



# Forensics Tools for Gasoline Spills and Case Studies

TCEQ ETFC 2025

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SAFER  
GREENER  
SMARTER





# 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





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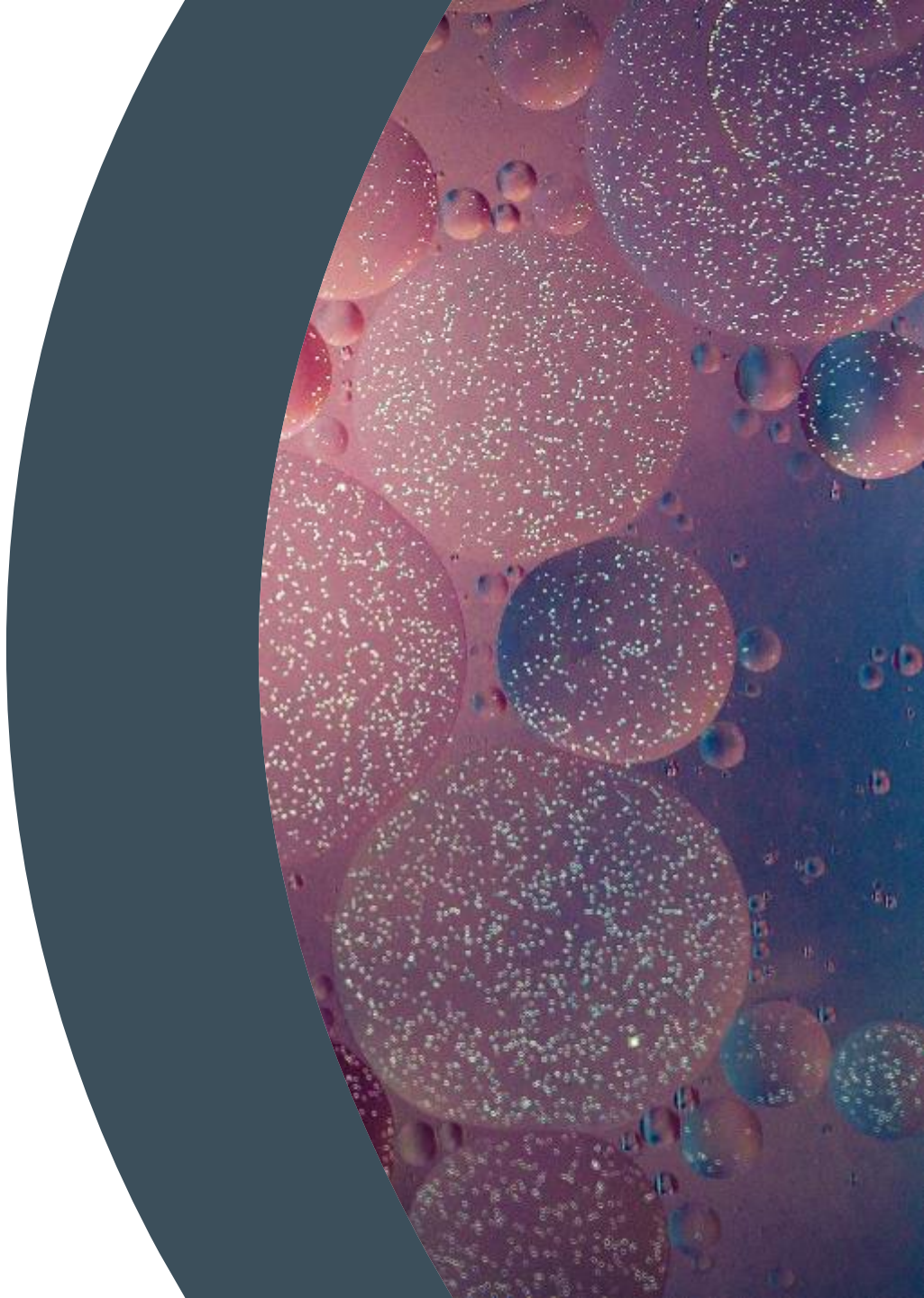
# Why do we need Hydrocarbon Fingerprinting?



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# Why do we need Hydrocarbon Fingerprinting?

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



A photograph of a pond or stream with a significant oil spill. The water is dark and covered in a thick layer of oil, with some ripples visible. A piece of wood or debris is floating in the water. The background shows dry grass and reeds.

## How do Hydrocarbons get into the Environment?


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# How do Hydrocarbons get into the Environment?

- Spills
- Leaks
- Explosions
- Natural Seeps
- Emissions





A decorative graphic on the left side of the slide, featuring several overlapping, semi-transparent yellow circles of various sizes. Some of these circles contain smaller, solid yellow circles, creating a nested or cellular effect. The background of the entire slide is a solid dark blue-grey color.

