
Real Relative (to air) Density of Gas	0.726
Mole weight of Heptanes Plus (g mol ⁻¹)	98.051
Density of Heptanes plus (g cm ⁻³ at 60°F)	0.787
Mole Weight of Undecanes plus (g mol ⁻¹)	147.000
Density of Undecanes plus (g cm ⁻³ at 60°F)	0.789
Calorific Value (MJ m ⁻³)	34.857

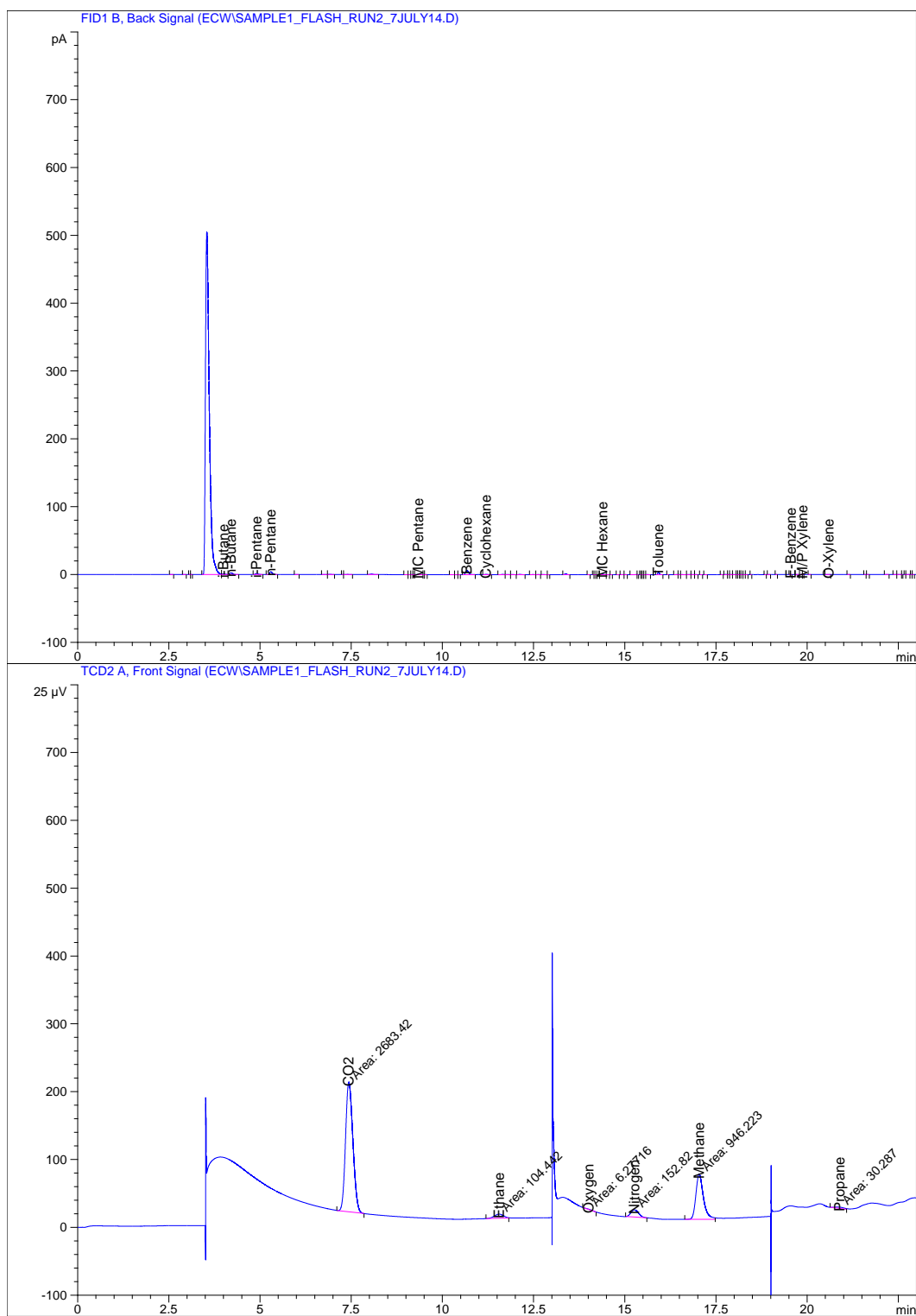


Figure 14 - Chromatogram Flashed Gas from Surface Sample 1

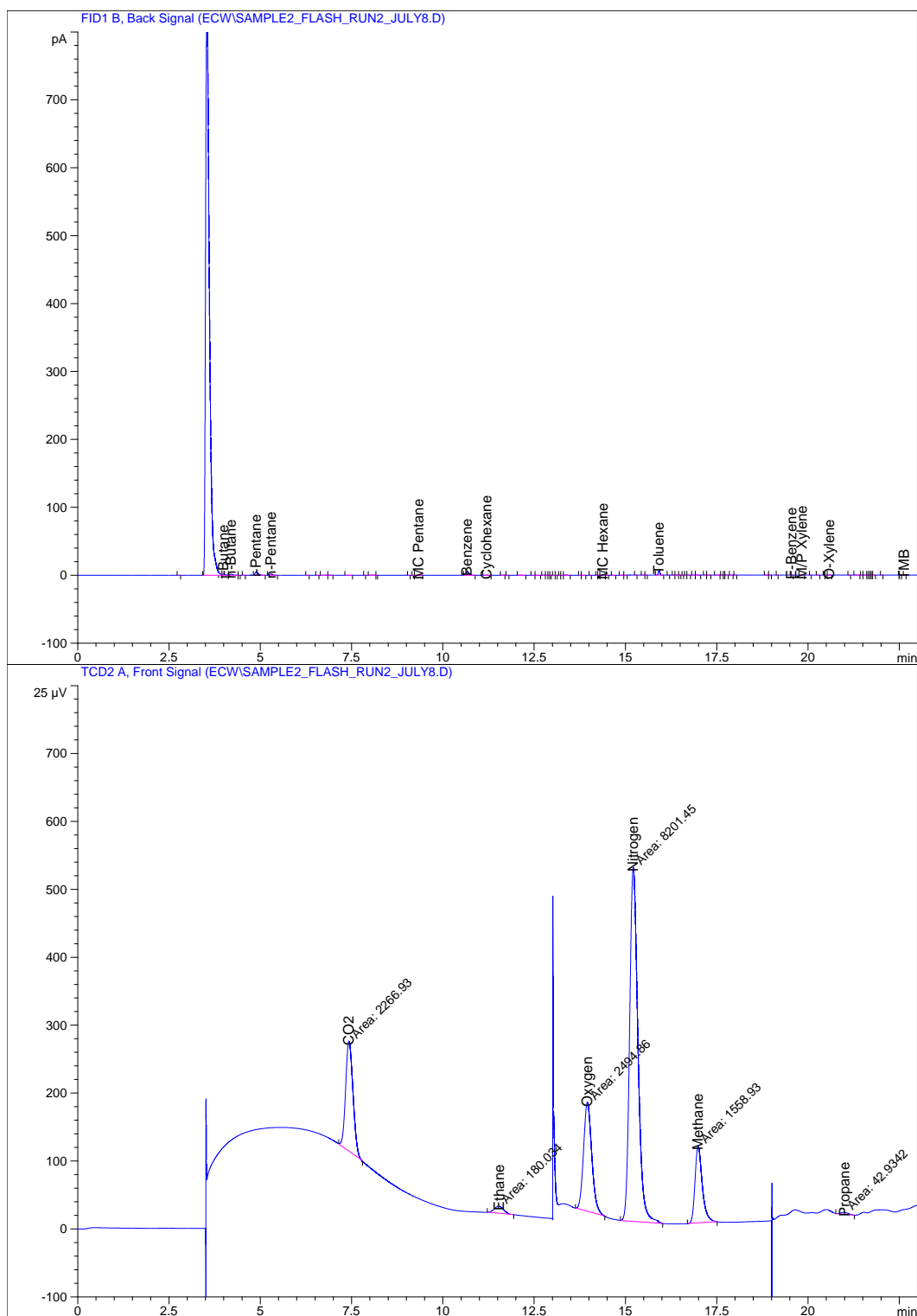


Figure 15 - Chromatogram Flashed Gas from Surface Sample 2

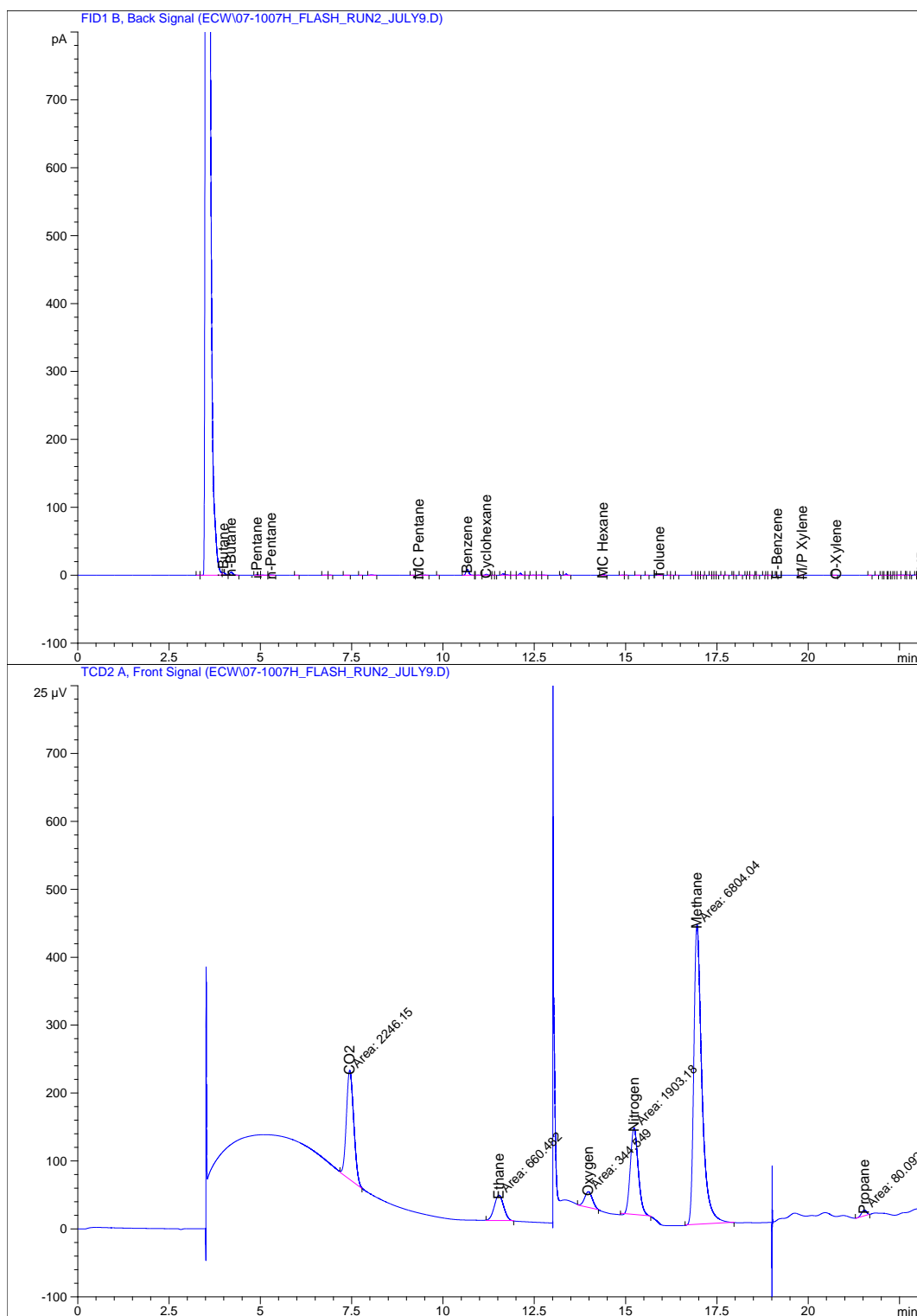


Figure 16 - Chromatogram Flashed Gas from Bottomhole Sample 07/1002

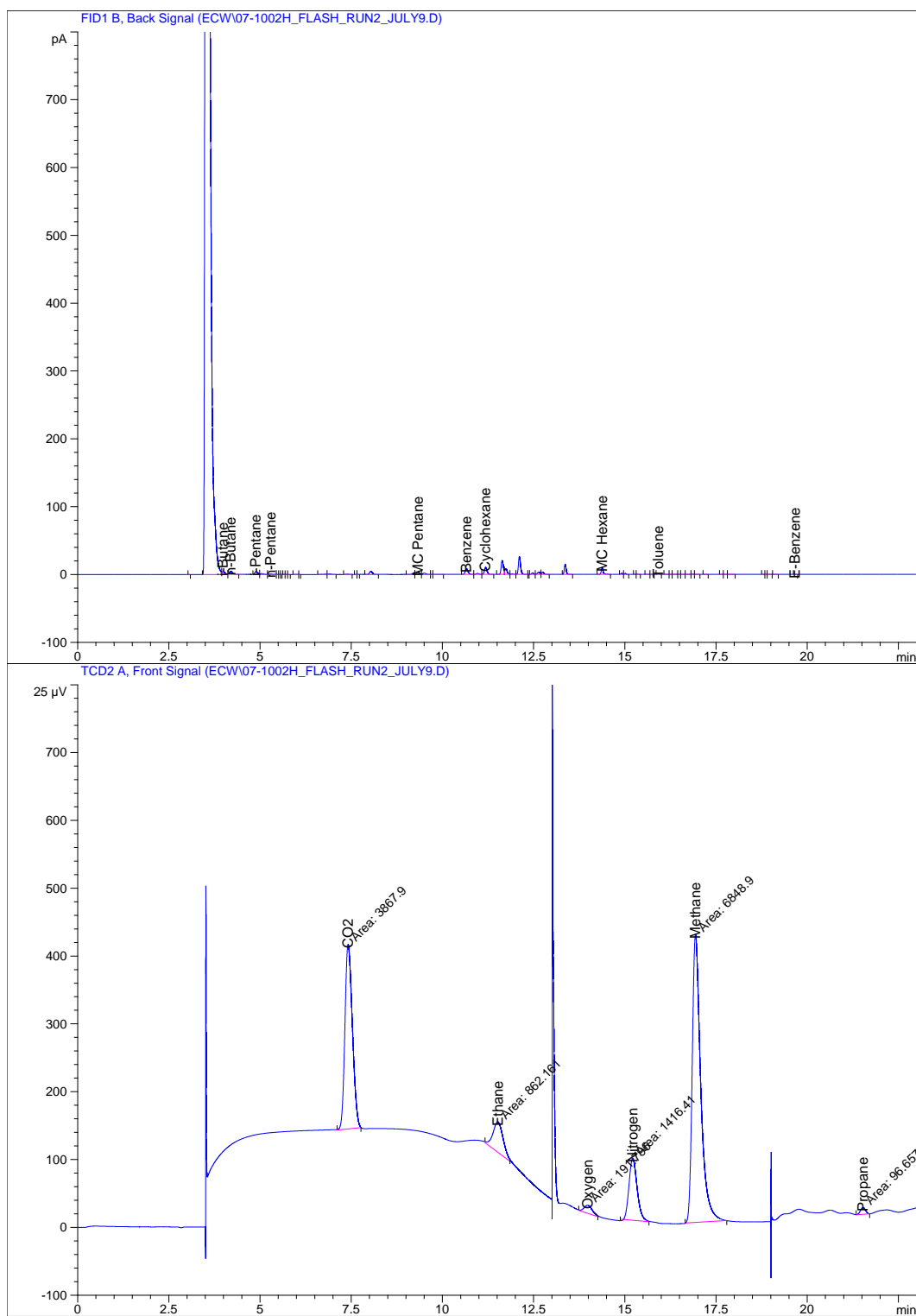


Figure 17 - Chromatogram Flashed Gas from Bottomhole Sample 07/1007

Table 8 - Physical Properties of Samples

Sample no.	Type	pH @ 25 ⁰ C of flashed water	Density (g/cm ³) of flashed water @ 15 ⁰ C	GWR (ncm ³ /cm ³) of live water	Bubble Point Pressure (psig) & 87 ⁰ C	Bubble Point Pressure (bar) & 87 ⁰ C
Sample 1	Surface	6.2	1.0929	0.2471	147	10.13
Sample 2	Surface	6.3	1.0932	0.3232	187	12.89
07/1002	BHS	6.3	1.0943	0.8795	770	53.09
07/1007	BHS	6.2	1.0936	0.7197	641	44.20

Bubble Point Measurement

The water at reservoir conditions is in liquid phase and incompressible. Below the saturation point (bubble point) the gas comes out and the two-phase sample is vastly more compressible.

