# Tank Release or Hydrocarbon Remobilization?

NEMC, August 8, 2016
Anaheim, California

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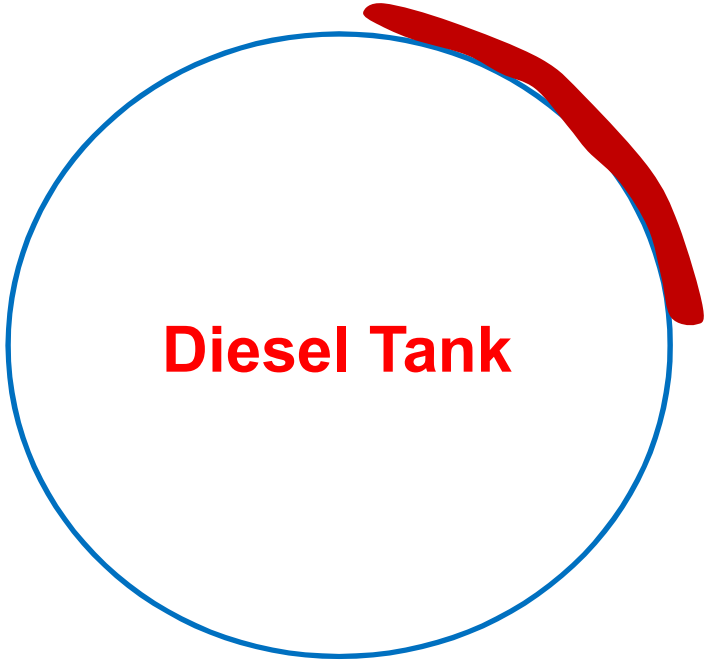
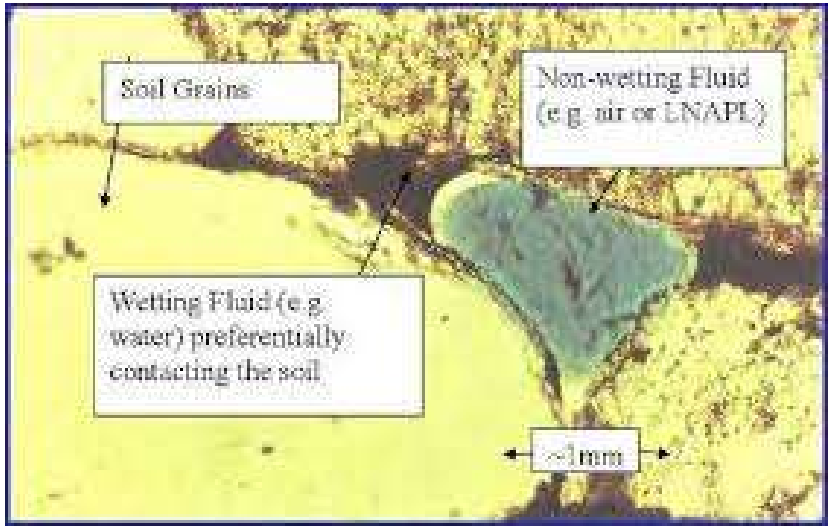
# SITE BACKGROUND

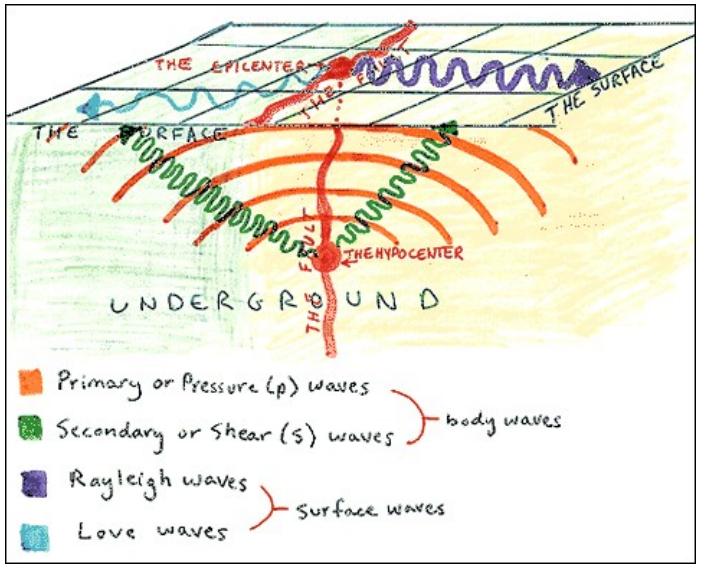
- Background
  - A diesel storage tank at a petroleum facility
  - Oil staining observed in the tank perimeter after a major earthquake in the area
- Investigation
  - Tank inspection and testing
  - Seismic waves vs. LNAPL  mobility
  - Forensic analysis



# SEISMIC WAVES VS. LNAPL MIGRATION

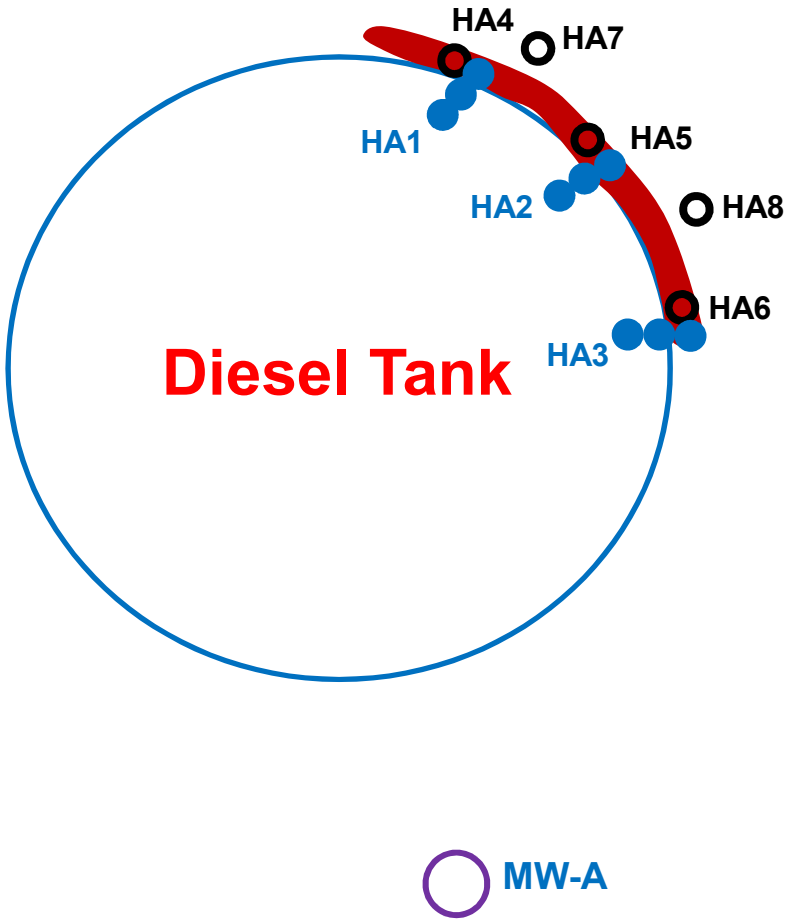
- LNAPL mobility
  - Capillary pressure
  - Entrance pressure
- Seismic waves
  - P waves
  - S waves
- Seismic wave induced LNAPL migration
  - Oil seeps in N. Ojai Valley (USGS)
  - LNAPL occurrences in monitoring wells (LU)
  - Others



