

# The cANIMIDA Project: Monitoring Sediment and Biota in Nearshore Oil and Gas Development and Production Areas in the Arctic Beaufort Sea, Alaska

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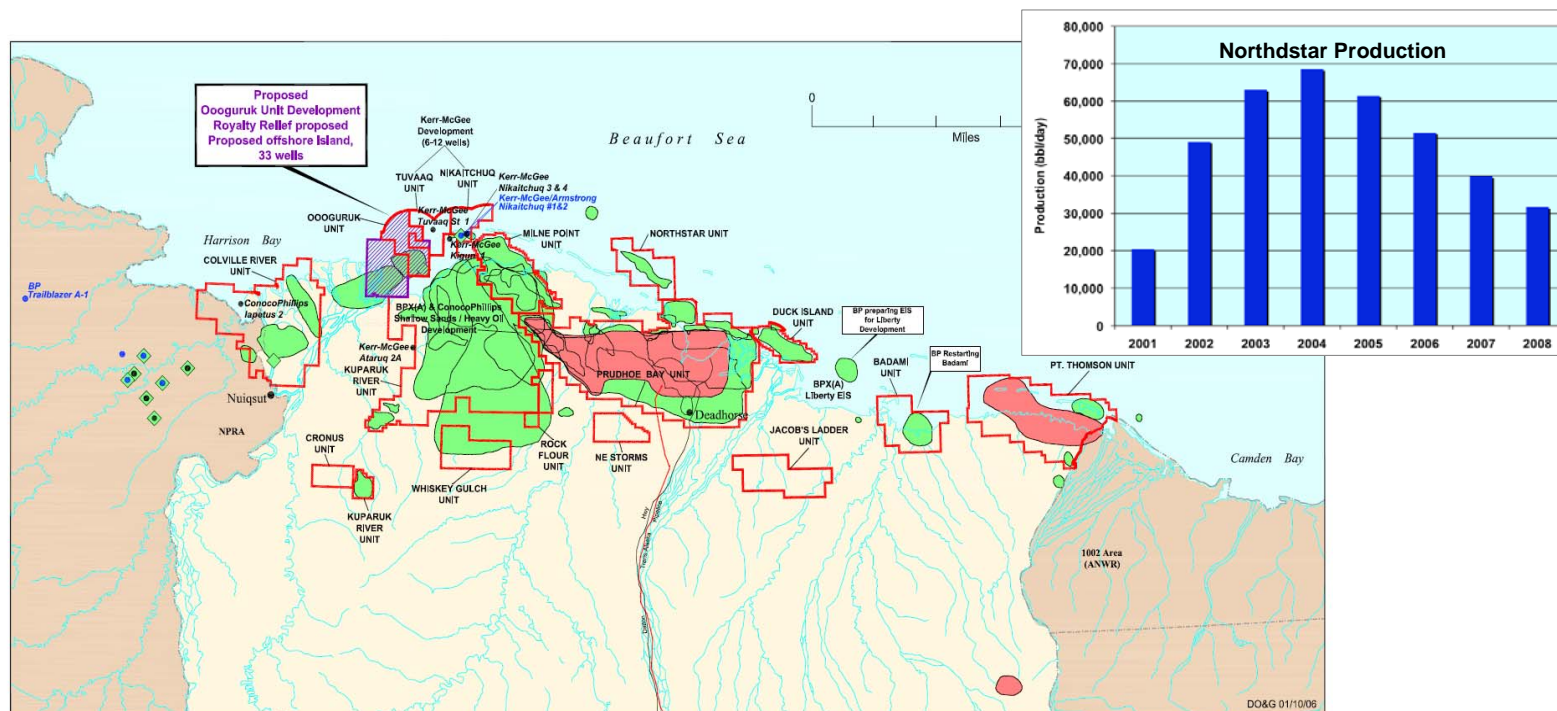
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**John Hardin. Battelle, US**

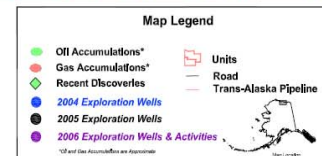
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# Introduction