That is the bubble point. It can be determined from the PV graph. The experiment is carried out by reducing the pressure in a PVT bottle or cell and measuring the volumes at each step.

Below the bubble point, the reduction in pressure will result in a much higher volume increase due to the gas expansion.

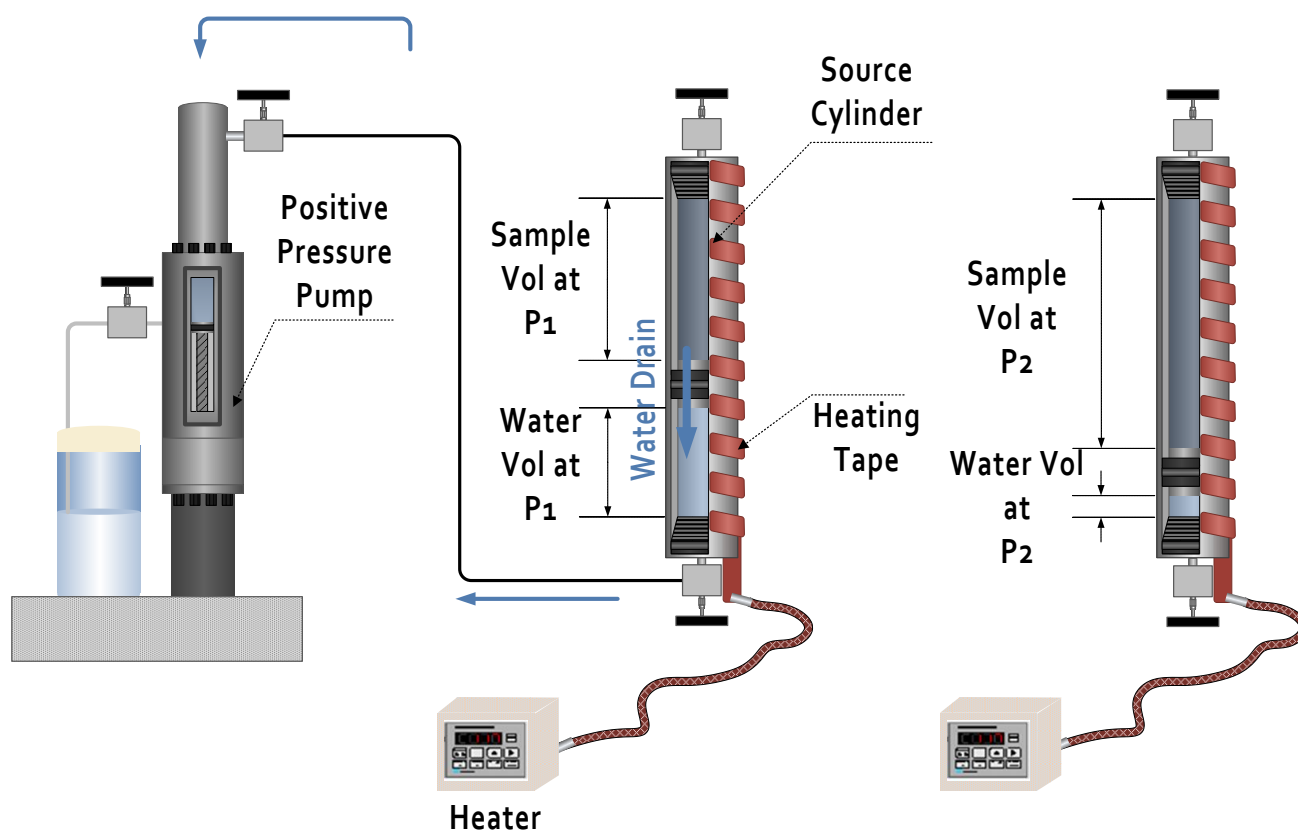


Figure 18 - Bubble Point Measurement Principle

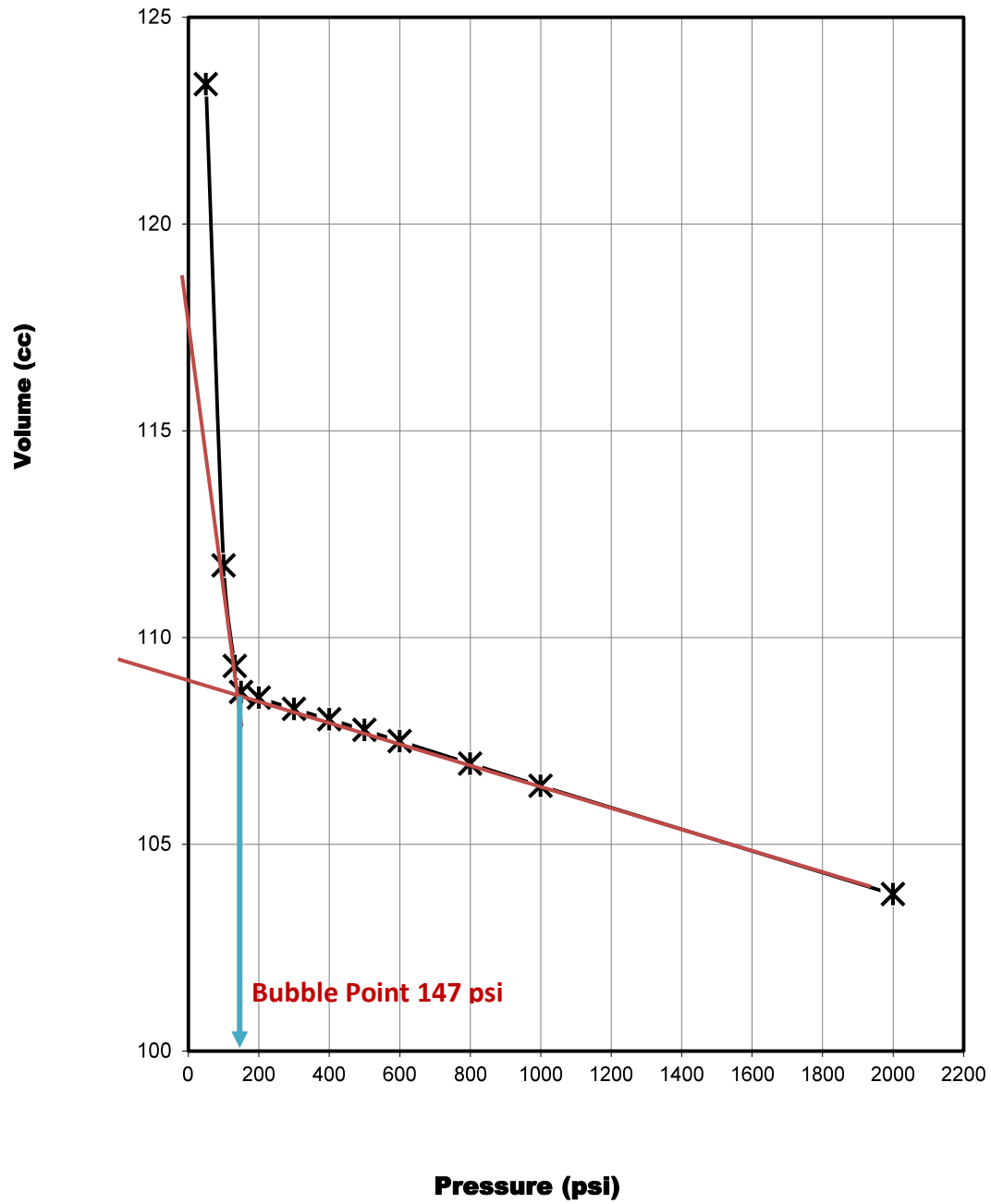


Figure 19 - Bubble Point Measurement Surface Sample 1

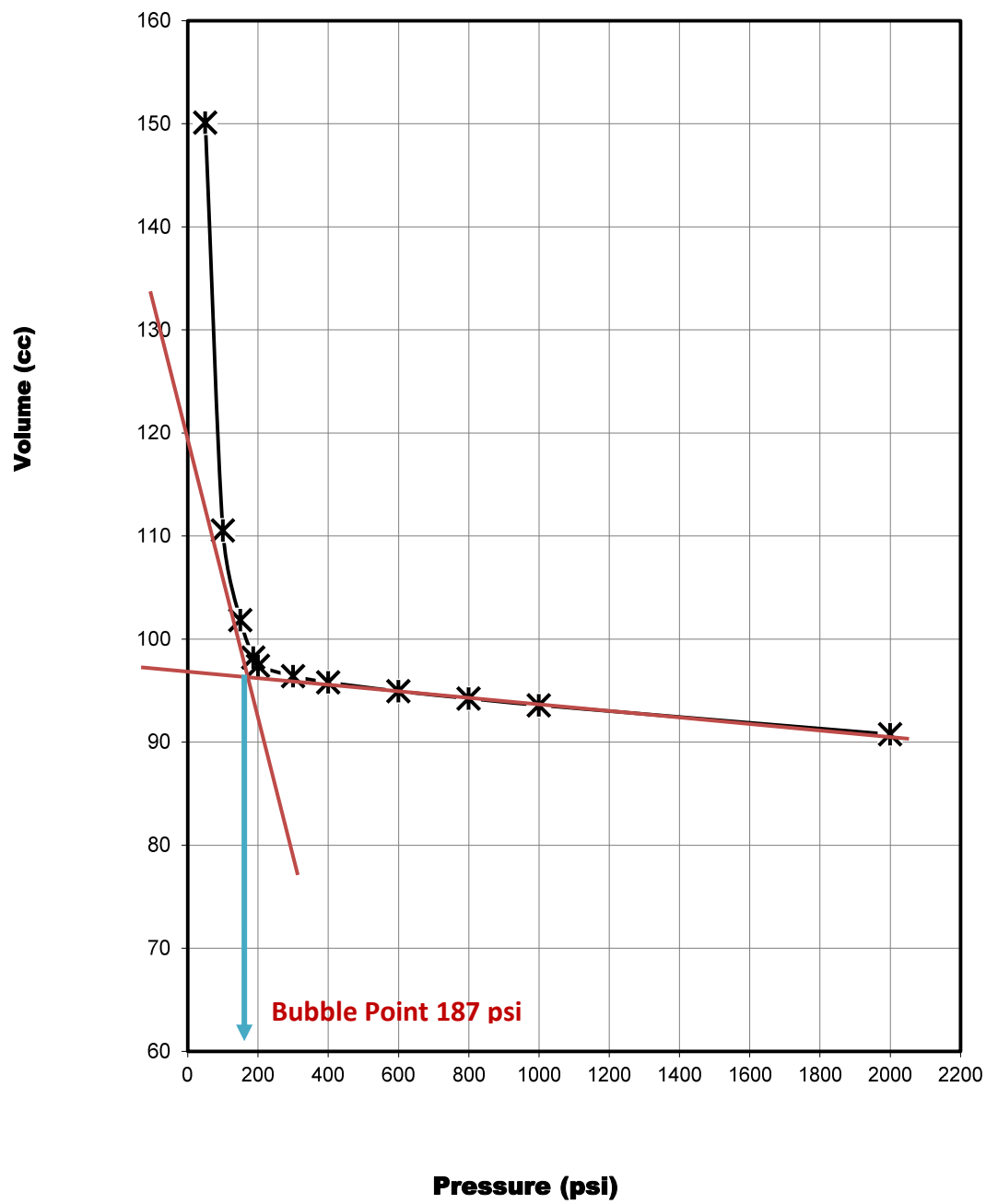


Figure 20 - Bubble Point Measurement Surface Sample 2

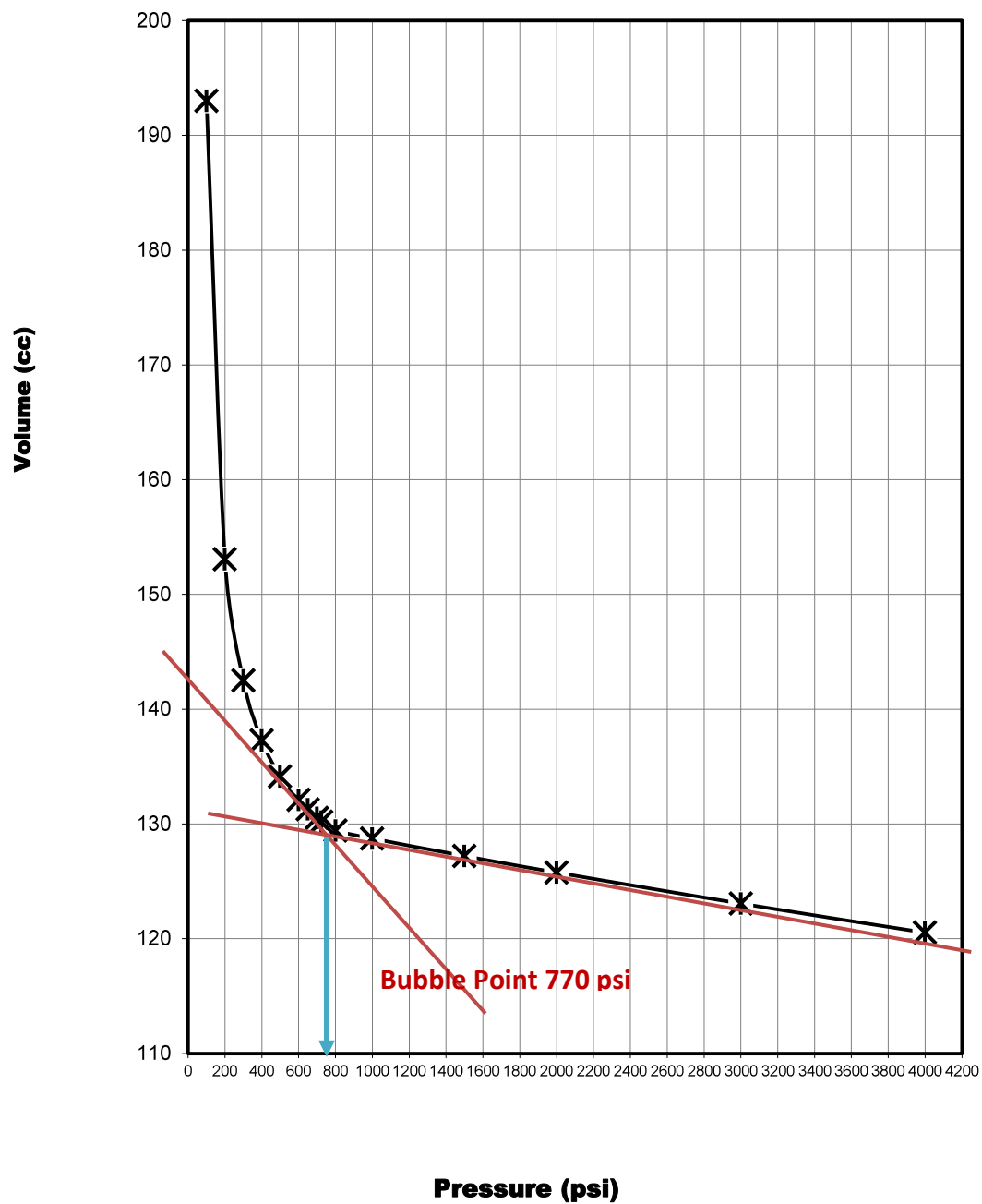


Figure 21 - Bubble Point Measurement Bottomhole Sample 07/1002

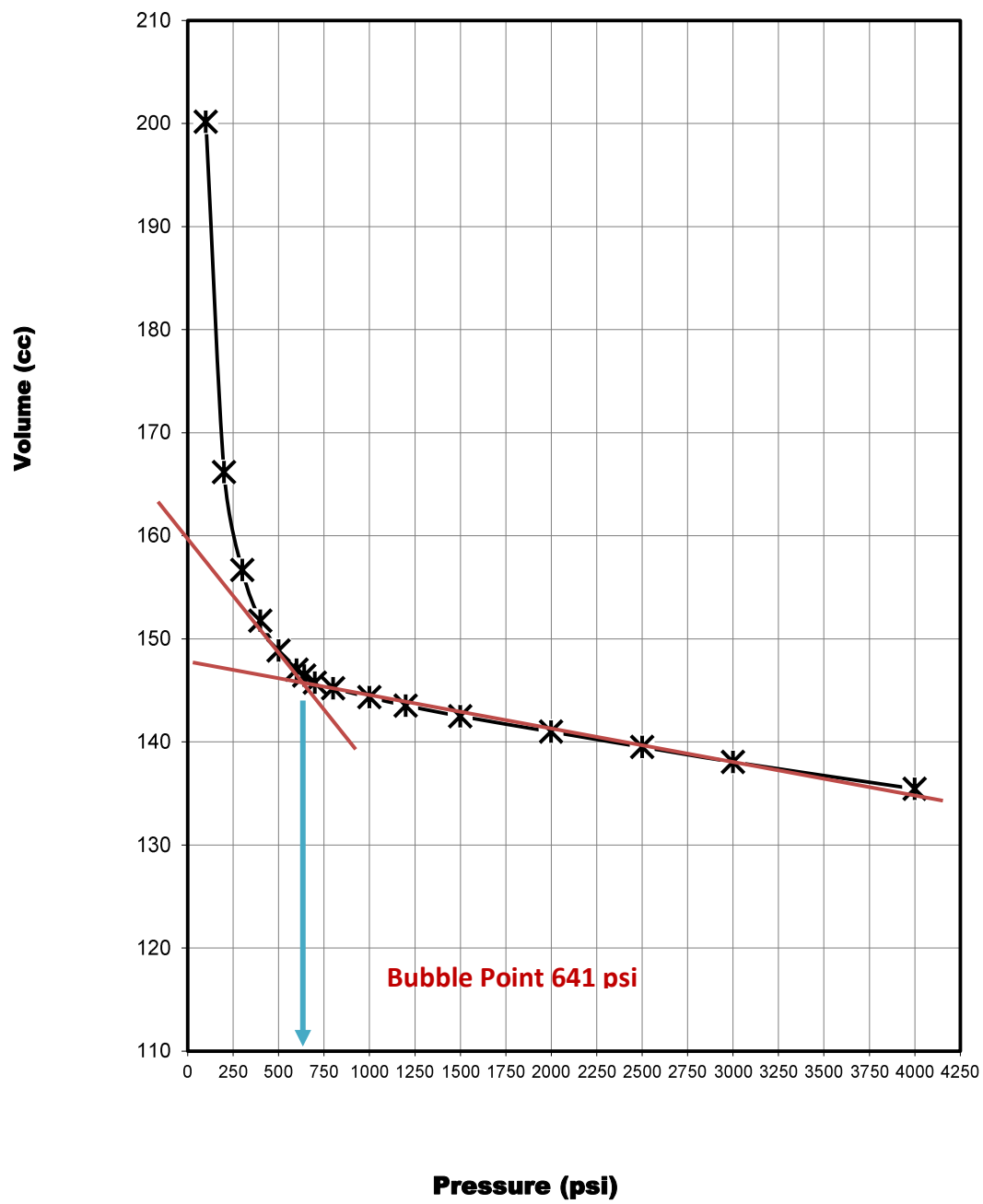


Figure 22 - Bubble Point Measurement Bottomhole Sample 07/1007

sample 1 (de Lier) :Run Number 1	