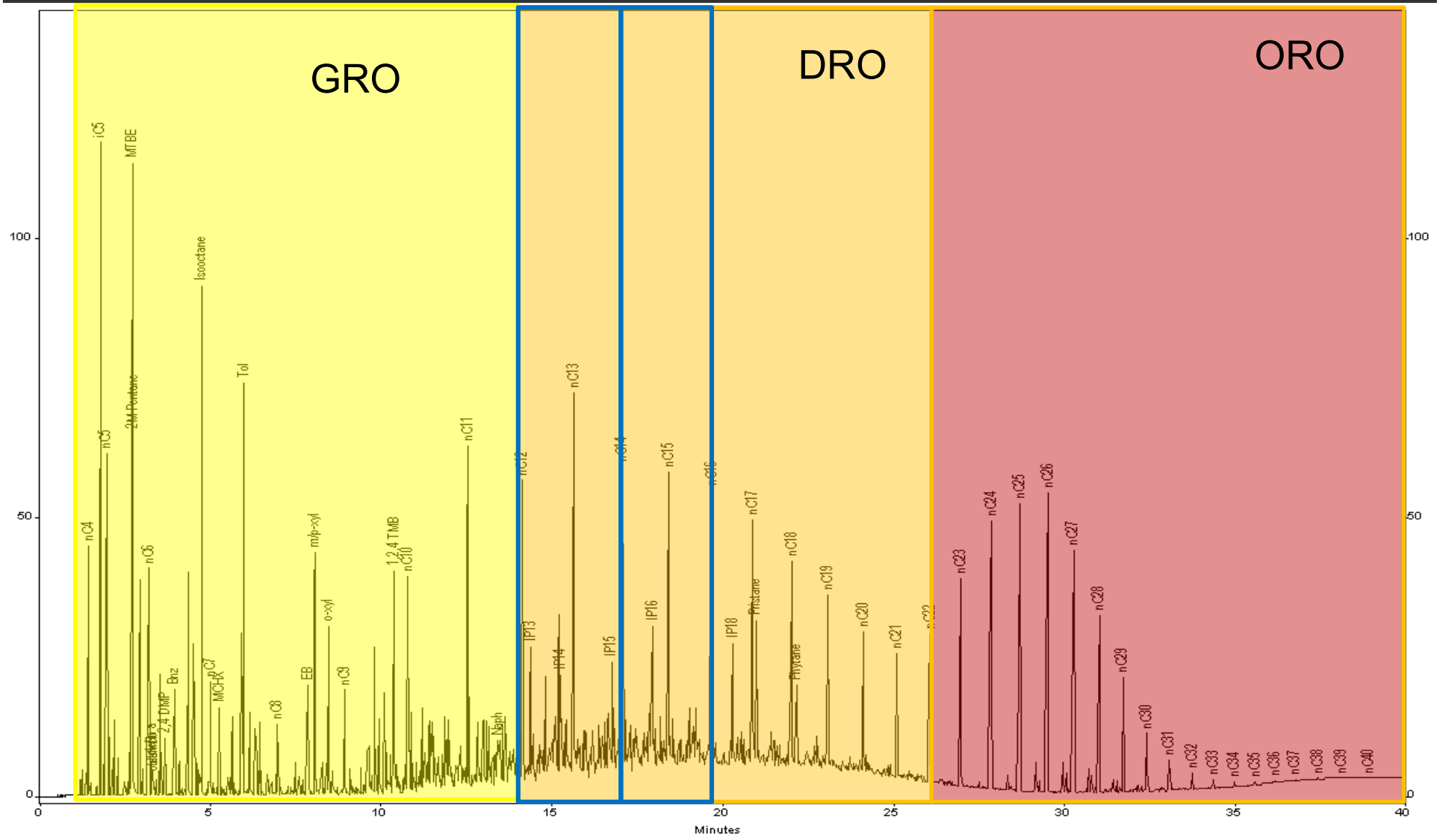



# FORENSIC ANALYSIS

- Sampling
  - Fresh diesel fuel from the tank
  - Soil samples
  - LNAPL sample from a well nearby
- Tiered approach
  - Visual examination/PID
  - Carbon chain screening analysis
  - GC/MS full scan
  - GC/MS SIM biomarkers



# CARBON CHAIN ANALYSIS - CONCEPT

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# CARBON CHAIN ANALYSIS – AN EXAMPLE

