



# Forensics Analysis – Gasoline Releases

NEMC 2025

Kesavalu M. Bagawandoss, Ph.D., J.D. | August 5, 2025 | 2:00 to 02:30 PM

SAFER  
GREENER  
SMARTER

SGS



A large, circular, semi-transparent graphic on the left side of the slide, featuring a vibrant blue water splash with numerous bubbles and droplets, creating a dynamic and textured appearance.

# Agenda

- Introduction
- 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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## Two Tracks of Data Collection

# Two Tracks of Data Collection

- Regulatory Aspects
- Determination of Source/ Multiple Sources





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# Analytical Tiers



# Analytical Tiers

- Tier I – GC/FID\*
- Tier II – GC/MS (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 D3328 (whole Oil)
- Physical Parameters by ASTM methods







## 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 image on the left side of the slide shows a dark, viscous liquid, likely oil, dripping from a curved structure into the water. 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

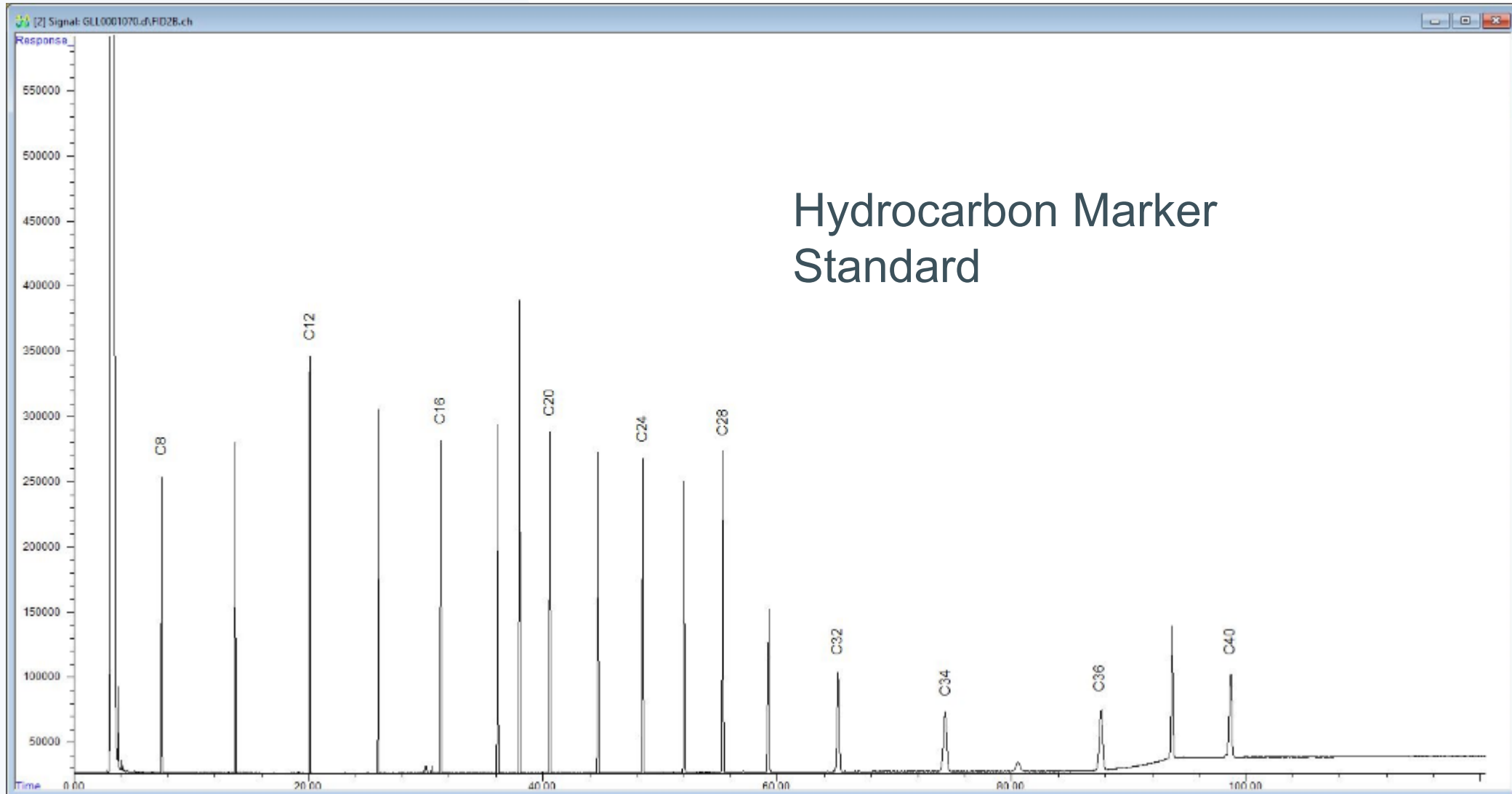
- GC/FID traces
- Total Ion Chromatograms
- Overlays based on Source Product or SGS Library
- Overlays comparison over time
- Overlays based on excavations at various intervals
- Diagnostic Ratios
- Radar Plots
- Data Interpretation Reports