# What is necessary to perform Fingerprinting?

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# What is necessary to perform Fingerprinting?

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

**MORE INFORMATION  
THE BETTER!!!**







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# Two Tracks of Data Collection

# Two Tracks of Data Collection

- Regulatory Aspects
- Determination of Source/ Multiple Sources





A photograph of a beach with a large oil spill. The oil is dark and viscous, covering a significant portion of the sand. A yellow buoy is visible in the water. The image is partially obscured by a dark blue semi-circular overlay on the right side.

# 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)







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# 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

A large, semi-circular inset on the left side of the slide shows a photograph of an oil spill. A dark, thick line of oil is flowing from a source on the left, creating a series of arches and drips that fall into the water below. The background of the slide is a solid dark blue-grey color.

# 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

**DANGEROUS GOODS IN EXCEPTED**

This package contains dangerous goods in excepted s  
in all respects in compliance with applicable intern  
government regulations and the IATA Dangerous Goods

Signature of Shipper

Title Date

Name and Address of Shipper

This package contains substance(s) in Class(es)  
(check applicable box(es))

Class: 2 3 4 5 6 8 9

☐ ☐ ☐ ☐ ☐ ☐ ☐

and the applicable UN numbers are:

# 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







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## 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

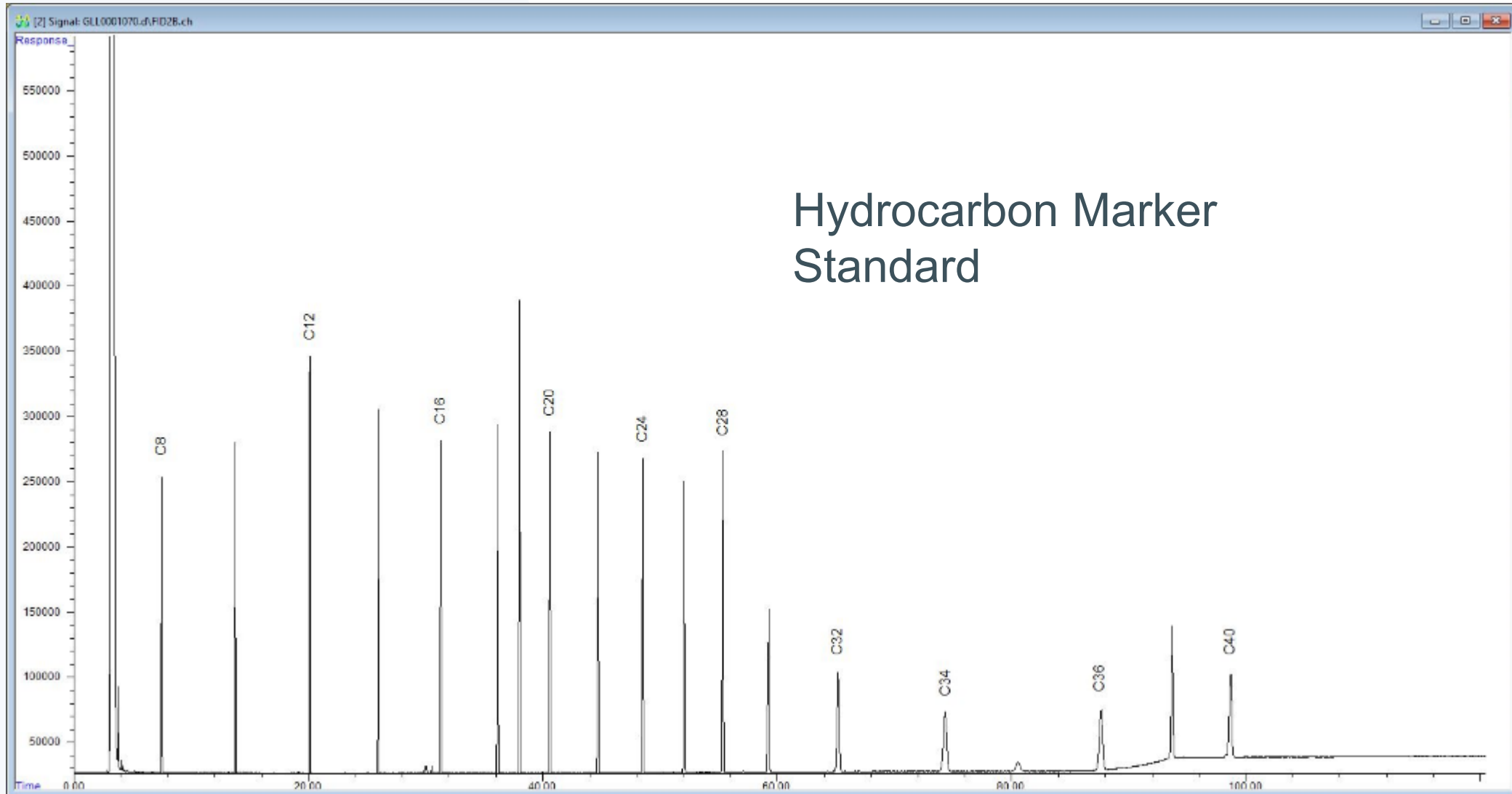


A large, abstract, colorful graphic on the left side of the slide, featuring horizontal bands of blue, green, yellow, and red, resembling a stylized oil spill or a microscopic view of oil.

