

GPAC / PJVA Annual Joint Conference
Calgary – 2010 11 03

Success Through Science®

Extended Analysis of Natural Gas “Financial Impact”

Presented by Owen Krauss



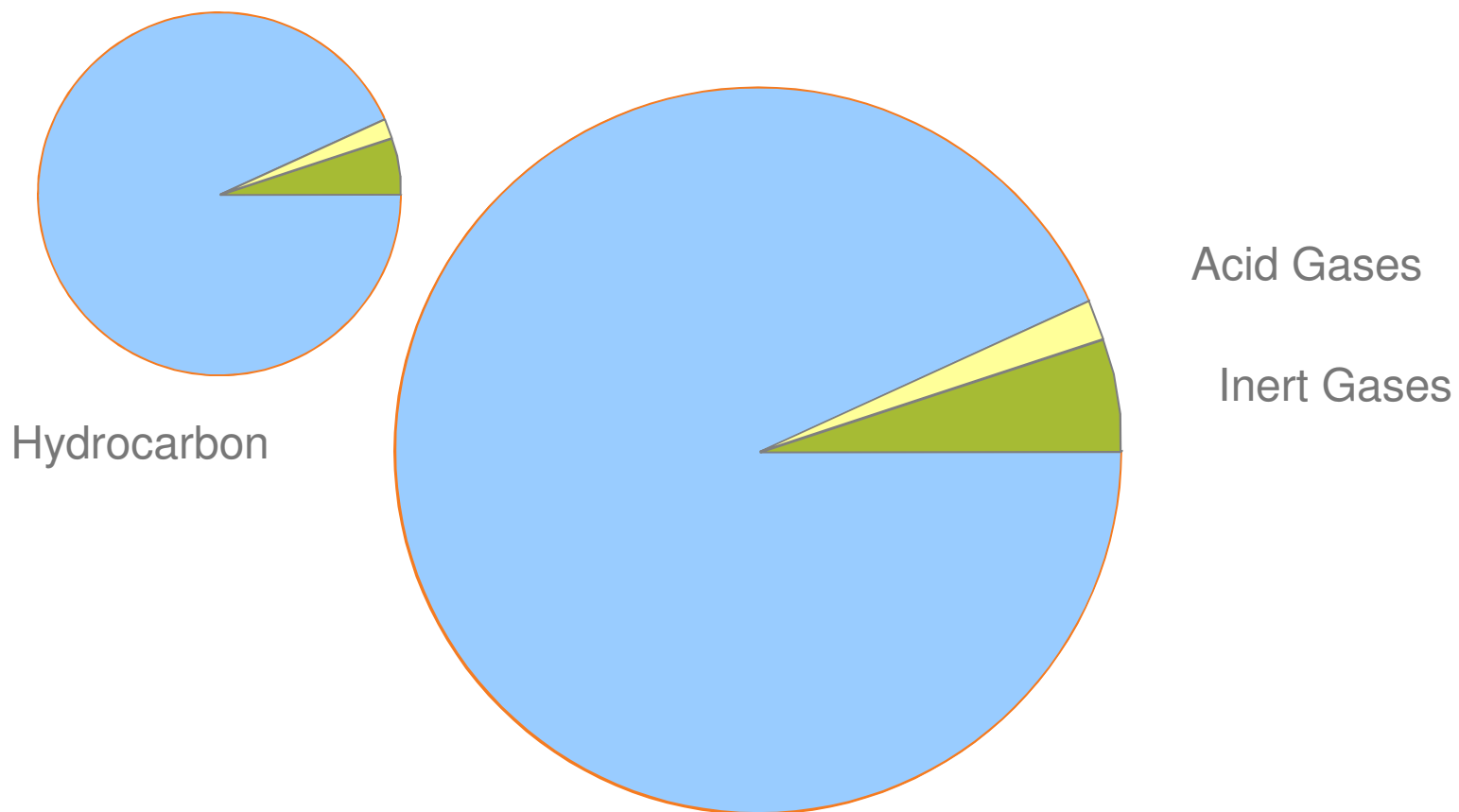
EXTENDED ANALYSIS OF NATURAL GAS FINANCIAL IMPACT

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- Purpose
 - Understand Impact of Various Analyses of Natural Gas
- Process
 - Review Chemistry of Natural Gas
 - Present Conventional, Shortcut and Precut Methods
 - Display Flow Schematic of Extended Analysis
 - Illustrate the “Financial Impact” of Compositional Variance
- Payoff
 - Understand Various Methods
 - Understand Impact and Value of Extended Analysis.

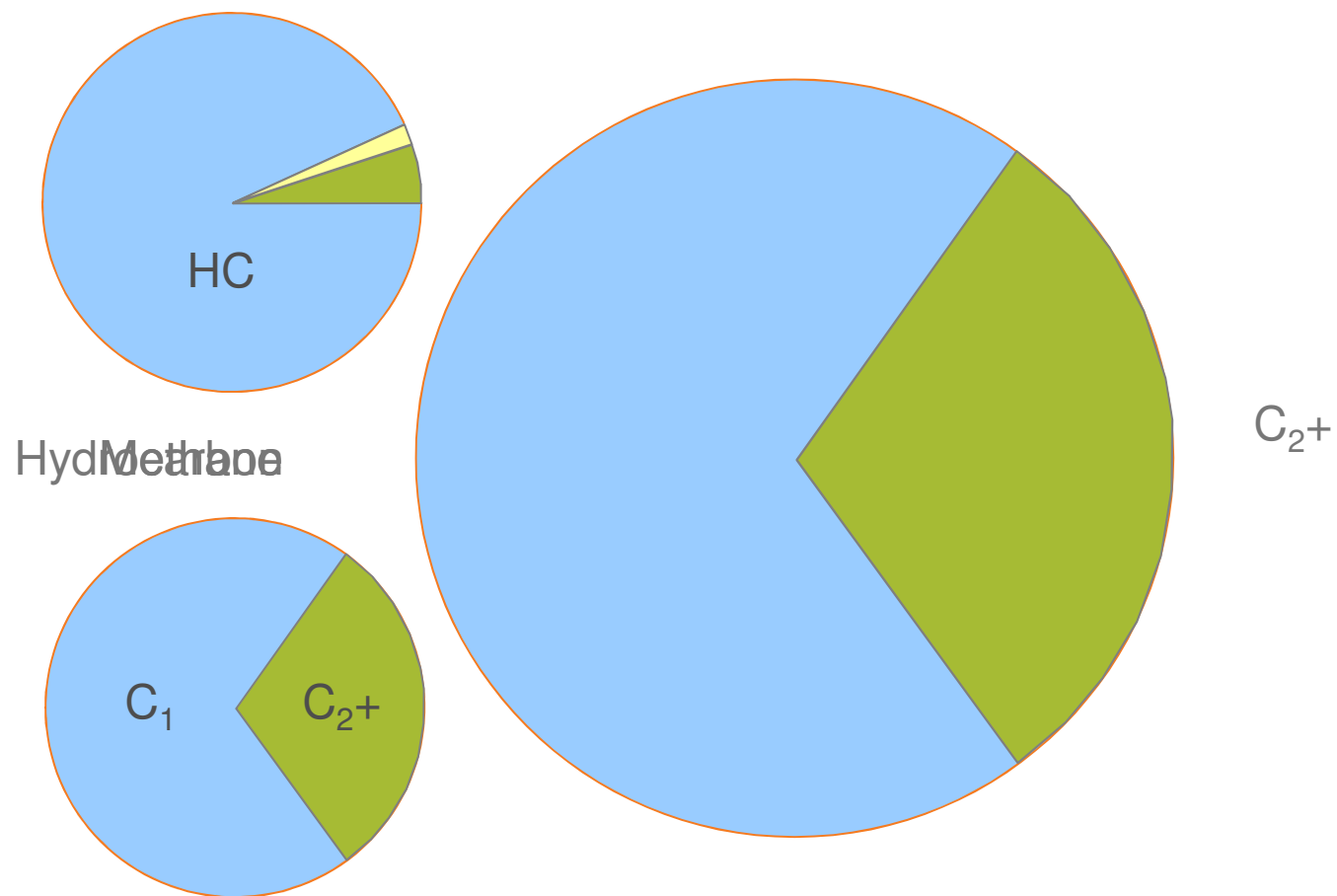
CHEMISTRY OF NATURAL GAS

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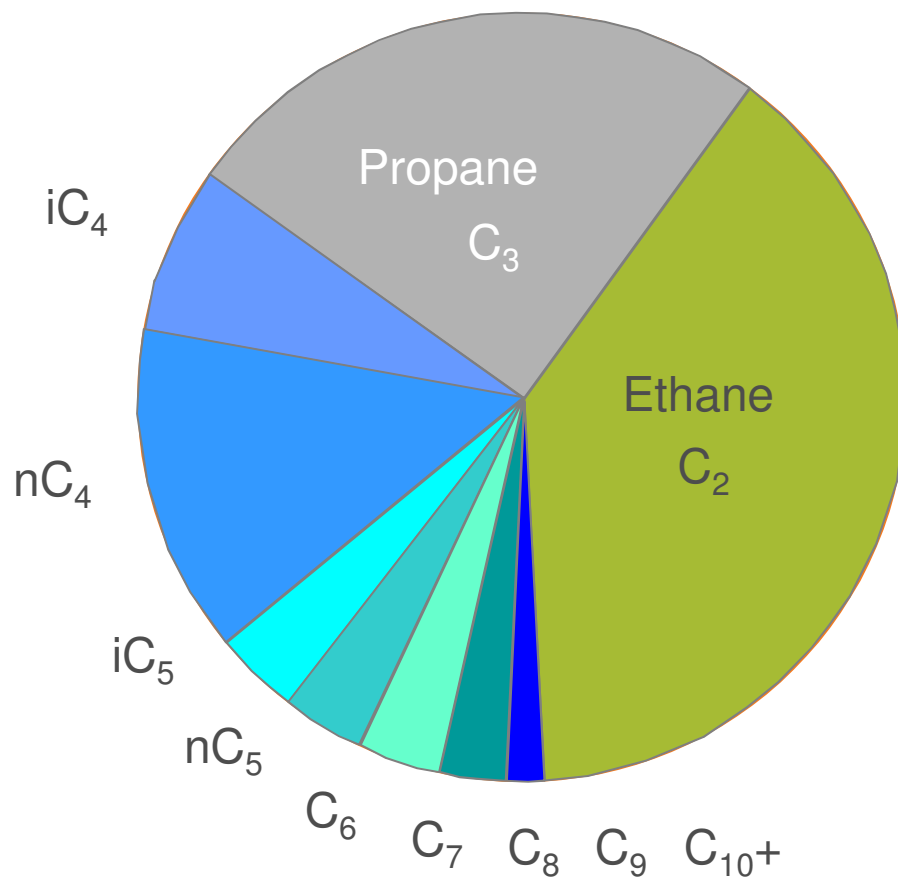
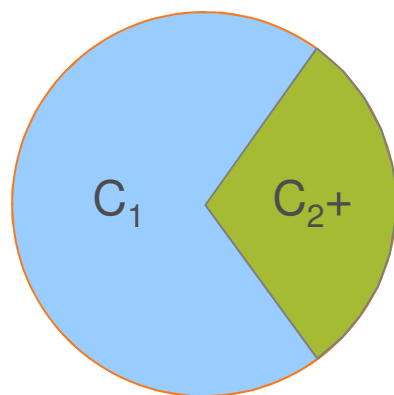
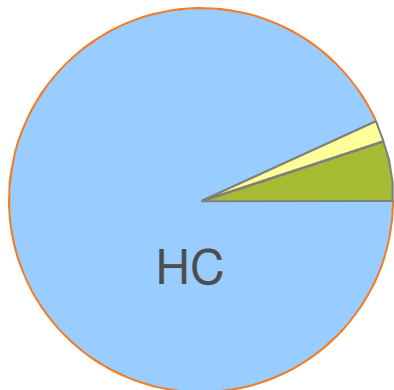
CHEMISTRY OF NATURAL GAS