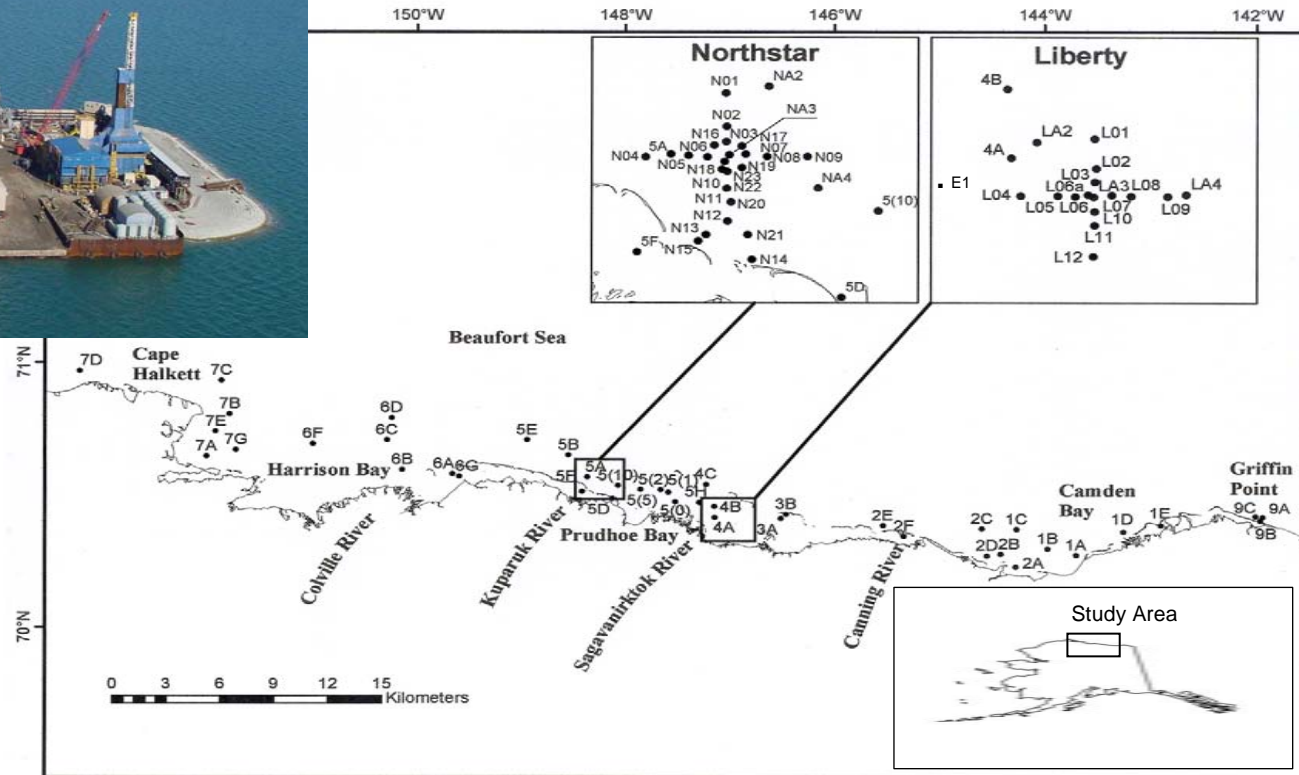
O&G development/production has until recently been on land, but there is increasing interest in the offshore environments of northern Alaska



**North Slope Oil & Gas Activity & Discoveries  
January 2006**



# Introduction



## cANIMIDA: **Continuation** of Arctic Nearshore Impact Monitoring in Development Area (2004-2008)

Continuation of ANIMIDA, expanding the monitoring area, employing new assessment measures, and providing more data for more confident trends and impact analysis.

# cANIMIDA Program Objectives

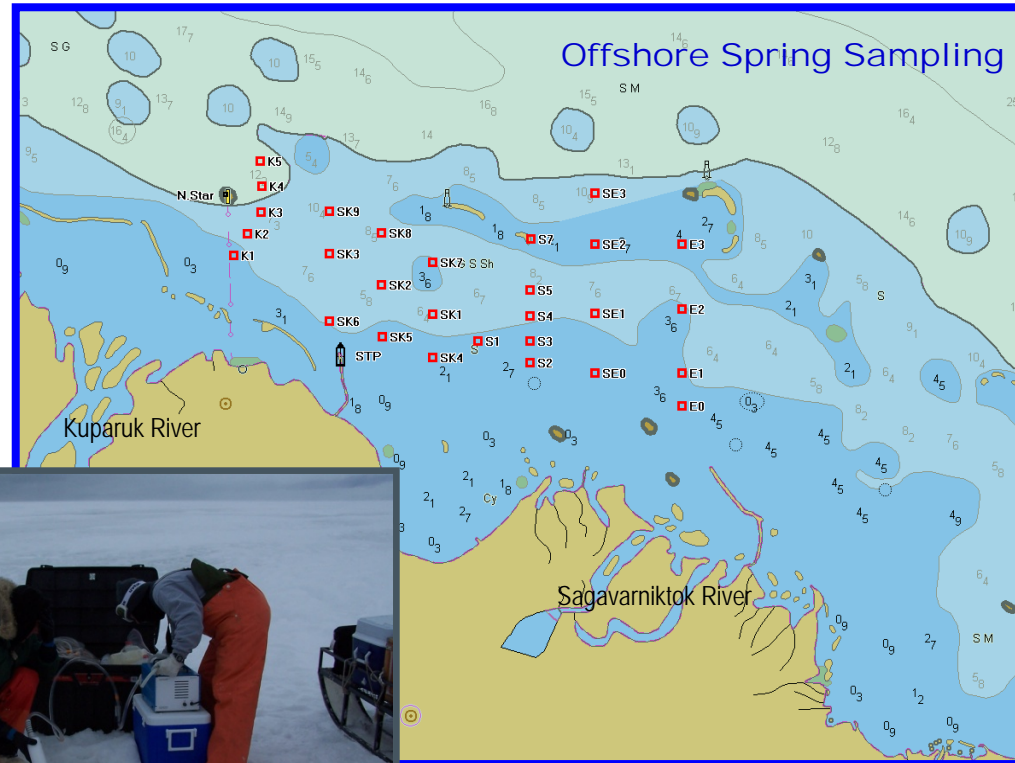
Gather baseline and long-term monitoring data to provide basis for evaluating potential effects from O&G development and production in Beaufort Sea OCS (Northstar, Liberty,..)