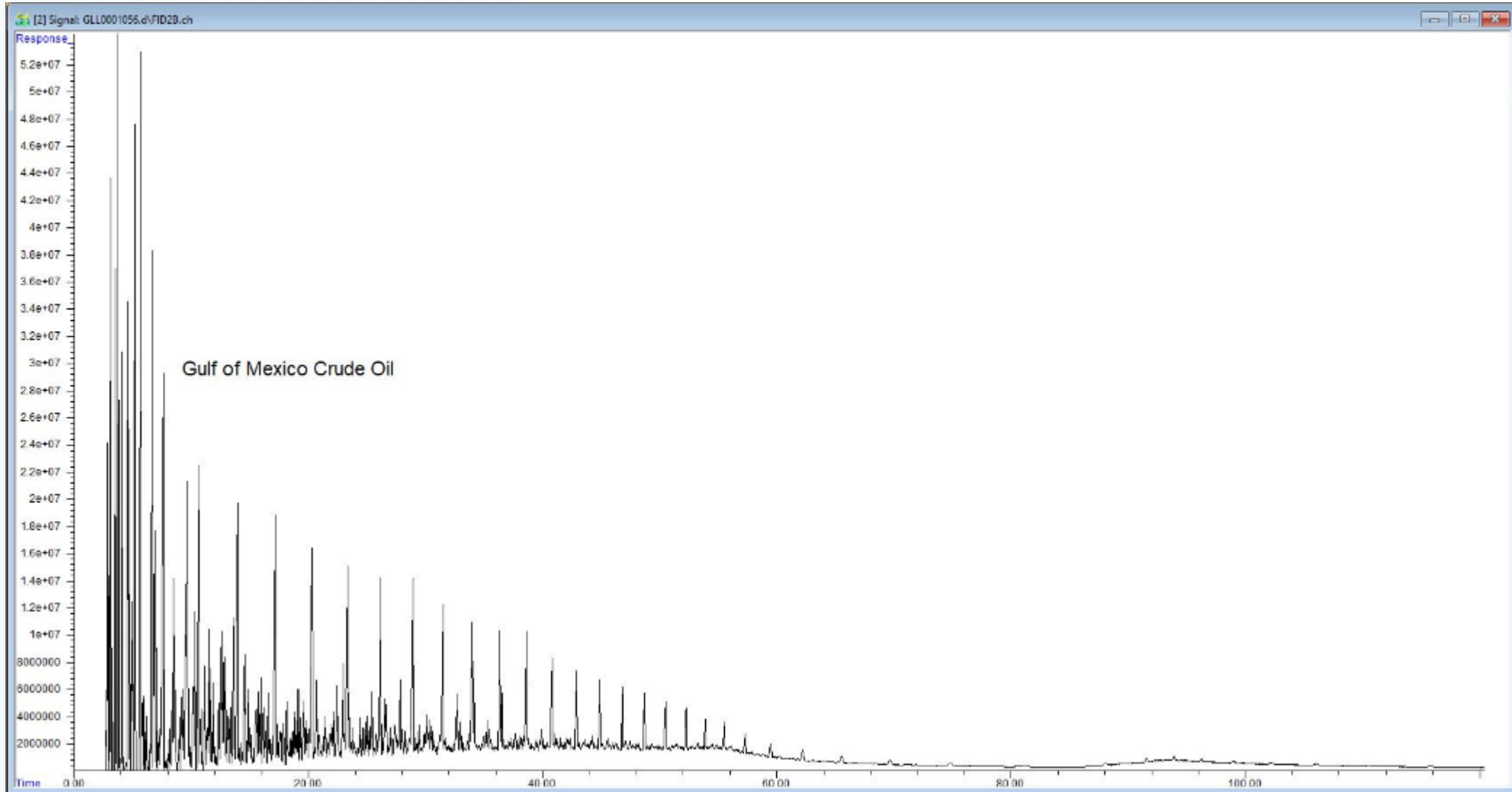
# Whole Oil Analysis Forensics



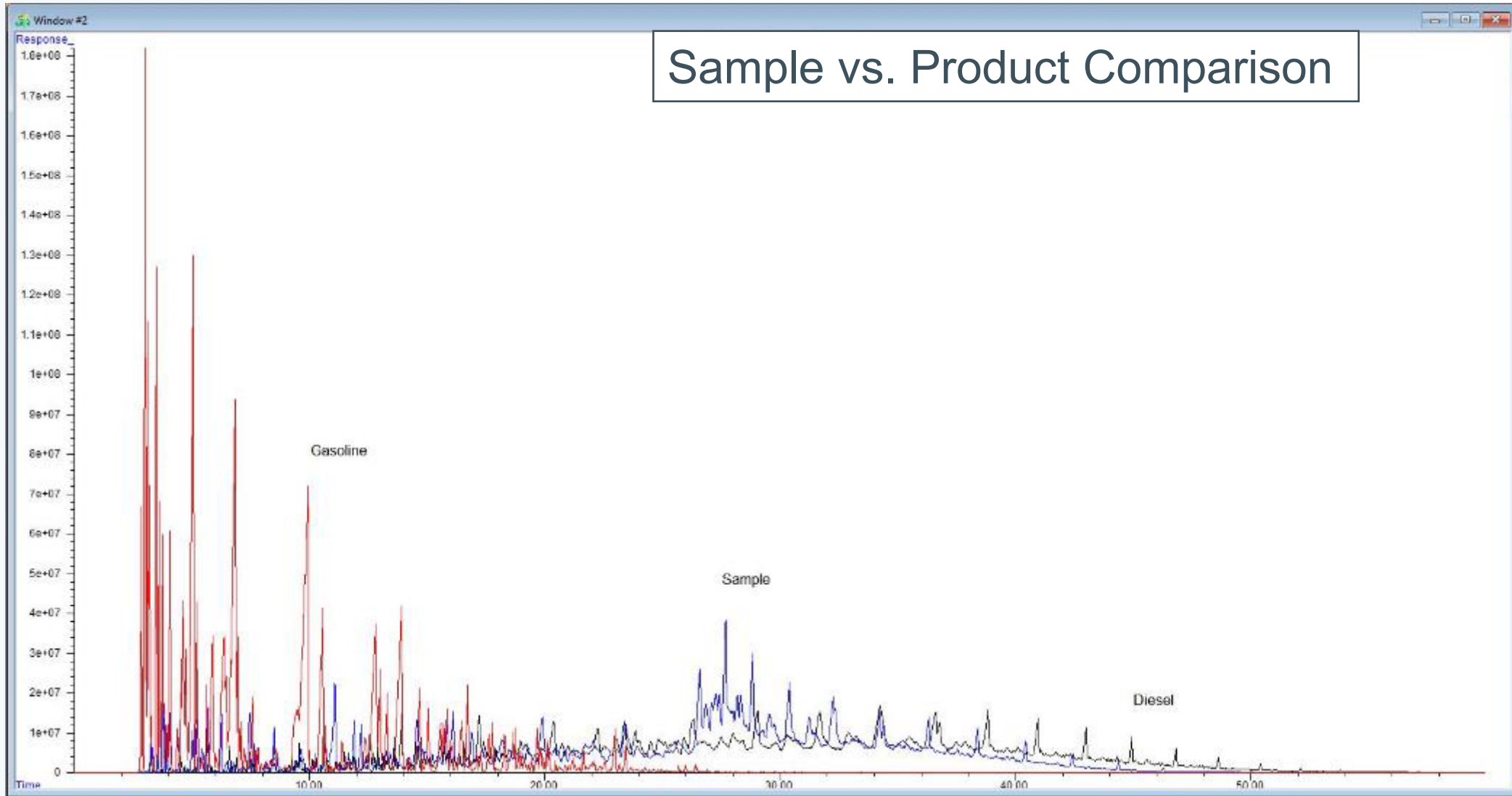
