National Perspective of Natural Resource Damage Claims: Challenges and Opportunities

Minnesota Ground Water Association
Ground Water Contamination: State of the Art
Earle Brown Continuing Education Center
University of Minnesota
St. Paul Campus

May 4, 2004

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Presentation Objectives

NRD Concepts & Definitions

Status of NRD in the United States

Scientific Challenges & Opportunities

“Natural Resources”

Natural resources are land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by, the United States, a State or an Indian Tribe.[1]

[1] CERCLA 42 U.S.C § 9601(16)

NRD Concepts & Definitions

Natural Resource Damages – The public law (CERCLA, public trust doctrine, and state laws, e.g., New Jersey Spill Act) allows for" injury" to "natural resources".

Injury - a scientific concept – an adverse impact on natural resources.

Damage – a legal concept determining what an entity can do to make the public or environment whole for the injuries to natural resources.

Natural Resources - includes land, fish, wildlife, biota, air, water, ground water, drinking water supplies, and other such resources.

Restoration Damages – Costs to restore the injured natural resource, loss of loss of the resource and costs associated with conducting damage assessment.

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NRD Claim via Clean Water Act

- Discharge of a hazardous substance.
- Discharge occurred from an onshore facility owner or operated by the defendant(s).
- Discharge occurred into or upon navigable waters of the United States.
- Natural resources are damaged or destroyed as a result of the discharge.

Historical Context of NRD

Originally about managing and preserving natural resources (NEPA, Wetlands Regulations, Endangered Species Act, Public Trust Doctrine)

Then controlling pollution in business operations (Clean Air Act, National Ambient Air Quality Standards, State Implementation Plans)

Remediation (CERCLA, RCRA, state programs)

Balance between regulations and property rights (Government internalizes the cost of some environmental regulations)

Full circle now to natural resources (CERCLA, NOAA, Public Trust Doctrine, State Laws (New Jersey Spill Act)

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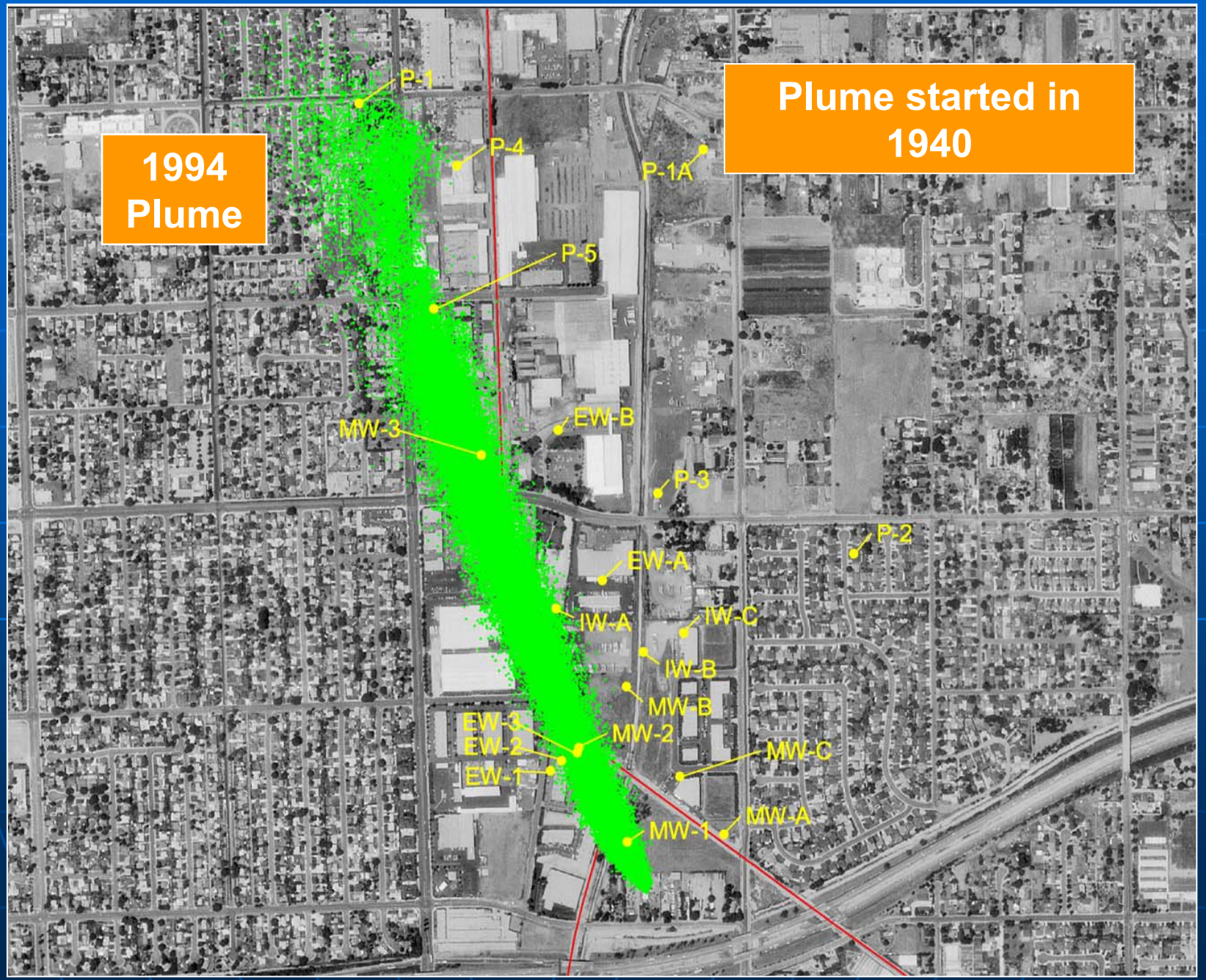
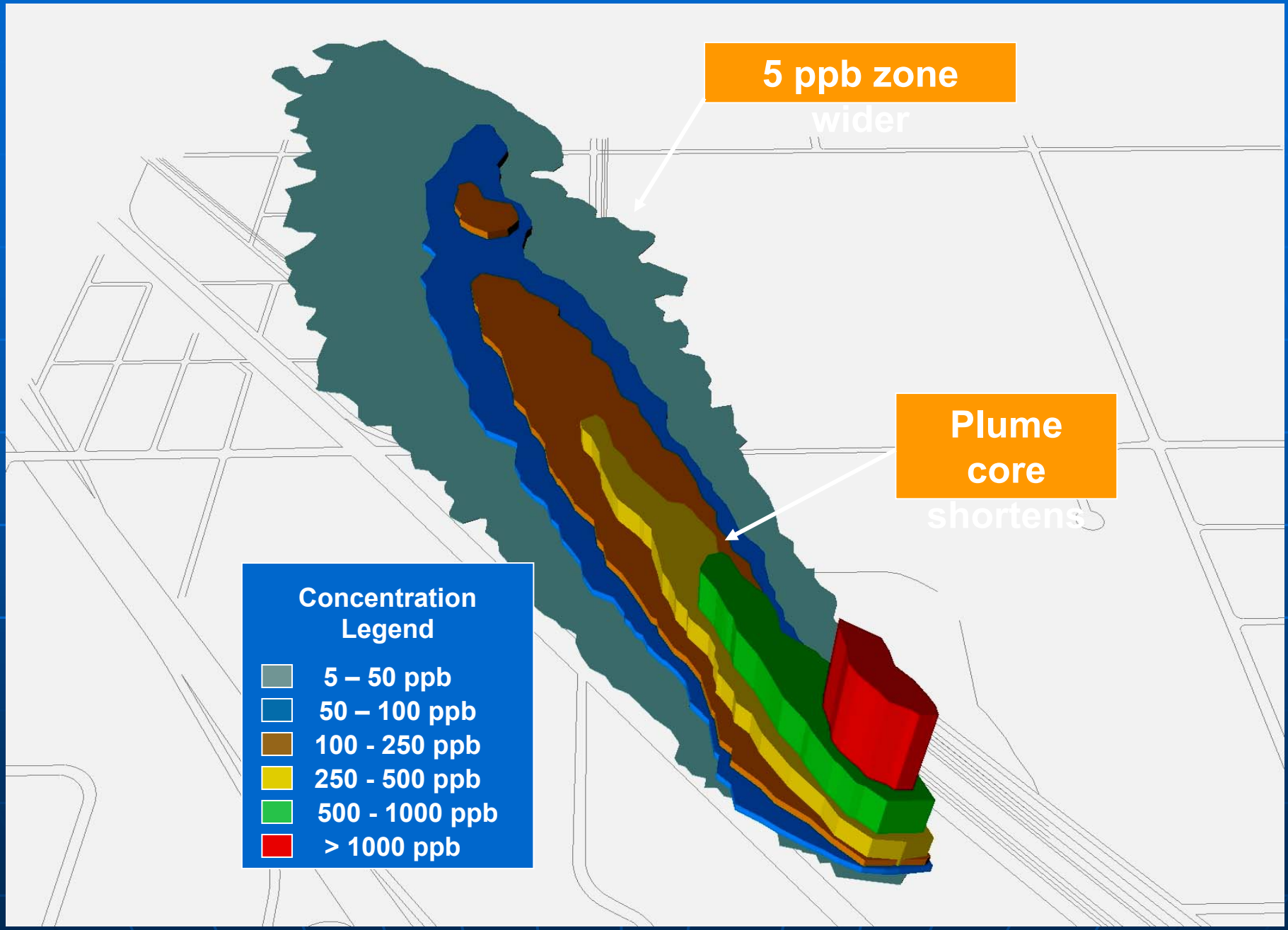
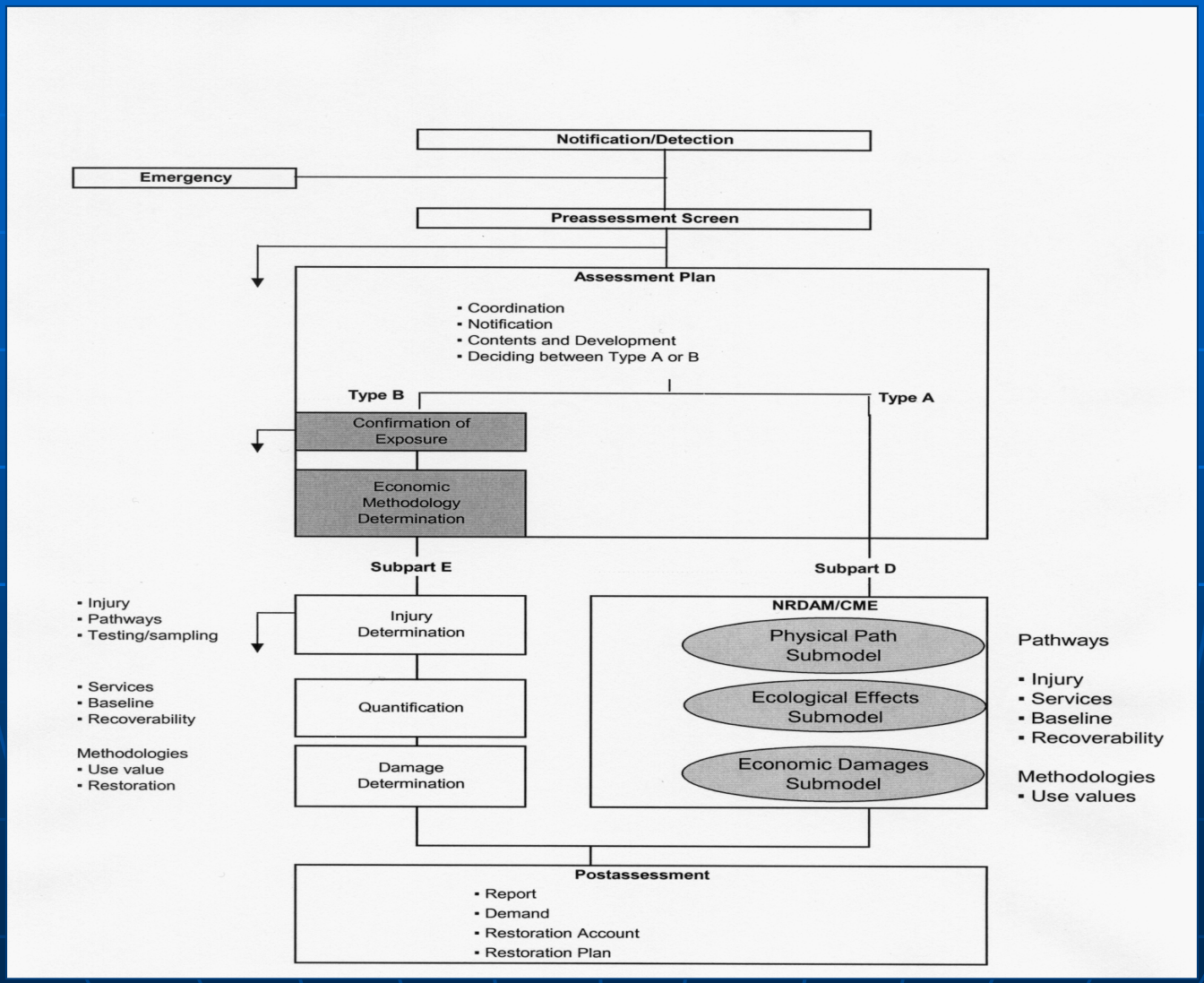

