I&E INDUSTRIES & ENVIRONMENT

Forensics Tools for Gasoline Spills and Case Studies

TCEQ ETFC 2025

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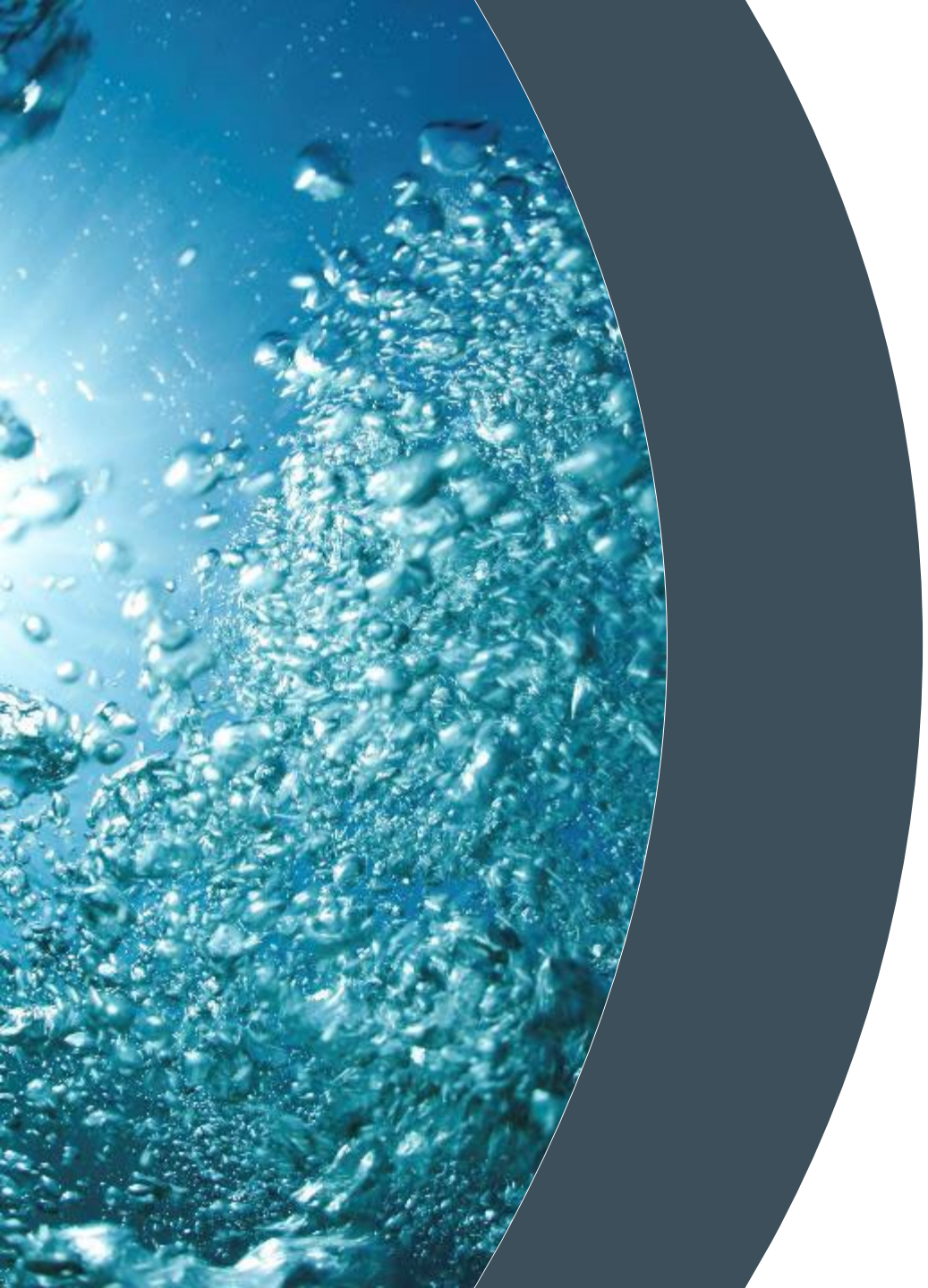
SAFER
GREENER
SMARTER

SGS



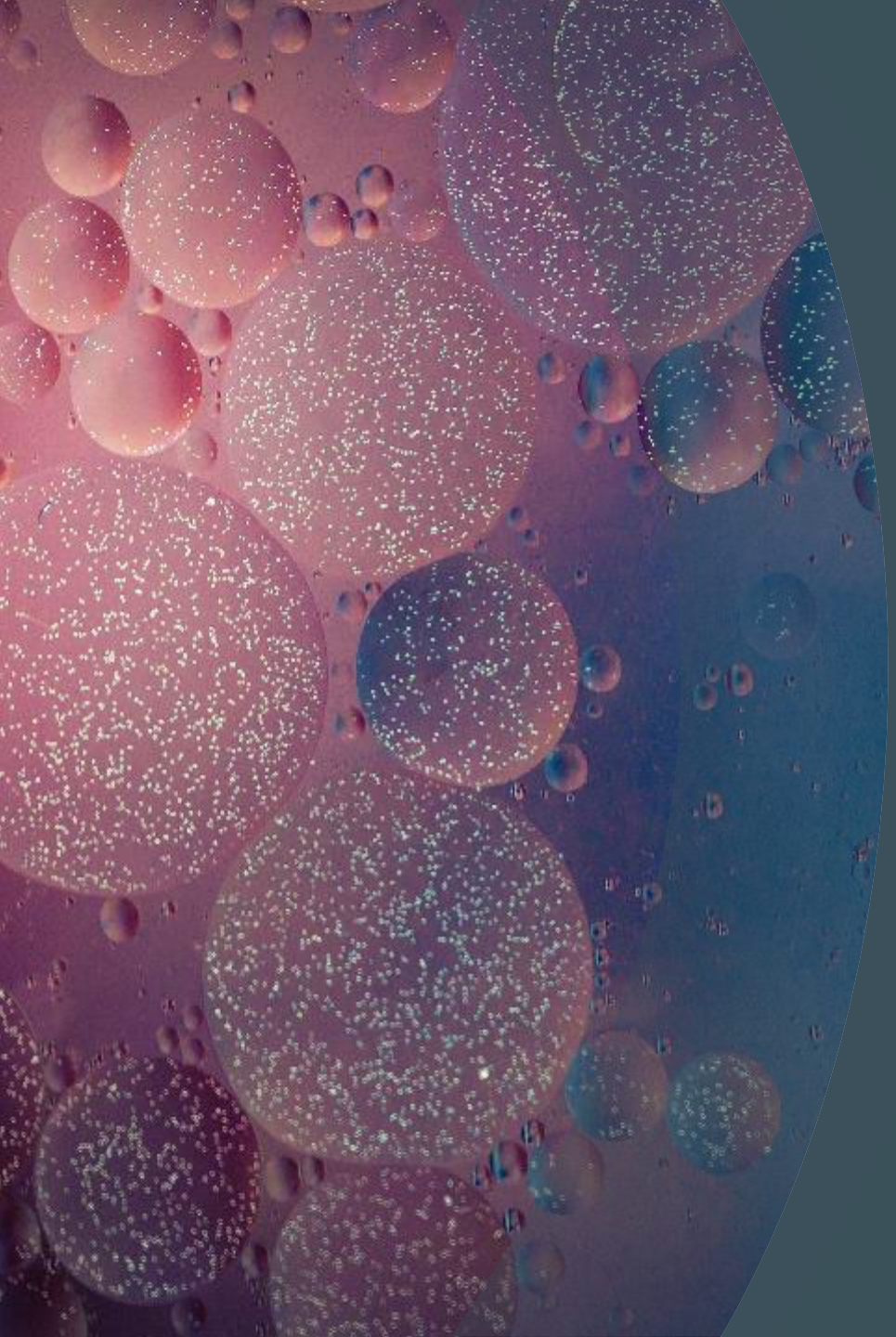
Agenda

- Introduction
- Why do we need Hydrocarbon Fingerprinting ?
- How do Hydrocarbons get into the Environment?
- What is necessary to perform Fingerprinting?
- Two Tracks of Data Collection
- Analytical Tiers
- Methods
- Matrices
- Sample Collection and Shipping
- Laboratory Information (Data Presentation)
- Summary