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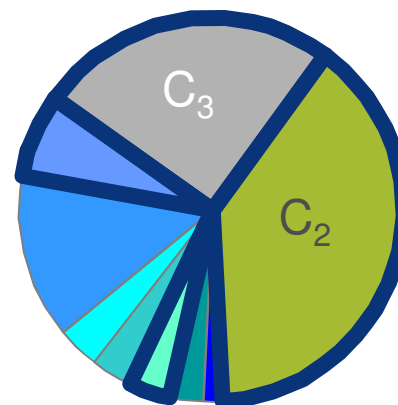
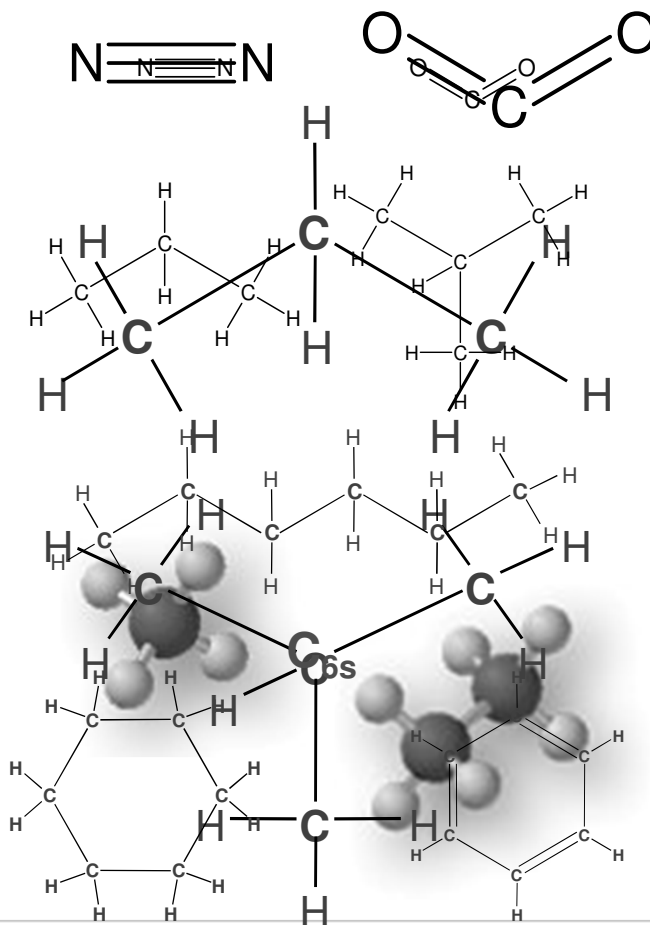
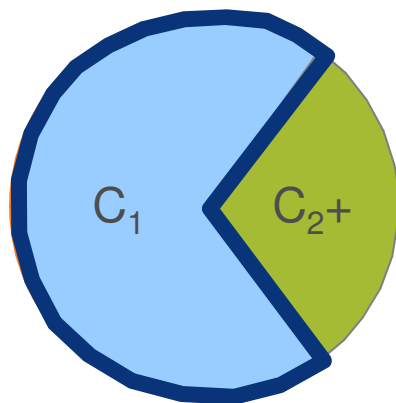
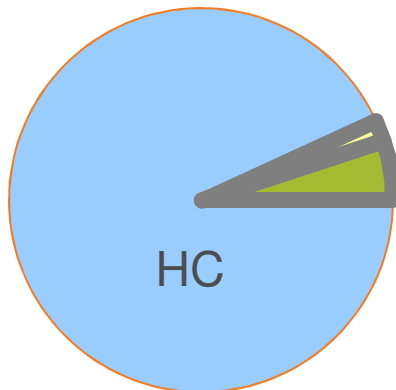
CHEMISTRY OF NATURAL GAS

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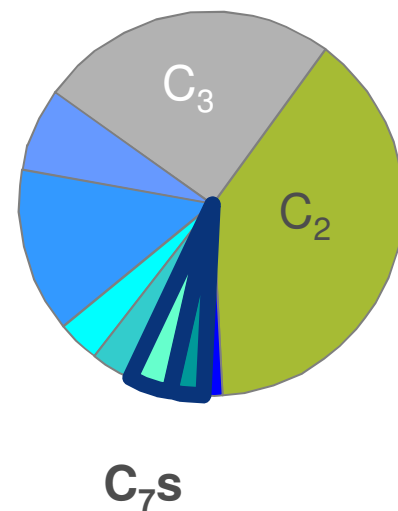
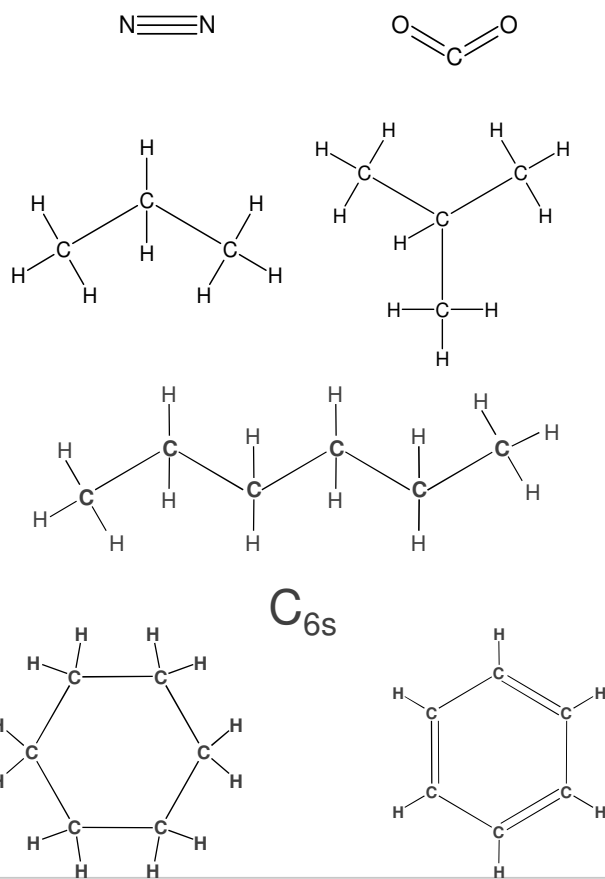
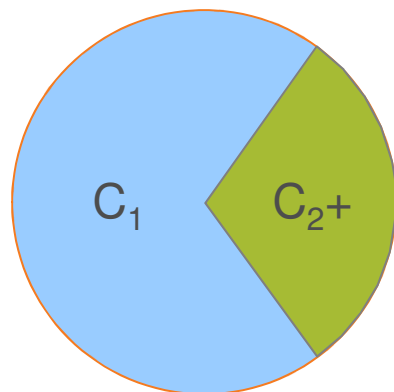
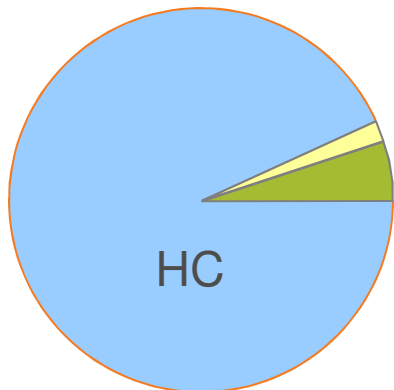
CHEMISTRY OF NATURAL GAS

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CHEMISTRY OF NATURAL GAS

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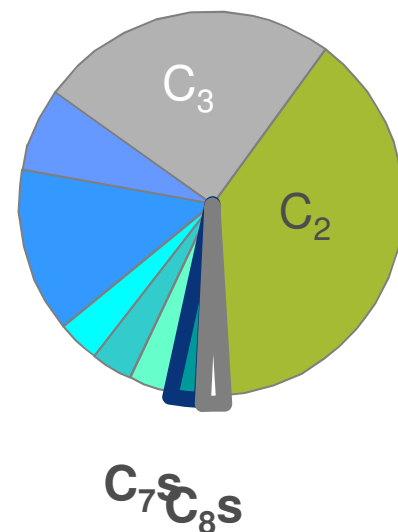


CHEMISTRY OF NATURAL GAS

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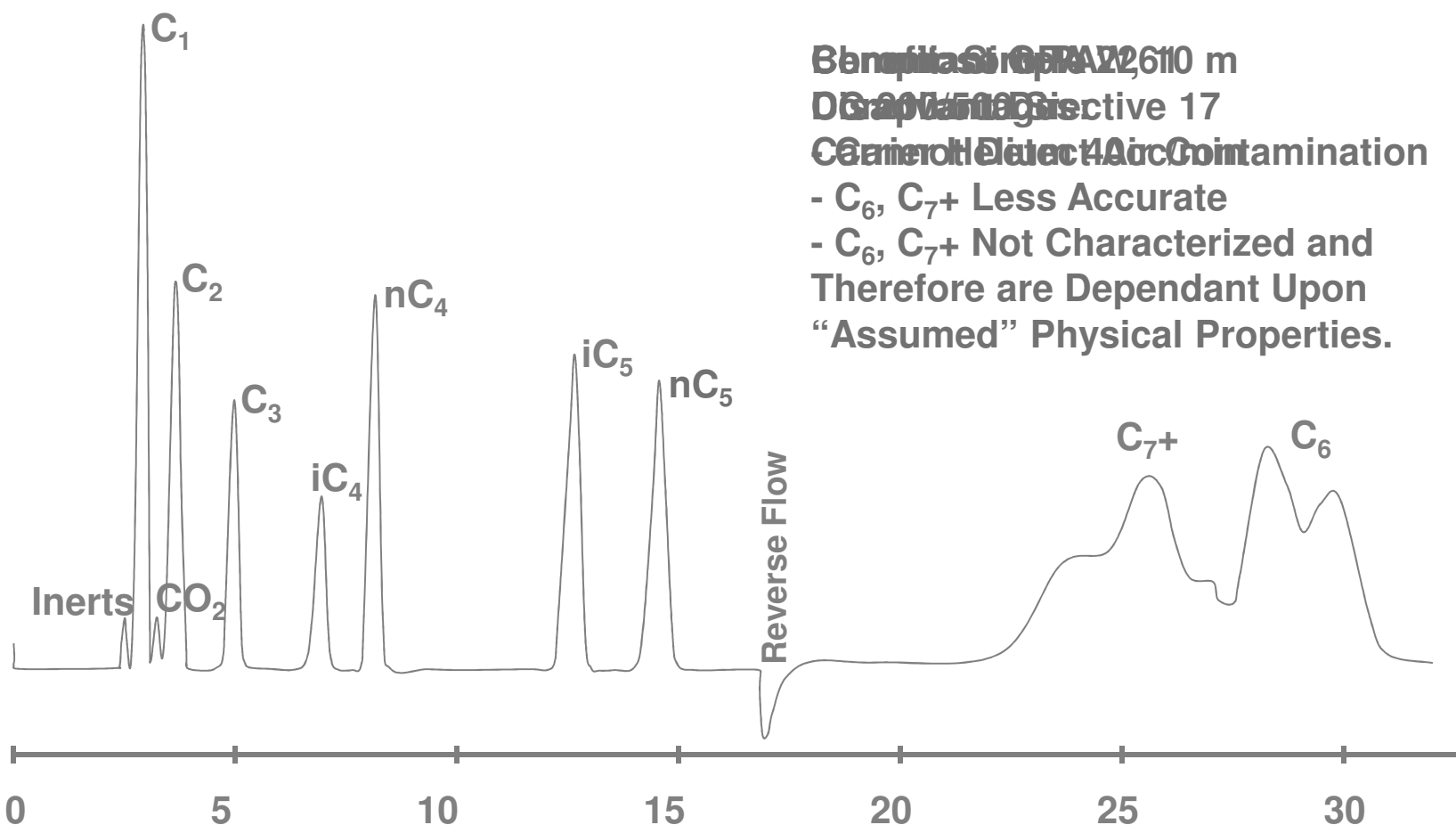
Methylcyclohexane
 2,2-Dimethylhexane
 Methylcyclopentane
 Ethylcyclopentane
 2,2,3-Trimethylpentane
 2,3-Dimethylpentane
 2,5-Dimethylhexane
 2,2,3-Trimethylbutane
 2,4-Dimethylhexane
 Benzene
 trans,cis-1,2,4-Trimethylcyclopentane
 trans,cis-1,3,2-Dimethylcyclopentane
 2,3,4-Trimethylcyclopentane
 Cyclohexane
 Toluene
 2-Methylhexane
 2,3,3-Trimethylpentane
 2,3-Dimethylpentane
 1,1-Dimethylcyclopentane
 2-Methylheptane
 3-Methylhexane
 4-Methylheptane
 cis-1,3-Dimethylcyclopentane
 cis,trans-1,2,4-Trimethylcyclopentane
 trans-1,3-Dimethylcyclopentane
 3-Methylheptane
 3-Ethylpentane
 trans-1,4-Dimethylcyclohexane
 trans-1,2-Dimethylcyclopentane
 3-Ethylhexane
 2,2,4-Trimethylpentane
 1-Methyl-1-ethylcyclopentane
 trans-1,2-Dimethylcyclohexane
 cis,cis-1,2,3-Trimethylcyclopentane
 n-Octane