Plume started in 1940
1994 Plume
P-1
P-4
P-1A
P-5
MW-3
EW-B
P-3
P-2
EW-A
IW-A
IW-C
IW-B
MW-B
EW-3
EW-2
EW-1
MW-2
MW-C
MW-1
MW-A


5 ppb zone
wider
Plume core
shortens
Concentration Legend
5 – 50 ppb
50 – 100 ppb
100 - 250 ppb
250 - 500 ppb
500 - 1000 ppb
> 1000 ppb

NATURAL RESOURCE ASSESSMENT RULE CERCLA (43 C.F.R. Part 11)



HISTORICAL NATURAL RESOURCE DAMAGE SETTLEMENTS

Major NRD Settlements

Case Description	Natural Resource Damage at Issue	Date Consent Decree Was Lodged or Entered	NRD Settlement
United States v. Montrose Chemical Corp. of California, No. CV-90-3122-AAH (Jrx) (U.S.D.-C.D. California)	Release of DDT, MCB, and PCBs into the coastal waters off of Los Angeles, California.	Entered 5/19/92 *See* 57 Fed. Reg. 2,930 (Jan. 24, 1992)	$12,000,000. Two corporate defendants agreed to pay $412 million over 4 years for natural resource damages.
United States v. Shell Oil Co., No. c-89-4220-CAL (U.S.D.C.-N.D. California)	1988 oil spill from the Shell Oil facility in Martinez, California.	Lodged 11/29/89 54 Fed. Reg. 52,471 (Dec. 21, 1989)	$11,588.000
United States v. AVX Corp., No. 83-3882-Y (U.S.D.C.-D Massachusetts)	Release of PCB into New Bedford Harbor, Massachusetts.	Lodged 9/4/92 54 Fed. Reg. 43,024 (Sept. 17, 1992)	$10,000,000. Final defendants in suit required to pay $10 million in natural resource damages. An additional 410 million will be paid to cover future cleanup costs and natural resource restoration.

HISTORICAL NATURAL RESOURCE DAMAGE SETTLEMENTS

Major NRD Settlements

Case Description	Natural Resource Damage at Issue	Date Consent Decree Was Lodged or Entered	NRD Settlement
United States v. Exxon Corp. ("Bayway/Arthur Kill spill") No. 90-5-1-1-3519 (U.S.D. C. D.-E.D. New York)	Release of 567,000 gallons of home heating oil into a heavily industrialized waterway between New York and New Jersey in January 1990.	Entered 3/20/90 *See* 56 Fed. Req. 12,956 (March 28, 1991)	$9,250,000. Settlement includes payment of an additional $750,000 for response costs and improvements to waterfront area.
United States v. AVX Corp., No. 83-3882-Y (U.S.D.C.-D Massachusetts)	Release of PCB into New Bedford Harbor, Massachusetts	Approved 2/3/92 *See* 56 Fed. Reg. 51,238 (Oct. 10,1991) Final judgment against AVX Corp. entered 3/6/92. Appeal of judgment by National Wildlife Federation dismissed after settlement. 57 Fed. Reg. 33,211 (July 27, 1992)	$7,000,000. AVX Corp required to pay a total of $66 million for cleanup costs and natural resource damages.
United States v. AVX Corp., No. 83-3882-Y (U.S.D.C.-D Massachusetts)	Release of PCB into New Bedford Harbor, Massachusetts	Approved 7/16/91 *See* 56 Fed. Reg. 535 (Jan. 7, 1991) Appeal of judgment by National Wildlife Federation dismissed after settlement. 57 Fed. Reg. 33,211 (July 27, 1992)	Two settling defendants agreed to pay $3.15 million in natural resource damages.

HISTORICAL NATURAL RESOURCE DAMAGE SETTLEMENTS

Major NRD Settlements

Case Description	Natural Resource Damage at Issue	Date Consent Decree Was Lodged or Entered	NRD Settlement
United States v. Thatcher Co. (John Day Acid spill), No. 92-1187 JO (U.S.D.C.-D. Oregon)	Release of hydrochloric acid into the John Day River in Oregon.	Lodged 9/25/92 57 Fed. Reg. 46,408 (Oct. 8,1992)	$275,000
In re Insilco Corp., No. SA-92-CA-210 (U.S.D.C.-W.D. Texas)	Sixteen Superfund sites.	Lodged 9/21/92 57 Fed. Reg. 45,400 (Oct. 1, 1992)	Defendant Insilco Corp. agreed to make a cash payment of $5,050,000 and allowed a general unsecured claim of $4,227,560 in its bankruptcy. No distinction between response costs and natural resource damages was indicated in the Federal register notice.
In re U.E. Systems, Inc., No. 91-32791-HCD (Bk. N.D. Indiana)	Damage at 200 sites.	Lodged 8/10/92 57 Fed. Reg. 37,839 (Aug. 20, 1992)	Debtor agreed to allow a general unsecured claim of $27,775,409 in debtors bankruptcy proceeding for response costs and natural resource damages. No distinction between response costs and natural resource damages was indicated in the Federal Register notice.
State of New York v. Shore Realty Corp., No. 84-0864 (JBW) No. 85-2270 (JBW) (U.S.D.C.-E.D. New York)	Cleanup of the Applied Environmental Services site located in New York.	Lodged 6/11/92 57 Fed. Reg. 27,067 (June 17, 1992)	$124,000

Status of NRD in the United States

Coeur D'Alene Tribe v. Asarco Inc., et al., Sept. 3, 2003.