- Studies continued and were expanded dealing with
  - **Characterization of sediments**
  - Characterization of suspended sediments, including natural sources, dispersion
  - Partitioning of chemicals between dissolved and particulate phases
  - **Characterization of chemicals in biota; bioaccumulation and effects**
  - Monitoring the Boulder Patch ecosystem (Ken Dunton, UT and Dale Funk, LGL)
  - Assessment of subsistence whaling (Mike Galginaitis, ASR)

# Methods - Field

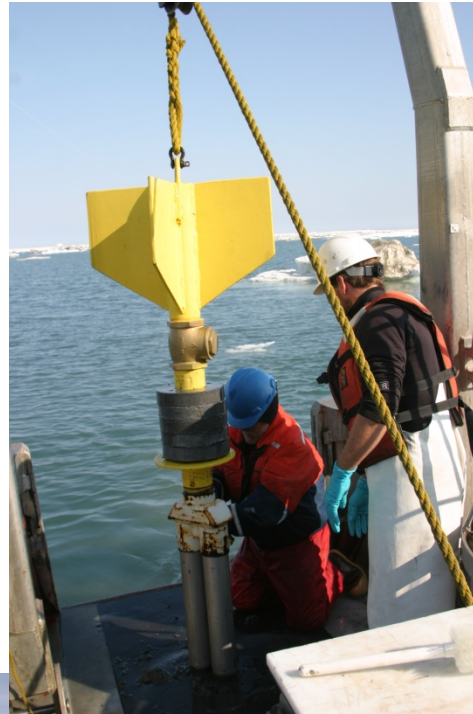
- Sampling Site Locations
  - Near potential sources
  - Regional influenced locations
  - Reference locations



- Sampling
  - Water sampling (in-situ and grab sampling)
  - Sediment sampling (surface and core)
  - Time integrated sampling (caged mussels, SPMDs)
  - Food-web component (plankton, amphipods, clams, fish)

# Methods - Field

MMS Launch 1273



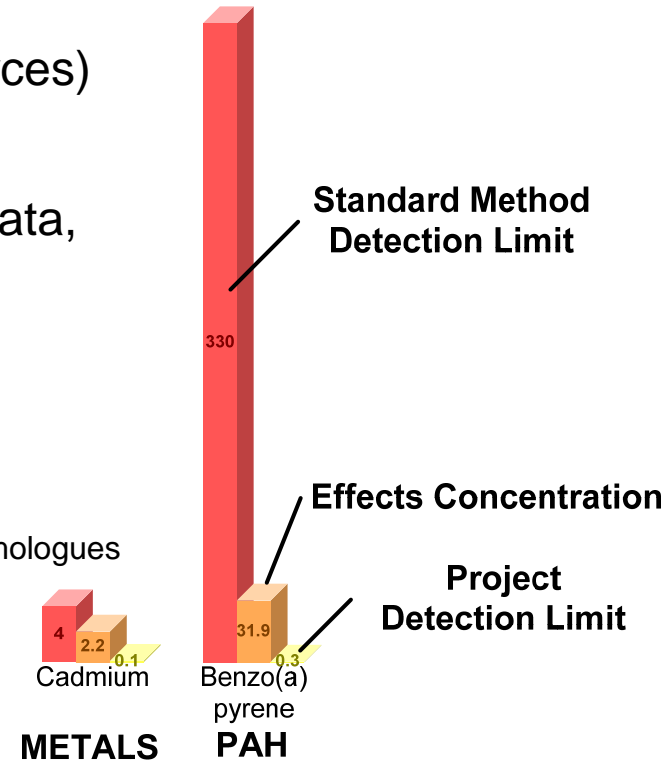
# Methods – Lab Analysis

- Analytical Approach

- Targeted parameters (O&G activities and sources)
- Matrix-optimized methods
- Trace-level analysis for background and risk data, and to discern subtle changes