27 C₈s



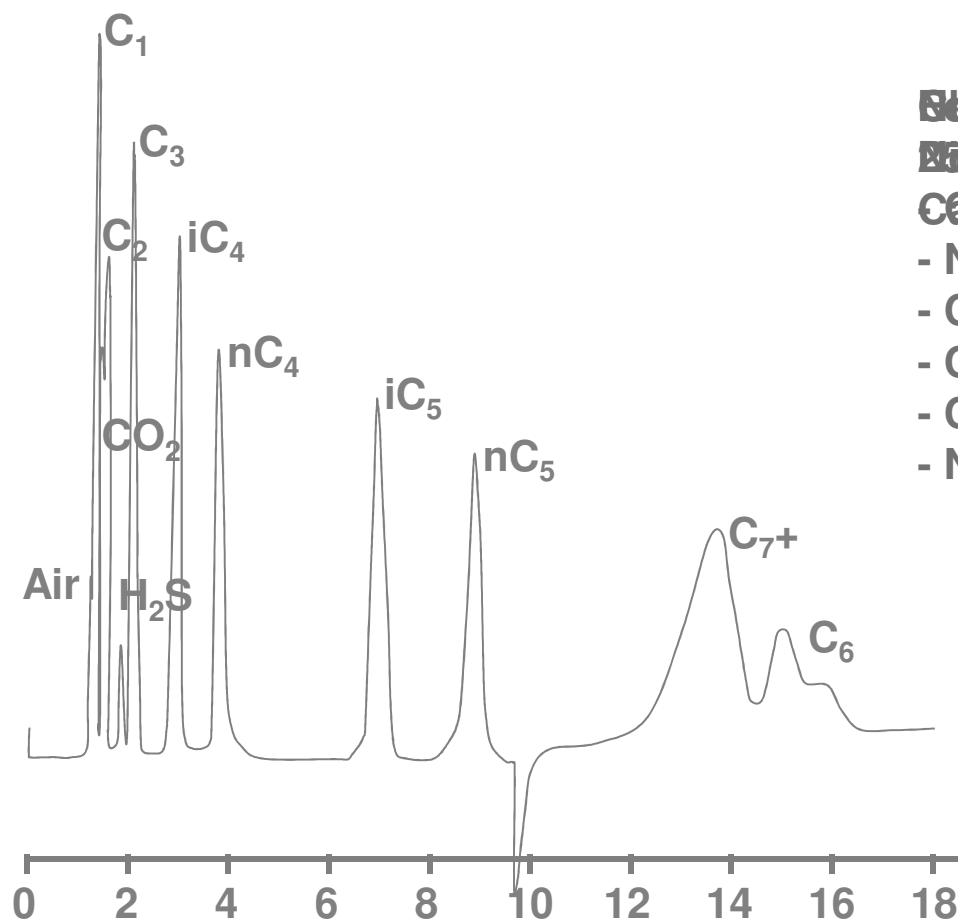
CONVENTIONAL BACK-FLUSH C₇+ ANALYSIS

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SHORTCUT METHOD

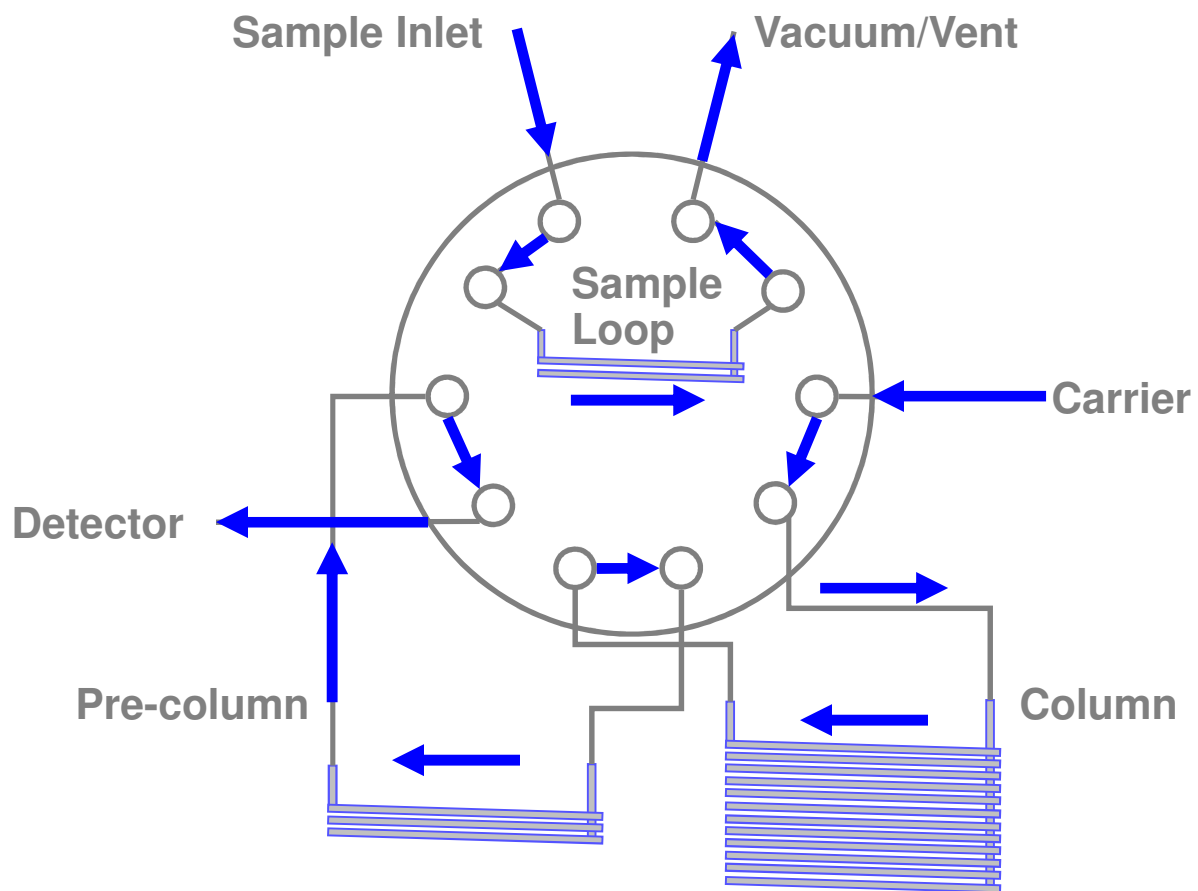
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- Shortcuts with GPA**
Not a BME File
Can Not Detect Air/Contamination
- N₂, CO₂ Inaccurate
 - C₆, C₇+ Inaccurate
 - C₆, C₇+ Not Characterized
 - C₆, C₇+ "Assumed" Properties
 - NOT Suitable for Custody Transfer.

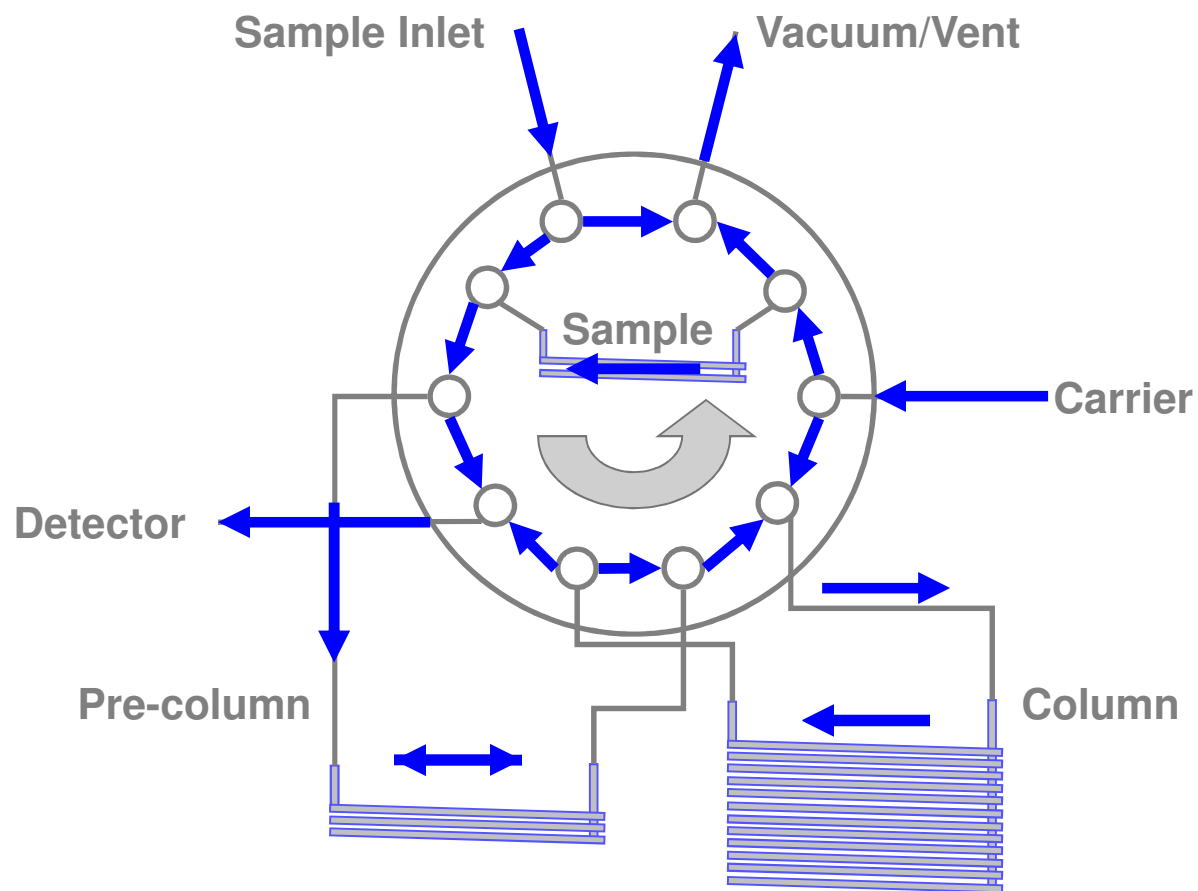
PRECUT METHOD C₇+ ANALYSIS

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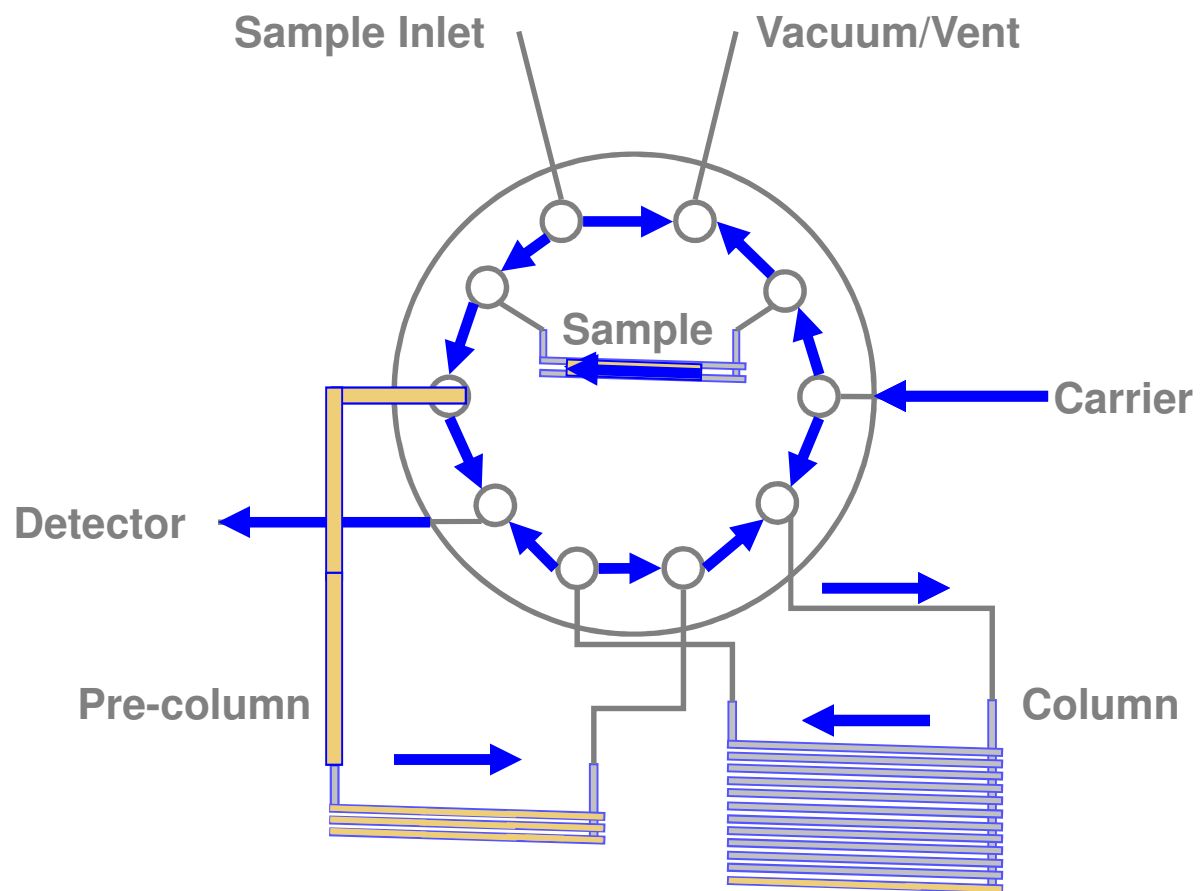
PRECUT METHOD C₇+ ANALYSIS