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. It is partially enclosed by a dark, curved shape.

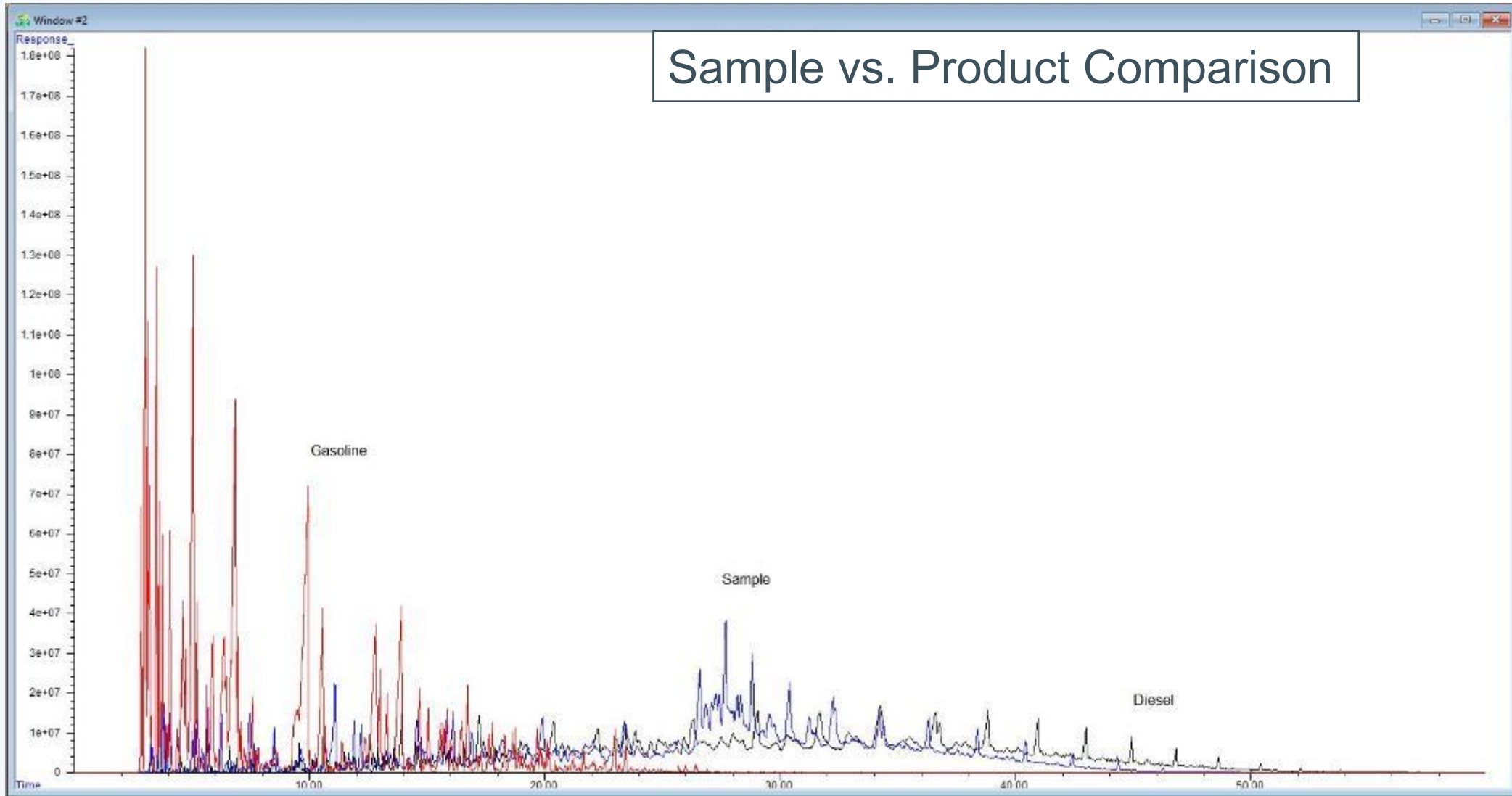
# Whole Oil Analysis Forensics

# Laboratory Information