flash 1 c13043 Geothermie	
Sample File Name: PAN2014 , Record: 226 Measured on: Thu, Jul 10, 2014 11:18AM Last saved on: Thu, Jul 10, 2014 11:18AM	Source: Analysed

Presentation: (20HD) 1.330, 1.530 + i 0.10000 Polydisperse model	Volume Result	Focus = 300 mm.
Residual = 3.018 % d (0.5) = 7.79 µm D [4, 3] = 27.89 µm Sauter Mean (D[3,2]) = 5.37 µm Specific Surface Area = 1.1171 sq. m. / gm	Concentration = 0.007 % d (0.1) = 2.11 µm Span = 9.73	Obscuration = 10.13 % d (0.9) = 77.91 µm Mode = 72.30 µm Density = 1.00 gm. / c.c.

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %	Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
0.50	0.59	1.32	0.59	25.46	1.73	31.01	63.69
1.32	2.79	1.60	3.38	31.01	2.62	37.79	66.31
1.60	4.52	1.95	7.90	37.79	3.89	46.03	70.20
1.95	5.63	2.38	13.53	46.03	5.77	56.09	75.98
2.38	6.16	2.90	19.68	56.09	8.05	68.33	84.01
2.90	6.33	3.53	26.01	68.33	8.81	83.26	92.82
3.53	6.36	4.30	32.37	83.26	5.52	101.44	98.34
4.30	6.29	5.24	38.67	101.44	1.51	123.59	99.84
5.24	6.02	6.39	44.69	123.59	0.15	150.57	100.00
6.39	5.28	7.78	49.97	150.57	0.00	183.44	100.00
7.78	4.13	9.48	54.10	183.44	0.00	223.51	100.00
9.48	2.90	11.55	57.00	223.51	0.00	272.31	100.00
11.55	1.85	14.08	58.85	272.31	0.00	331.77	100.00
14.08	1.22	17.15	60.07	331.77	0.00	404.21	100.00
17.15	0.80	20.90	60.86	404.21	0.00	492.47	100.00
20.90	1.10	25.46	61.96	492.47	0.00	600.00	100.00

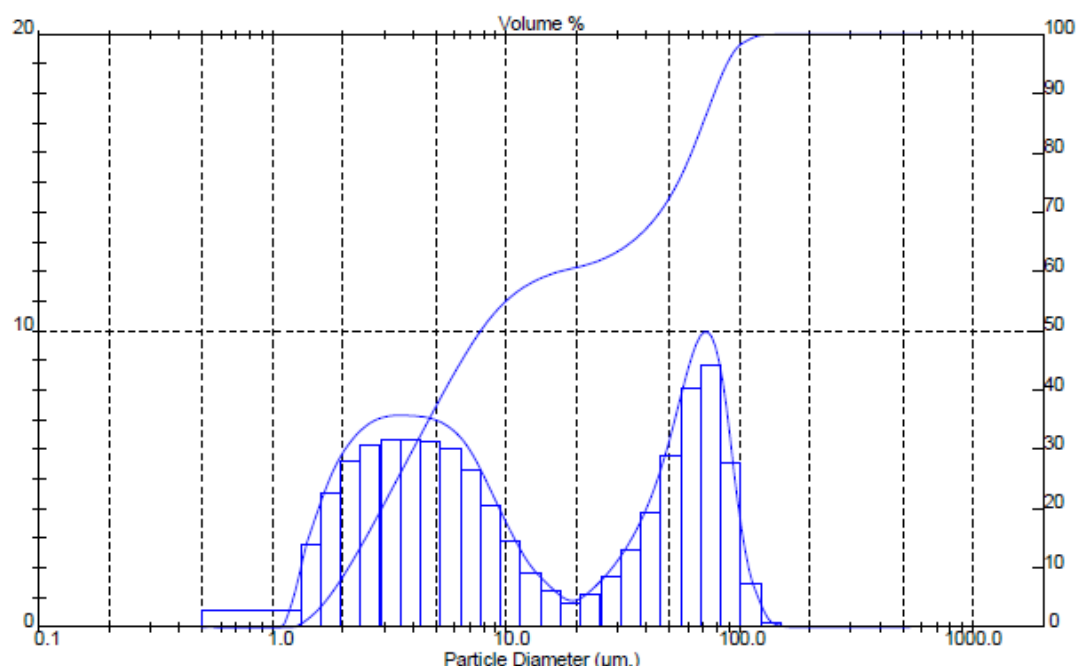


Figure 23 - Particle Size Analysis Results Surface Sample 1

sample 2 (de Lier) : Run Number 2	
flash 2 c13043 Geothermie	
Sample File Name: PAN2014 , Record: 229 Measured on: Thu, Jul 10, 2014 11:26AM	Source: Analysed