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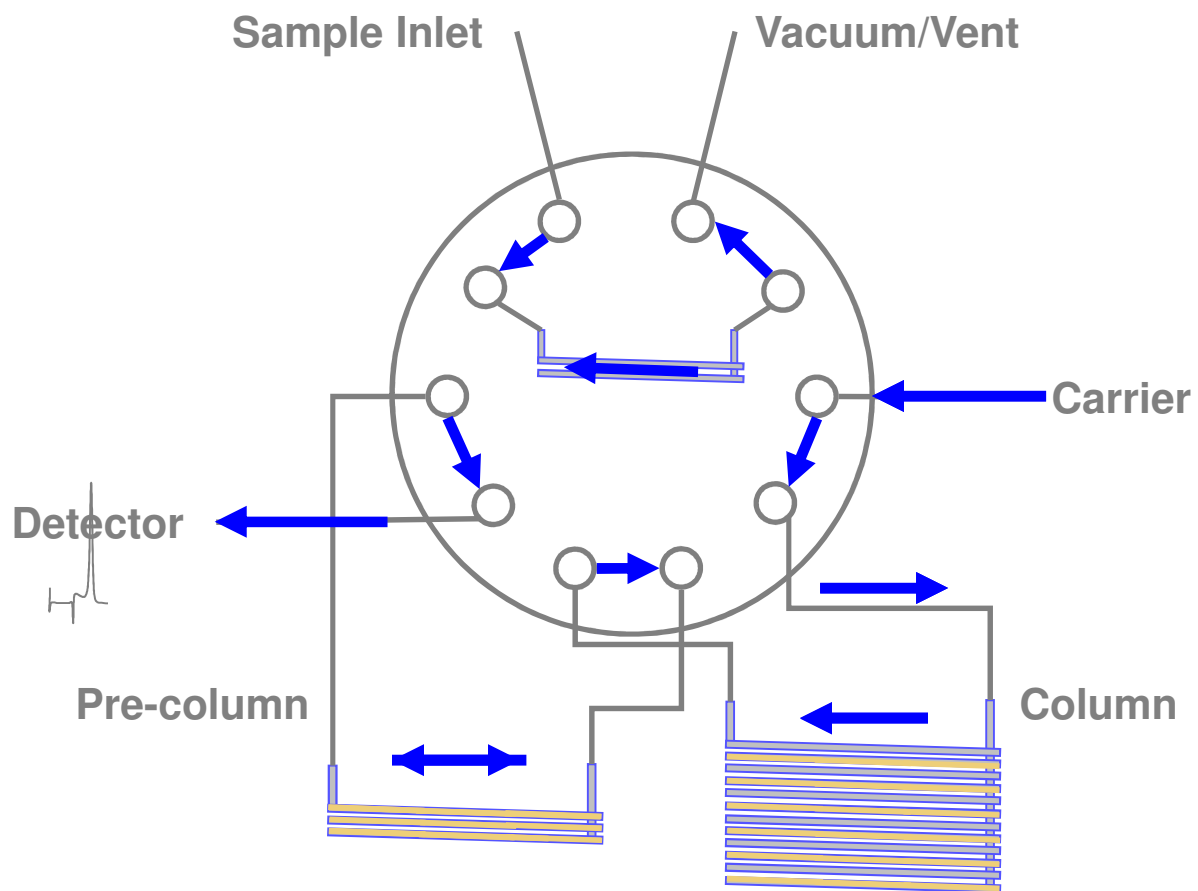
PRECUT METHOD C₇+ ANALYSIS

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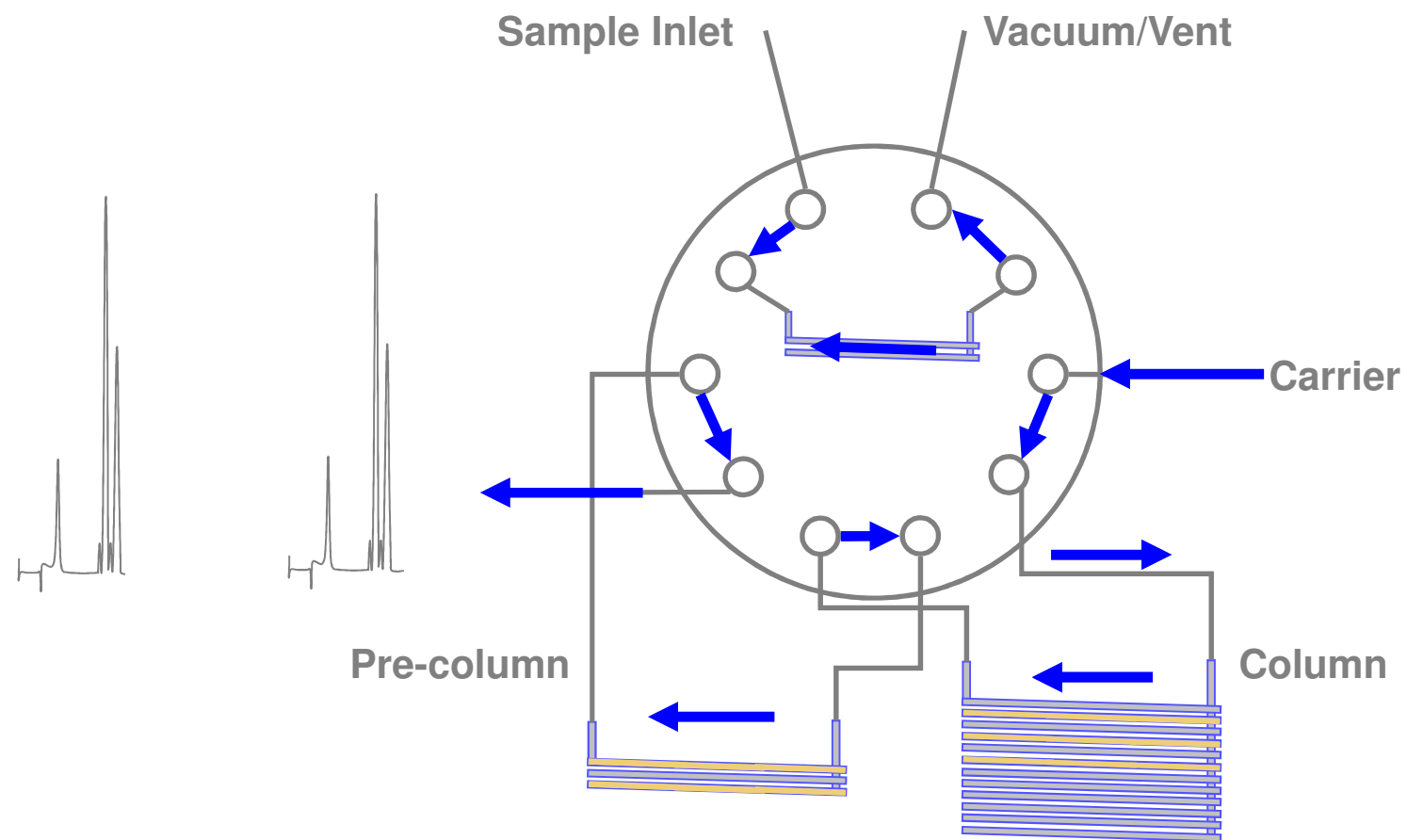
PRECUT METHOD C₇+ ANALYSIS

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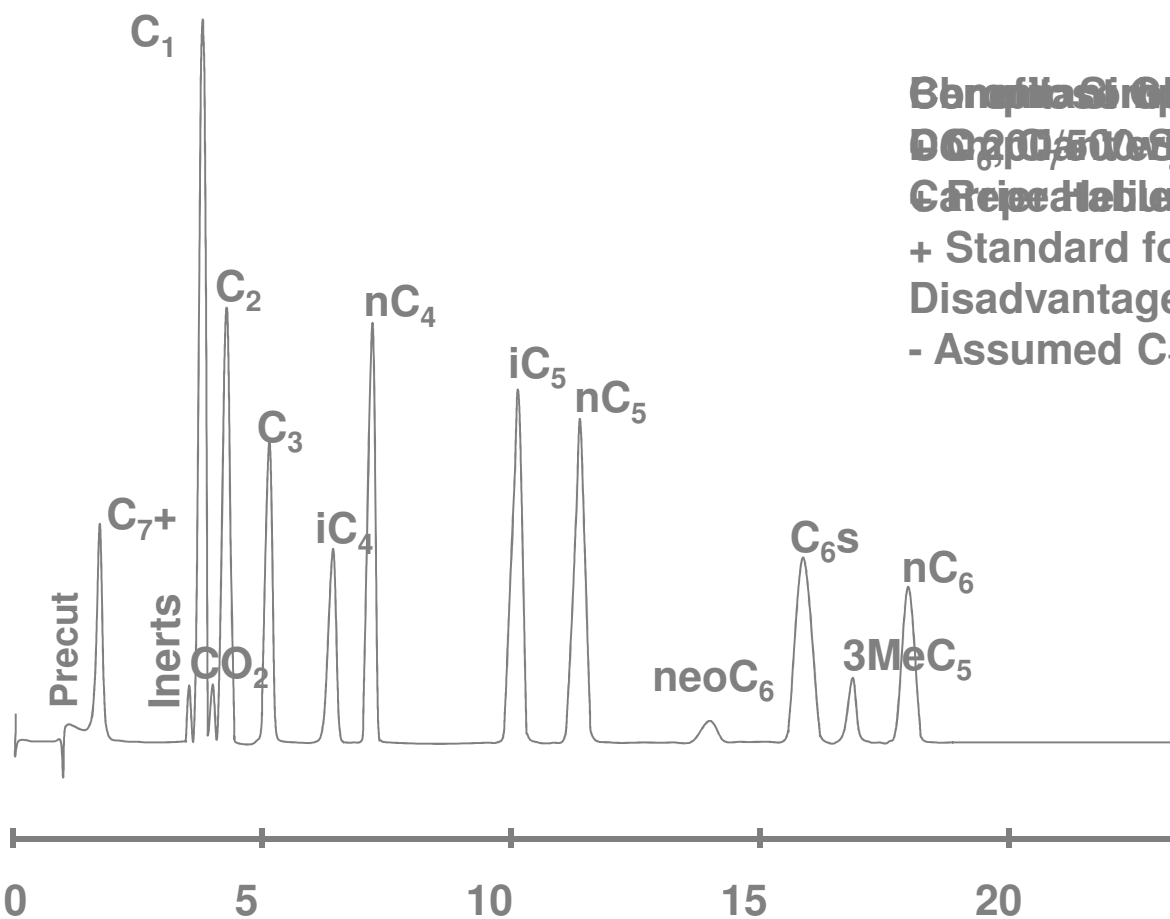
PRECUT METHOD C₇+ ANALYSIS

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PRECUT METHOD C₇+ ANALYSIS

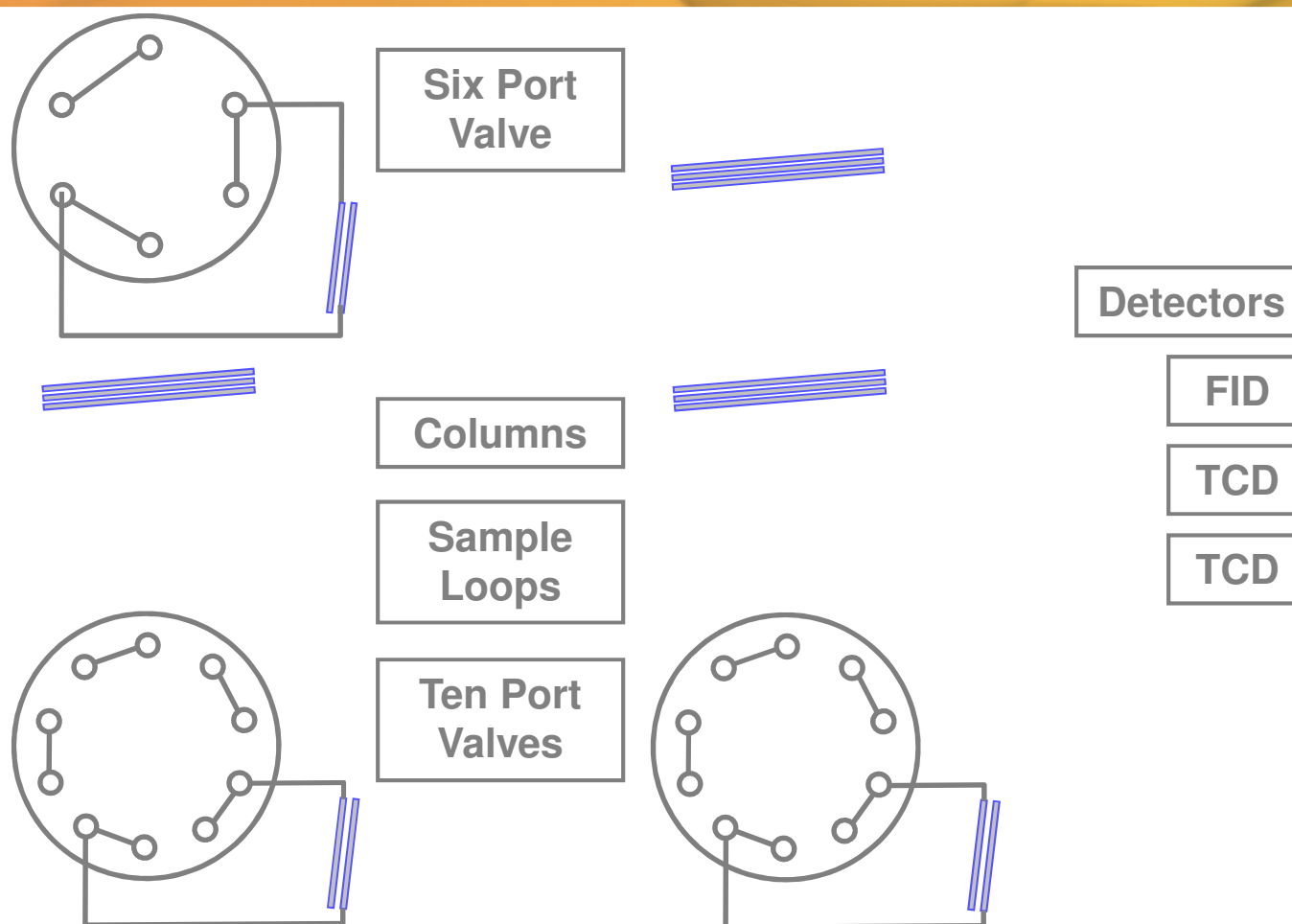
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Benefits of the Precut Method:
 - Simple and easy to use
 - No need for complex sample preparation
 - High repeatability and accuracy
 - Standard for Custody Transfer
 Disadvantage:
 - Assumed C₇+ Properties.