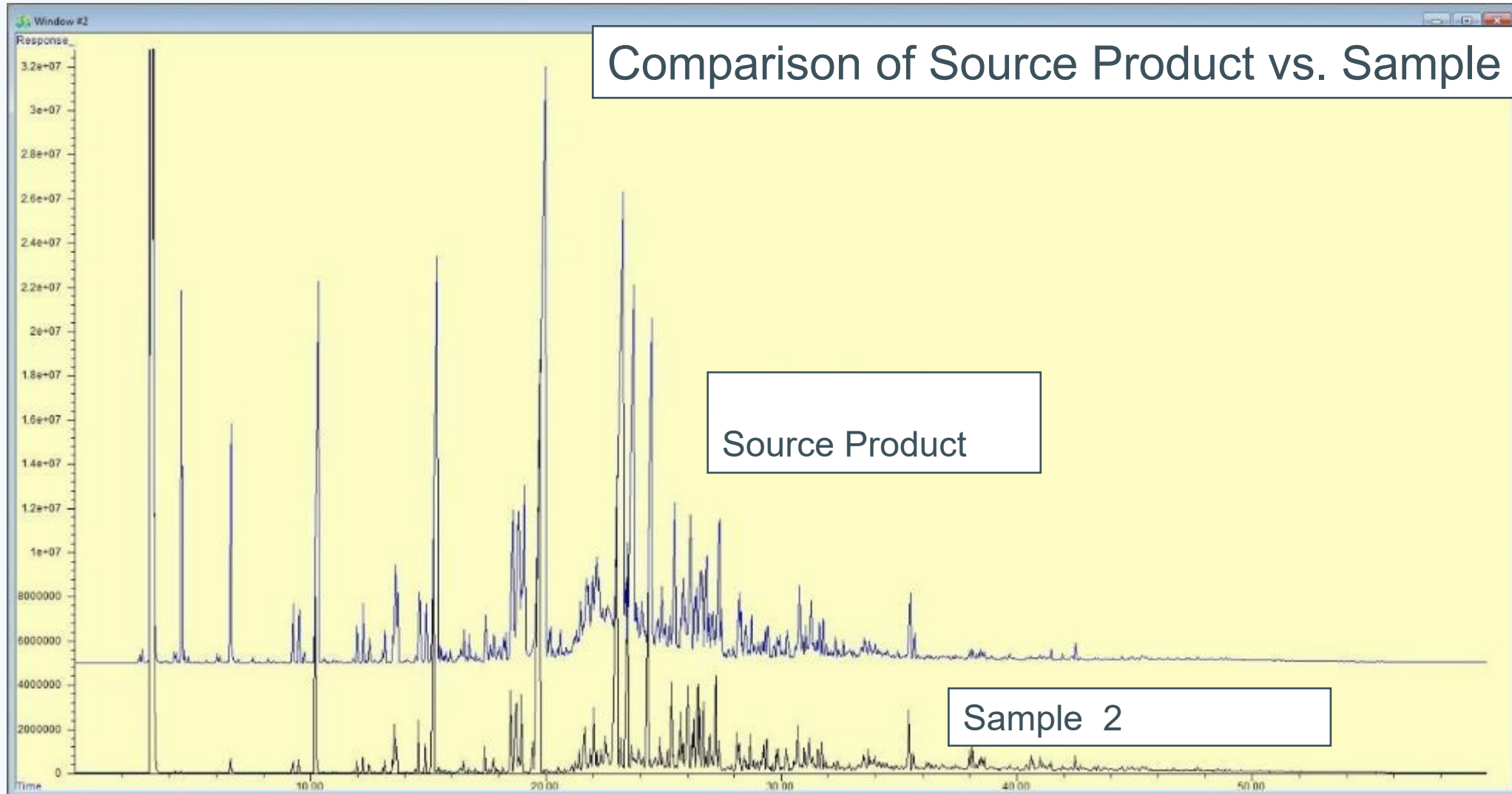




# Laboratory Information



# Laboratory Information

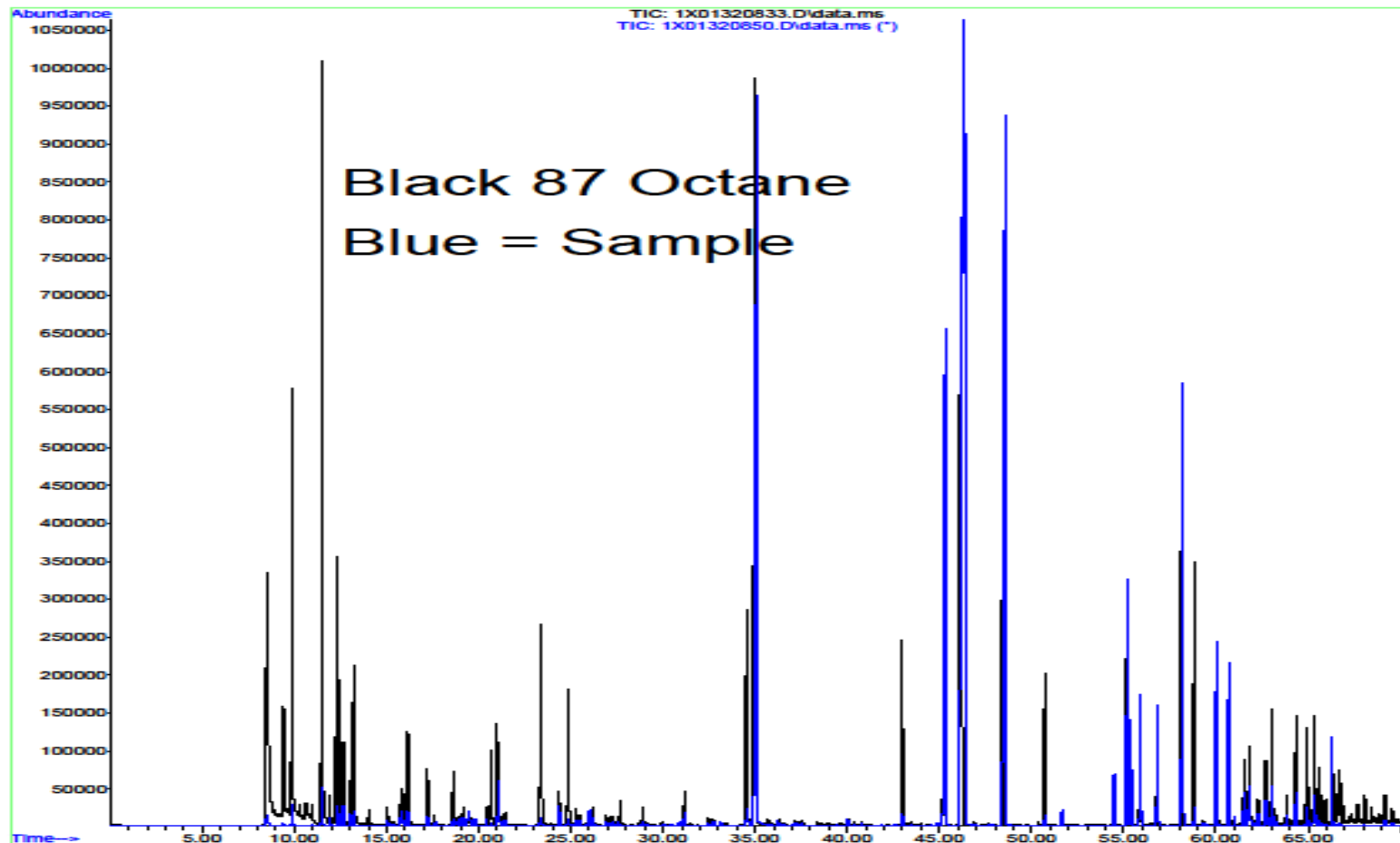


A large, abstract graphic on the left side of the slide, featuring a circular shape with a complex, multi-colored, and distorted internal pattern, resembling a lens flare or a stylized eye. The colors include bright yellow, green, blue, and red, set against a dark background.