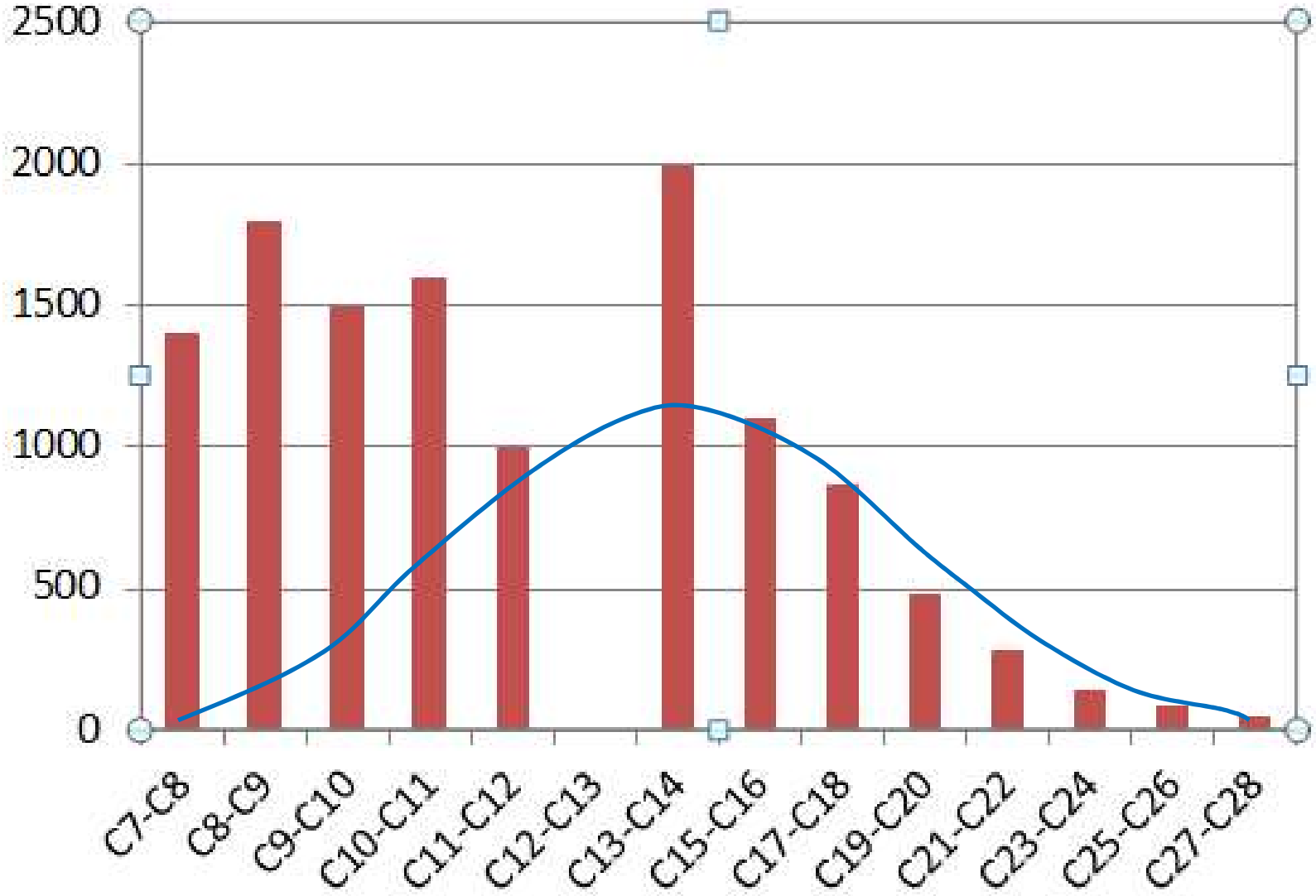
## Method: 8015B - Gasoline Range Organics - (GC)

| Analyte | Result | Qualifier | RL | MDL | Unit |
|---|---|---|---|---|---|
| C7-C8 | 1400 | J | 2000 | 980 | mg/Kg |
| C8-C9 | 1800 | J | 2000 | 980 | mg/Kg |
| C9-C10 | 1500 | J | 2000 | 980 | mg/Kg |
| C10-C11 | 1600 | J | 2000 | 980 | mg/Kg |
| C11-C12 | 1000 | J | 2000 | 980 | mg/Kg |
| C12-C13 | ND | | 2000 | 980 | mg/Kg |

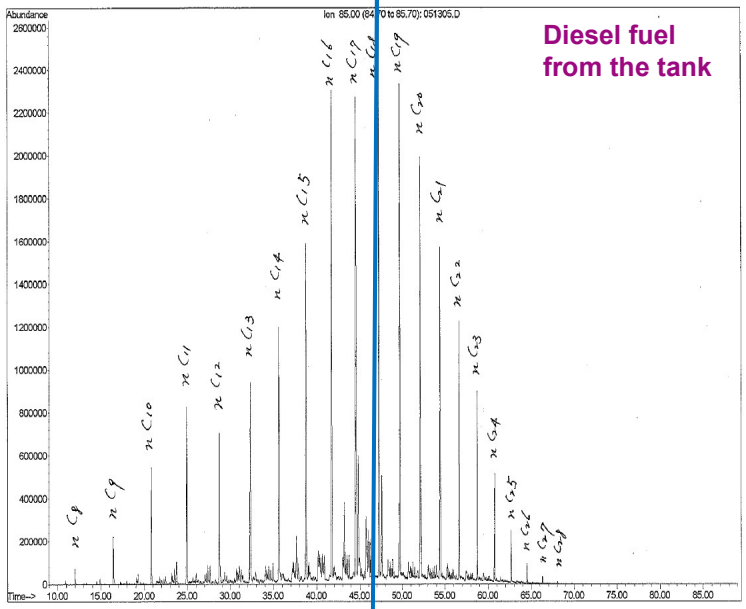
## Method: 8015B - Diesel Range Organics (DRO) (GC)

| Analyte | Result | Qualifier | RL | MDL | Unit |
|---|---|---|---|---|---|
| EFH (C13-C14) | 2000 | | 50 | 25 | mg/Kg |
| EFH (C15-C16) | 1100 | | 50 | 25 | mg/Kg |
| EFH (C17-C18) | 870 | | 50 | 25 | mg/Kg |
| EFH (C19-C20) | 480 | | 50 | 25 | mg/Kg |
| EFH (C21-C22) | 280 | | 50 | 25 | mg/Kg |
| EFH (C23-C24) | 140 | | 50 | 25 | mg/Kg |
| EFH (C25-C26) | 83 | | 50 | 25 | mg/Kg |
| EFH (C27-C28) | 50 | | 50 | 25 | mg/Kg |

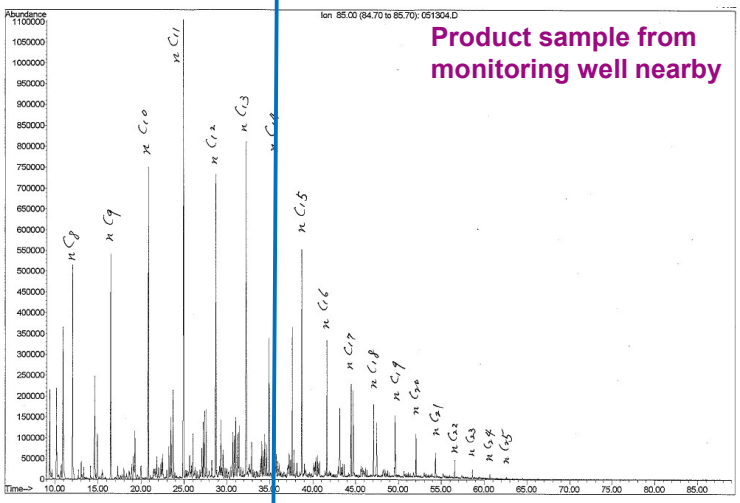
# CARBON CHAIN ANALYSIS – AN EXAMPLE (CONTINUED)