# Laboratory Information



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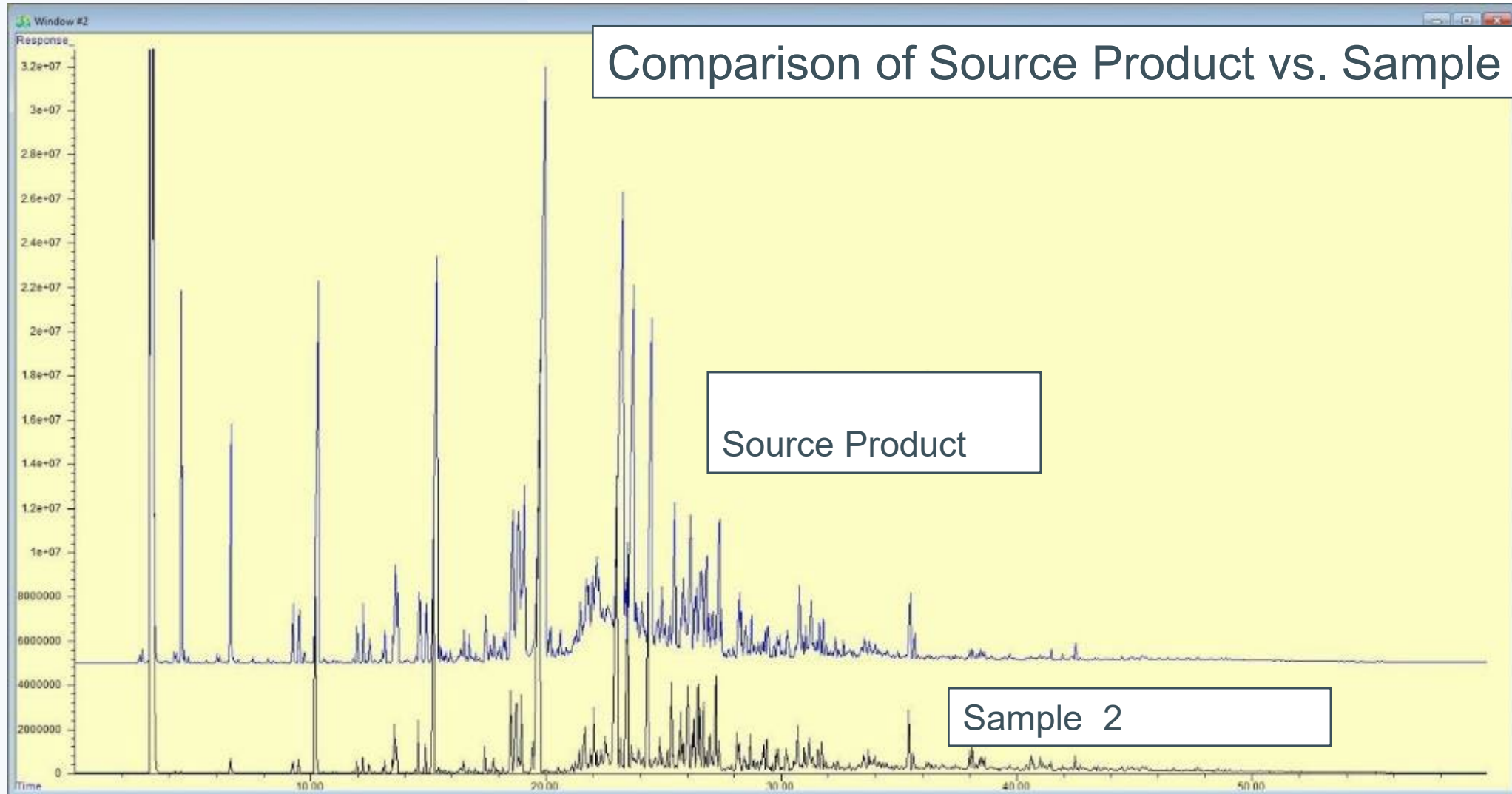