Introduction

Introduction

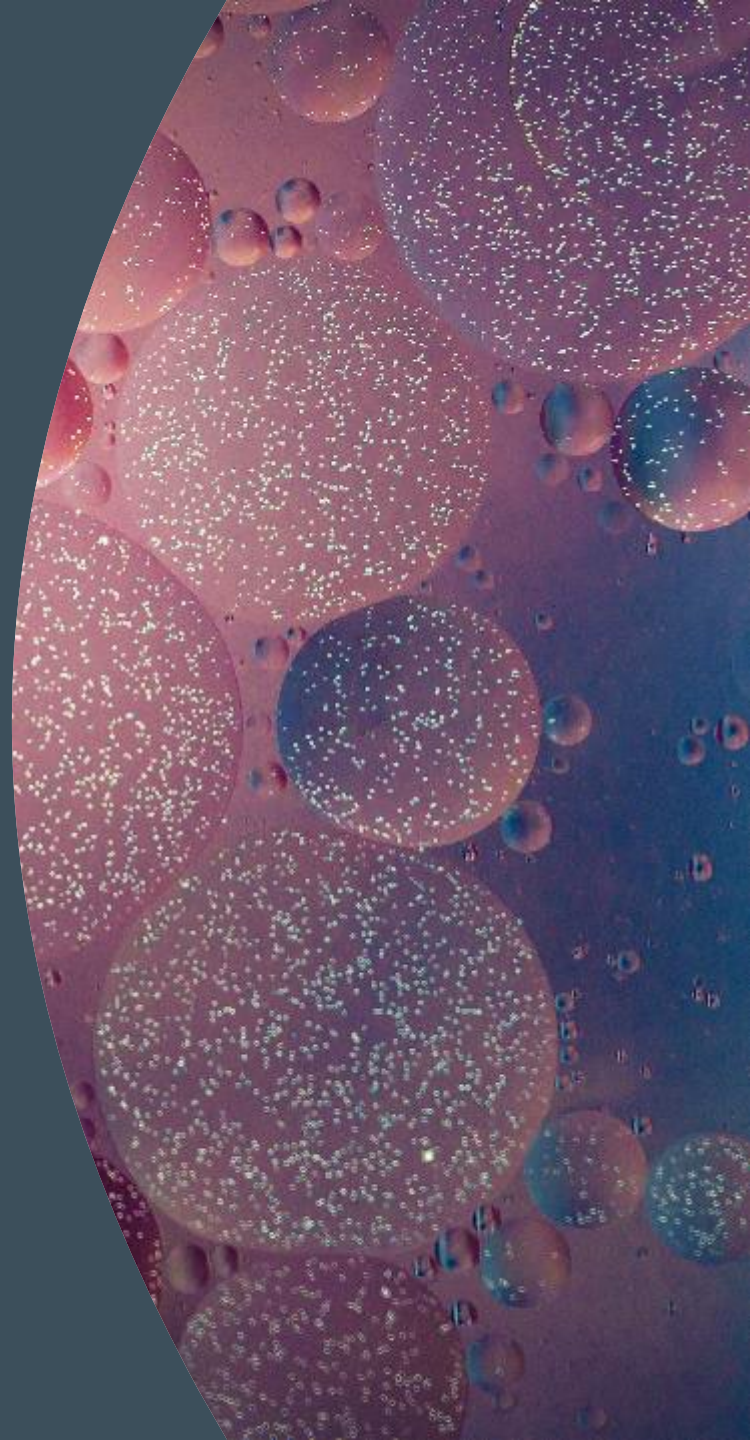
- Whole Oil Analysis
- PIANO Analysis
- Additives – Alkylated Leads, Oxygenates, Halogens, Thiophenes
- Isotopic Analysis
- Interpretation



Why do we need Hydrocarbon Fingerprinting?

Why do we need Hydrocarbon Fingerprinting?

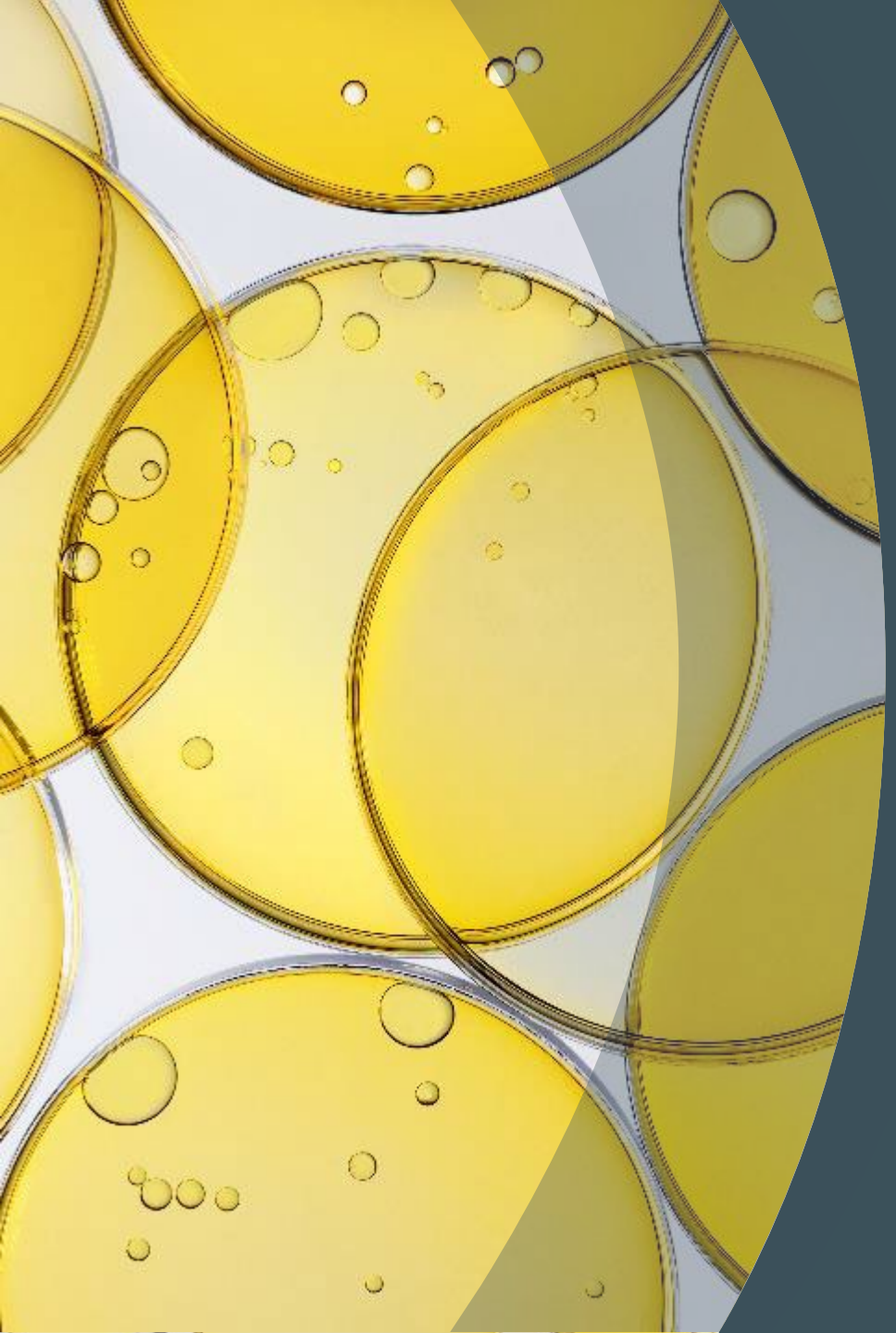
- Characterization of Product
- Determination of Source
- Multiple Sources?
- Range of Approximate Time of Release
- Allocation of Liability



How do Hydrocarbons get into the Environment?

How do Hydrocarbons get into the Environment?

- Spills
- Leaks
- Explosions
- Natural Seeps
- Emissions



What is necessary to perform Fingerprinting?

What is necessary to perform Fingerprinting?

- Samples from Site
- Source Product or Products
- Historical Background
- All other Information

MORE INFORMATION
THE BETTER!!!