- Analyses

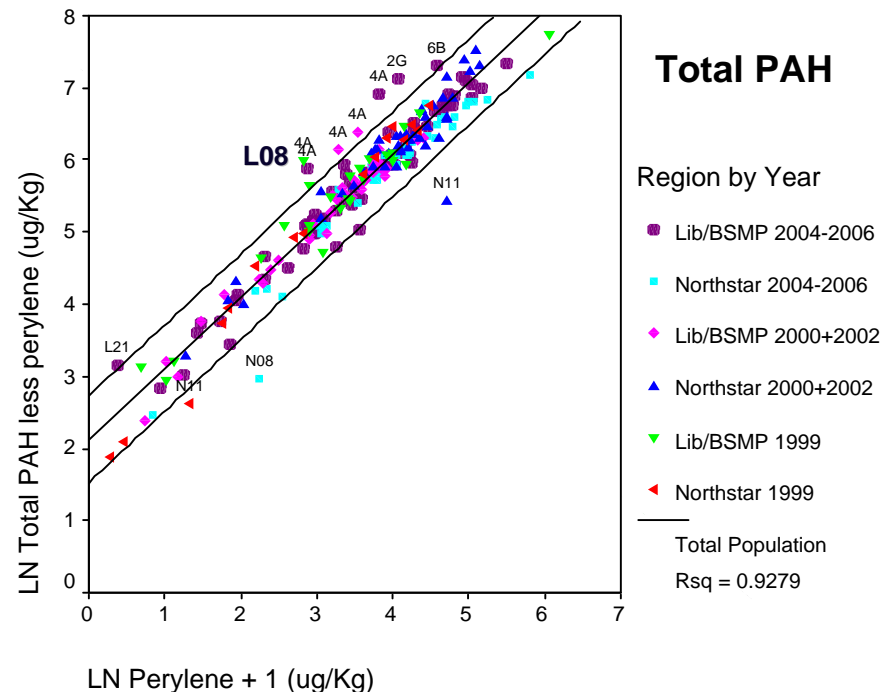
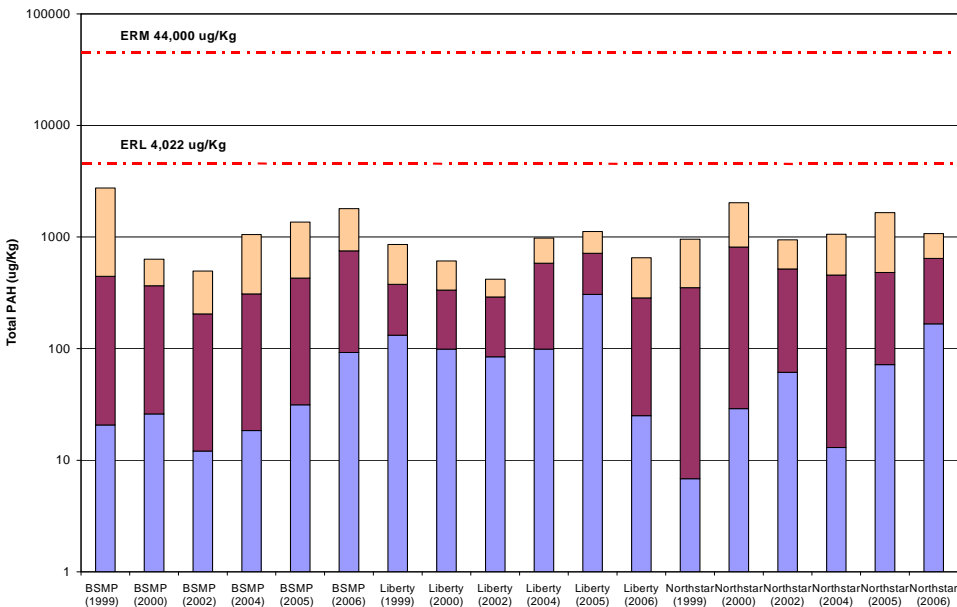
- Polycyclic aromatic hydrocarbons (PAH).  
>50 benzothiophenes, naphthalenes through 5-ring PAH, w. alkyl homologues
- Saturated hydrocarbons
- Chemical biomarkers (steranes, triterpanes)
- Series of metals
- Biological markers (PAH metabolites, organ P450 induction)
- Supporting ancillary measurements (radiochem, grain size, TOC, lipid, ..)



# Results - Sediment

Sediment hydrocarbon concentrations are quite low, relatively consistent, with only subtle differences within the study area.