# Laboratory Information

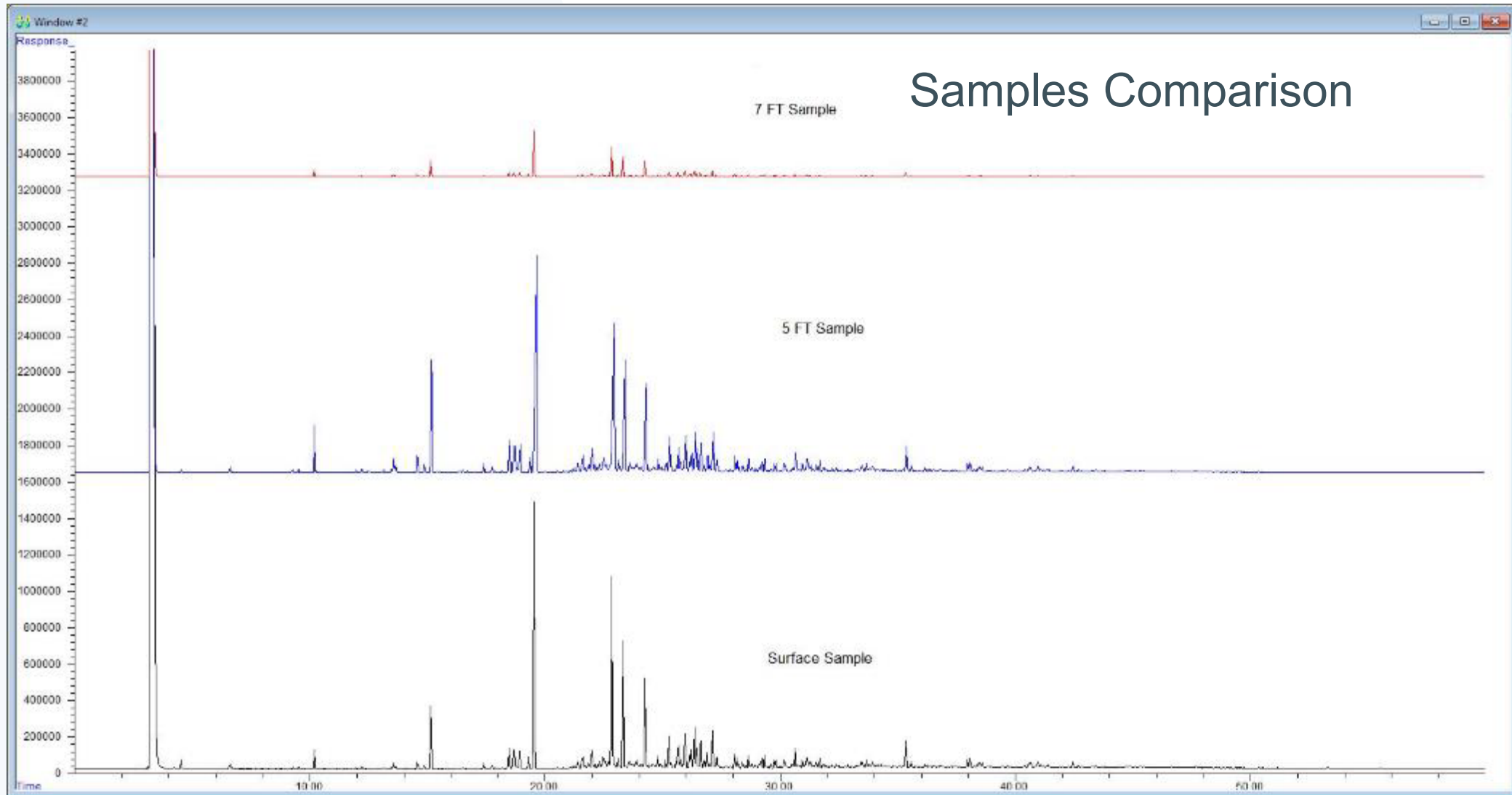




# Laboratory Information