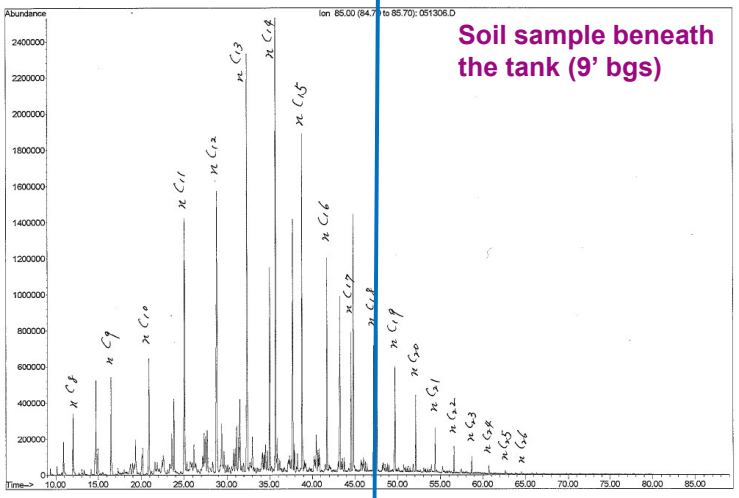
# GC/MS FULL SCAN – M/Z 85



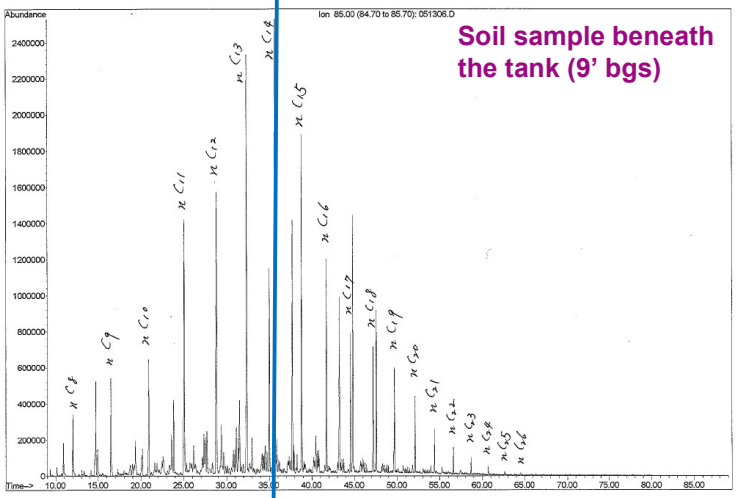

Diesel fuel from the tank




Product sample from monitoring well nearby




Soil sample beneath the tank (9' bgs)




Soil sample beneath the tank (9' bgs)



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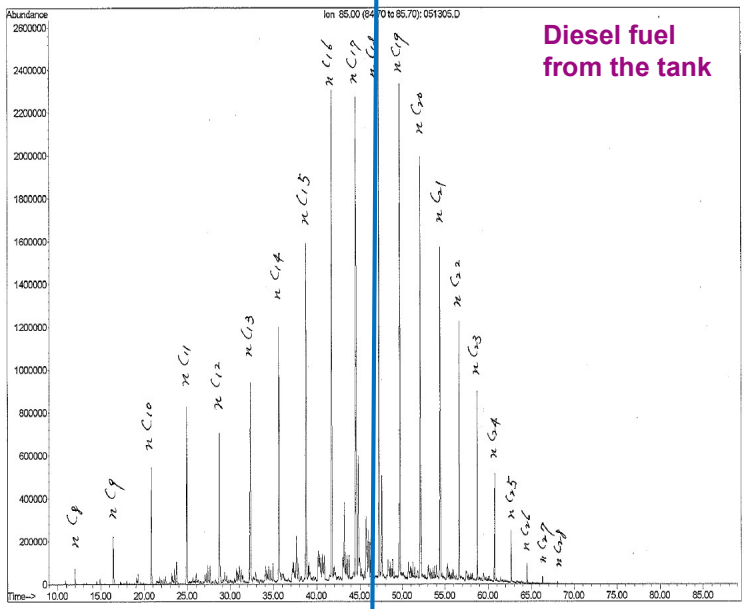
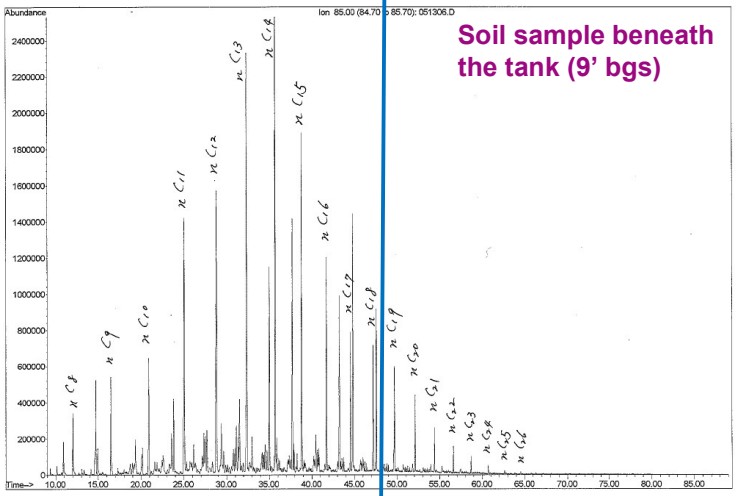
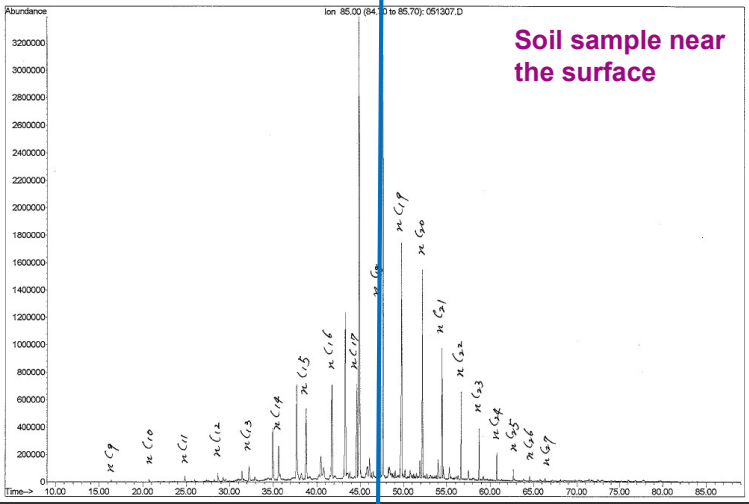