Two Tracks of Data Collection

Two Tracks of Data Collection

- Regulatory Aspects
- Determination of Source/ Multiple Sources

Analytical Tiers

Analytical Tiers

- Tier I – GC/FID*
- Tier II – GC/MS (SHC's, PAH/APAH's, BIOMARKERS, PIANO)
- Tier III – CSIA (Carbon Stable Isotope Analysis)
- All 3 Tiers Offered at SGS
- *Products comparison
- Whole Oil Analysis (GC/FID)
- Other Parameters… additives, metals, wear metals, sulfur, organic Pbs, Mn etc..
- P (Paraffins), I (Isoparaffins), A (Aromatics), N (Naphthenes), O (Olefins)

Methods

Methods

- ASTM Methods
- ASTM D7900 (Detailed Hydrocarbon Analysis (DHA))
- ASTM D6730 Mod. (DHA Analysis)
- ASTM D8003 HPLIS (n-C1 through n-C24)
- ASTM D2887
- ASTM D7169
- ASTM D3328 (whole Oil)
- Physical Parameters by ASTM methods
- ASTM D7363 (Microextraction/SPE method)
- ASTM D5739 (Extraction and Analysis)

Methods - SGS Scott

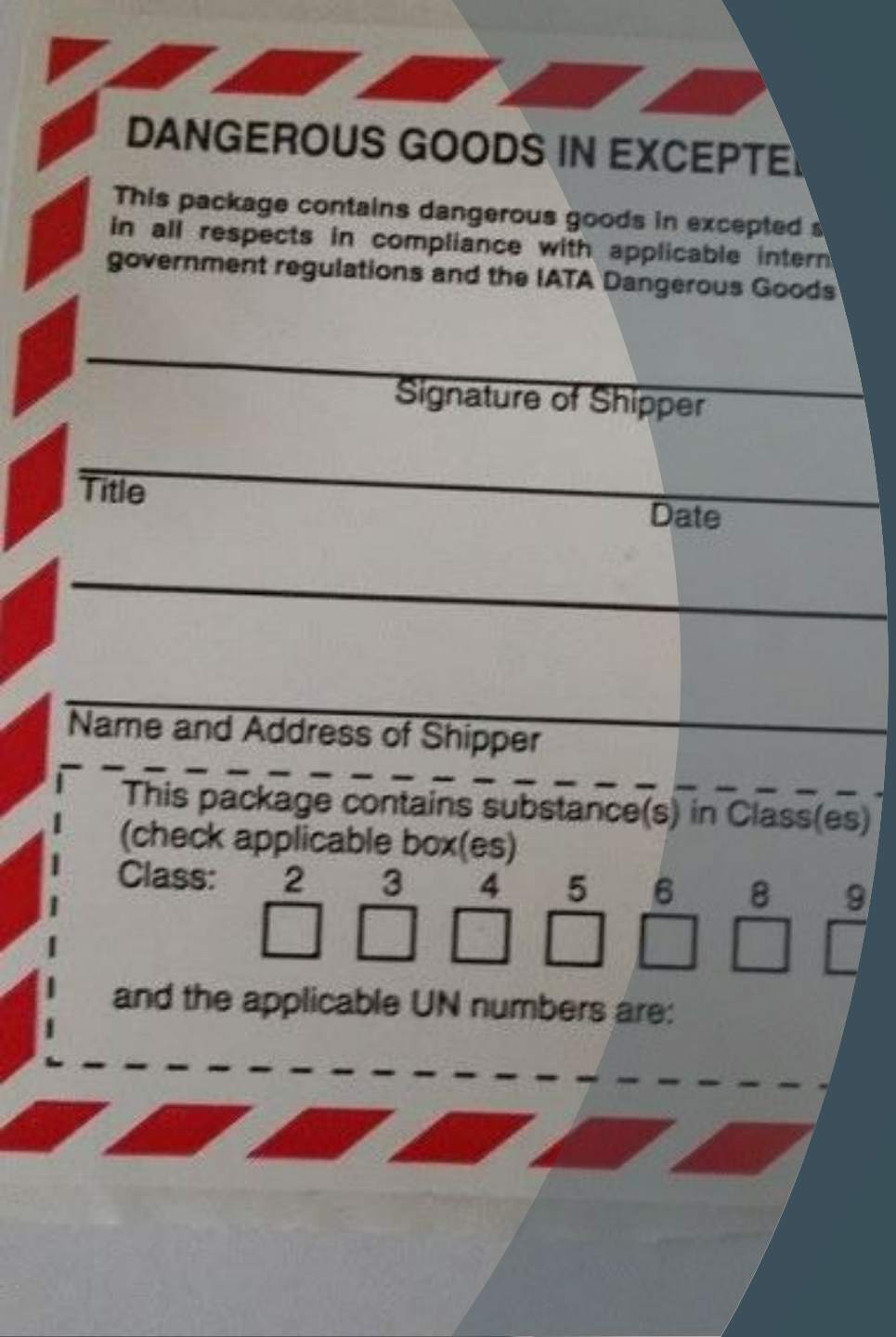
- GC Methods
- SW846 8015 Mod. (whole Oil)
- Ethanol
- GC/MS Methods
- SW846 8260 Mod. (PIANO) (Oxygenates, Thiophenes, Halogens)
- SW846 8270 Mod., - Organic Leads (5)
- SW846 6010D for metals - Pb, Cr, Ni, V including Sulfur

Matrices

Matrices

- Pure Product
- NAPL (Nonaqueous Phase Liquids) (Light and Dense)
- Soils & Sediments
- Water
- Matrix Combinations

Method Choice based on Matrix
(ASTM or EPA)



Sample Collection and Shipping

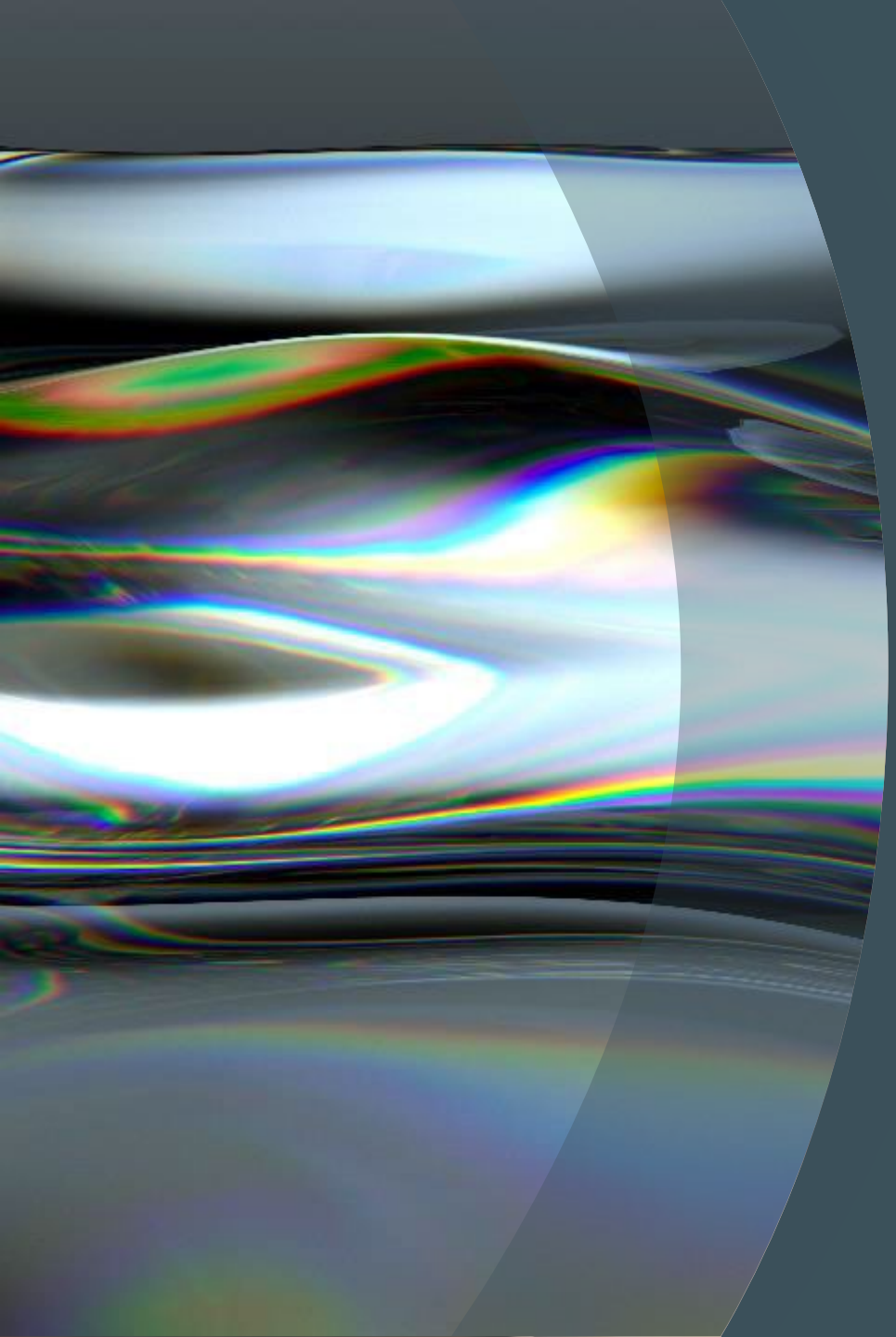
Sample Collection and Shipping

- Normal Sample Collection Protocols
- GW & Soils – Regular Protocols
- Product Samples - Special Handling
- DOT Shipping Rules
- Exempted Quantity Shipping
- 30 ml VOA Vials
- No more than 300 ml in a Shipment
- Requires Exempted Quantity Label on the outside of the Shipment