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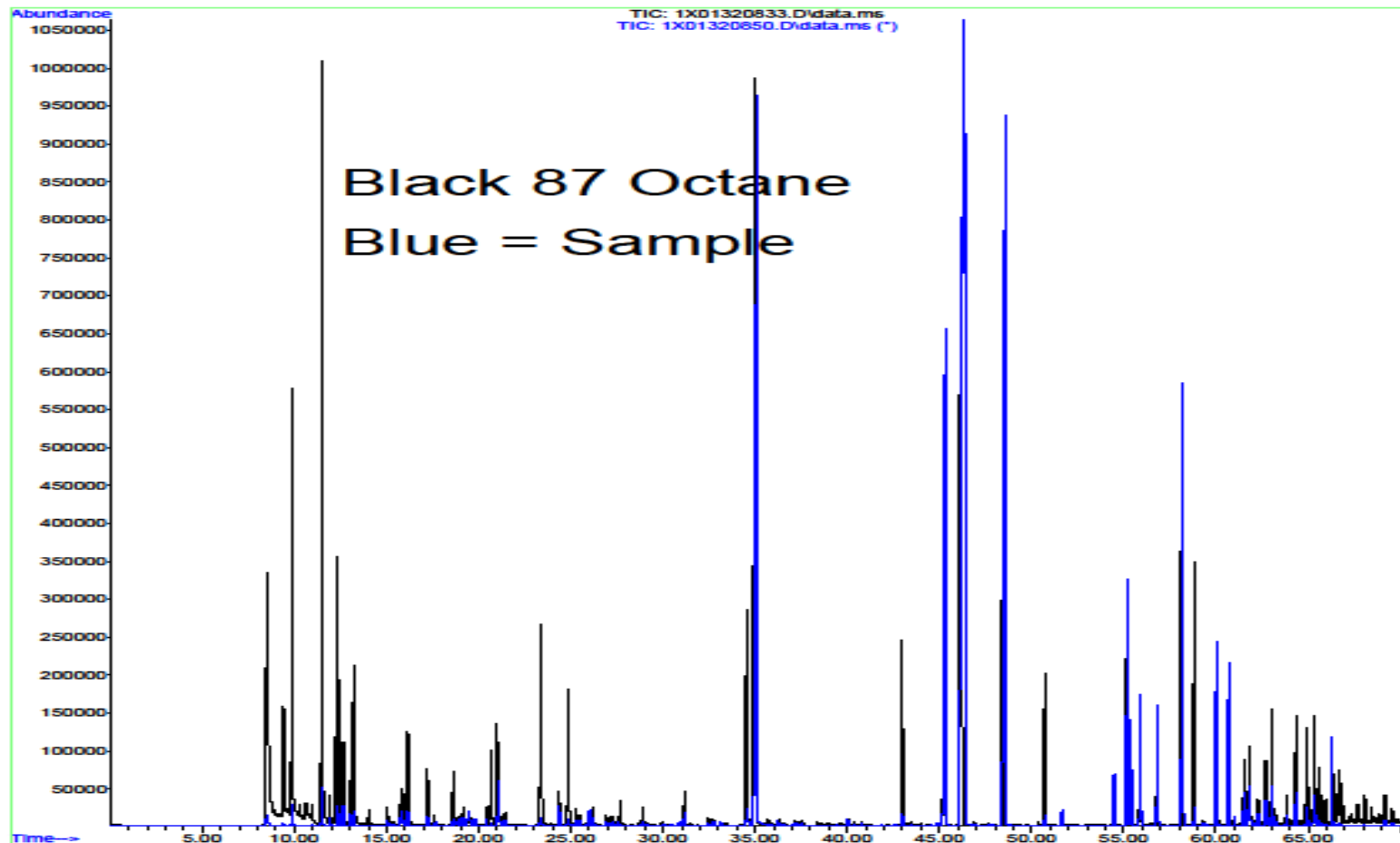