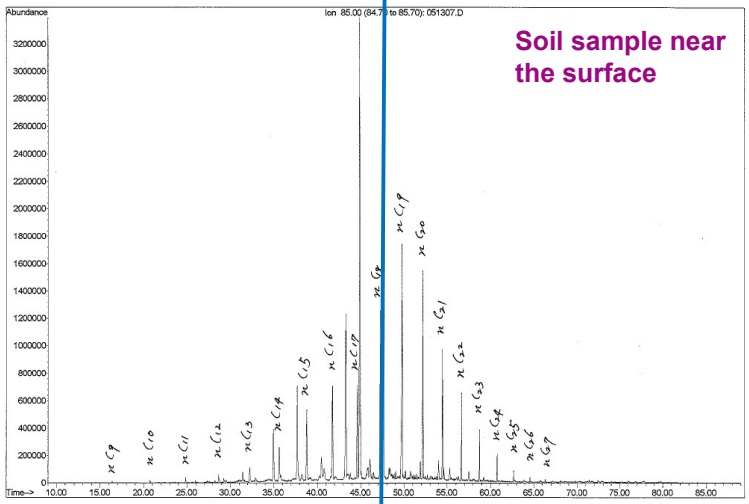

Diesel fuel from the tank




Soil sample beneath the tank (9' bgs)




Soil sample near the surface




Soil sample near the surface



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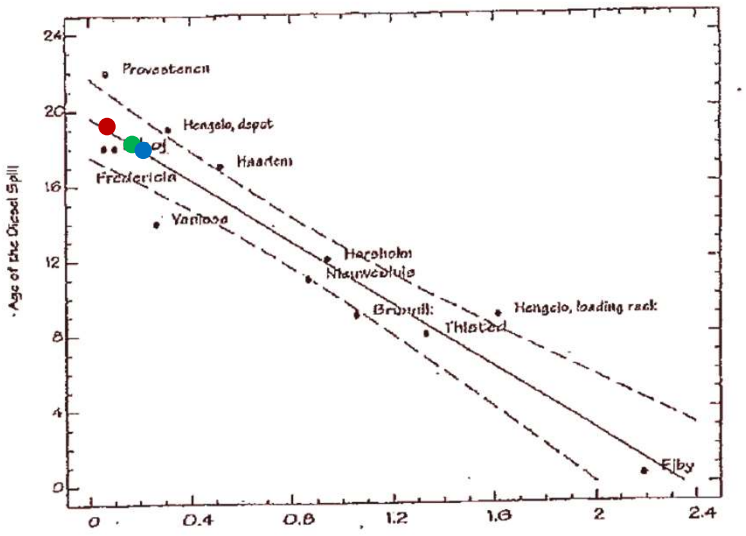
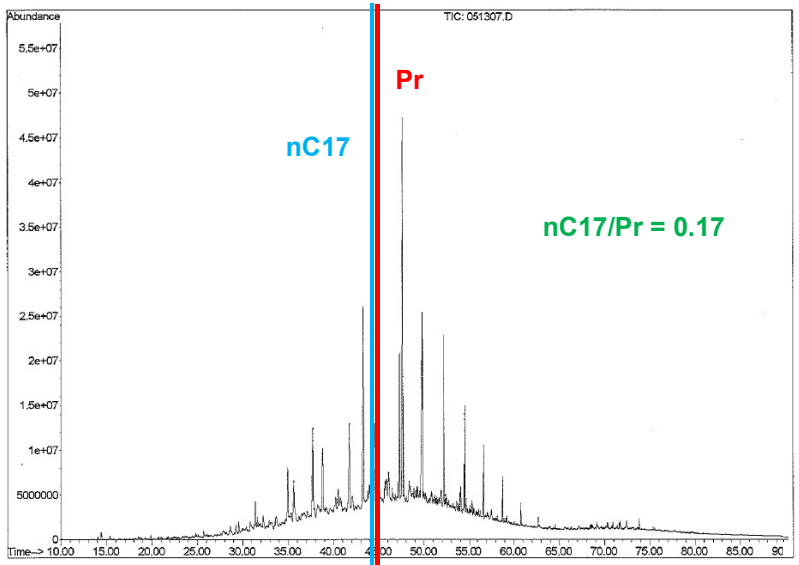
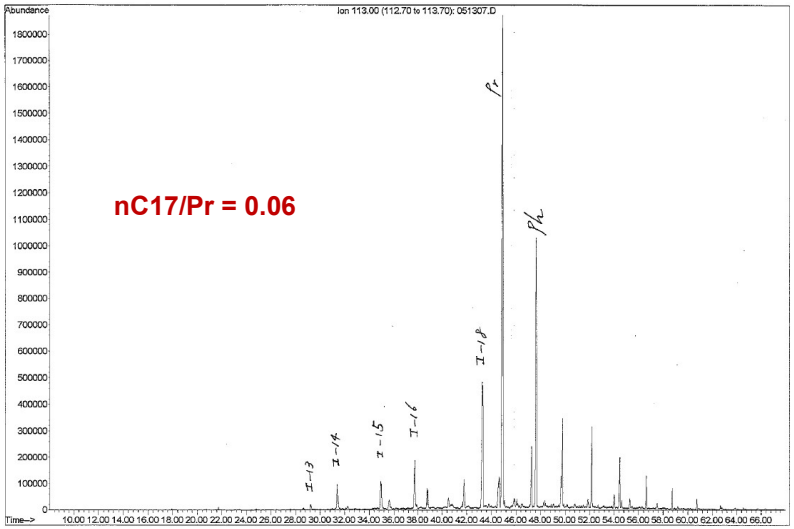
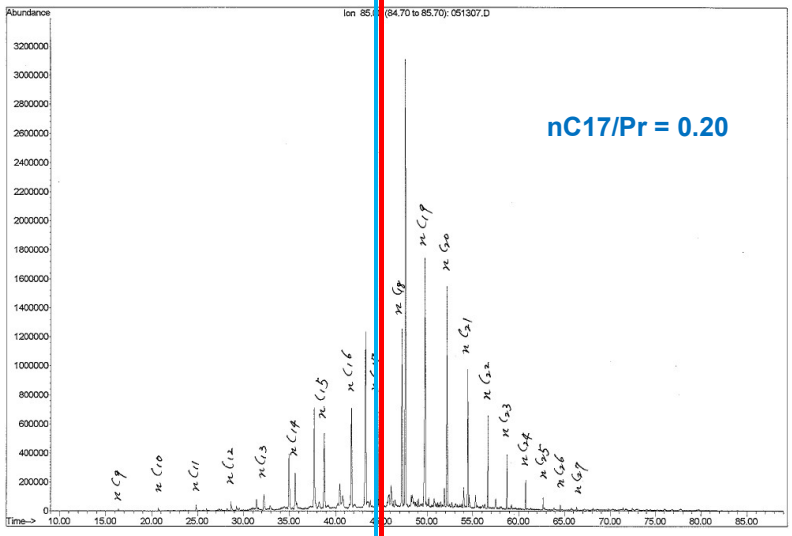
# AGE DATING – CHRISTENSEN-LARSEN MODEL