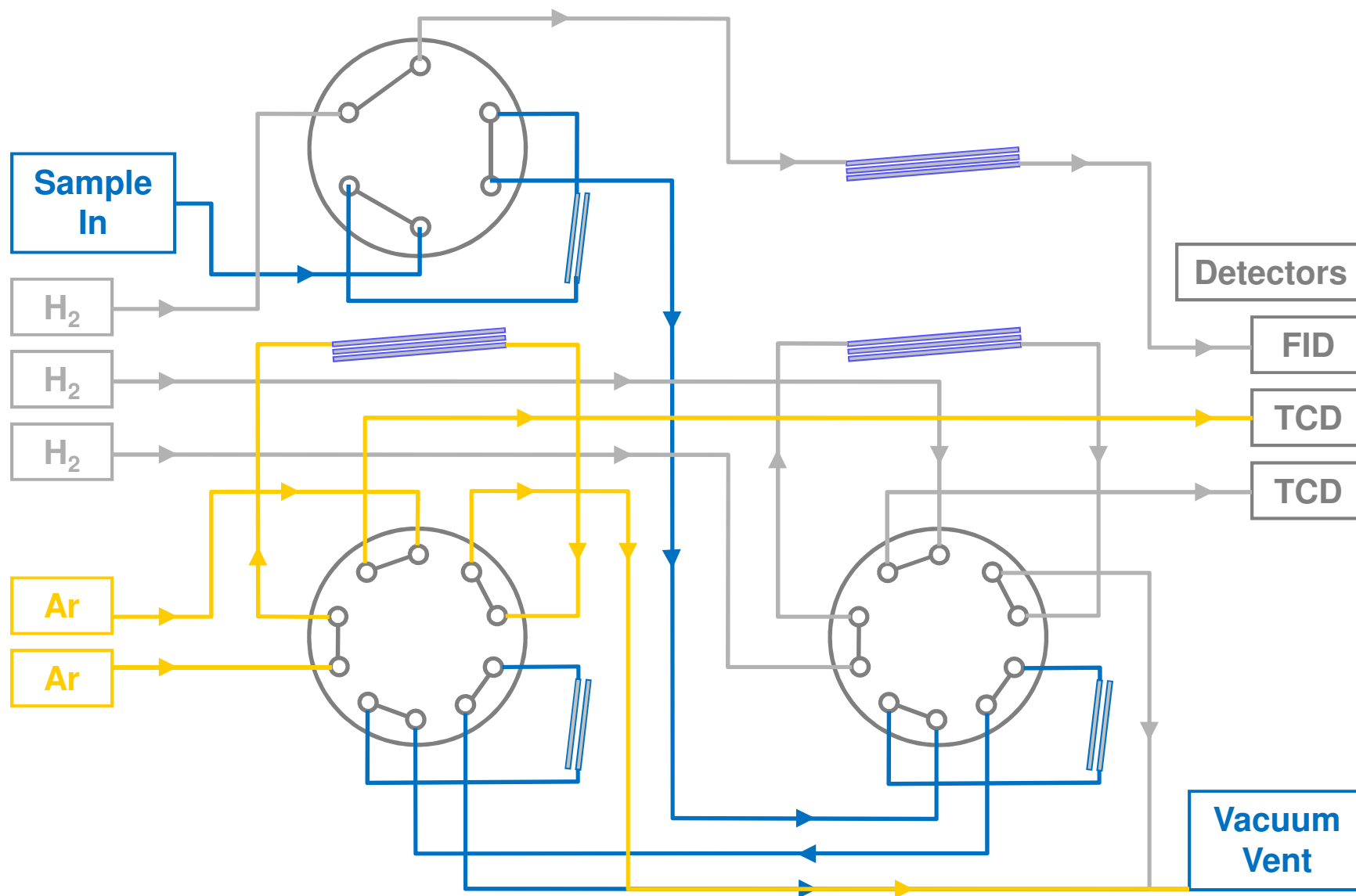
EXTENDED ANALYSIS TO C₁₅⁺

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EXTENDED ANALYSIS TO C₁₅⁺

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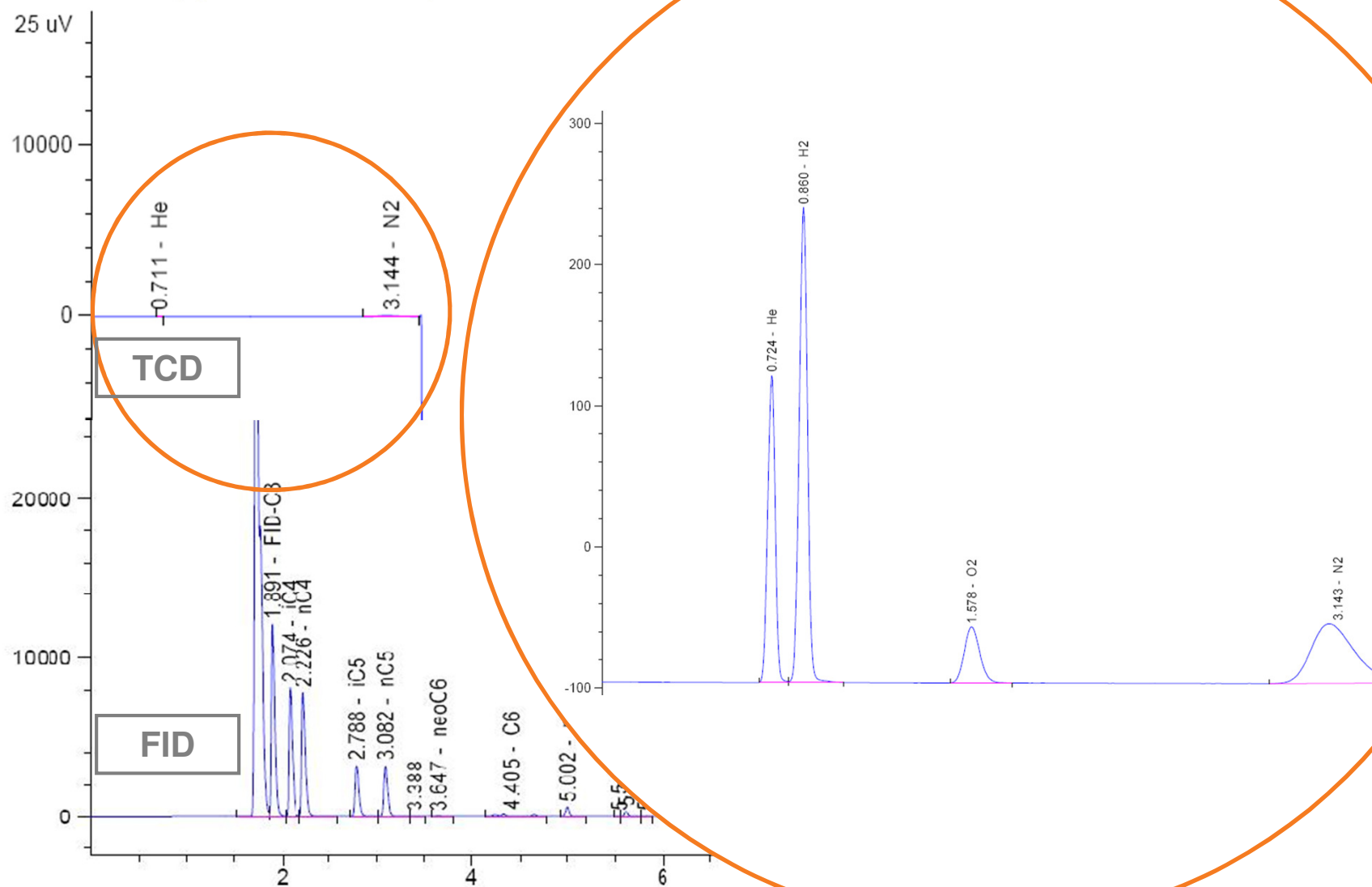
EXTENDED ANALYSIS TO C₁₅⁺

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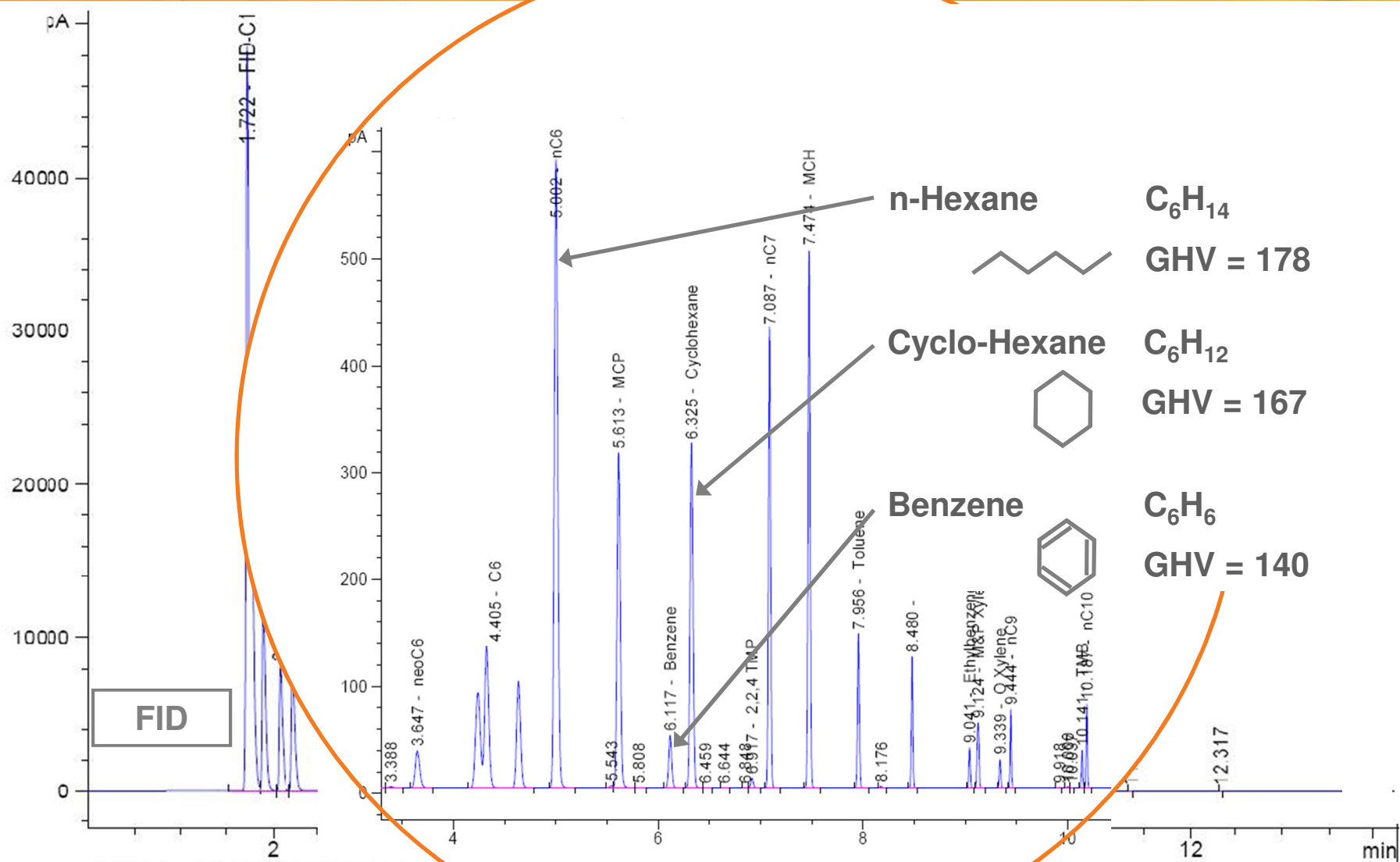
EXTENDED ANALYSIS TO C₁₅⁺