# PIANO Analysis



## PIANO Analysis – Sample vs. Product Comparison



# Laboratory Information - PIANO DIAGNOSTIC RATIOS



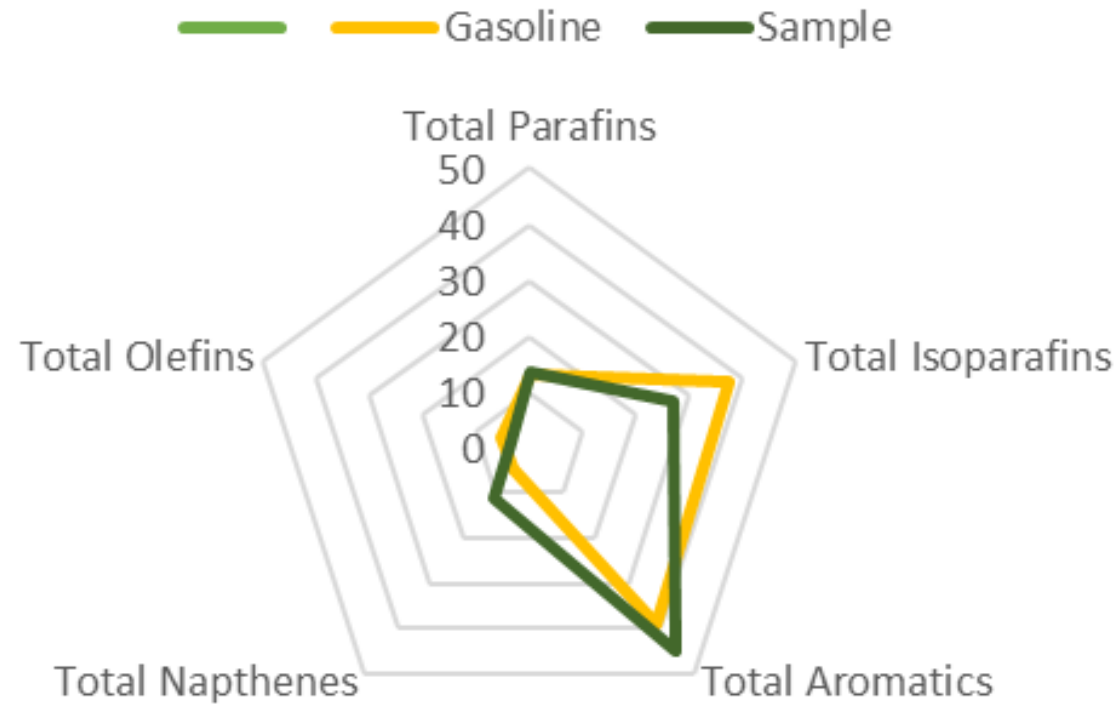
PIANO Composition		%Makeup	
Total Parafins		185.84	12.98
Total Isoparafins		538.99	37.66
Total Aromatics		559.02	39.06
Total Napthenes		69.97	4.89
Total Olefins		77.39	5.41
Total		1431.20924	
DIAGNOSTIC Ratios			
Isomerization		Ratio	
Isopentane/Pentane		2.76	
2-Methylpentane/3-Methylpentane		1.8	
Evaporation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