Presentation: (20HD) 1.330, 1.530 + i 0.10000 Polydisperse model	Volume Result	Focus = 300 mm.
Residual = 0.814 %	Concentration = 0.020 %	Obscuration = 8.91 %
d (0.5) = 120.08 µm	d (0.1) = 7.34 µm	d (0.9) = 192.46 µm
D [4, 3] = 117.18 µm	Span = 1.54	Mode = 138.21 µm
Sauter Mean (D[3,2]) = 22.33 µm		Density = 1.00 gm. / c.c.
Specific Surface Area = 0.2686 sq. m. / gm		

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %	Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
0.50	0.12	1.32	0.12	25.46	0.52	31.01	14.03
1.32	0.58	1.60	0.70	31.01	0.12	37.79	14.15
1.60	0.94	1.95	1.64	37.79	0.03	46.03	14.18
1.95	1.18	2.38	2.82	46.03	0.75	56.09	14.93
2.38	1.30	2.90	4.12	56.09	2.83	68.33	17.76
2.90	1.34	3.53	5.46	68.33	6.68	83.26	24.44
3.53	1.34	4.30	6.80	83.26	11.87	101.44	36.31
4.30	1.30	5.24	8.10	101.44	16.23	123.59	52.54
5.24	1.19	6.39	9.29	123.59	18.09	150.57	70.64
6.39	0.96	7.78	10.25	150.57	16.22	183.44	86.86
7.78	0.65	9.48	10.91	183.44	9.69	223.51	96.54
9.48	0.42	11.55	11.33	223.51	3.31	272.31	99.85
11.55	0.36	14.08	11.69	272.31	0.15	331.77	100.00
14.08	0.47	17.15	12.16	331.77	0.00	404.21	100.00
17.15	0.64	20.90	12.80	404.21	0.00	492.47	100.00
20.90	0.71	25.46	13.51	492.47	0.00	600.00	100.00

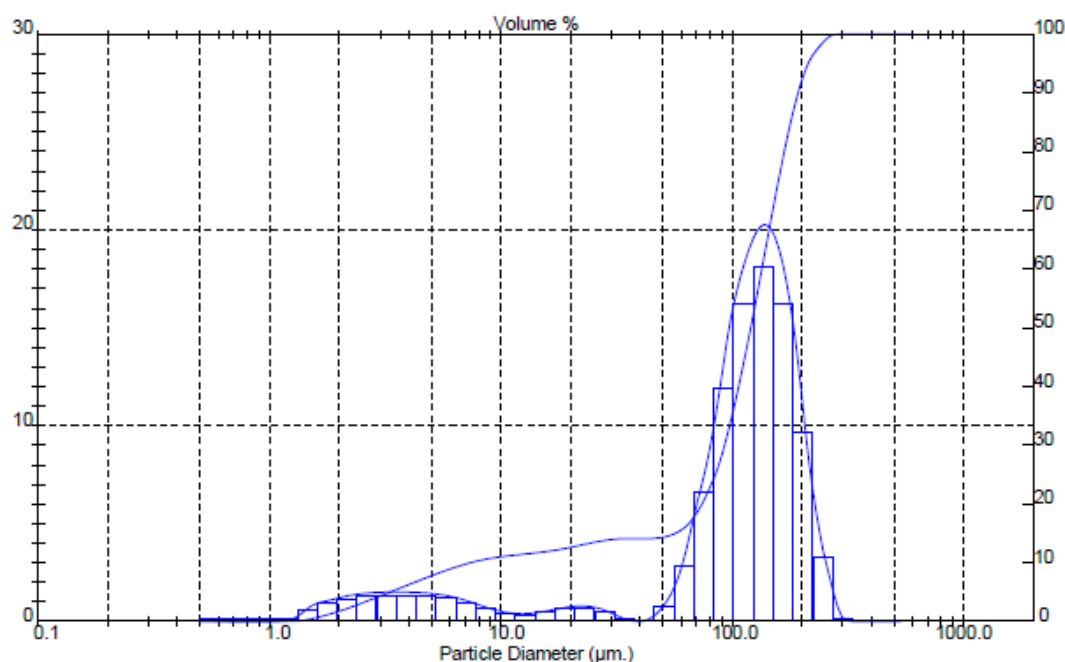


Figure 24 - Particle Size Analysis Results Water Surface Sample 2

07/1002 H	:Run Number 3
bottomhole sample c13043 Geothermie 2300m.	
Sample File Name: PAN2014 , Record: 224 Measured on: Thu, Jul 10, 2014 11:11AM	Source: Analysed

Presentation: (2OHD) 1.330, 1.530 + i 0.10000 Polydisperse model	Volume Result	Focus = 300 mm.
Residual = 1.098 %	Concentration = 0.018 %	Obscuration = 11.78 %
d (0.5) = 56.45 µm	d (0.1) = 3.38 µm	d (0.9) = 172.51 µm
D [4, 3] = 76.12 µm	Span = 3.00	
Sauter Mean (D[3,2]) = 11.54 µm		Mode = 136.28 µm
Specific Surface Area = 0.5198 sq. m. / gm		Density = 1.00 gm. / c.c.

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
0.50	0.43	1.32	0.43
1.32	1.43	1.60	1.85
1.60	2.10	1.95	3.95
1.95	2.34	2.38	6.29
2.38	2.20	2.90	8.49
2.90	1.90	3.53	10.40
3.53	1.64	4.30	12.04
4.30	1.57	5.24	13.61
5.24	1.72	6.39	15.34
6.39	2.02	7.78	17.35
7.78	2.35	9.48	19.70
9.48	2.68	11.55	22.37
11.55	2.97	14.08	25.34
14.08	3.19	17.15	28.53
17.15	3.36	20.90	31.89
20.90	3.50	25.46	35.39

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
25.46	3.61	31.01	38.99
31.01	3.68	37.79	42.65
37.79	3.64	46.03	46.29
46.03	3.60	56.09	49.89
56.09	3.62	68.33	53.51
68.33	4.23	83.26	57.74
83.26	6.09	101.44	63.83
101.44	9.04	123.59	72.88
123.59	10.68	150.57	83.54
150.57	8.85	183.44	92.39
183.44	5.10	223.51	97.49
223.51	2.20	272.31	99.69
272.31	0.31	331.77	100.00
331.77	0.00	404.21	100.00
404.21	0.00	492.47	100.00
492.47	0.00	600.00	100.00

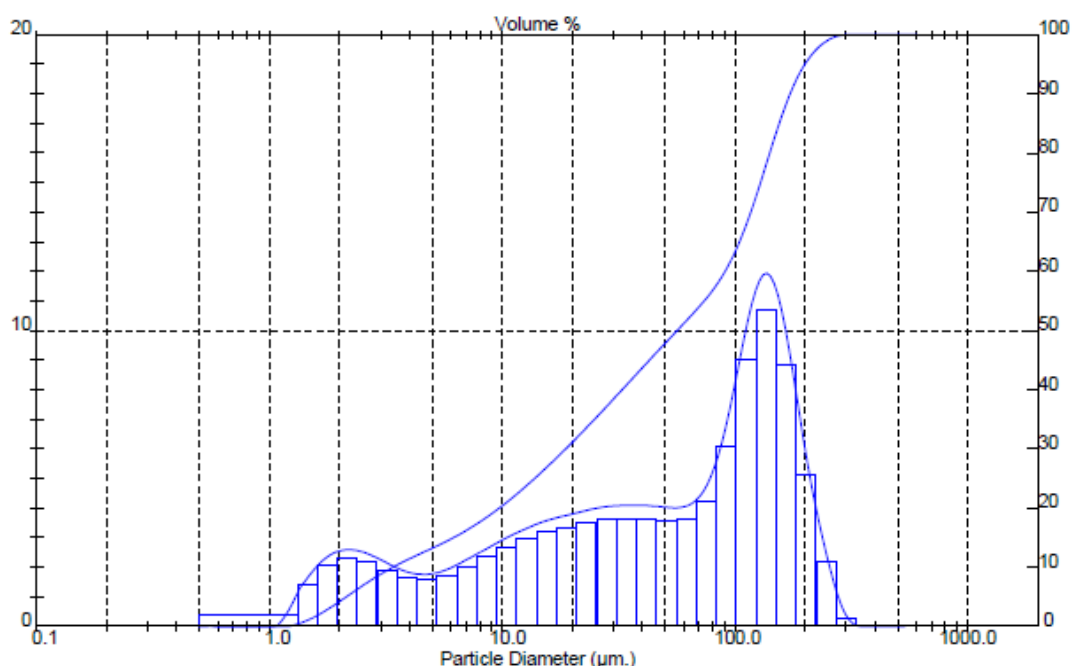


Figure 25 - Particle Size Analysis Results Bottomhole Sample 07/1002

07/1007 H	:Run Number 1
bottomhole sample c13043 Geothermie 2350m	
Sample File Name: PAN2014 , Record: 230 Measured on: Thu, Jul 10, 2014 11:31AM	Source: Analysed Last saved on: Thu, Jul 10, 2014 11:31AM