Access Through Science®



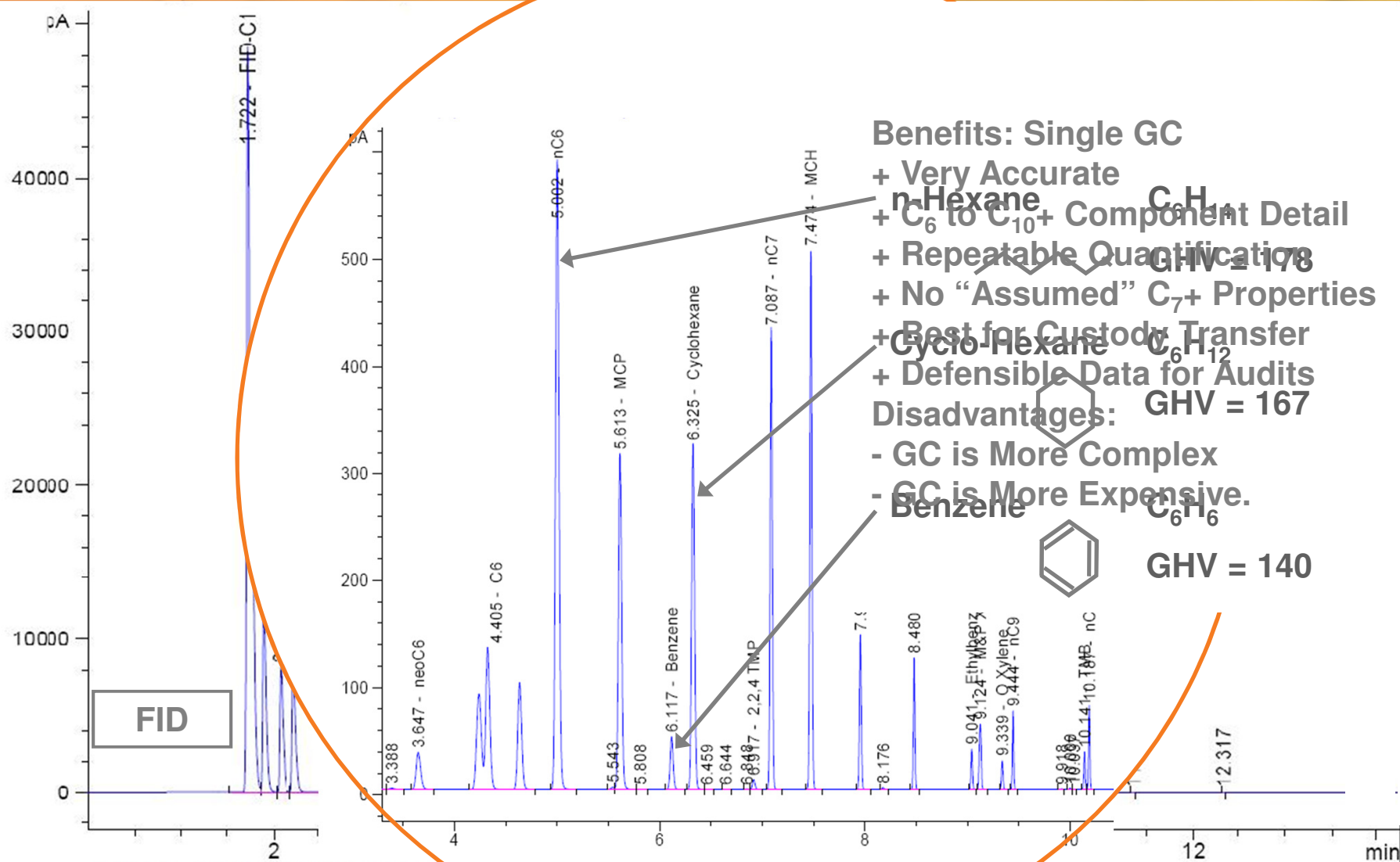
EXTENDING GRADIENTS TO C₁₅+

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"THE FINER DETAILS"

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EXTENDED ANALYSIS OF NATURAL GAS GAS ANALYSIS TO C₁₀+

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In addition to the
“Routine” Analysis

Finer Points Include:

C₆
C₇
C₈
C₉
C₁₀+

Based on “Detailed
Composition” C₆ & C₇+

Analytically Defined:

Relative Density

Molecular Mass

Gross Heating Value

Maxxam
Analytical Inc.

EXTENDED GAS ANALYSIS

SUNGL08GE P454659 N/A A634094 B58217
Sample Point ID Client ID Well Number Laboratory Number

SUNCOR ENERGY INC. 2007-30-076-11-W6M 100/07-30-076-11W6/D **
Operator Name Well Name LSO Well ID

SUNCOR GLACIER 07-30-076-11-W6M DWINM MAXXAM
Well Name Name of Sample Company

GLACIER U/S DEHYDRATOR 5165,5192
Field or Area Pool or Zone Sample Point Container Identity Percent Fuel

Test Recovery From: Internal 1 Internal 2 Internal 3
Test Type No. Multiple Recovery To: Elevations (ft) Sample Withdrawing Point Selection Valve

Production Status 1550 Gauge Pressure (PSI) 14 Temperature (°C) Well Fluid Status Well Status Mode
Water (ml) Oil (ml) Gas (ml) Source As Reported Source As Reported Well Status Type Well Type

2005/06/08 2005/06/09 2005/10/11 2005/10/11 KD
Date Sampled Start Date Sampled End Date Received Date Reported Date Received Reported Analyt

Component	COMPOSITION		Liquid Volume ml (US)	Molecular Weight Average	Tolerance Score
	Mole Fraction Air Free	Mole Fraction Acid Gas Free			
H ₂	0.0001	0.0001	0.0000		
He	0.0001	0.0001	0.0002		
N ₂	0.0016	0.0016	0.0016		
CO ₂	0.0201	0.0197	0.0197		
H ₂ O	0.0000		0.0000		
C ₁	0.9371	0.9366	0.9355		
C ₂	0.0341	0.0348	121.97	0.0338	
C ₃	0.0045	0.0045	16.36	0.0063	
IC ₄	0.0007	0.0007	2.90	0.0010	
NC ₄	0.0008	0.0008	3.32	0.0008	
IC ₅	0.0002	0.0002	1.03	0.0002	
NC ₅	0.0002	0.0002	0.72	0.0002	
C ₆	0.0001	0.0001	0.65	0.0001	
C ₇	0.0002	0.0002	0.88	0.0002	
C ₈	0.0001	0.0001	0.63	0.0002	
C ₉	Trace	Trace	0.10	0.0001	
C ₁₀ +	0.0000	0.0000	0.00	0.0000	
TOTAL	1.0000	1.0000	148.56		

Insufficient historical data to calculate T-Score

PROPERTIES

Calculated Mole Weight
Molecular Weight as Sampled
17.3 90.4 0.599 0.580 3.121
T (°C) C (°C) Molecular Weight as Sampled C (°C) Molecular Weight

Calculated Pseudo Critical Properties
As Sampled
4657.9 198.0 4602.2 195.9 73.7
P (PSIA) P (PSIA) P (PSIA) P (PSIA) C (°C)

Calculated Gross Heating Value (MJ/m³)
As Sampled
38.34 39.40 47.3 4.6 15.0076
G (PSIA) G (PSIA) G (PSIA) G (PSIA) C (°C)

Calculated Vapour Pressure
As Sampled
73.7
C (°C)

Gas Compressibility
As Sampled
15.0076
C (°C)

On Site In Lab
Hydrogen Sulphide
≤1 (ppm-v) (ppm-v) ≤1 (ppm-v) (ppm-v)
G (ppm-v) G (ppm-v) G (ppm-v) G (ppm-v)

QC Check Std # NOT WORKIN Date 2006/09/29 QC Passed Yes

*** Information not supplied by client - data derived from LSO information Results relate only to items tested

Maxxam

MaxxALERT

CALGARY: 102141 Avenue N.E., Calgary, Canada T2C 1P1 Tel: 403-291-9511 Fax: 403-291-9485
EDMONTON: 102141 Avenue N.E., Edmonton, Canada T6B 2J4 Tel: 780-458-1206 Fax: 780-458-1208

GRAND PRÉ: 102141 Avenue N.E., Grand Pré, Canada T5C 1A4 Tel: 403-291-9511 Fax: 403-291-9485
SHELL: 102141 Avenue N.E., Shell, Canada T5C 1A4 Tel: 403-291-9511 Fax: 403-291-9485

To view or Download your data on-line via MaxxLINK, please call 1-800-386-7247

2006/09/14 14:00

Gas Analysis to C₁₆+

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Maxxam ANALYTICS		SUNCOR ENERGY INC.		A624094 B56217	
Operator Name		U/S DEHYDRATOR		Laboratory Number	
SUNCOR GLACIER 07-30-075-11-W6M					
Maxxam	SUNGL08GE	P454559			
Company	Sample Place (C)	Client (C)			
2005/06/08	2005/06/09	2005/10/11	2005/10/11	KD	
Date Sampled (Start)	Date Sampled (End)	Date Reported	Date Revision Reported	Analyst	
COMPONENT	BOILING POINT (°C)	MOLE FRACTION AIR FREE AS REC'D	MOLE FRACTION AIR FREE AS REC'D	LIQUID VOLUME (L)	
Hydrogen	-253	0.0001	0.0001		
Helium	-269	0.0001	0.0001		
Nitrogen	-196	0.0016	0.0016		
Carbon Dioxide	-79	0.0201			
Hydrogen Sulphide	-60	0.0000			
Methane	-162	0.9371	0.9585		
Ethane	-89	0.0341	0.0348	121.97	
Propane	-42	0.0045	0.0045	16.36	
iso-Butane	-12	0.0007	0.0007	2.90	
n-Butane	0	0.0008	0.0008	3.33	
iso-Pentane	28	0.0002	0.0002	1.03	
n-Pentane	36	0.0002	0.0002	0.72	
C6	37-69	0.0001	0.0001	0.85	
C7	70-98	0.0002	0.0002	0.98	
C8	99-126	0.0001	0.0001	0.83	
C9	127-151	Trace	Trace	0.10	
C10	152-174	0.0000	0.0000	0.00	
C11	175-198	0.0000	0.0000	0.00	
C12	197-216	0.0000	0.0000	0.00	
C13	217-236	0.0000	0.0000	0.00	
C14	237-253	0.0000	0.0000	0.00	
C15+	254+	0.0000	0.0000	0.00	
TOTAL		1.0000	1.0000	149.56	
SPECIFIC COMPONENTS					
neoHexane (C6)	50	0.00000	0.00000	0.00	
n-Hexane (C6)	69	0.00005	0.00005	0.27	
Methylcyclopentane (C7)	72	0.00003	0.00003	0.14	
Benzene (C7)	80	0.00006	0.00006	0.22	
Cyclohexane (C7)	81	0.00006	0.00006	0.27	
2,2,4-Trimethylpentane (C8)	99	0.00000	0.00000	0.00	
Methylcyclohexane (C8)	101	0.00006	0.00006	0.32	
Toluene (C8)	111	0.00007	0.00007	0.31	
Ethylbenzene (C9)	136	0.00000	0.00000	0.00	
m,p-Xylene (C9)	139	0.00002	0.00002	0.10	
o-Xylene (C9)	144	0.00000	0.00000	0.00	
1,2,4-Trimethylbenzene (C10)	169	0.00000	0.00000	0.00	
SUMMARY					
C3+	-42+	0.0089	0.0089	26.59	51.7
C5+	28+	0.0006	0.0006	4.01	81.8
C6+	36+	0.0005	0.0005	2.26	89.3
C7+	70+	0.0003	0.0003	1.61	90.4
C10+	152+	0.0000	0.0000	0.00	
C12+	197+	0.0000	0.0000	0.00	
Nitrogen value minimum detection limit is 189 mole ppm.					
* Information not supplied by client - data derived from LSC information					
Pseudo values only to these listed					
Remarks:					
CALGARY: 332141 Avenue R.E., Calgary, Canada T2B 0P2 Tel: (403) 261-5577 Fax: (403) 261-9453 EDMONTON: 8231 46 Street, Edmonton, Canada T6C 5K6 Tel: (780) 458-5867 Fax: (780) 458-5868 SUNDREY: 50100 Highway 810, SUNDREY, ONTARIO, Canada L0N 1S0 Tel: (705) 522-8227 Fax: (705) 522-8201 2005/10/11 14:38					

Gas Analysis to C₁₅+

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Extended Analysis

Specific Components

Neohexane

n-Hexane

Methylcyclopentane

Benzene

Cyclohexane

2,2,4-Trimethylpentane

Methylcyclohexane

Toluene

Ethylbenzene

m&p-Xylene

o-Xylene

1,2,4-Trimethylbenzene

EXTENDED GAS ANALYSIS

SUNCOR ENERGY INC.