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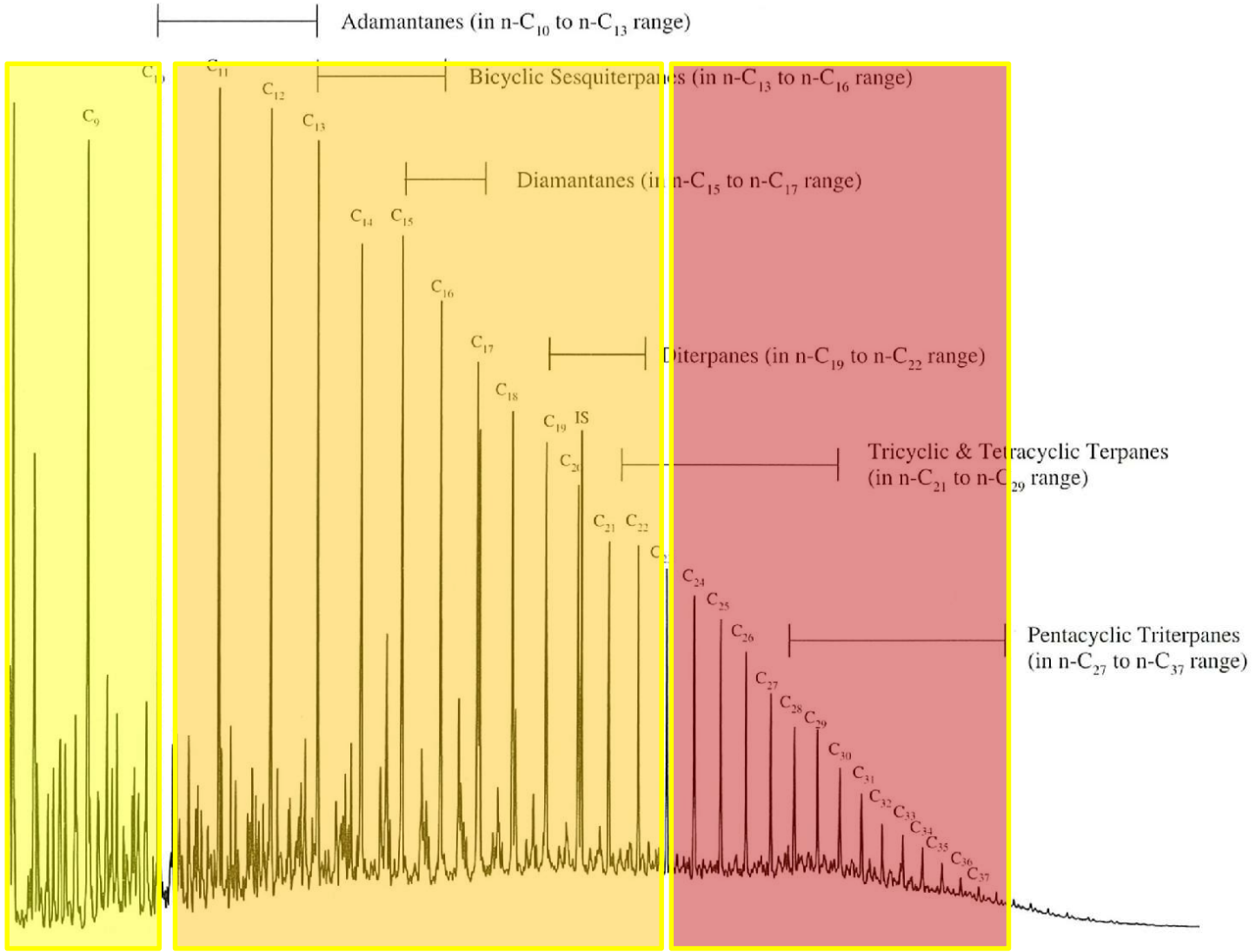
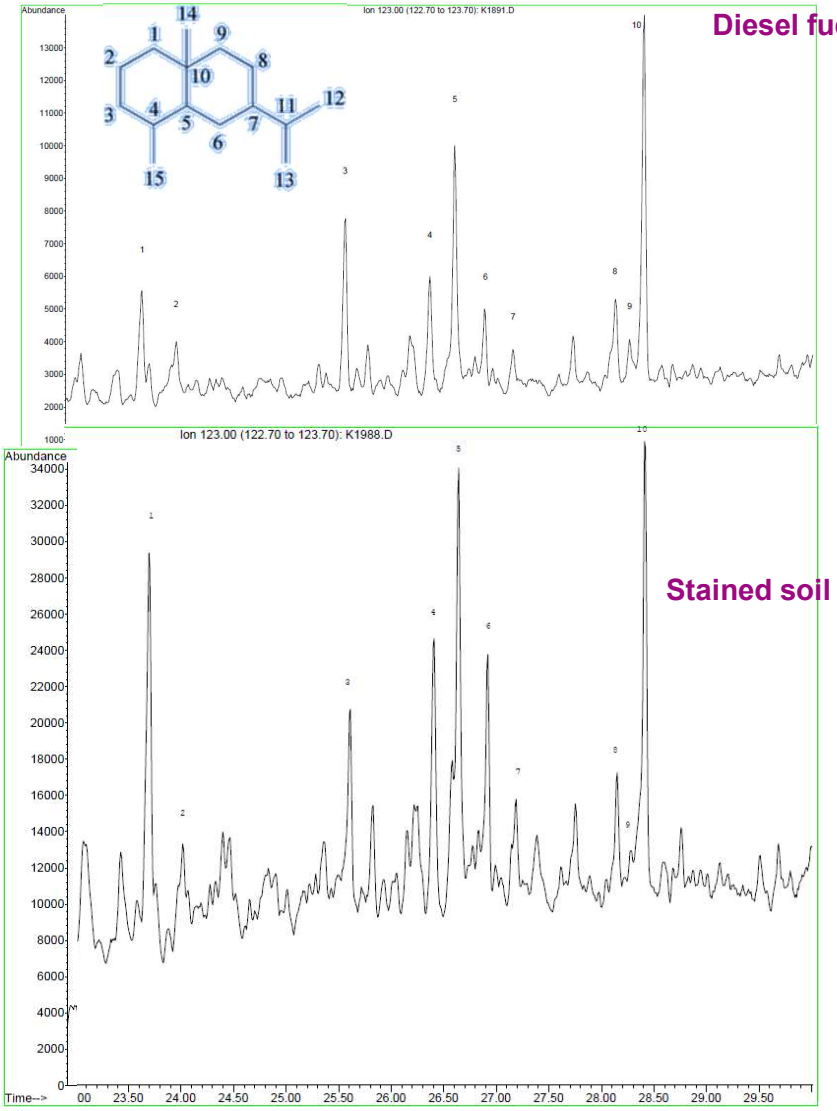
# BIOMARKER CLASSES