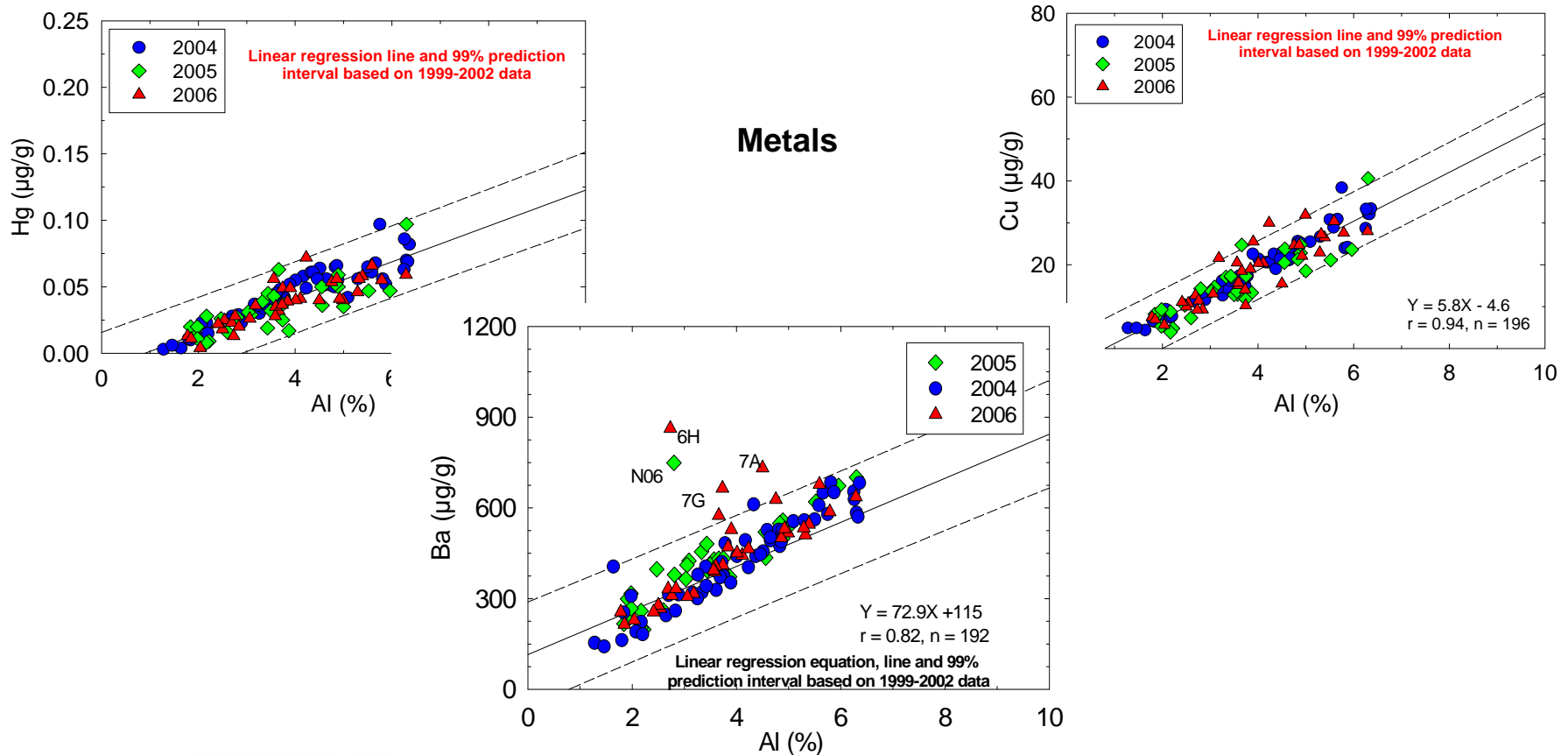
**Total PAH**



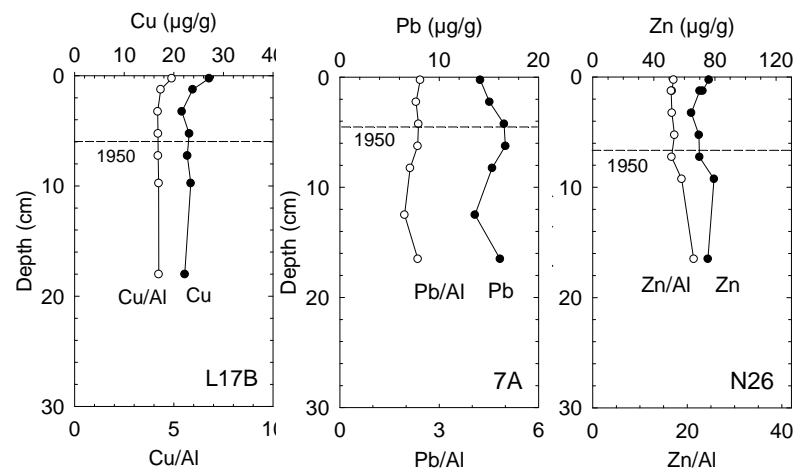
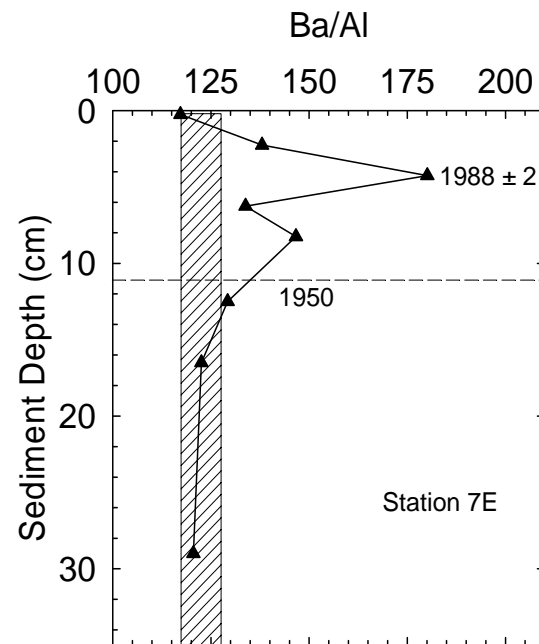
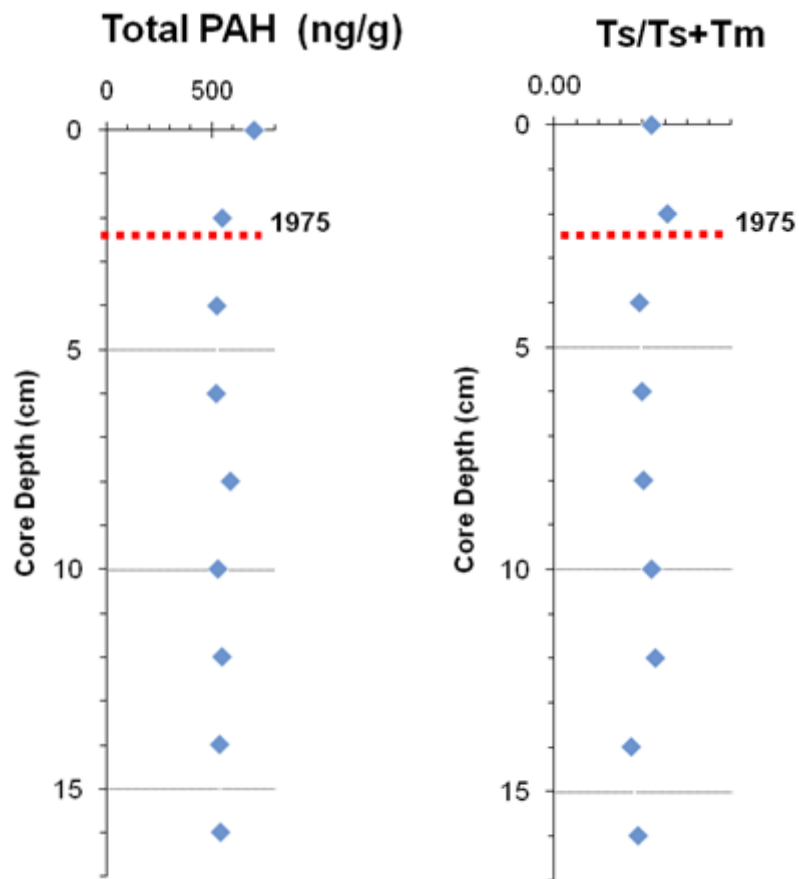
**Total PAH mostly 100-1,000 ug/kg (ppb)  
(grain size and TOC dependant)**

# Results - Sediment

Sediment metals concentrations indicate primarily natural sources, with small differences within the study area. Levels were quite stable throughout Program.