"The co-mingled mining waste is the primary cause of the damage to natural resources in the Basin".

"Ground water is affected by mining waste as demonstrated by metals content levels which exceed drinking water standards and aquatic life criteria."

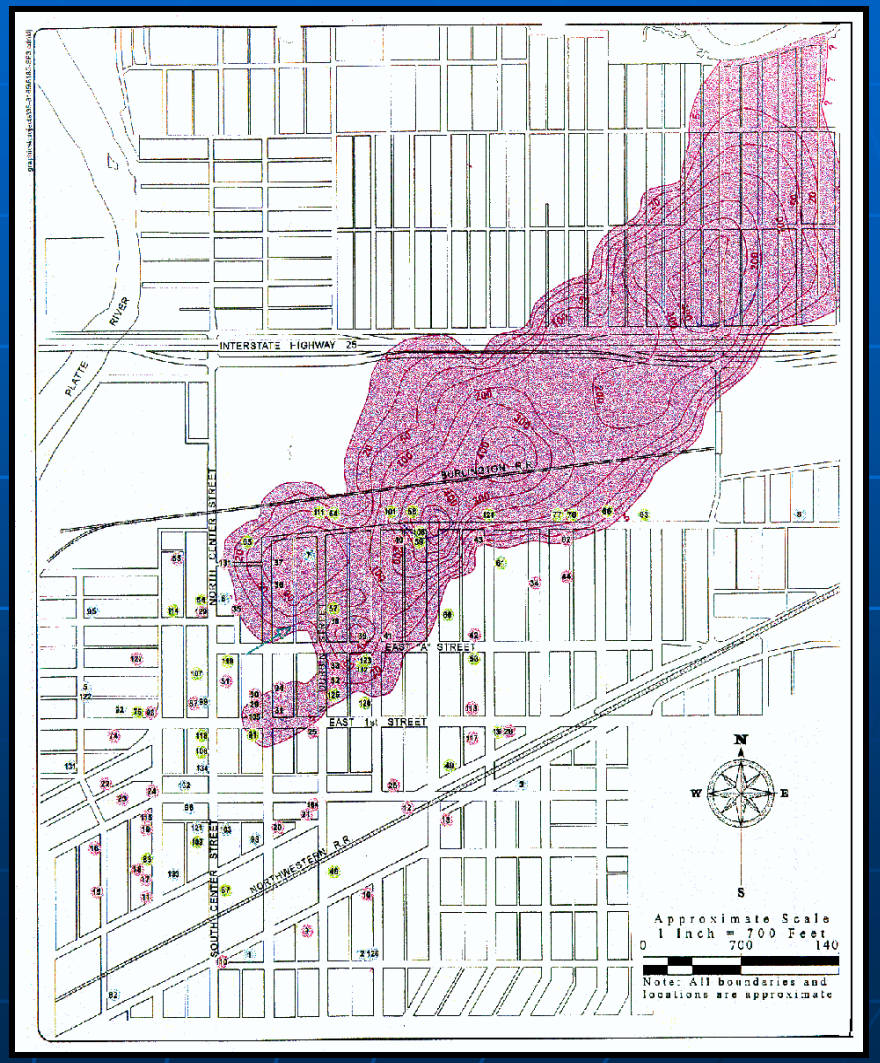
"Sediment concentrations of metals throughout the Basin exceed the applicable baseline."

"Water quality criteria are exceeded for metals in the South Fork and its tributaries and this is primarily due to the metals from the tailings."

"Cultural uses of water and soil by Tribe are not recoverable as natural resource damages."

Status of NRD Cases in the United States

- **New Jersey NRD Initiative**
  - Passaic River – 200 years of industrial use - 80 companies notified
  - $17M settlement for chromium claims in December 2003
  - Groundwater values by multiplying the aerial extent of the contamination > MCL, X the water rate, x average recharge rate x 30 years.
  - NRD claims with groundwater focus
    - ≈ 1000's of sites in New Jersey with groundwater issues



New Jersey NRD Initiative

Key Elements: Statutory Authority under the New Jersey Spill Act (Spill Compensation and Control Act, NJSA, 58:10-23.11 *et seq*).

The NJDEP Commissioner can also seek damages Under the Oil Pollution Act of 1990, CERCLA & the Clean Water Act.

Assessments performed in accordance with NOAA and DOI resource damage assessment guidance.

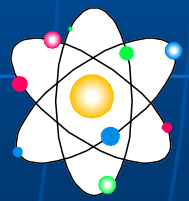
Natural resource injury defined as adverse change due to groundwater contamination including any Impairment to services.

Scientific Challenges & Opportunities

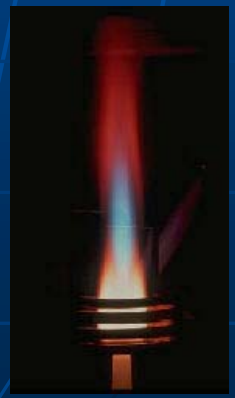
Primary issues still remain questions regarding

(1) origin of the contamination
(2) timing of the release, and
(3) allocation of responsibility between parties.

Opportunities for the use of forensic techniques applicable to NRD engagements, including:



(1) Isotopic analysis
(2) Delineation of UCM (petroleum hydrocarbons)
(3) Microbiological opportunities (DNA)



Isotope Analysis

Traditional age dating groundwater (^{3}H, ^{3}He, ^{39}Ar, ^{14}C and ^{137}Cs)

Dating Sediments (^{137}Cs and ^{210}Pb)

Distinguish between crude oils ($^{13}C/^{12}C$)

Distinguish between fuels ($^{205}Pb/^{204}Pb$ and $^{206}Pb/^{207}Pb$)

Distinguish between manufacturers of PCE, TCE and 1,1,1 TCA (^{37}Cl and ^{13}C)

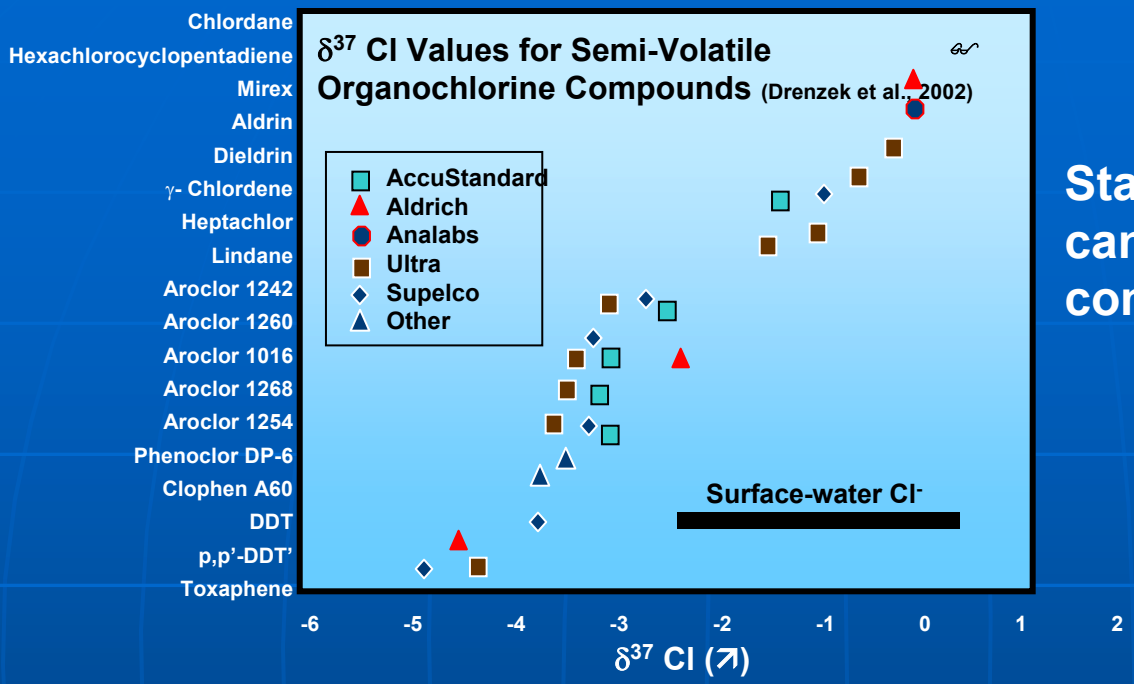
In-situ biodegradation (^{13}C and ^{14}C in soil CO_2) MTBE enrichment in groundwater – decrease in concentration & increase in C and H enrichment possible age indicator.

$$\text{Delta } (\delta)\ ^{13}C_{ppt} = \left[\frac{(^{13}C/^{12}C_{sample}) - (^{13}C/^{12}C_{std})}{(^{13}C/^{12}C_{std})} \right] \times 1000$$