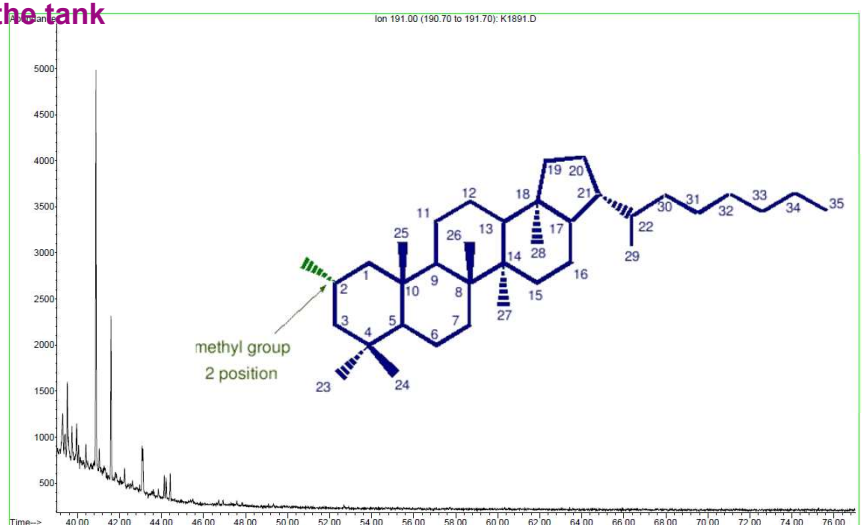



(Wang et. al.,2007)

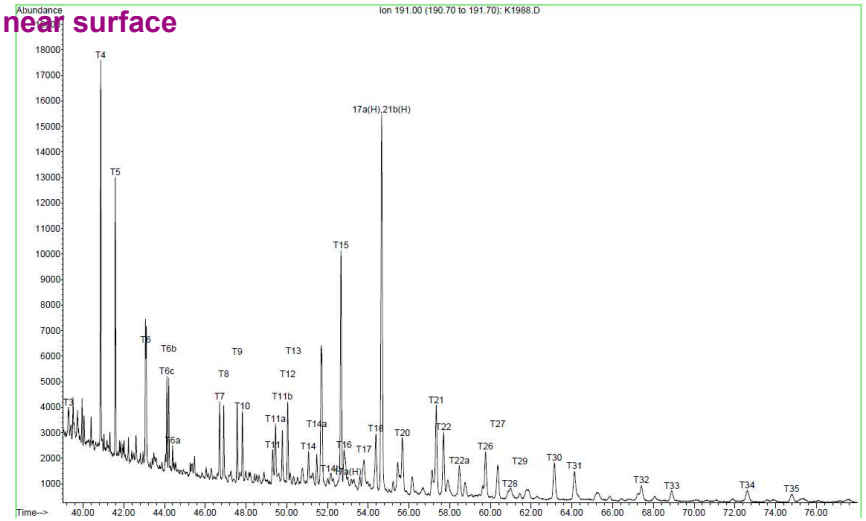
# SESQUITERPANE AND TERPANE BIOMARKERS




Diesel fuel from the tank




Stained soil sample near surface

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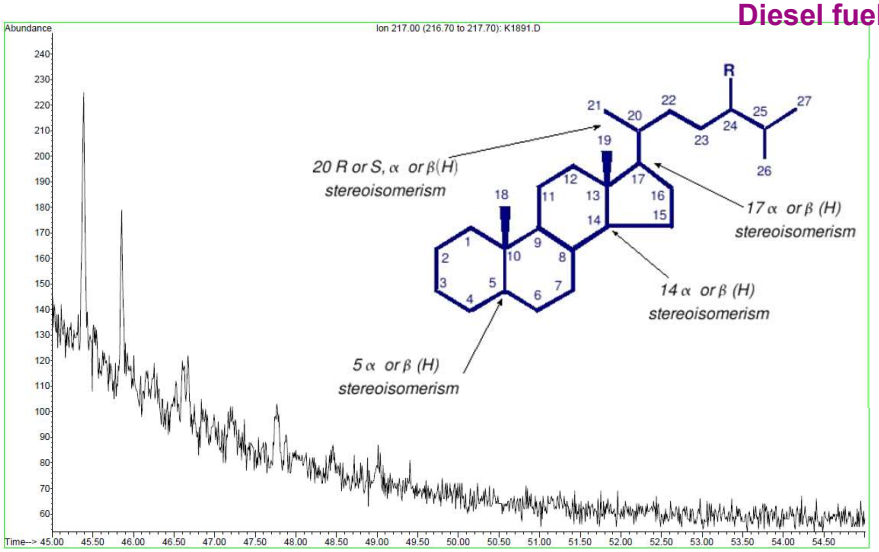
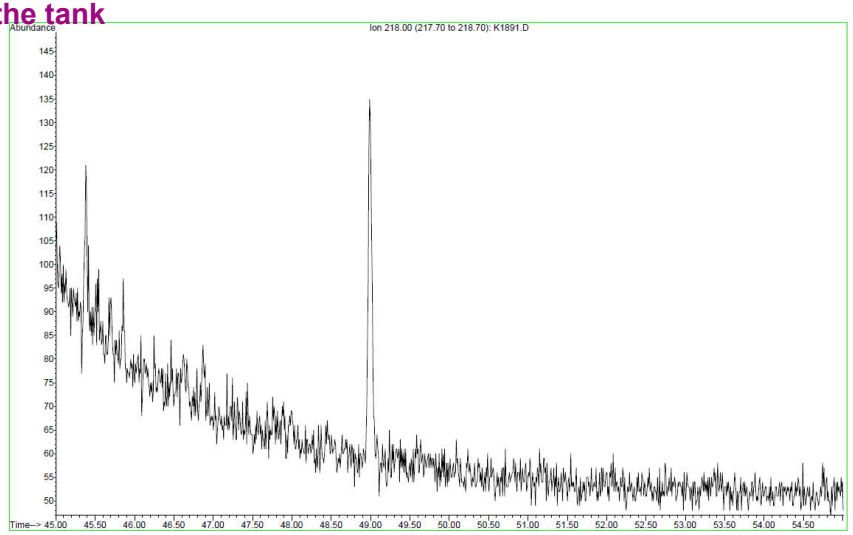
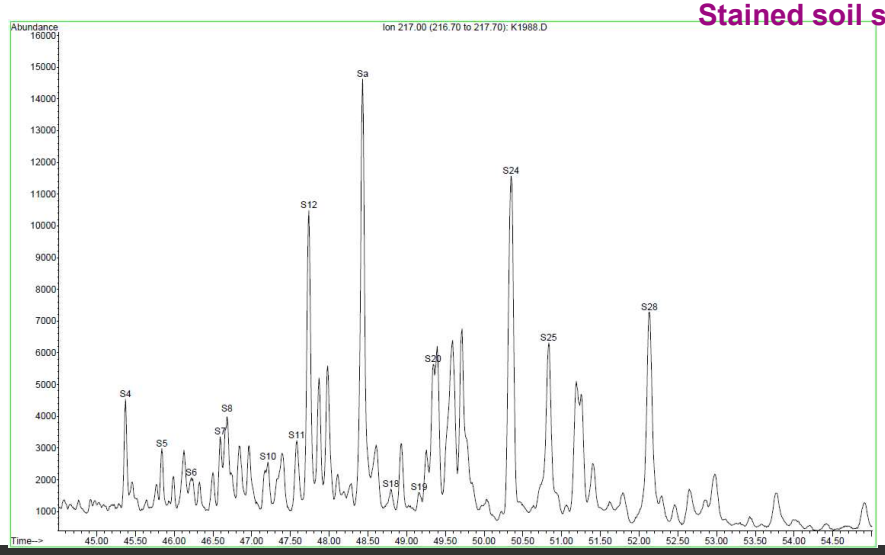
# STERANE BIOMARKERS