# Results - Sediment

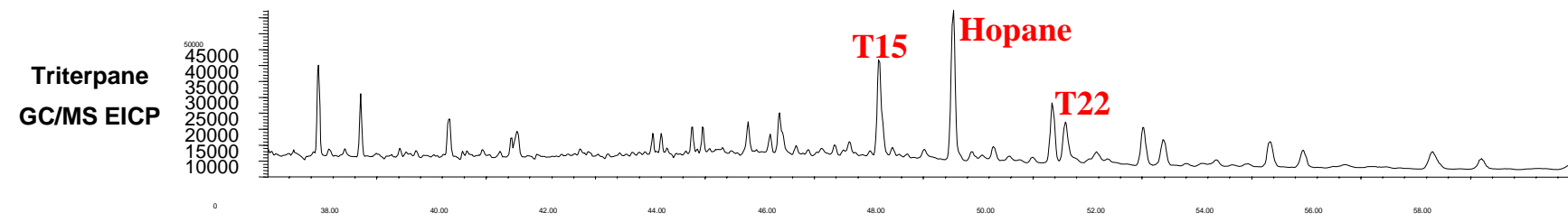
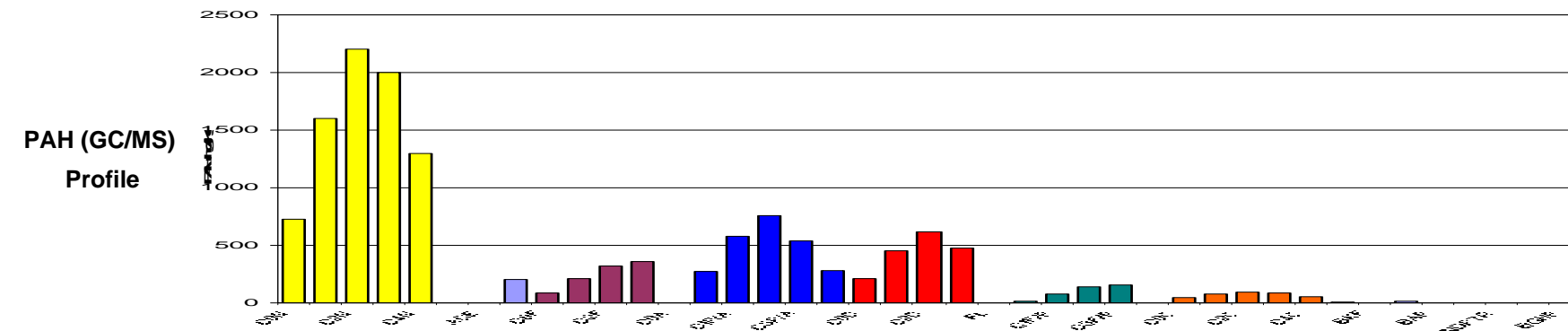
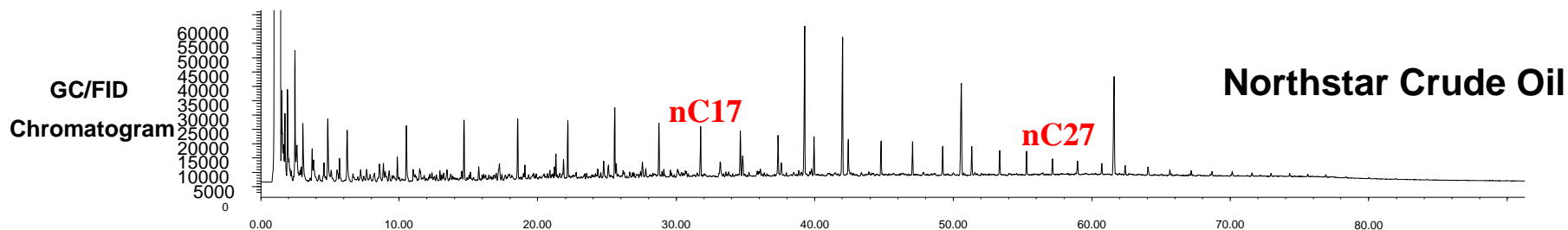


Some regional increase in HCs since Prudhoe Bay O&G production began.

Increase in natural source input as well.