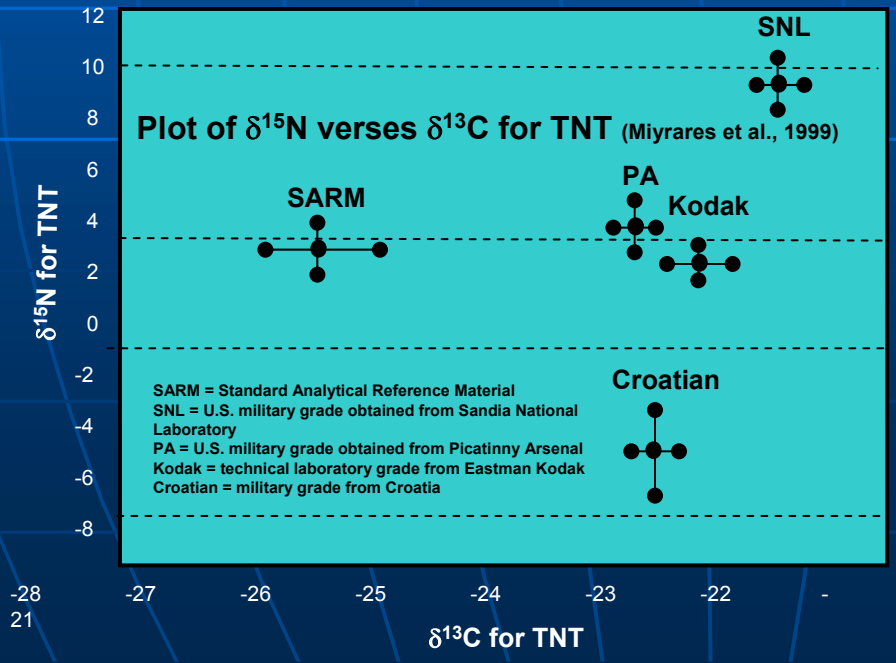
- By convention:
  - Enrichment of heavy isotope relative to standard assigned positive values
  - Enrichment of light isotope relative to standard given negative values

Examples of Useful Stable Isotope Ratios

$^{2}H/^{1}H$	Identifying landfill gas and leachate.
$^{37}Cl/^{35}Cl$	Distinguish manufacturers of chlorinated solvents.
$^{204}Pb/^{206}Pb/^{207}Pb/^{208}Pb$ ^{205}Pb is "effectively stable"	Age dating gasoline spills. Sources of lead in blood.
$^{13}C/^{12}C$	Distinguish crude oils. Distinguish BTEX sources. Monitor biodegradation.
$^{15}N/^{14}N$	Distinguish natural from anthropogenic sources of ground water nitrate contamination.
$^{18}O/^{16}O$	Identify water sources.
$^{34}S/^{32}S$	Determine SO_2 sources responsible for gypsum crust on stone buildings and monuments.

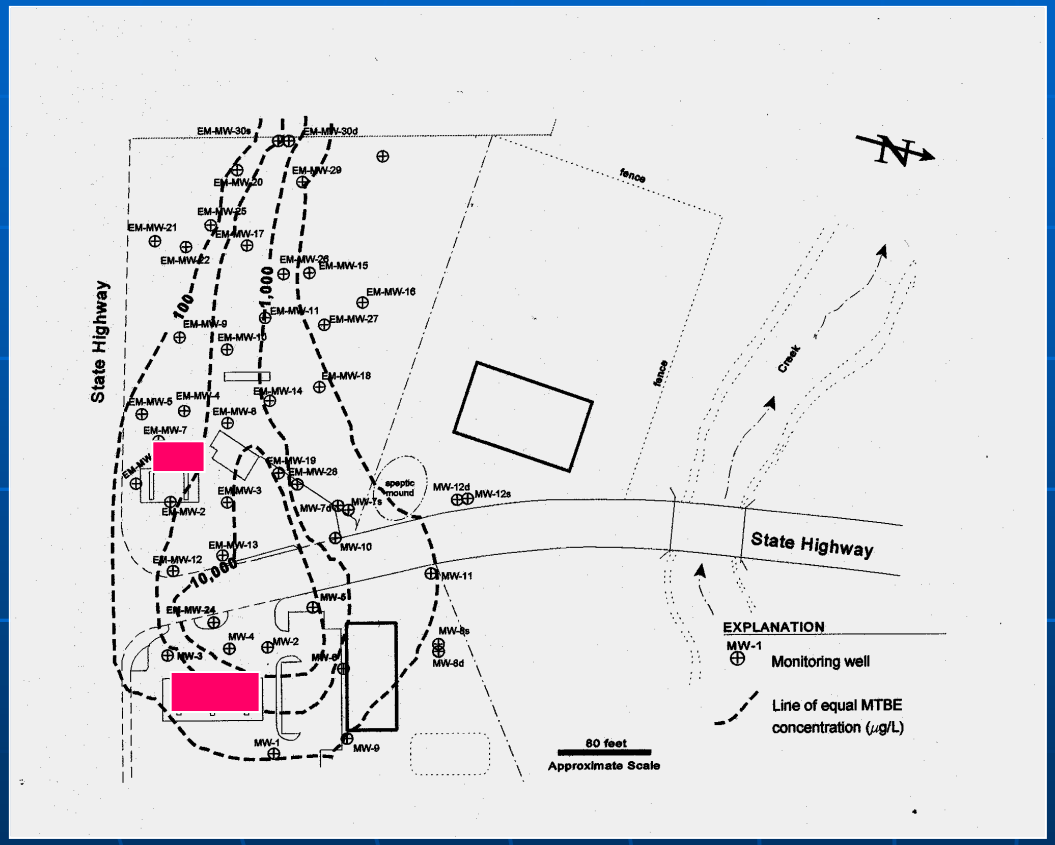


Stable isotopes analysis can be used for organochlorine compounds, including PCBs



Stable isotopes analysis can be used for TNT based on an understanding of the original formulations.

Case Study - Range of $\delta^{13}C$ Values



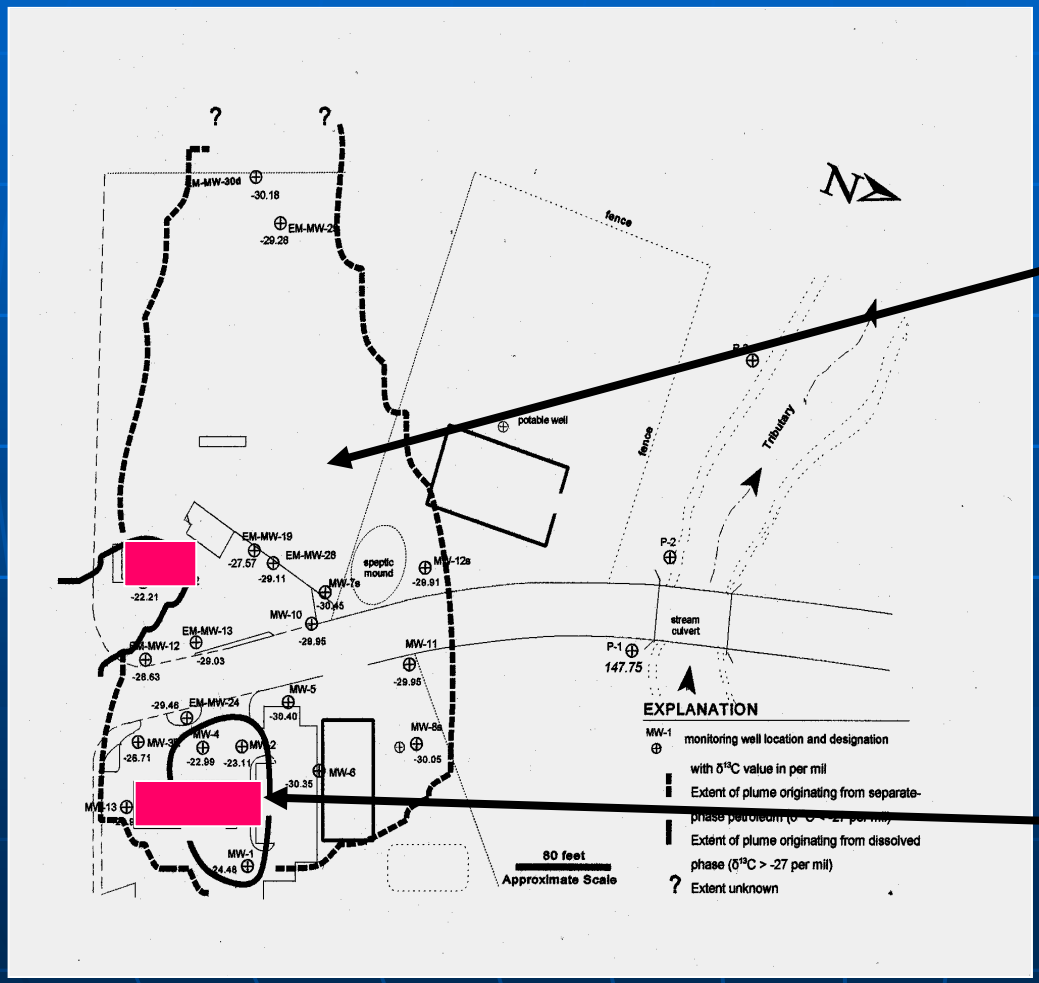
MTBE concentrations in groundwater ranged from N.D. to >10,000 ug/l

Two potential sources of gasoline

<u>One source</u> indicated per MTBE concentrations in groundwater

Oudijk, G., 2003. The Use of Stable Carbon Isotopes to Differentiate MTBE Plumes Impacting Ground Water. ISEF Workshop Environmental Forensics: Using Science to Reconstruct Contamination Events and Determine Liability. Virginia Beach, VA. September 9-10, 2003.