Presentation: (20HD) 1.330, 1.530 + i 0.10000 Polydisperse model	Volume Result	Focus = 300 mm.
Residual = 1.661 %	Concentration = 0.028 %	Obscuration = 19.13 %
d (0.5) = 84.05 µm	d (0.1) = 2.91 µm	d (0.9) = 177.36 µm
D [4, 3] = 85.93 µm	Span = 2.08	Mode = 107.31 µm
Sauter Mean (D[3,2]) = 10.81 µm		Density = 1.00 gm. / c.c.
Specific Surface Area = 0.5550 sq. m. / gm		

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
0.60	0.38	1.32	0.38
1.32	1.52	1.60	1.90
1.60	2.36	1.95	4.26
1.95	2.80	2.38	7.06
2.38	2.88	2.90	9.94
2.90	2.73	3.53	12.67
3.53	2.52	4.30	15.19
4.30	2.33	5.24	17.53
5.24	2.14	6.39	19.67
6.39	1.87	7.78	21.54
7.78	1.56	9.48	23.10
9.48	1.33	11.55	24.43
11.55	1.30	14.08	25.73
14.08	1.43	17.15	27.16
17.15	1.53	20.90	28.69
20.90	1.41	25.46	30.09

Size (Lo) µm	Result In %	Size (Hi) µm	Result Below %
25.46	1.05	31.01	31.14
31.01	0.78	37.79	31.92
37.79	1.16	46.03	33.08
46.03	2.58	56.09	35.66
56.09	5.13	68.33	40.79
68.33	8.70	83.26	49.49
83.26	12.09	101.44	61.59
101.44	13.01	123.59	74.60
123.59	10.20	150.57	84.80
150.57	6.06	183.44	90.86
183.44	3.94	223.51	94.81
223.51	3.02	272.31	97.83
272.31	1.91	331.77	99.74
331.77	0.26	404.21	100.00
404.21	0.00	492.47	100.00
492.47	0.00	600.00	100.00

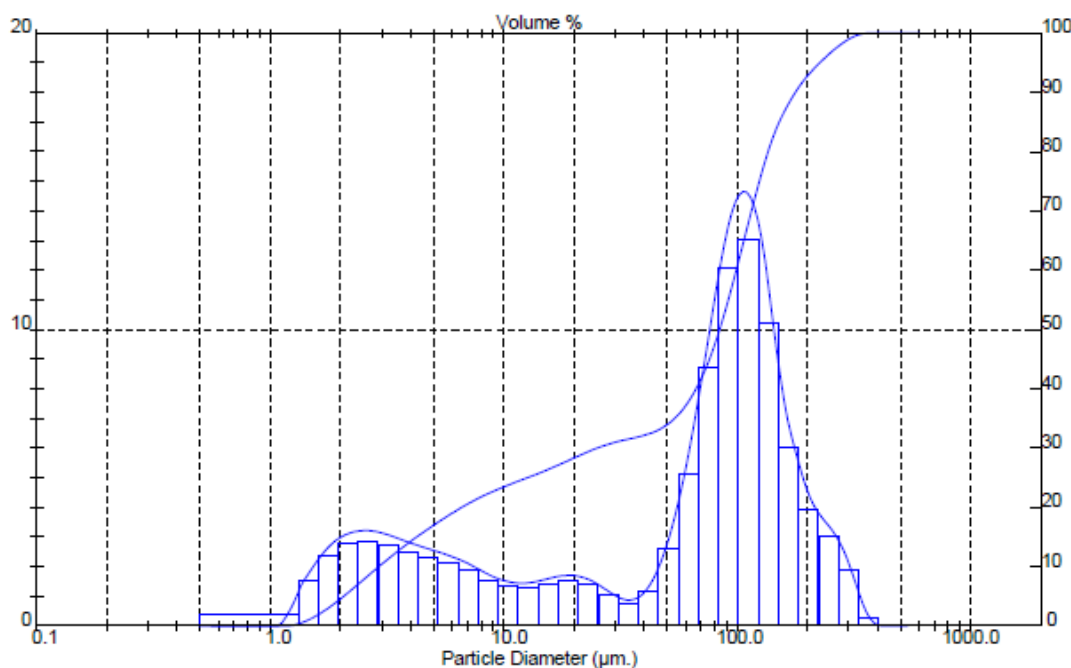


Figure 26 - Particle Size Analysis Results Bottomhole Sample 07/1007

Water Composition Analysis

Analysis description	Method	Qual	Dupl.	Result	UoM
Aluminium, ICP-MS	CM.W.11.1	1		< 250	µg/l
Arsenic, ICP-MS	CM.W.11.1	1		< 50	µg/l
Barium, ICP-MS	CM.W.11.1	1		6700	µg/l
Cadmium, ICP-MS	CM.W.11.1	1		< 5	µg/l
Calcium, ICP-MS	CM.W.11.1	1		6140	mg/l
Chromium, ICP-MS	CM.W.11.1	1		< 50	µg/l
Potassium, ICP-MS	CM.W.11.1	1		280	mg/l
Mercury, cold vapour AFS	CM.W.17.1	1		0.06	µg/l
Lead, ICP-MS	CM.W.11.1	1		< 50	µg/l
Magnesium, ICP-MS	CM.W.11.1	1		904	mg/l
Sodium, ICP-MS	CM.W.11.1	1		36400	mg/l
Nickel, ICP-MS	CM.W.11.1	1		150	µg/l
Strontium, ICP-MS	CM.W.11.1	1		354000	µg/l
Iron, ICP-MS	CM.W.11.1	1		75.9	mg/l
Zinc, ICP-MS	CM.W.11.1	1		420	µg/l
Total hardness calculated	CM.W.11.2	1		190.5	mmol/l
Aromatic and aliphatic hydrocarbons	CO.W.18.1				
benzene		1		210	µg/l
toluene		1		63	µg/l
ethylbenzene		1		< 1	µg/l
n-propylbenzene		1		< 1	µg/l
iso-propylbenzene		1		< 1	µg/l
n-butylbenzene		1		< 1	µg/l
iso-butylbenzene		1		< 1	µg/l
secondary-butylbenzene		1		< 1	µg/l
tertiary-butylbenzene		1		< 1	µg/l
n-pentylbenzene		1		< 1	µg/l
o-xylene		1		< 1	µg/l
m+p-xylene		1		< 1	µg/l
4-isopropyltoluene		1		< 1	µg/l
1,2,3-trimethylbenzene		1		< 1	µg/l
1,2,4-trimethylbenzene		1		< 1	µg/l
1,3,5-trimethylbenzene		1		< 1	µg/l
1,2,3,4-tetramethylbenzene		1		< 1	µg/l
1,2,3,5-tetramethylbenzene		1		< 1	µg/l
1,2,4,5-tetramethylbenzene		1		< 1	µg/l
2-ethyltoluene		1		< 1	µg/l
3-ethyltoluene		1		< 1	µg/l
4-ethyltoluene		1		< 1	µg/l
1,2-diethylbenzene		1		< 1	µg/l

Figure 27 – Water Analysis (Cations, Aromatic, Polycyclic and Heavy Metals Content)
Surface Sample 1+Surface Sample 2 – page 1 of 2