A large, abstract graphic on the left side of the slide, featuring a circular shape with a complex, multi-colored, and distorted internal pattern, resembling a lens flare or a stylized eye. The colors include white, yellow, green, blue, and red, set against a dark background.

# PIANO Analysis



## PIANO Analysis – Sample vs. Product Comparison



# Laboratory Information - PIANO DIAGNOSTIC RATIOS



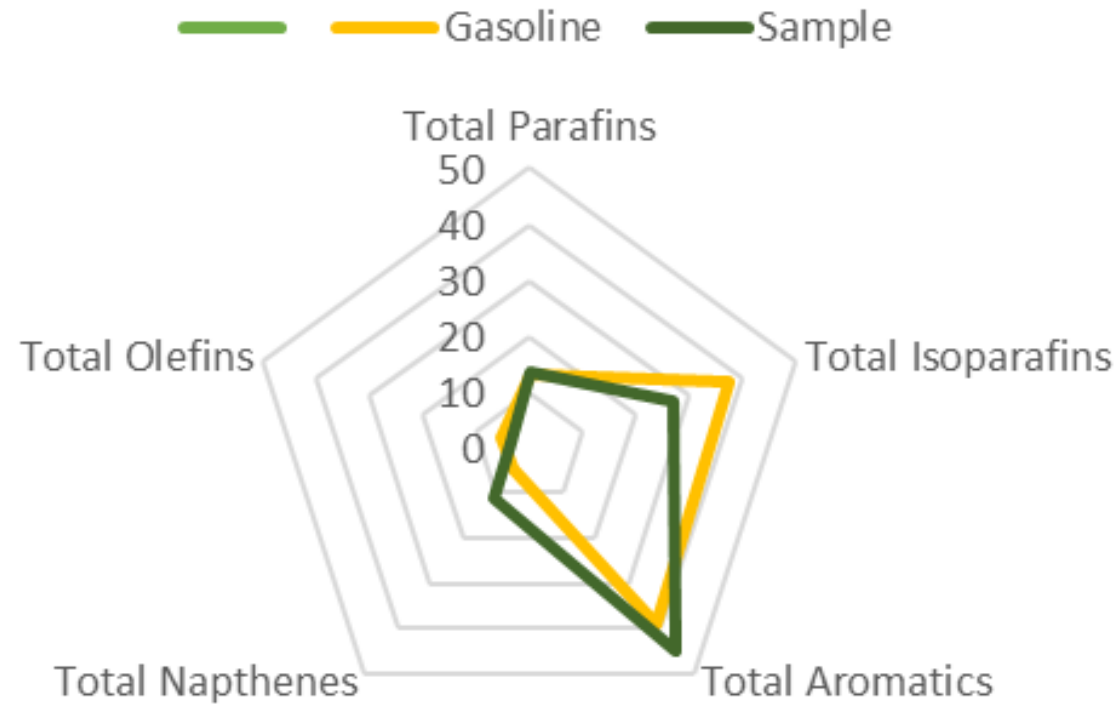
PIANO Composition		%Makeup	
Total Parafins		185.84	12.98
Total Isoparafins		538.99	37.66
Total Aromatics		559.02	39.06
Total Napthenes		69.97	4.89
Total Olefins		77.39	5.41
Total		1431.20924	
DIAGNOSTIC Ratios			
Isomerization		Ratio	
Isopentane/Pentane		2.76	
2-Methylpentane/3-Methylpentane		1.8	
Evaporation			
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	
Biodegradation			
(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