Isotope Ratio Analysis of MTBE Plume in Groundwater Indicates Two Sources of MTBE



$\delta^{13}C < -27$ per mil

Fresh gasoline = ~ -26 to -30 per mil
Weathered gasoline = ~ 0 to -26 per mil

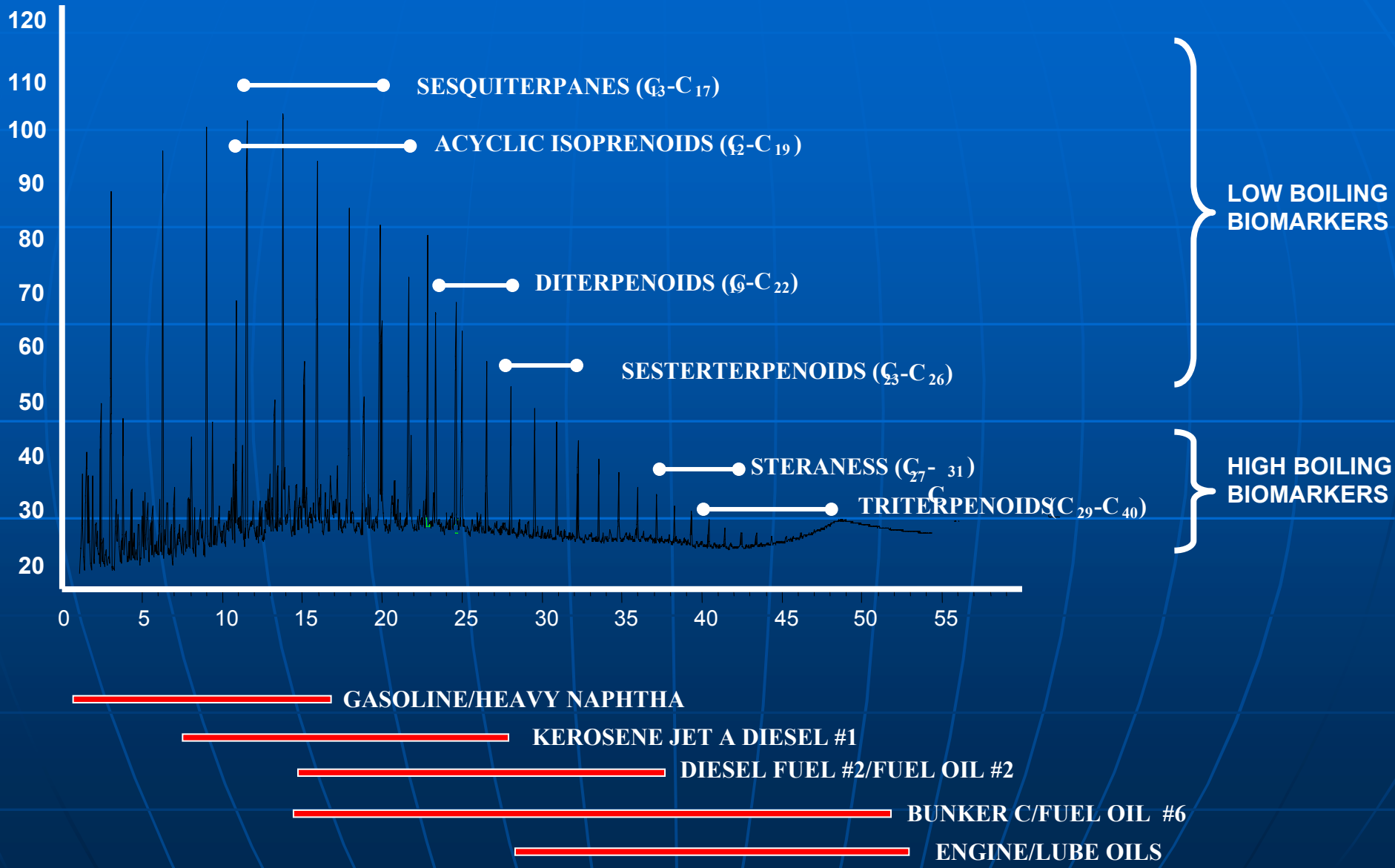
$\delta^{13}C > -27$ per mil

Fuel Biodegradation Levels & Marker Compounds

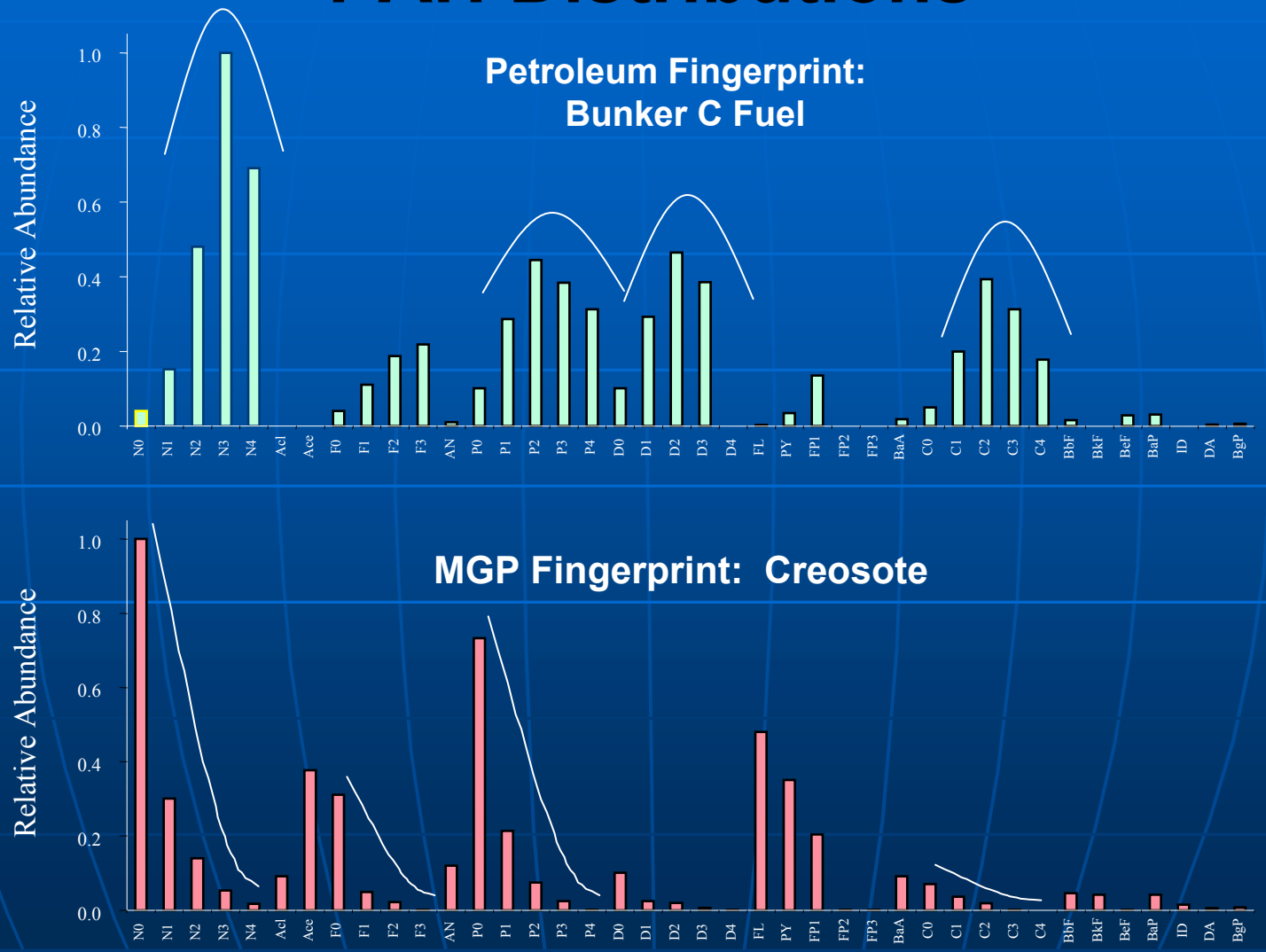
FUEL TYPE	LEVEL OF BIODEGRADATION	CHEMICAL COMPOSITION
GASOLINE, DIESEL, BUNKER C FUEL	1	Abundant n-alkanes
	2	Light-end n-alkanes removed
	3	Middle-range n-alkanes, olefins, benzene & toluene removed
	4	More than 90% of n-alkanes removed
	5	Alkylcyclohexanes & alkylbenzenes removed Isoprenoids & C_0-naphthalenes removed
	6	Isoprenoids, C_1-naphthalenes, benzothiophenes & alkylbenzothiophenes removed C_2-naphthalenes selectively reduced
	7	Phenanthrenes, dibenzothiophenes & other polynuclear aromatic hydrocarbons reduced
	8	Tricyclic terpanes enriched Regular steranes relatively removed C_{31}- to C_{35}-homohopanes reduced
	9	Tricyclic terpanes, diasteranes & aromatic steranes abundant