Analysis description	Method	Qual.	Dupl.	Result	UoM
Aromatic and aliphatic hydrocarbons	CO.W.15.1				
1,3-diethylbenzene		1	<	1	µg/l
1,4-diethylbenzene		1	<	1	µg/l
1,3-diisopropylbenzene		1	<	1	µg/l
1,3,5-triisopropylbenzene		1	<	1	µg/l
styrene		1	<	1	µg/l
naphthalene		1	<	1	µg/l
biphenyl		1	<	2.5	µg/l
biphenylether		1	<	2.5	µg/l
chlorobenzene		1	<	1	µg/l
1,2-dichlorobenzene		1	<	1	µg/l
1,3-dichlorobenzene		1	<	1	µg/l
1,4-dichlorobenzene		1	<	1	µg/l
1,2,3-trichlorobenzene		1	<	1	µg/l
1,2,4-trichlorobenzene		1	<	1	µg/l
1,3,5-trichlorobenzene		1	<	1	µg/l
2-chlorotoluene		1	<	1	µg/l
4-chlorotoluene		1	<	1	µg/l
cyclohexane		1	<	5	µg/l
methylcyclohexane		1	<	5	µg/l
cyclohexene		1	<	1	µg/l
1,2,3,4-tetrachlorobenzene		1	<	1	µg/l
1,2,3,5+1,2,4,5-tetrachlorobenzene		1	<	1	µg/l
bromobenzene		1	<	2.5	µg/l
Total Aromatic and aliphatic hydrocarbon		1		270	µg/l
Sum BTEX		1		275	µg/l
PAH, water, GC/MS TSQ	CO.W.37.1				
acenaphtylene		1	<	0.02	µg/l
acenaphtene		1	<	0.02	µg/l
fluorene		1	<	0.02	µg/l
fenantrene		1	<	0.02	µg/l
anthracene		1	<	0.02	µg/l
fluoranthene		1	<	0.02	µg/l
pyrene		1	<	0.02	µg/l
bens(a)anthracene		1	<	0.02	µg/l
chrysene		1	<	0.02	µg/l
benzo(b)fluoranthene		1	<	0.02	µg/l
benzo(k)fluoranthene		1	<	0.02	µg/l
benzo(a)pyrene		1	<	0.02	µg/l
dibenz(ah)anthracene		1	<	0.02	µg/l
benso(ghi)perylene		1	<	0.02	µg/l
indeno(1,2,3-cd)pyrene		1	<	0.02	µg/l
naphthalene		1		0.47	µg/l
Sum PAK GC/MS TSQ		1		0.47	µg/l

Figure 28 - Water Analysis (Cations, Aromatic, Polycyclic and Heavy Metals Content)
Surface Sample 1+Surface Sample 2 – page 2 of 2

Analysis description	Method	Qual	Dupl.	Result	UoM
Aluminium, ICP-MS	CM.W.11.1		1	320	µg/l
Arsenic, ICP-MS	CM.W.11.1		1	< 50	µg/l
Barium, ICP-MS	CM.W.11.1		1	6200	µg/l
Cadmium, ICP-MS	CM.W.11.1		1	< 5	µg/l
Calcium, ICP-MS	CM.W.11.1		1	5180	mg/l
Chromium, ICP-MS	CM.W.11.1		1	< 50	µg/l
Potassium, ICP-MS	CM.W.11.1		1	230	mg/l
Mercury, cold vapour AFS	CM.W.17.1		1	0.08	µg/l
Lead, ICP-MS	CM.W.11.1		1	< 50	µg/l
Magnesium, ICP-MS	CM.W.11.1		1	786	mg/l
Sodium, ICP-MS	CM.W.11.1		1	32300	mg/l
Nickel, ICP-MS	CM.W.11.1		1	< 50	µg/l
Strontium, ICP-MS	CM.W.11.1		1	307000	µg/l
Iron, ICP-MS	CM.W.11.1		1	111	mg/l
Zinc, ICP-MS	CM.W.11.1		1	970	µg/l
Total hardness calculated	CM.W.11.2		1	161.6	mmol/l
Aromatic and aliphatic hydrocarbons					
benzene	CO.W.15.1		1	91	µg/l
toluene			1	6.3	µg/l
ethylbenzene			1	< 1	µg/l
n-propylbenzene			1	< 1	µg/l
iso-propylbenzene			1	< 1	µg/l
n-butylbenzene			1	< 1	µg/l
iso-butylbenzene			1	< 1	µg/l
secondary-butylbenzene			1	< 1	µg/l
tertiary-butylbenzene			1	< 1	µg/l
n-pentylbenzene			1	< 1	µg/l
o-xylene			1	< 1	µg/l
m+p-xylene			1	< 1	µg/l
4-isopropyltoluene			1	< 1	µg/l
1,2,3-trimethylbenzene			1	< 1	µg/l
1,2,4-trimethylbenzene			1	< 1	µg/l
1,3,5-trimethylbenzene			1	< 1	µg/l
1,2,3,4-tetramethylbenzene			1	< 1	µg/l
1,2,3,5-tetramethylbenzene			1	< 1	µg/l
1,2,4,5-tetramethylbenzene			1	< 1	µg/l
2-ethyltoluene			1	< 1	µg/l
3-ethyltoluene			1	< 1	µg/l
4-ethyltoluene			1	< 1	µg/l
1,2-diethylbenzene			1	< 1	µg/l

Figure 29 - Water Analysis (Cations, Aromatic, Polycyclic and Heavy Metals Content)
Bottomhole Sample 07/1007+07/1002 – page 1 of 2

Analysis description	Method	Qual.	Dupl.	Result	UoM
Aromatic and aliphatic hydrocarbons	CO.W.15.1				
1,3-diethylbenzene		1	<	1	µg/l
1,4-diethylbenzene		1	<	1	µg/l
1,3-diisopropylbenzene		1	<	1	µg/l
1,3,5-triisopropylbenzene		1	<	1	µg/l
styrene		1	<	1	µg/l
naphthalene		1	<	1	µg/l
biphenyl		1	<	2.5	µg/l
biphenylether		1	<	2.5	µg/l
chlorobenzene		1	<	1	µg/l
1,2-dichlorobenzene		1	<	1	µg/l
1,3-dichlorobenzene		1	<	1	µg/l
1,4-dichlorobenzene		1	<	1	µg/l
1,2,3-trichlorobenzene		1	<	1	µg/l
1,2,4-trichlorobenzene		1	<	1	µg/l
1,3,5-trichlorobenzene		1	<	1	µg/l
2-chlorotoluene		1	<	1	µg/l
4-chlorotoluene		1	<	1	µg/l
cyclohexane		1	<	5	µg/l
methylcyclohexane		1	<	5	µg/l
cyclohexene		1	<	1	µg/l
1,2,3,4-tetrachlorobenzene		1	<	1	µg/l
1,2,3,5+1,2,4,5-tetrachlorobenzene		1	<	1	µg/l
bromobenzene		1	<	2.5	µg/l
Total Aromatic and aliphatic hydrocarbon		1		97	µg/l
Sum BTEX		1		95	µg/l
PAH, water, GC/MS TSQ	CO.W.37.1				
acenaphthylene		1	<	0.02	µg/l
acenaphthene		1	<	0.02	µg/l
fluorene		1	<	0.02	µg/l
fenanthrene		1	<	0.02	µg/l
anthracene		1	<	0.02	µg/l
fluoranthene		1	<	0.02	µg/l
pyrene		1	<	0.02	µg/l
bens(a)anthracene		1	<	0.02	µg/l
chrysene		1	<	0.02	µg/l
benzo(b)fluoranthene		1	<	0.02	µg/l
benzo(k)fluoranthene		1	<	0.02	µg/l
benzo(a)pyrene		1	<	0.02	µg/l
dibenz(ah)anthracene		1	<	0.02	µg/l
benzo(ghi)perylene		1	<	0.02	µg/l
indeno(1,2,3-cd)pyrene		1	<	0.02	µg/l
naphthalene		1		0.37	µg/l
@Som PAK GC/MS TSQ		1		0.37	µg/l

Figure 30 - Water Analysis (Cations, Aromatic, Polycyclic and Heavy Metals Content)
Bottomhole Sample 07/1007+07/1002 – page 2 of 2

Parameter	Result	UoM
Hydrogen carbonate	43	mg/l
Hydrogen carbonate (in mmol)	0.703	mmol/l
Carbonate	< 10	mg/l
Chloride	84000	mg/l
Sulphate	198	mg/l

Figure 31 - Water Analysis (Anions) Surface Sample 1+Surface Sample 2

Parameter	Result	UoM
Hydrogen carbonate	220	mg/l
Hydrogen carbonate (in mmol)	3.68	mmol/l
Carbonate	< 10	mg/l
Chloride	85000	mg/l
Sulphate	194	mg/l

Figure 32 - Water Analysis (Anions) Bottomhole Sample 07/1007+07/1002