Laboratory Information (Data Presentation)

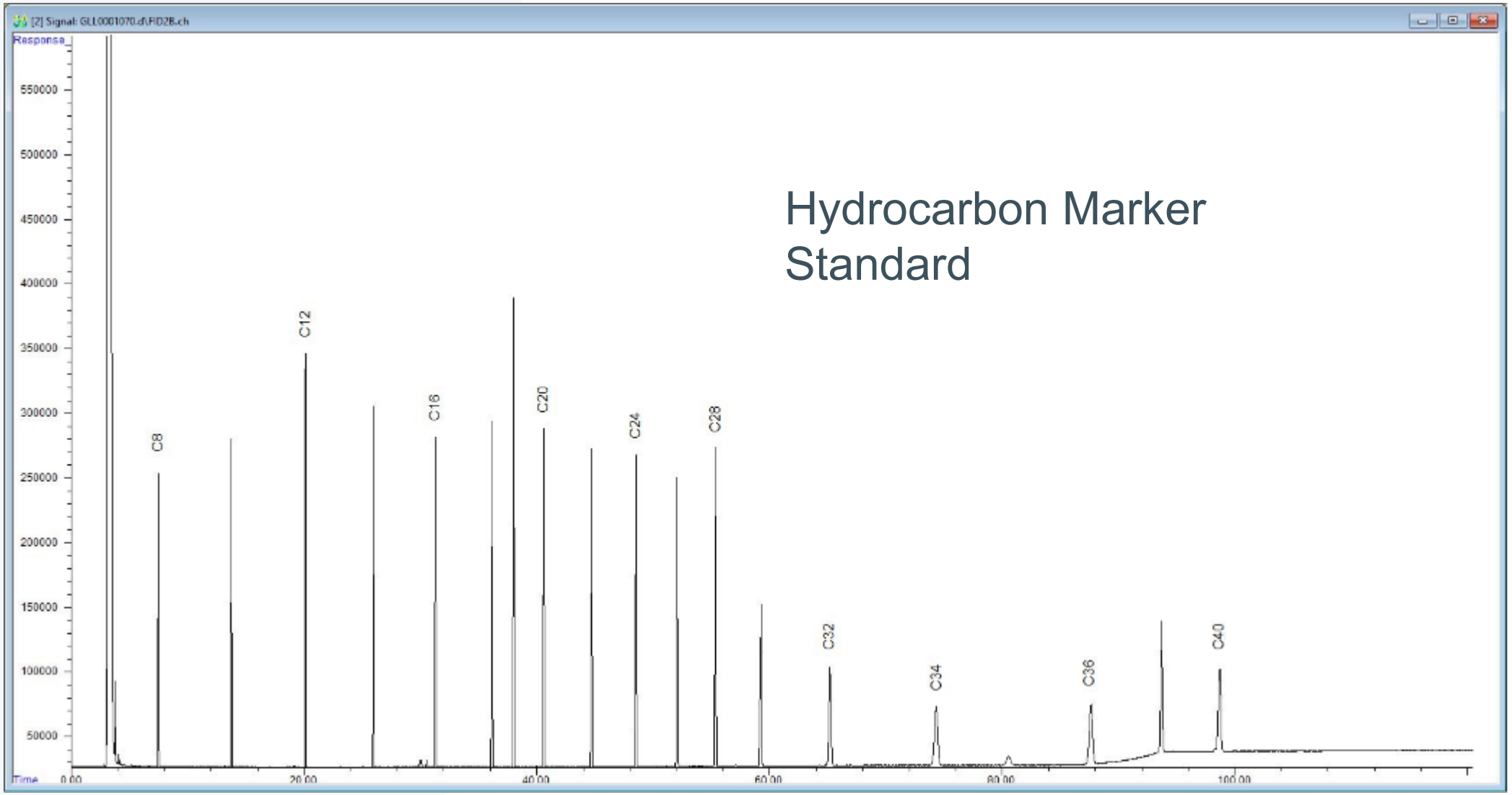
Laboratory Information

- GC/FID traces
- Total Ion Chromatograms
- Overlays based on Source Product or SGS Library
- Overlays comparison over time
- Overlays based on excavations at various intervals
- Diagnostic Ratios
- Radar Plots
- Data Interpretation Reports