A624094 B58217

Operator Name

U/S DEHYDRATOR

Laboratory Number

SUNCOR GLACIER 07-30-075-11-W6M

Job Name

Sample Point

MAXXAM

SUNGL08GE

P454559

Company

Sample Place ID

Client ID

2005/06/08

2005/06/09

2005/10/11

2005/10/11

KD

Date Sampled Start

Date Reported

Date Revision Reported

Analyst

Date Sampled End

Date Reported

Date Revision Reported

COMPONENT	BOILING POINT (°C)	MOLE FRACTION AIR FREE AS REC'D	MOLE FRACTION AIR & ACID GAS FREE	LIQUID VOLUME AIR FREE AS REC'D
Hydrogen	-253	0.0001	0.0001	
Helium	-269	0.0001	0.0001	
Nitrogen	-196	0.0016	0.0016	
Carbon Dioxide	-79	0.0201		
Hydrogen Sulphide	-60	0.0000		
Methane	-162	0.9371	0.9595	121.97
Ethane	-89	0.0341	0.0348	
Propane	-42	0.0045	0.0045	18.36
iso-Butane	-12	0.0007	0.0007	2.90
n-Butane	0	0.0006	0.0006	3.32
iso-Pentane	28	0.0002	0.0002	1.03
n-Pentane	36	0.0002	0.0002	0.72
C6	37-69	0.0001	0.0001	0.85
C7	70-98	0.0002	0.0002	0.88
C8	99-126	0.0001	0.0001	0.83
C9	127-151	Trace	Trace	0.10
C10	152-174	0.0000	0.0000	0.00
C11	175-196	0.0000	0.0000	0.00
C12	197-216	0.0000	0.0000	0.00
C13	217-236	0.0000	0.0000	0.00
C14	237-253	0.0000	0.0000	0.00
C15+	254+	0.0000	0.0000	0.00
TOTAL		1.0000	1.0000	148.56
SPECIFIC COMPONENTS				
neoHexane (C6)	50	0.00000	0.00000	0.00
n-Hexane (C6)	69	0.00005	0.00005	0.27
Methylcyclopentane (C7)	73	0.00003	0.00003	0.14
Benzene (C7)	80	0.00006	0.00006	0.22
Cyclohexane (C7)	81	0.00006	0.00006	0.27
2,2,4-Trimethylpentane (C8)	99	0.00000	0.00000	0.00
Methylcyclohexane (C8)	101	0.00006	0.00006	0.32
Toluene (C8)	111	0.00007	0.00007	0.31
Ethylbenzene (C9)	136	0.00000	0.00000	0.00
m&p-Xylene (C9)	139	0.00002	0.00002	0.10
o-Xylene (C9)	144	0.00000	0.00000	0.00
1,2,4-Trimethylbenzene (C10)	169	0.00000	0.00000	0.00
SUMMARY				
C3+	42+	0.0089	0.0089	28.59
C5+	28+	0.0009	0.0009	4.01
C6+	36+	0.0005	0.0005	2.26
C7+	70+	0.0003	0.0003	1.61
C10+	152+	0.0000	0.0000	0.00
C12+	197+	0.0000	0.0000	0.00
				MOLE WEIGHT AIR FREE AS REC'D
				51.7
				81.8
				89.3
				90.4

Nitrogen value minimum detection limit is 100 mole ppm.

* Information not supplied by client - data derived from LSC information

Results relate only to those tested

Remarks:

CALGARY 1001-01 Avenue R.E. Calgary, Canada T2C 1P2 Tel: (403) 261-9077 Fax: (403) 261-9078
 EDMONTON 1001-01 Avenue R.E. Edmonton, Canada T6C 1P2 Tel: (780) 440-2960 Fax: (780) 440-2960

GRANDE PRATIQUE 1001-01 Avenue R.E. Grande Prairie, Canada T6V 1S4 Tel: (800) 555-8227 Fax: (800) 555-8228
 1001-01 Avenue R.E. Bay, 4105-42 Street, Medicine, Canada T6C 1P2 Tel: (403) 261-9077 Fax: (403) 261-9078

2005/10/11 14:18

WHAT'S THE DIFFERENCE?

C₇+ HEATING VALUE

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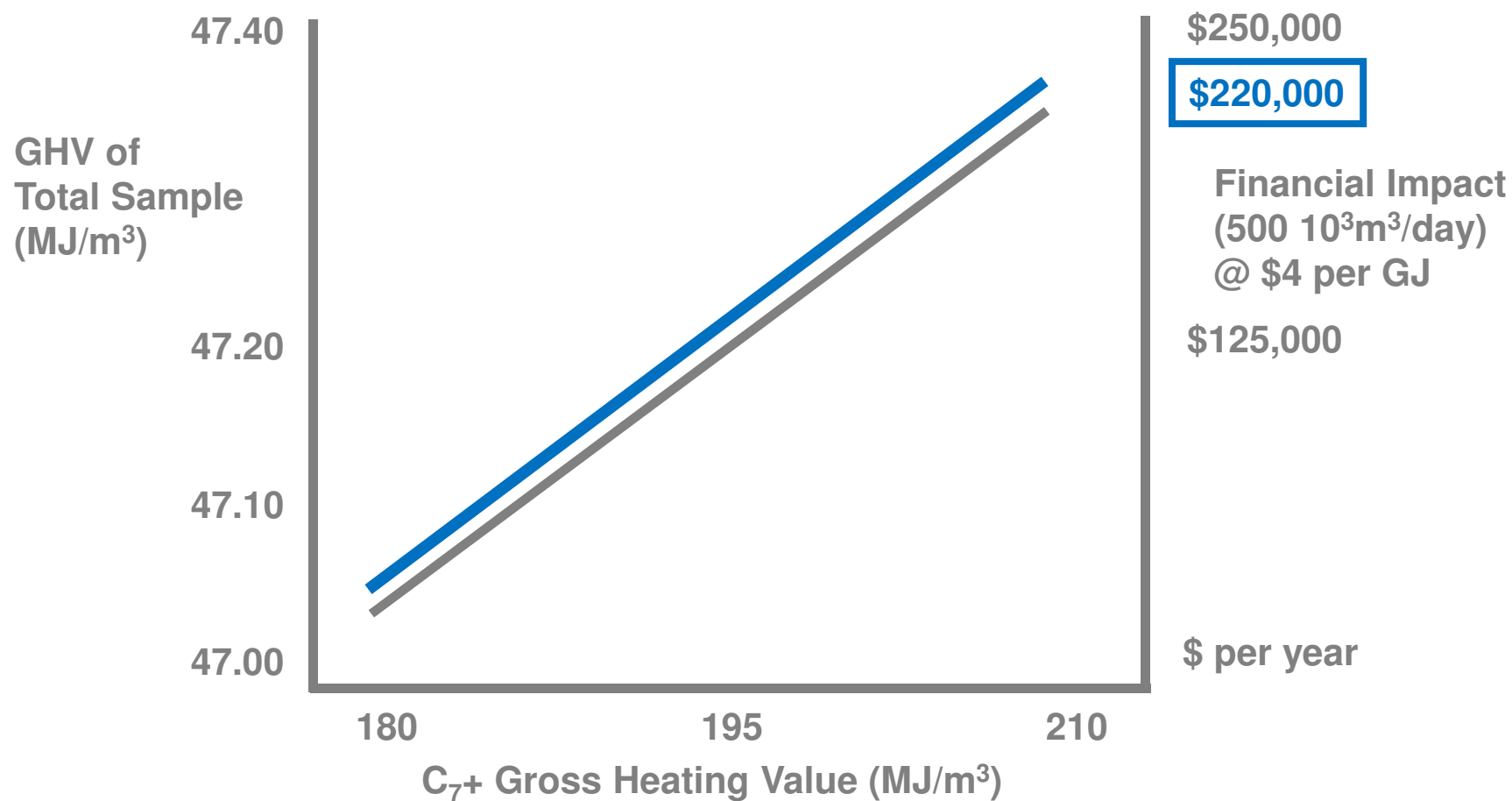
	Analysis	Analysis	Analysis
C ₇ + Concentration		0.0100	
GHV C ₇ +		195	
GHV (MJ/m ³)		47.19	

→ 0.6% →

FINANCIAL IMPACT

C₇+ HEATING VALUE

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WHAT'S THE DIFFERENCE?

C₇+ CONCENTRATION

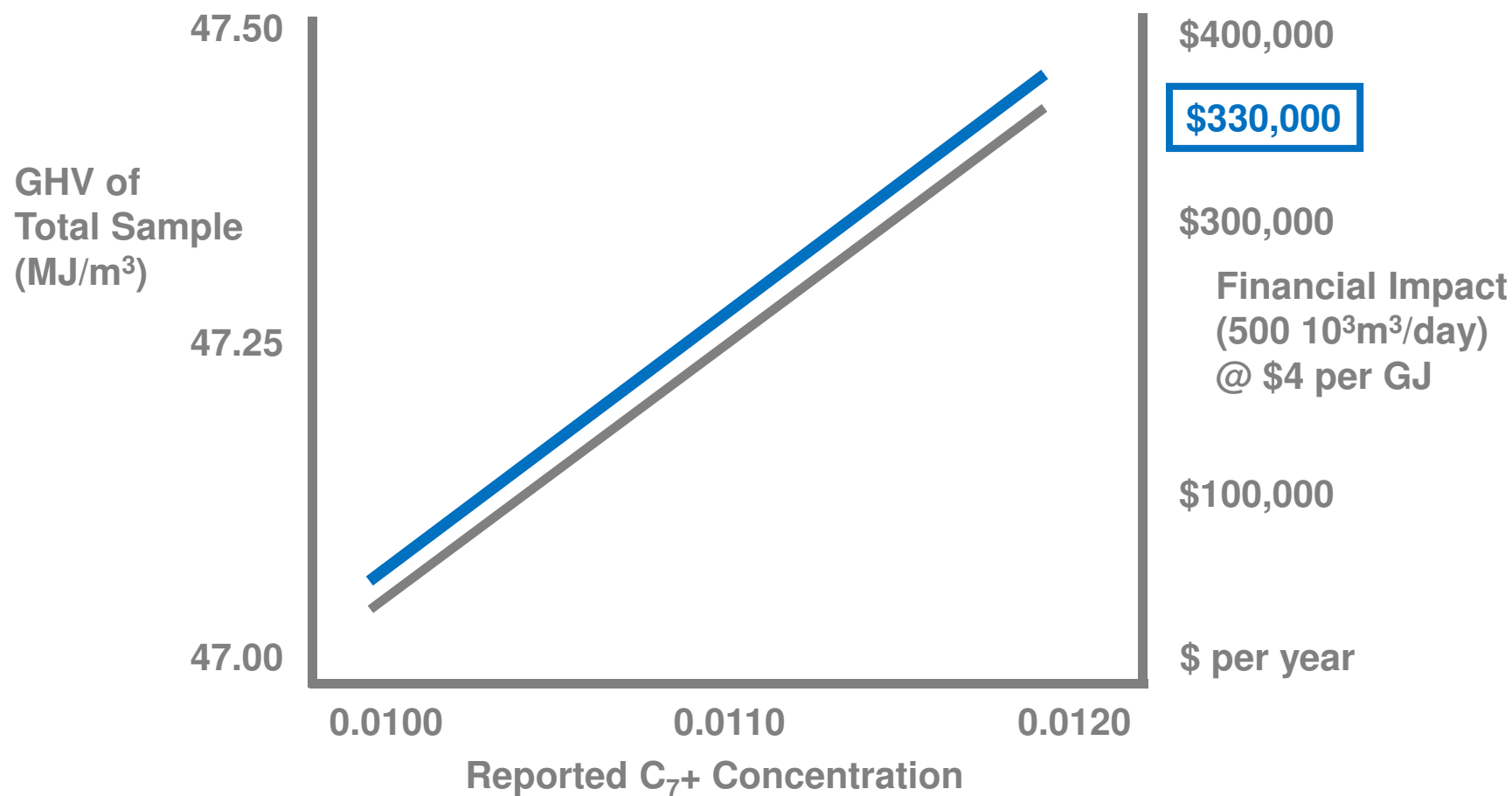
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	Analysis	Analysis	Analysis
C ₇ + Concentration	0.0100		
GHV C ₇ +	195		
GHV (MJ/m ³)	47.04		

→ 0.9% →

FINANCIAL IMPACT C₇+ CONCENTRATION

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WHAT'S THE DIFFERENCE?