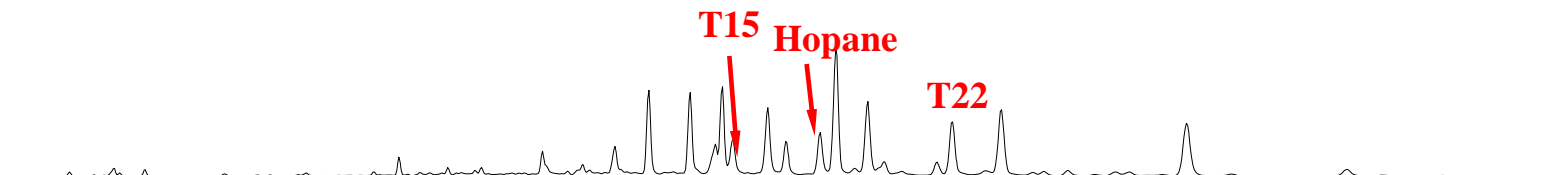
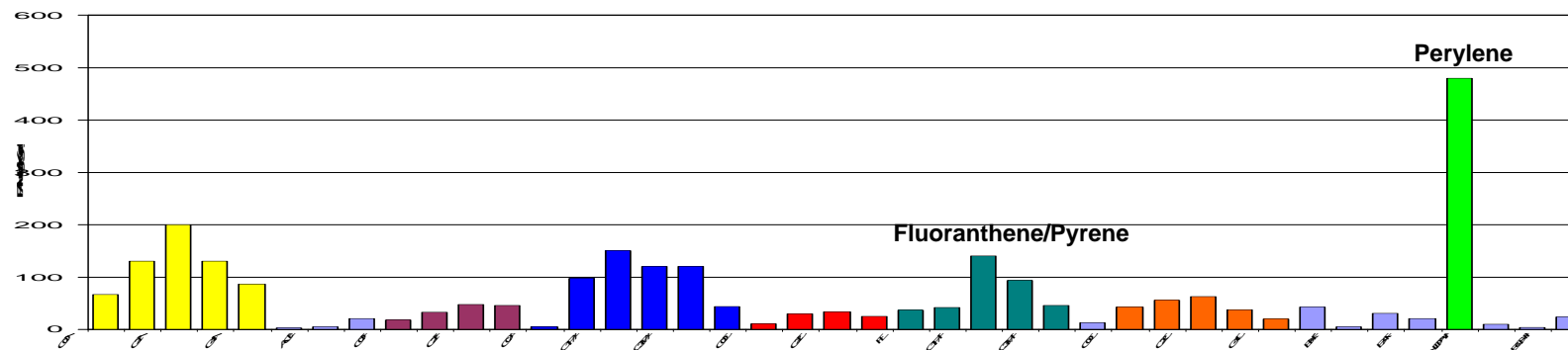
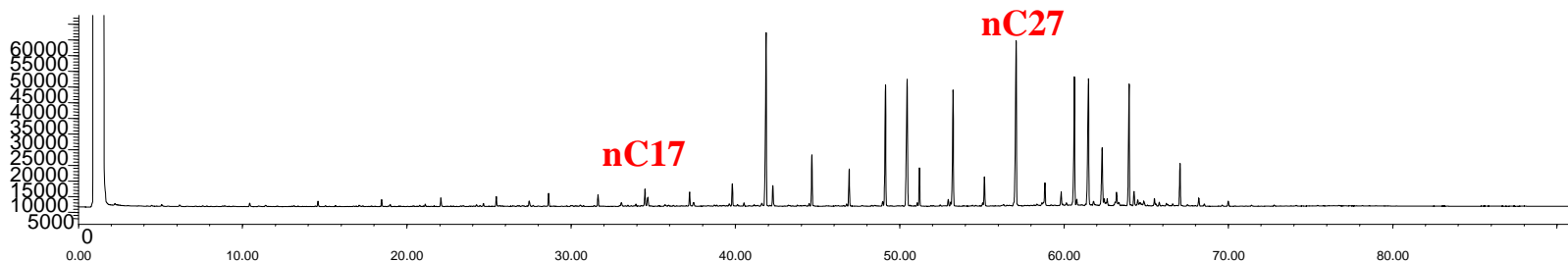
# Results - Sediment

Subtle HC compositional information differences allows for assessment of contributions from different source(s)