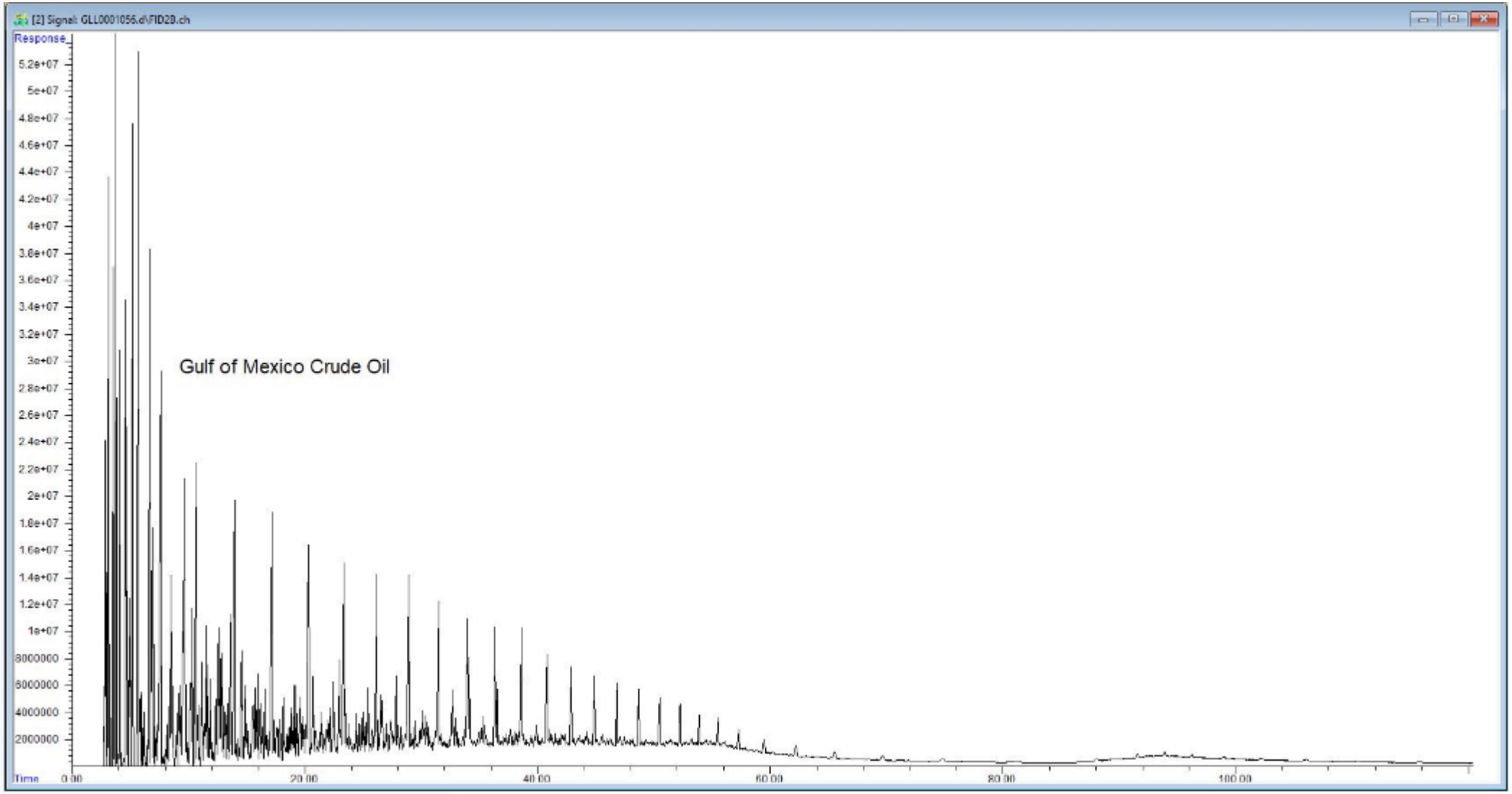
Whole Oil Analysis Forensics

Laboratory Information



Hydrocarbon Marker Standard

Laboratory Information



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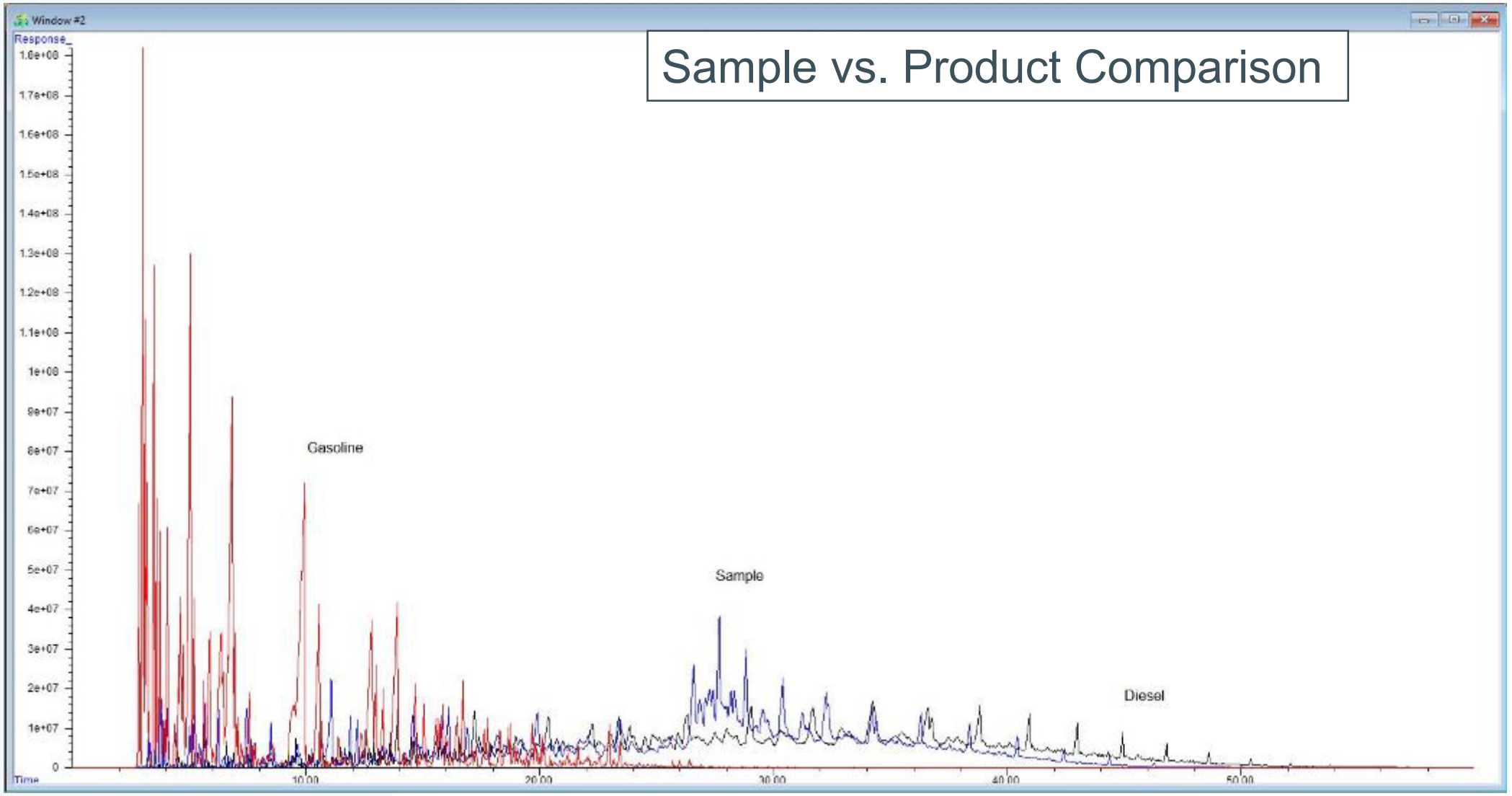
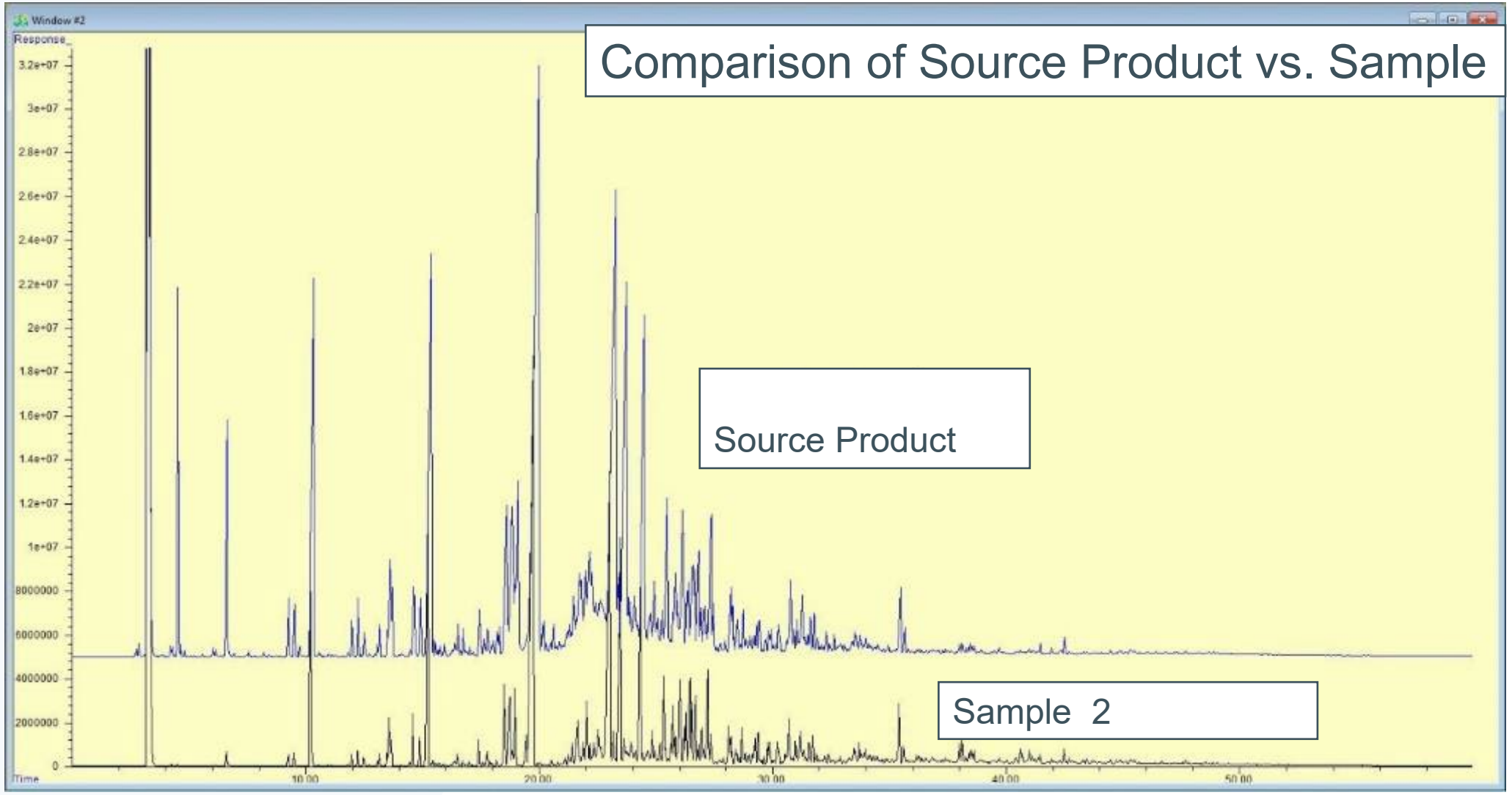