INCREASING LEVEL OF BIODEGRADATION

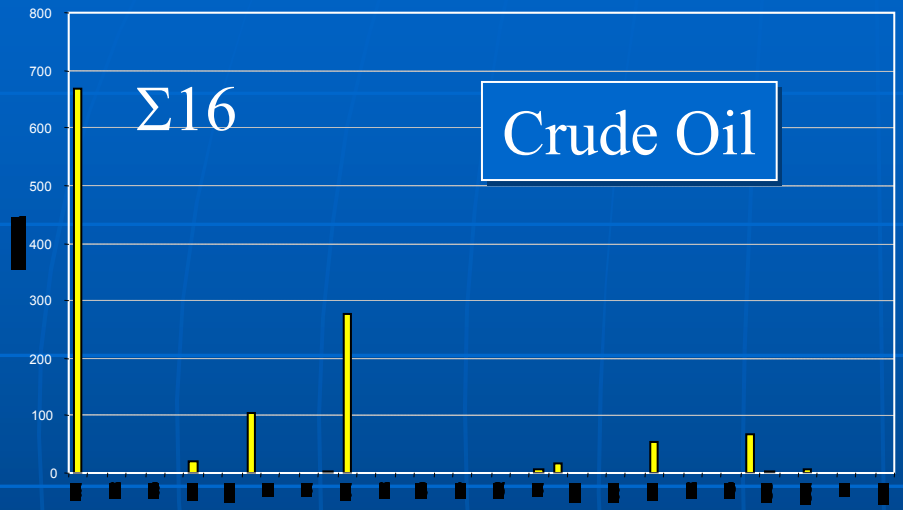
Biomarkers in Distilled Petroleum Products