## PIANO FRACTIONS - GASOLINE COMPARED TO SAMPLE

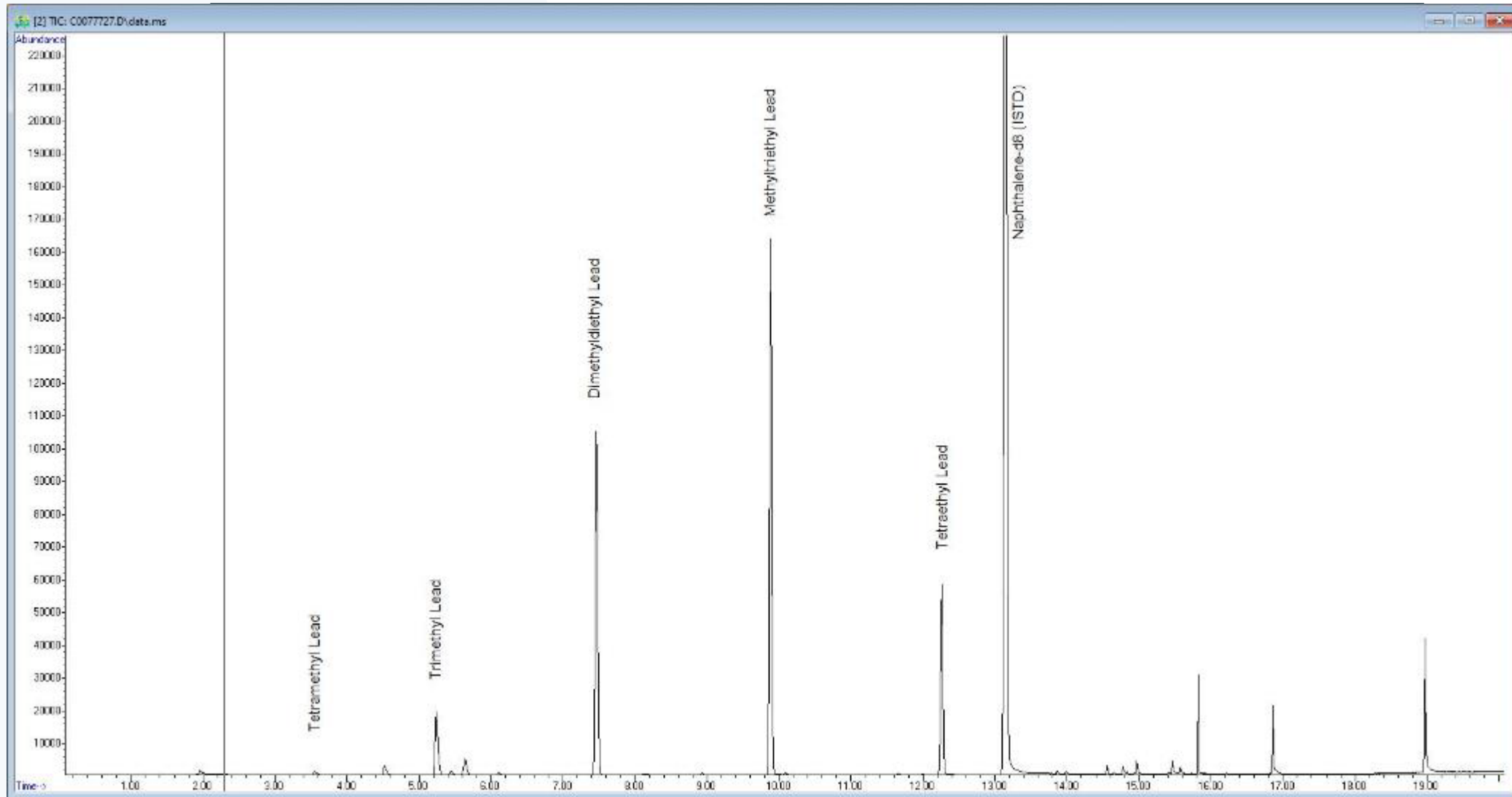




A large, semi-circular abstract graphic on the left side of the slide. It features a dark background with vibrant, horizontal, wavy bands of light in shades of blue, green, yellow, and red, creating a sense of motion and depth.

# Alkylated Leads

# Laboratory Information – Alkylated Leads



A large, semi-circular graphic on the left side of the slide features a high-speed photograph of a water droplet falling and creating a splash. The droplet is suspended in mid-air, and the splash below it is detailed with ripples and smaller droplets. The background of the splash is a blurred, blue-toned industrial or laboratory setting.

# 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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