Sample vs. Product Comparison

Laboratory Information



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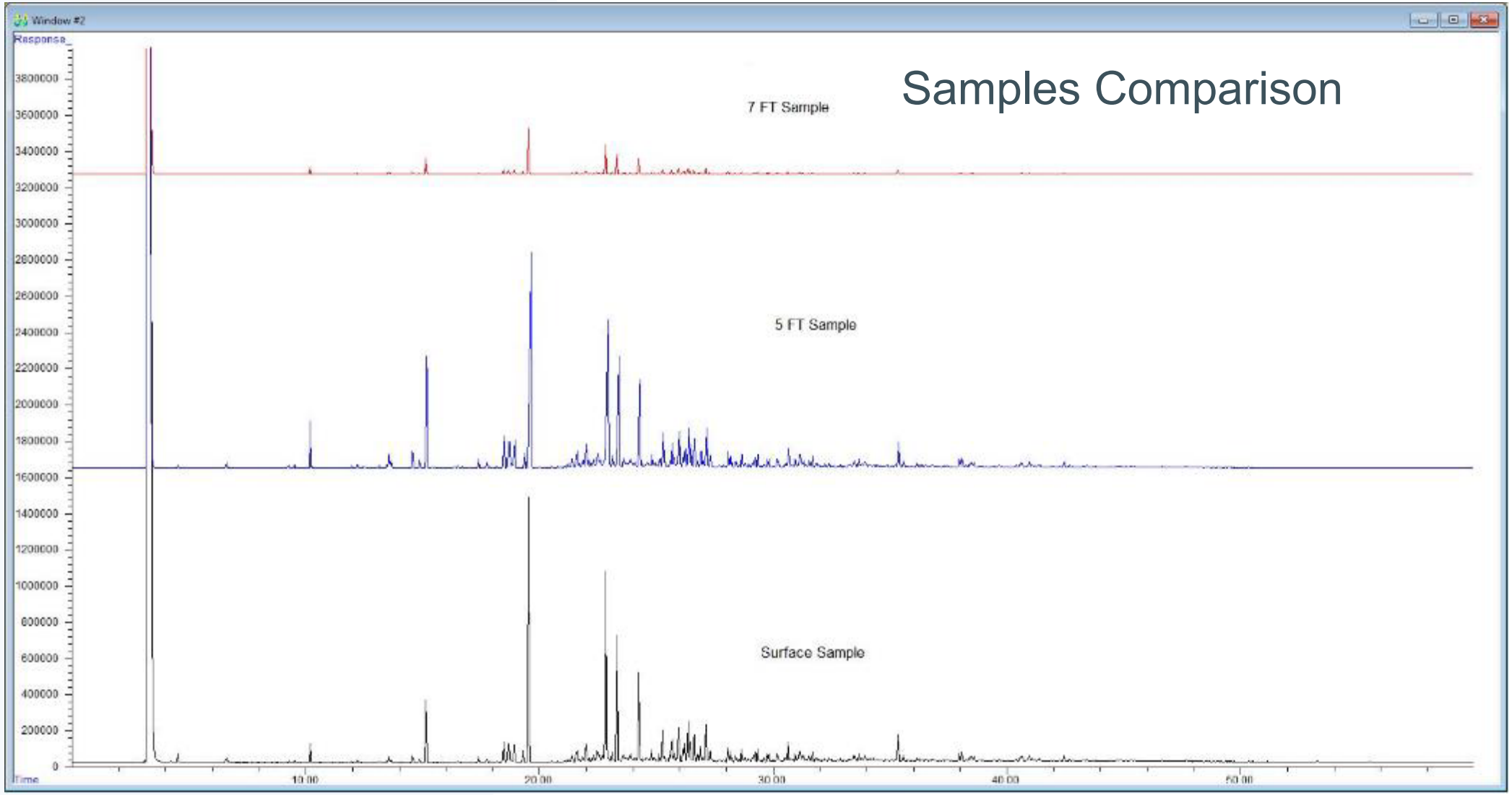
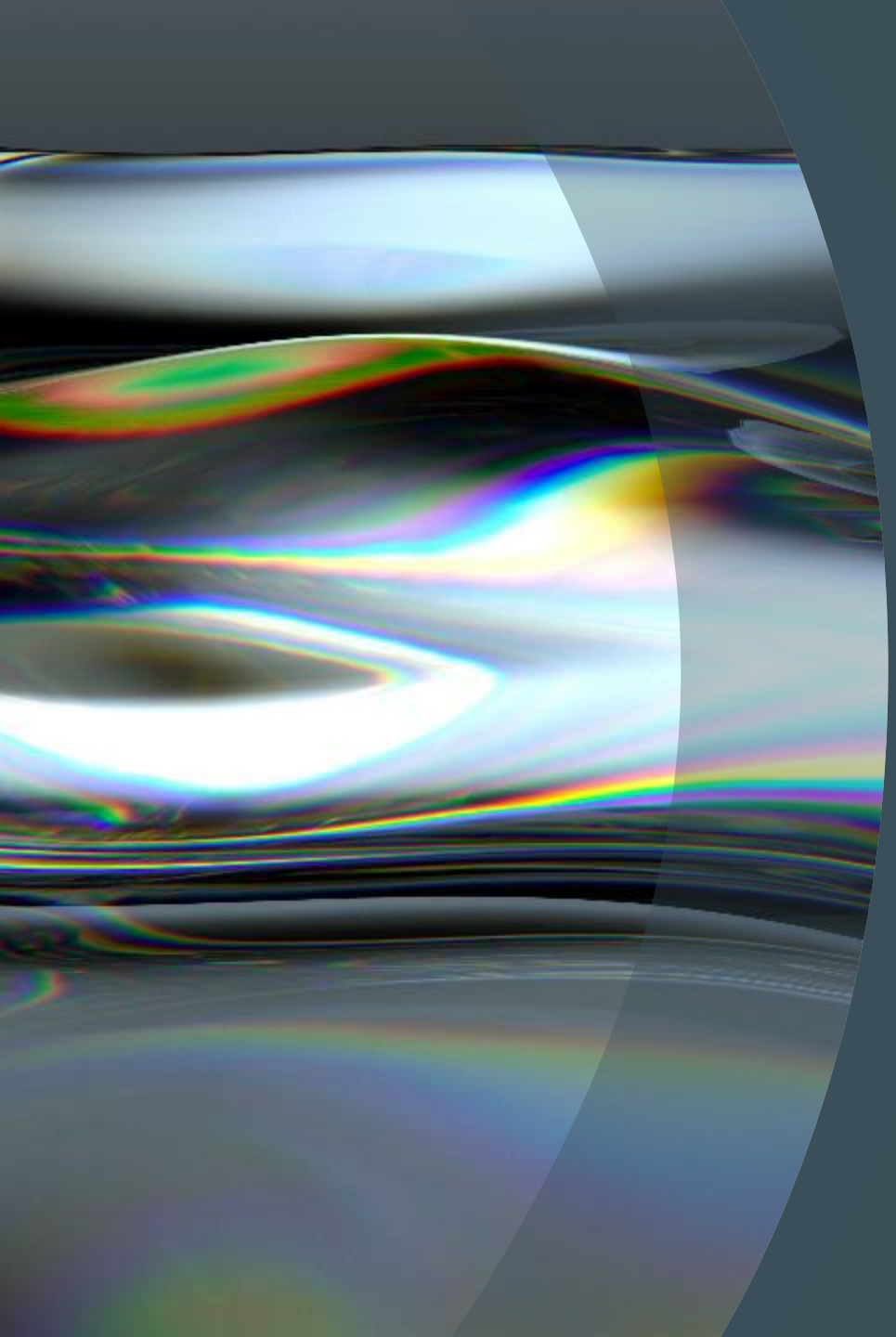
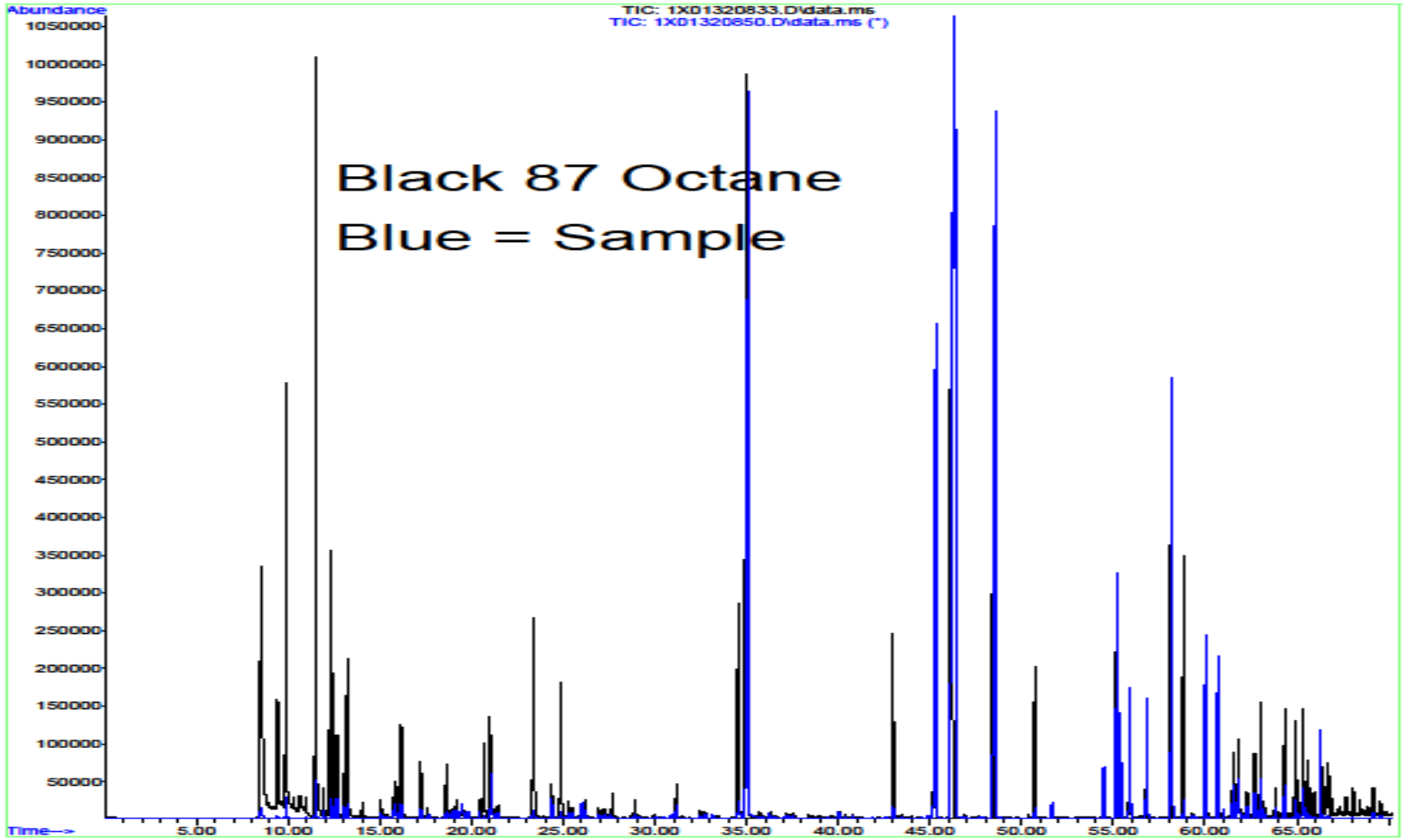