CO₂ CONCENTRATION

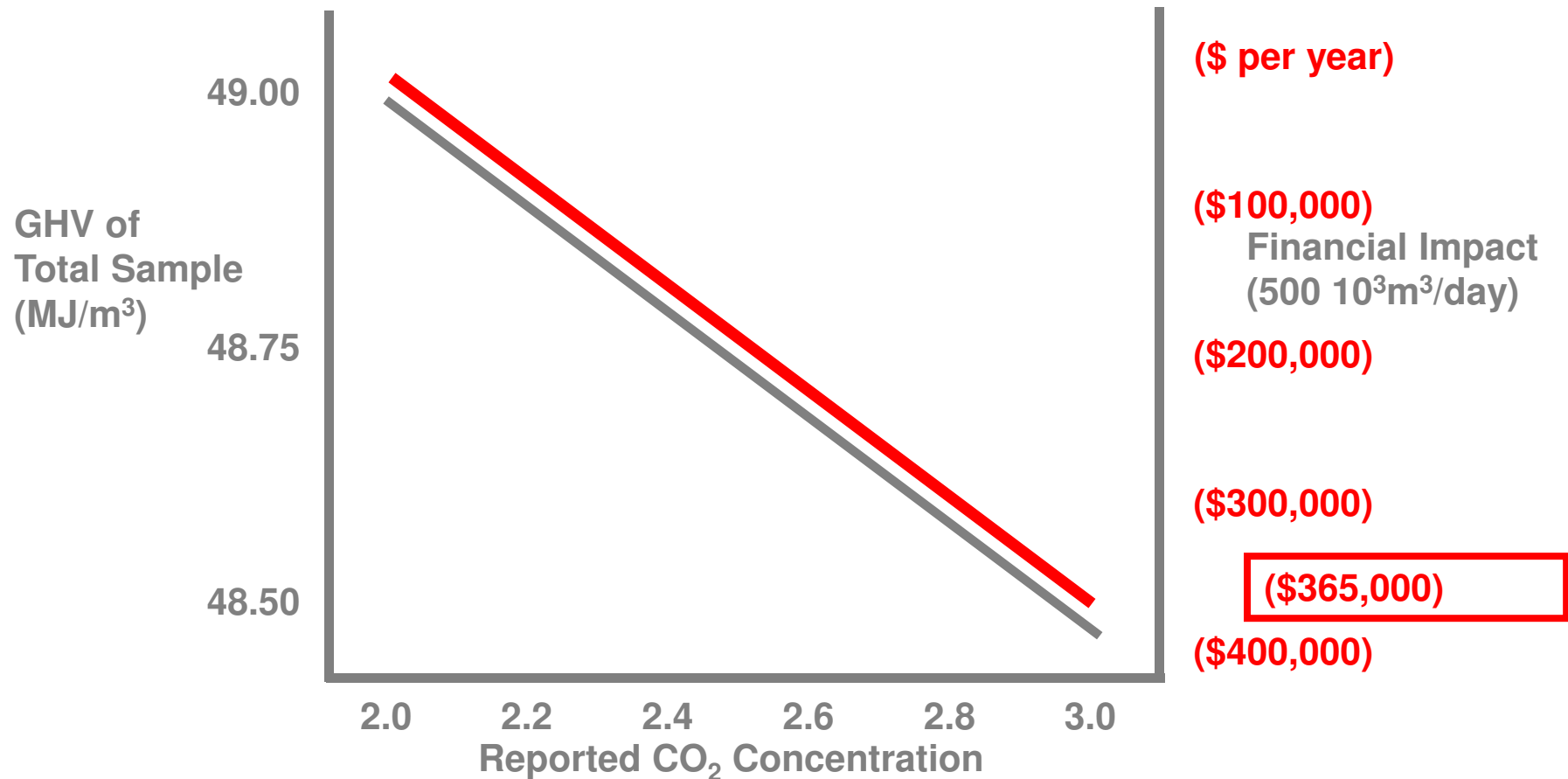
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	Analysis\$	Analysis\$	Analysis\$
Other Components	0.9800		
CO ₂	0.0200		
GHV (MJ/m ³)	49.00		

→ **-1.0%** →

FINANCIAL IMPACT CO₂ CONCENTRATION

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WHAT'S THE DIFFERENCE?

H₂S CONCENTRATION

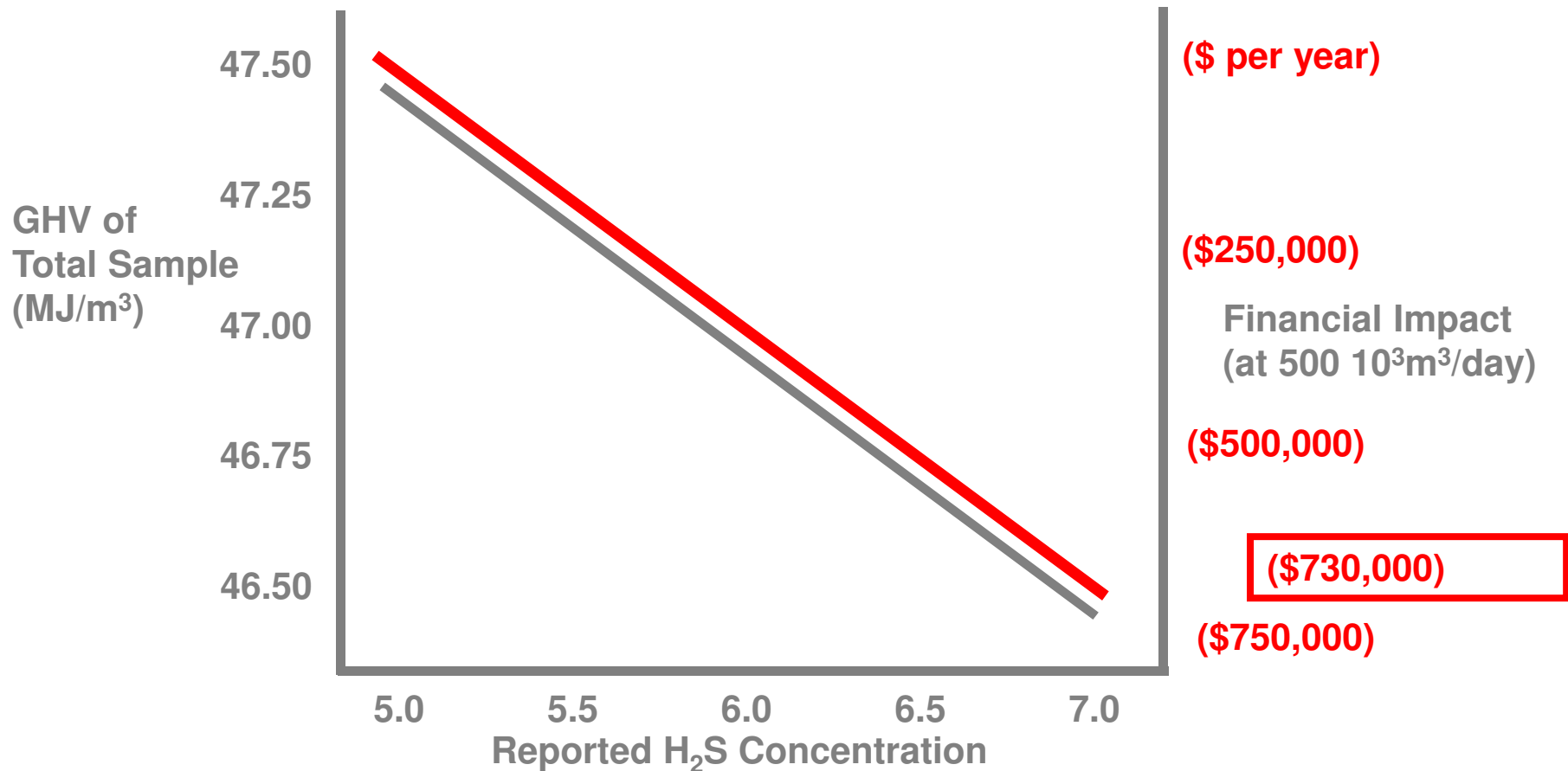
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	Analysis	Analysis	Analysis
Other Components	0.9500		
H ₂ S	0.0500		
GHV (MJ/m ³)	47.50		

→ -2.1% →

FINANCIAL IMPACT H₂S CONCENTRATION

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TOOLS-OF-THE-TRADE GAS ANALYSIS

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Method	Compliant	GPA 2261	GPA 2286	Dir 017
C ₇ + Precut	☒		☒	
C ₇ + Backflush	☒		☒	
C ₁₅ + M _V M _C M _D		☒	☒	
Other Methods				NO

WHAT IS YOUR ROLE?

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Balance	Minimum	Acceptable	High	Maximum
Confidence				
Reliability				
Accuracy				
Value				
Risk				

Success Through Science®

Thank You

GIBAC/PJVA Questions

Maxxam Analytics

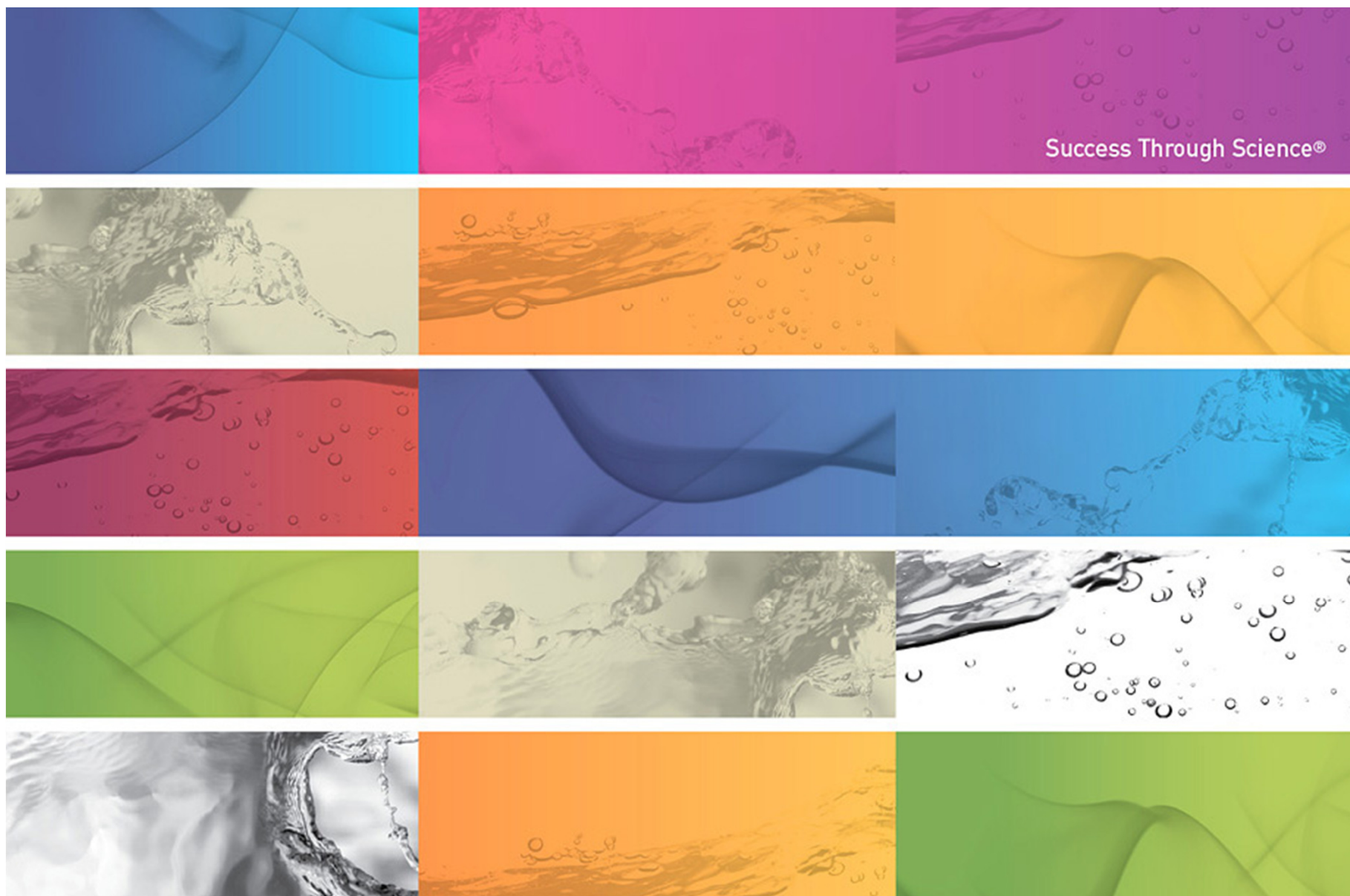
Coauthors
Scientific Specialists

GPAC / PJVA Annual Joint Conference
Calgary – 2010 11 03

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Extended Analysis of Natural Gas “Financial Impact”

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