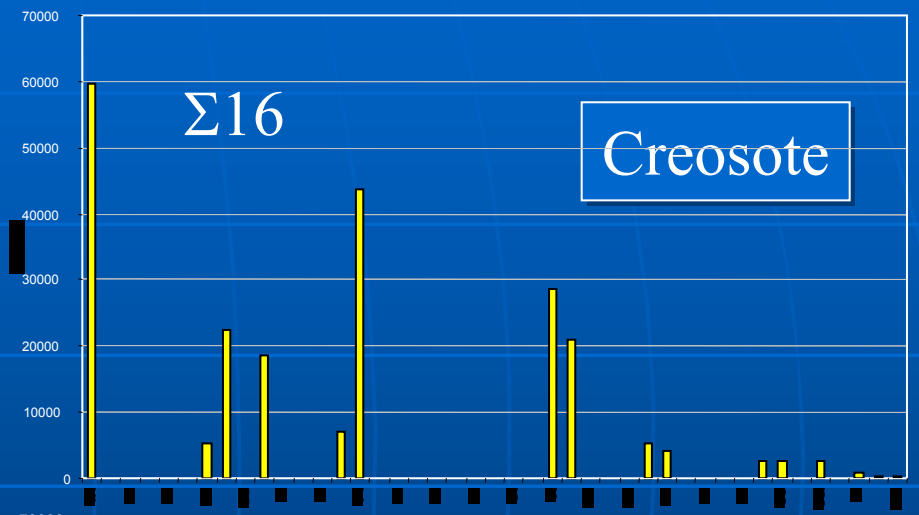


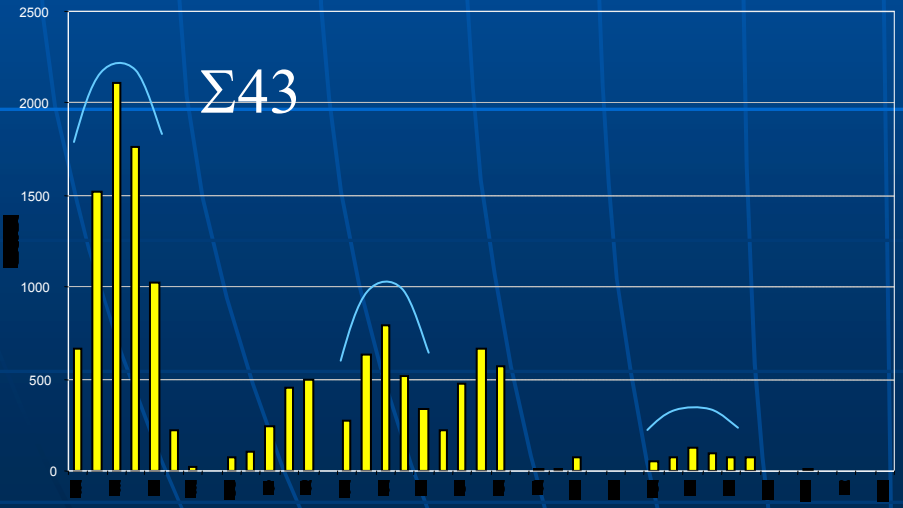
Petroleum vs. MGP PAH Distributions

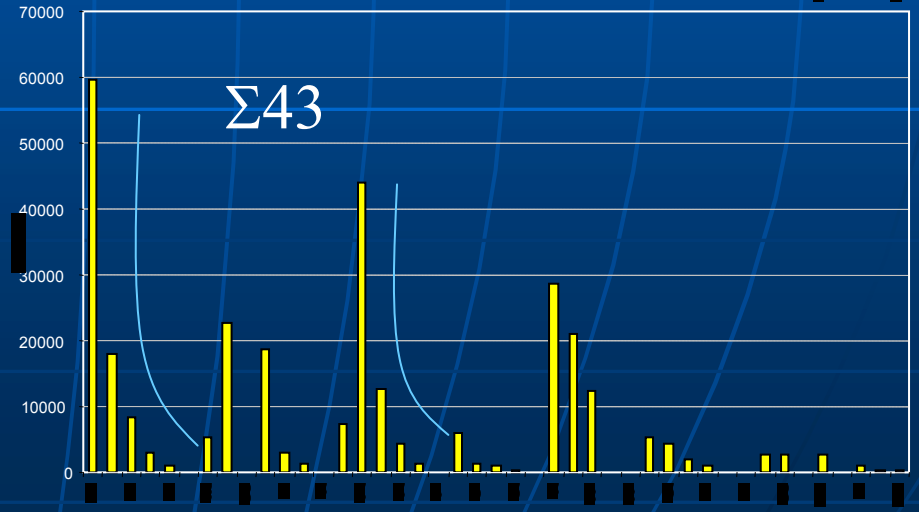


∑16 vs. ∑43 PAH Analyses: Informational Differences

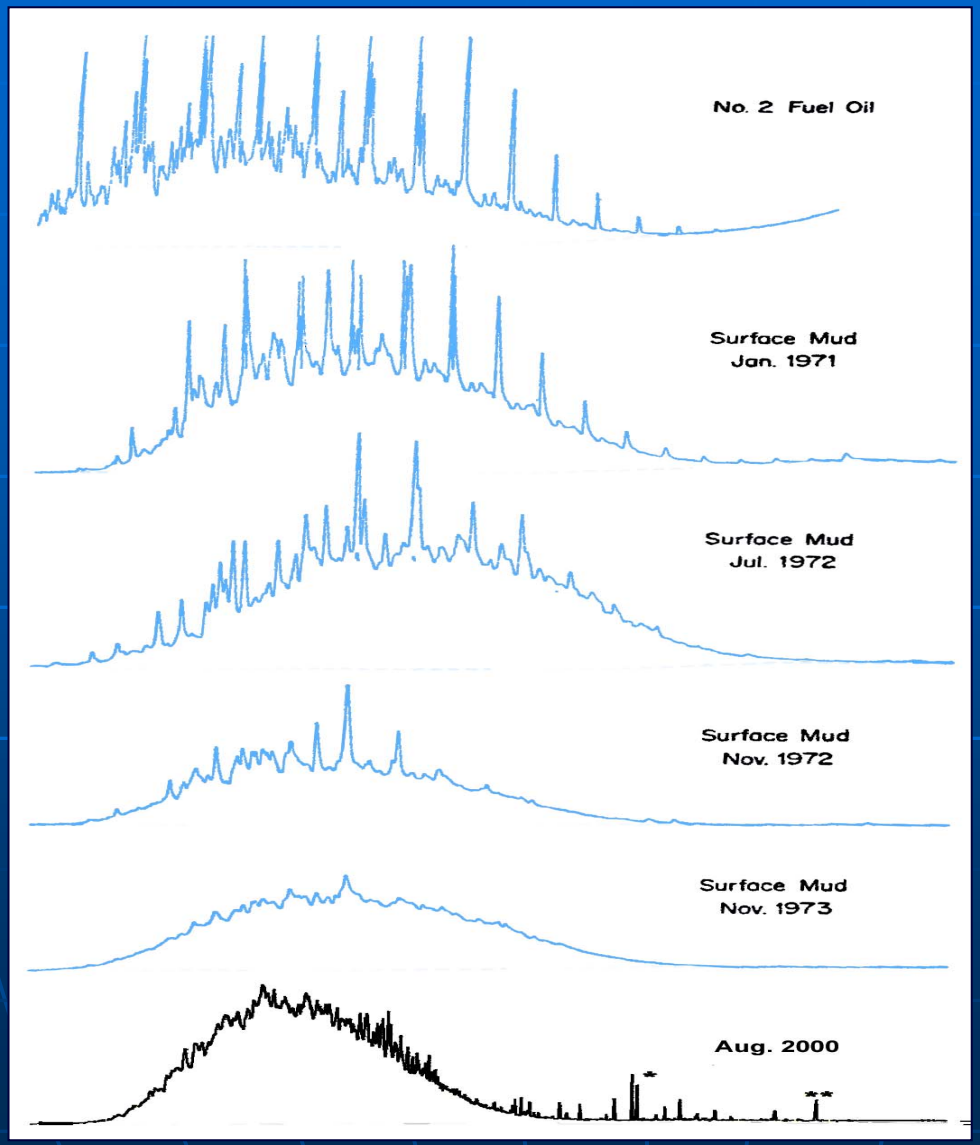








No. 2 Fuel Oil Degradation from 1971-2000



1971

1971

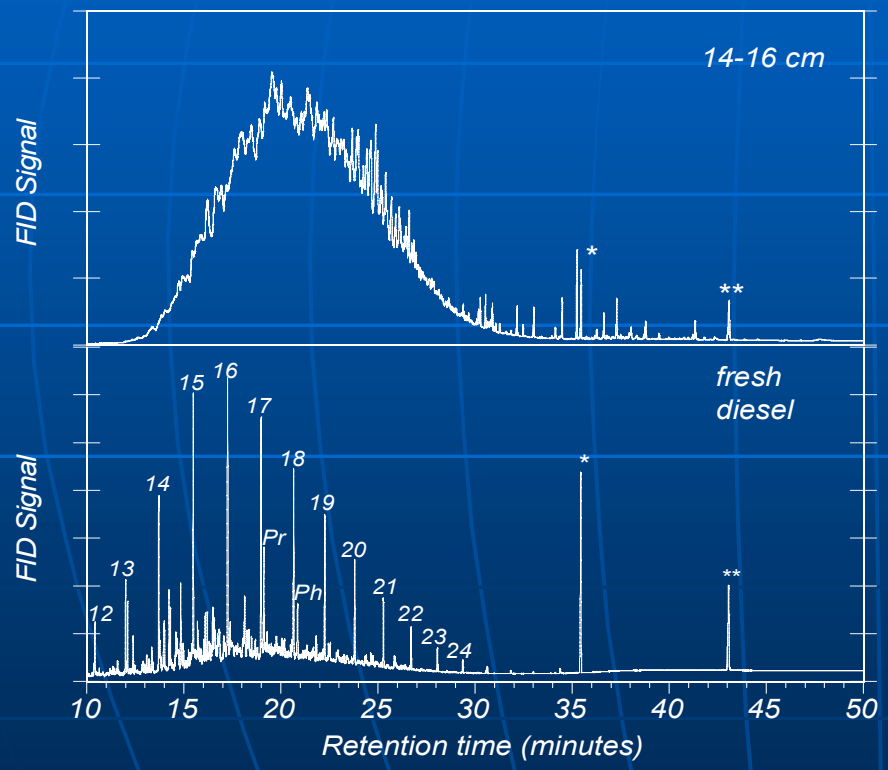
1972

1972

1973

2000

Unresolved Complex Mixture (UCM)

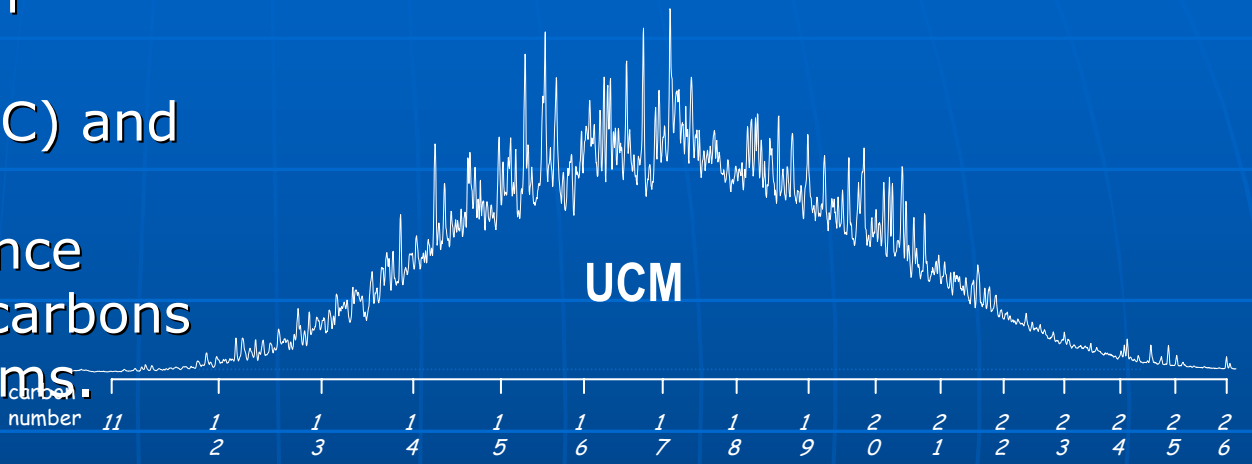


UCM is derived from traditional gas chromatography (GC) and refers to a hump of unresolved and, hence unidentified, hydrocarbons in gas chromatograms.

Too many compounds with very similar GC characteristics (multiple co-elutions) and mass spectral properties (multiple ions).

Unresolved Complex Mixture (UCM)

UCM is derived from traditional gas chromatography (GC) and refers to a hump of unresolved and, hence unidentified, hydrocarbons in gas chromatograms.



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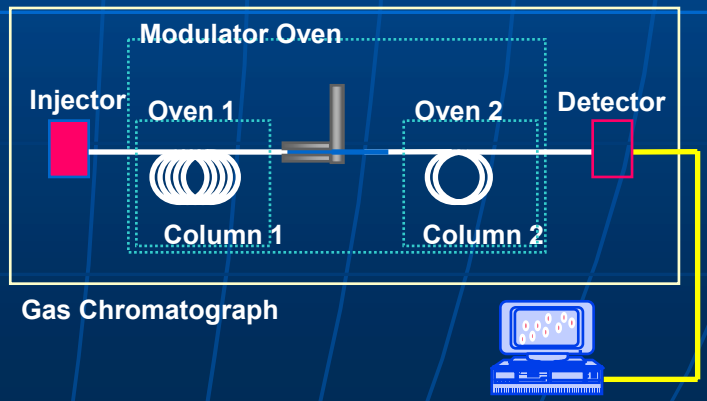
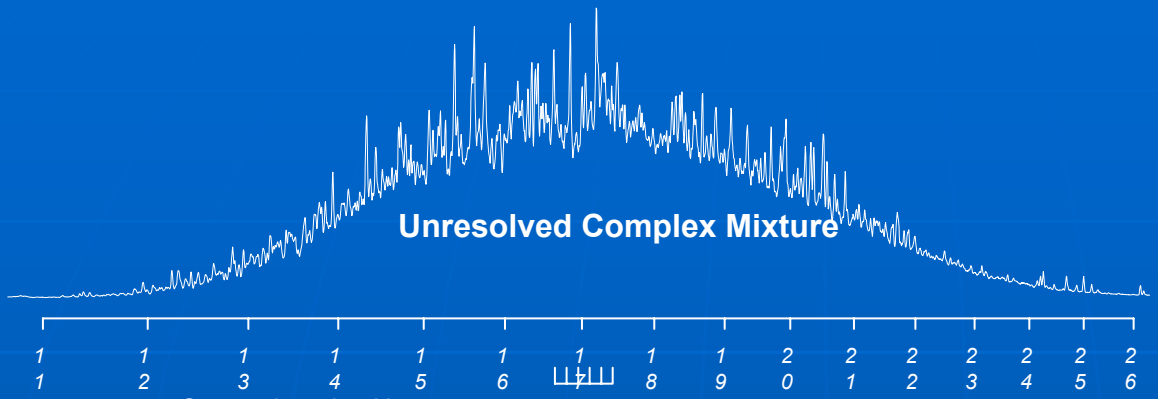
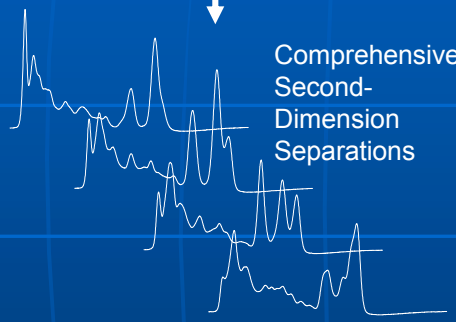