PIANO Analysis

Laboratory Information

PIANO Analysis – Sample vs. Product Comparison

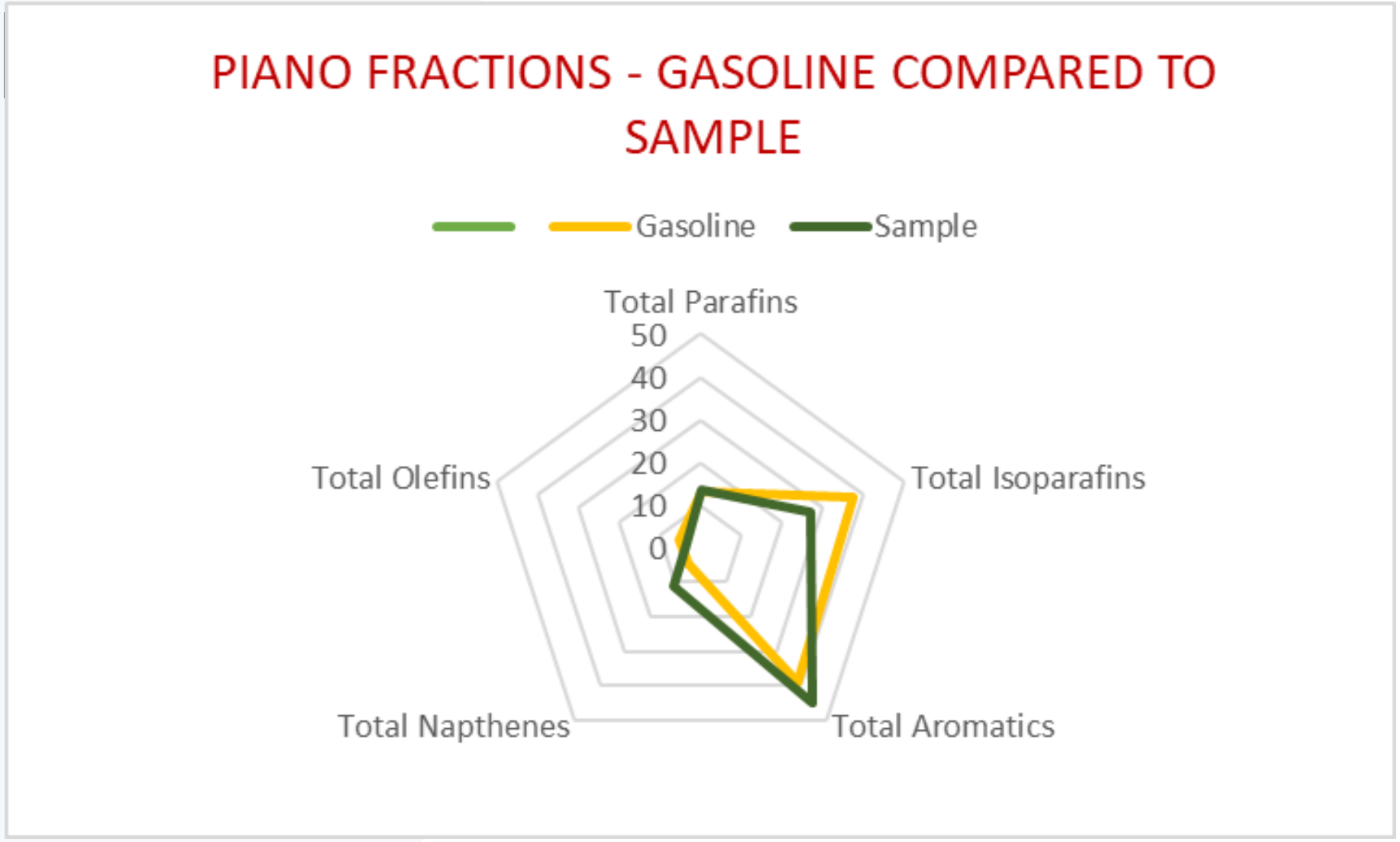


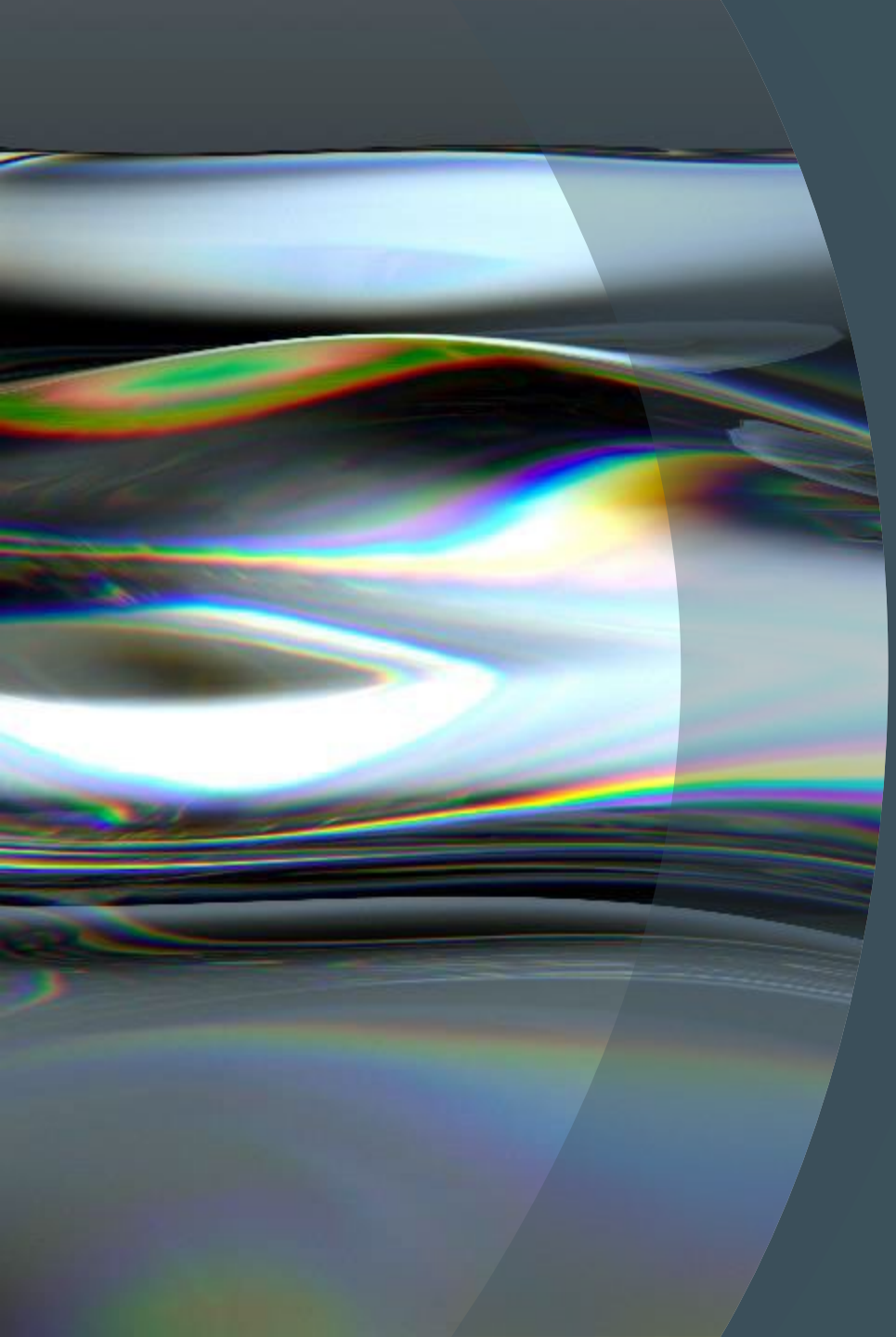
Laboratory Information - PIANO DIAGNOSTIC RATIOS

PIANO Composition			%Makeup
Total Parafins		185.84	12.98
Total Isoparafins		538.99	37.66
Total Aromatics		559.02	39.06
Total Napthenes		69.97	4.89
Total Olefins		77.39	5.41
Total		1431.20924	
DIAGNOSTIC Ratios			
Isomerization		Ratio	
Isopentane/Pentane		2.76	
2-Methylpentane/3-Methylpentane		1.8	
Evaporation			
n-Pentane/n-Heptane		16.43	
2-Methylpentane/2-Methylheptane		16.84	
Water Washing			
Benzene/Cyclohexane		4.09	
Toluene/Methylcyclohexane		12.09	
Aromatics/Parafins		3.01	
Aromatics/Napthenes		7.99	
Benzene/Toluene		0.33	
Toluene/Total Xylenes		0.94	
Biodegredation			
(C4 to C8 Parafins + Isoparafins) / C4-C8 Olefins		9.35	