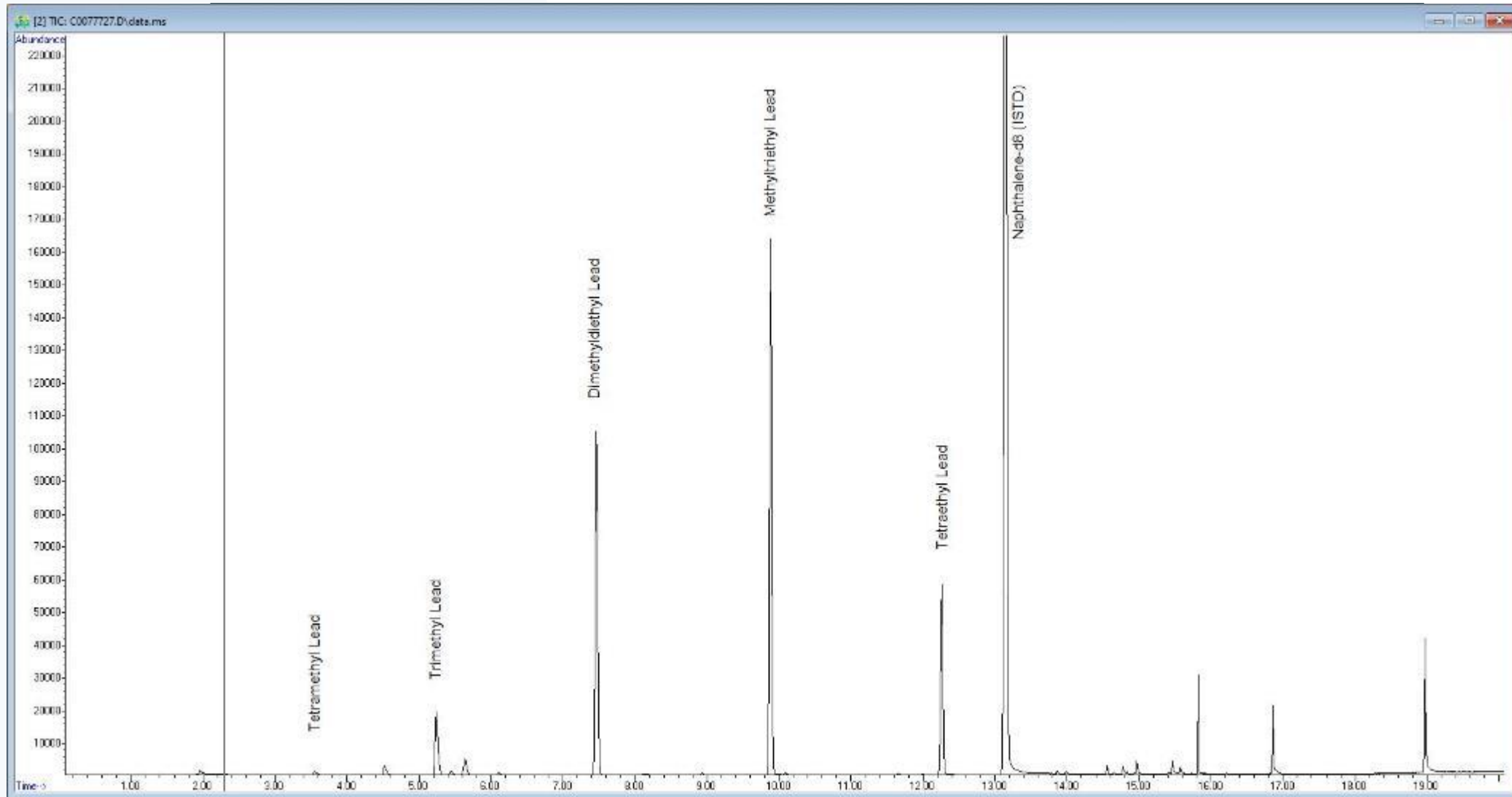




A large, semi-circular abstract graphic on the left side of the slide. It features a spectrum of colors including blue, green, yellow, and red, with a bright white light source on the left creating a lens flare effect. The colors are layered and wavy, giving it a sense of depth and movement.

# Alkylated Leads

# Laboratory Information – Alkylated Leads



A large, semi-circular graphic on the left side of the slide. It features a high-speed photograph of a water droplet falling and creating a splash. The droplet is suspended in mid-air above a pool of water, with a smaller droplet visible just below it. The background is a blurred, blue-toned image of water.

## 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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