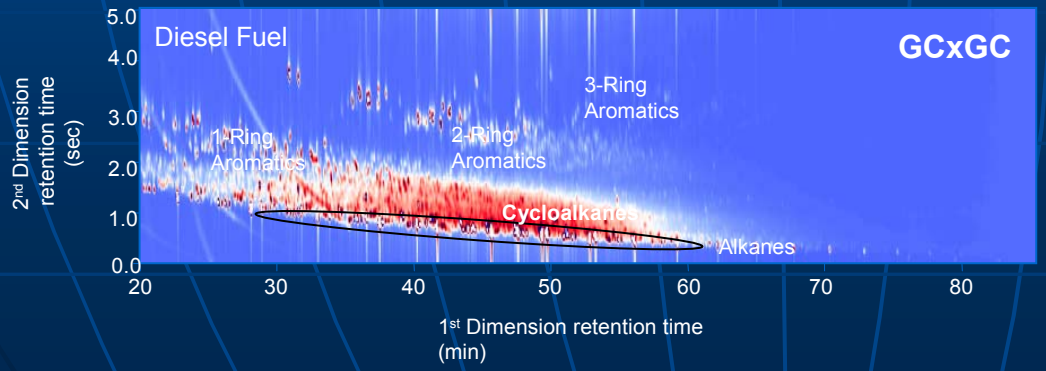




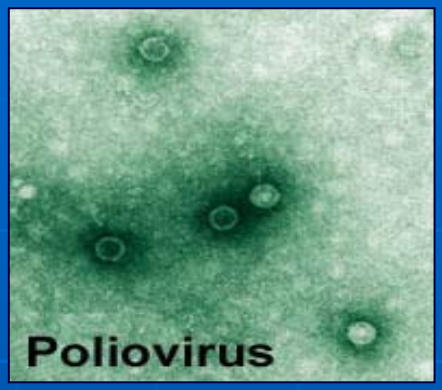
Two Dimensional Gas Chromatography

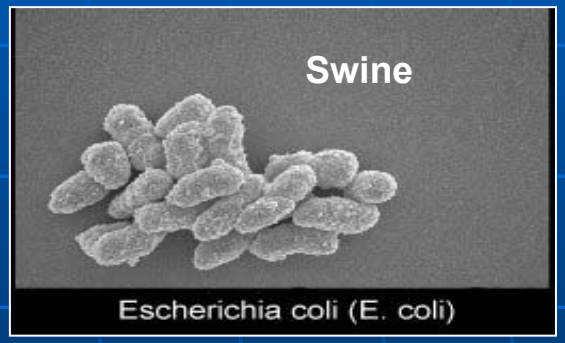
GCXGC will provide the capability to separate hundreds to thousands of more compounds in complex mixtures

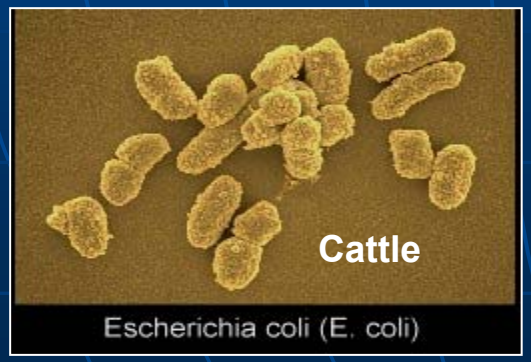
Expands our analytical window into Unresolved Complex Mixtures



Microbiological Fingerprinting





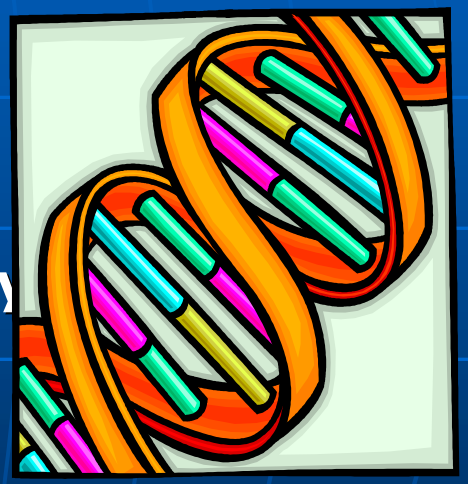


The primary forensic application of this technique is to provide associations and discrimination of different sources of contamination that have a microbiological component such as waste originating from human waste, swine or cattle.

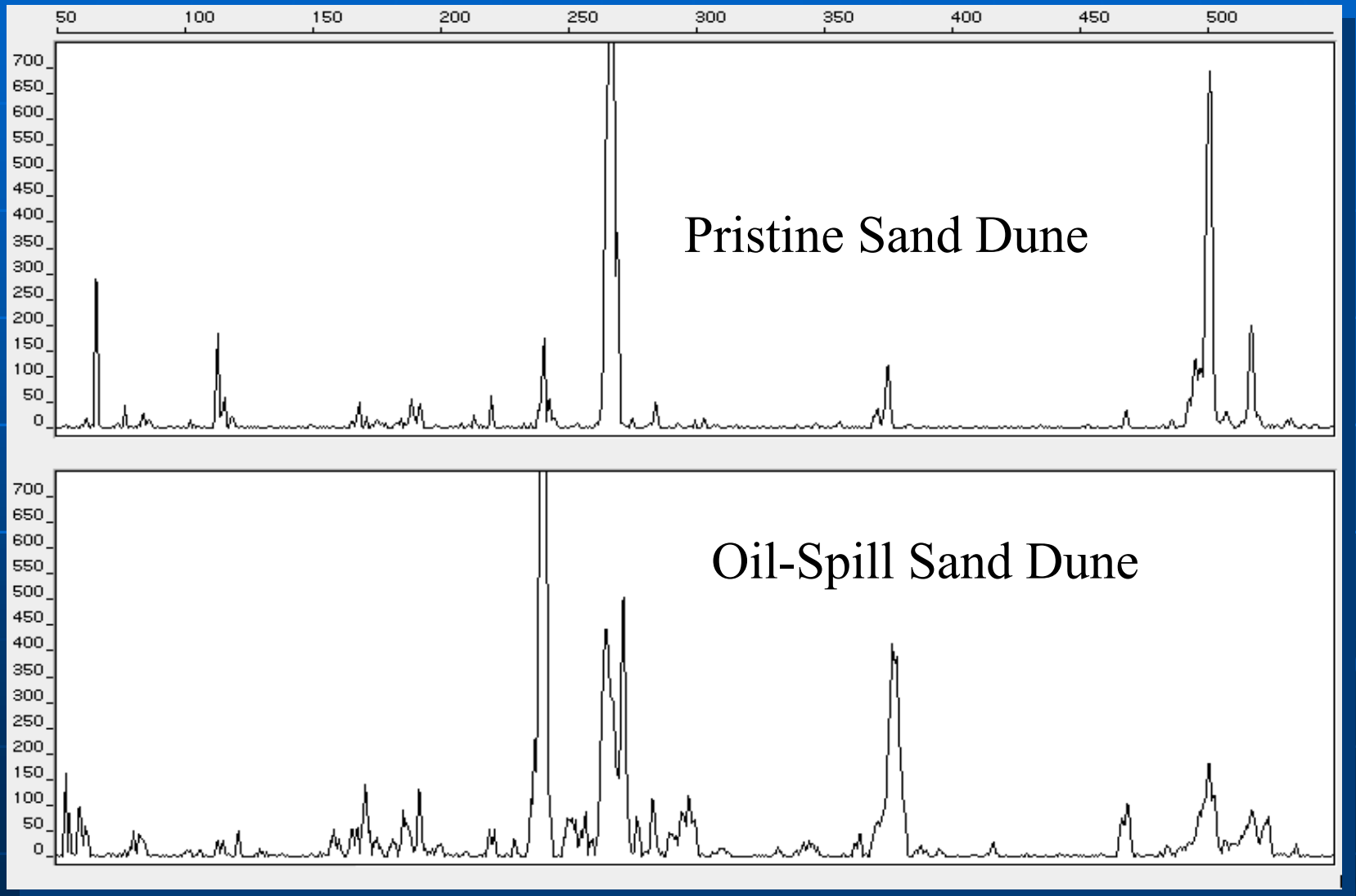
Fingerprinting Microbial DNA to Locate Methanogenic Bacteria

Terminal Restriction Fragment Patterns

- Extract microbial DNA
- Amplify gene of interest
- Cut DNA fragments with restriction enzy
- Measure fragment lengths
- Evaluate community structure and taxonomy



Two Different Soil Community Terminal Restriction Fragment Patterns



Body Farm

- Microbial communities change over time due to the introduction of fluids resulting from the decomposition of corpses.
- An identical change occurs when a contaminant travels through a soil column whereby a change in the DNA structure of the soil microbiological community occurs.
- The change in the DNA fragment of specific soil mico-organisms can be attributed to specific contaminants (perchlorate, TPH, PCE, MTBE, etc)
- DNA fragments from living and dead microorganisms can be obtained thereby providing a basis to determine whether a particular contaminant migrated through the soil column at any point in time, regardless of whether it can currently be detected.

Conclusions

NRD is potentially the most significant source of work for ground water professionals in the next 10-15 years.

The realization of the NRD potential for ground water professionals will manifest, in part, from the success of these types of claims in New Jersey and on tribal lands.

Environmental forensic techniques unavailable to ground water professionals in prior decades, are now available for us to use in NRD related projects.

DPRA