3-methylhexane/n-Heptane		0.91	
Methylcyclohexane/n-Heptane		1.44	
Isoparaffins+Napthenes/Parafins		3.28	
Octane Rating/Alkylation			
2,2,4-Trimethylpentane / Methylcyclohexane		0.16	
Refining Ratios			
2,2,4-TMP+Toluene / n-C7+n-C8		13.58	
2,2,4-TMP / (2,2,4-TMP + 2,2,3 - TMP + 2,3,4-TMP + 2,3,3-TMP)		0.15	
i-C5 / (i-C5 + n-C5)		0.73	
Napthalene / n-C12		0.08	

87 Octane Gasoline

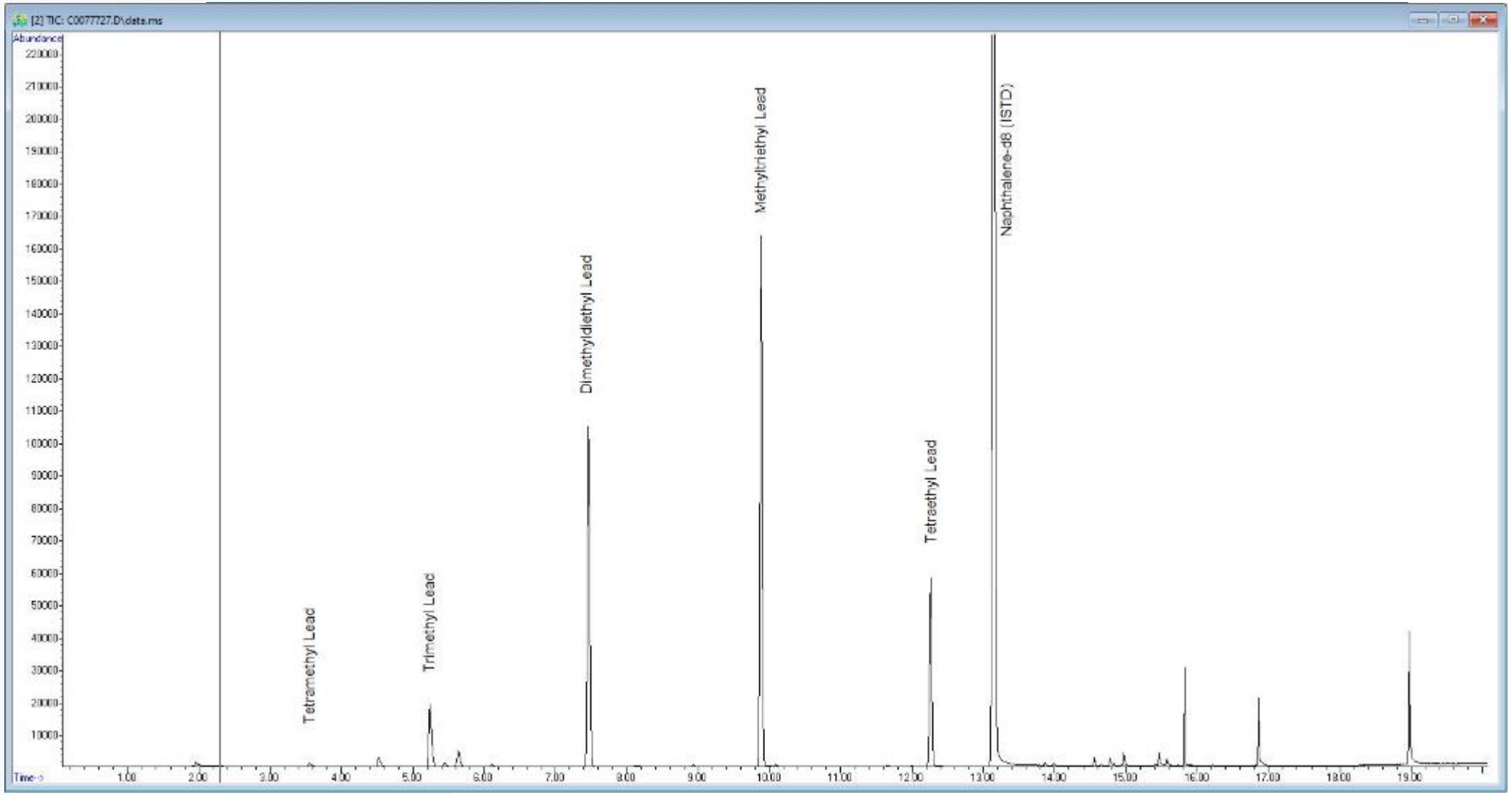
Laboratory Information - PIANO Fractions





Alkylated Leads

Laboratory Information – Alkylated Leads



Summary

Summary

- Whole Oil Analysis
  - GC/FID
- PIANO Analysis
  - GC/MS SW846 8260 Mod.
  - Oxygenates (Various time periods)
  - Thiophenes
  - Halogenated Additives
- Alkylated Leads
  - 5 Isomers
  - Isomers added at different points in time (1923-1992)

Thank you!

Do you have any questions?

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