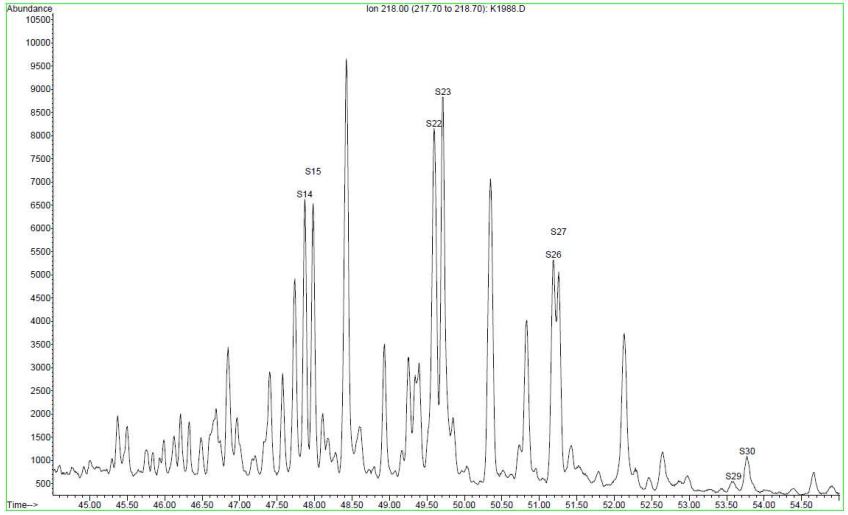
**Diesel fuel from the tank**




**Stained soil sample near surface**

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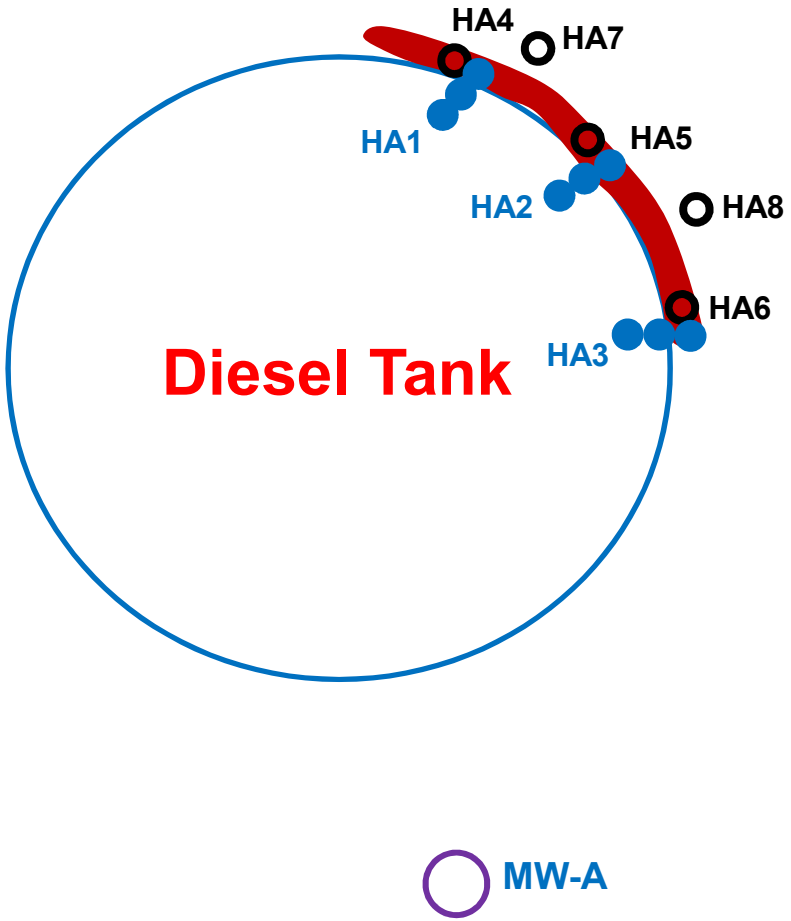
# FINDINGS

- The product from the monitoring well and hydrocarbons in the deep soil are from historical releases
- Hydrocarbon staining in near-surface soil is not source related to the diesel in the tank based on:
  - Christensen-Larsen model
  - Sesquiterpane biomarkers
  - Terpane biomarkers
  - Sterane biomarkers
- No remedial investigation required



# Thank You!

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