# Results - Sediment

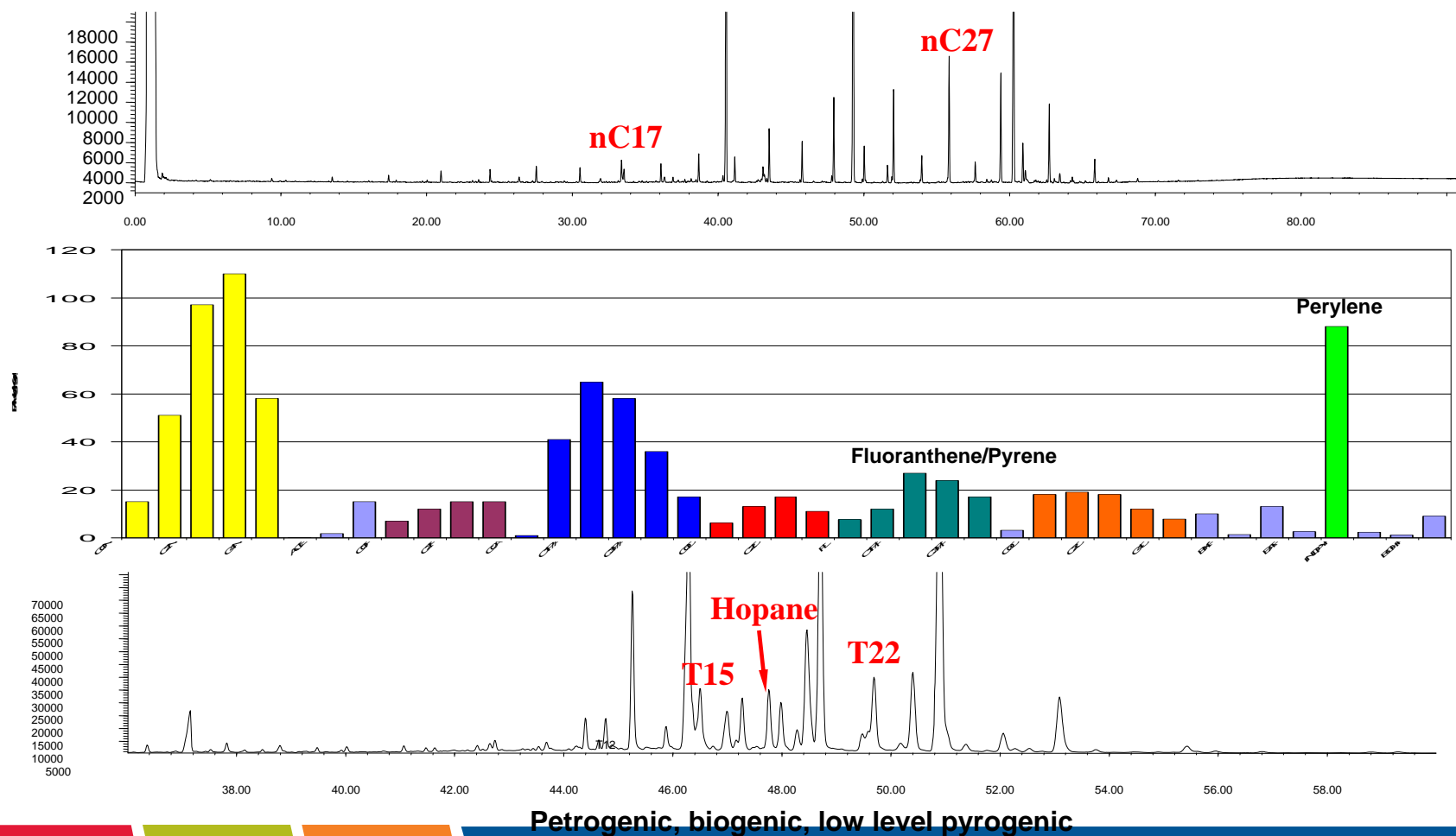
## Colville River Sediment



Petrogenic and biogenic; shale, peat, seeps

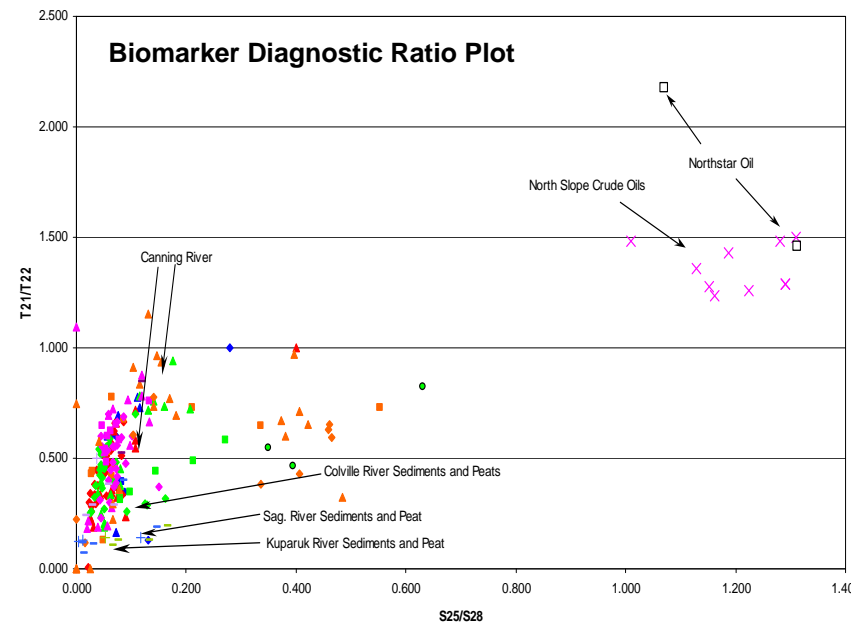
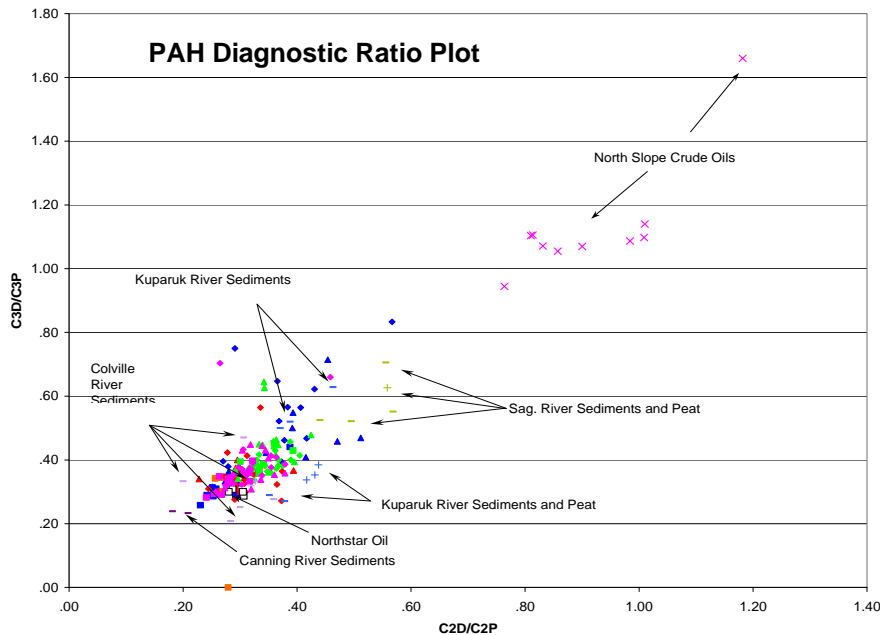
# Results - Sediment

## Background AND Northstar Site Sediment



# Results - Sediment

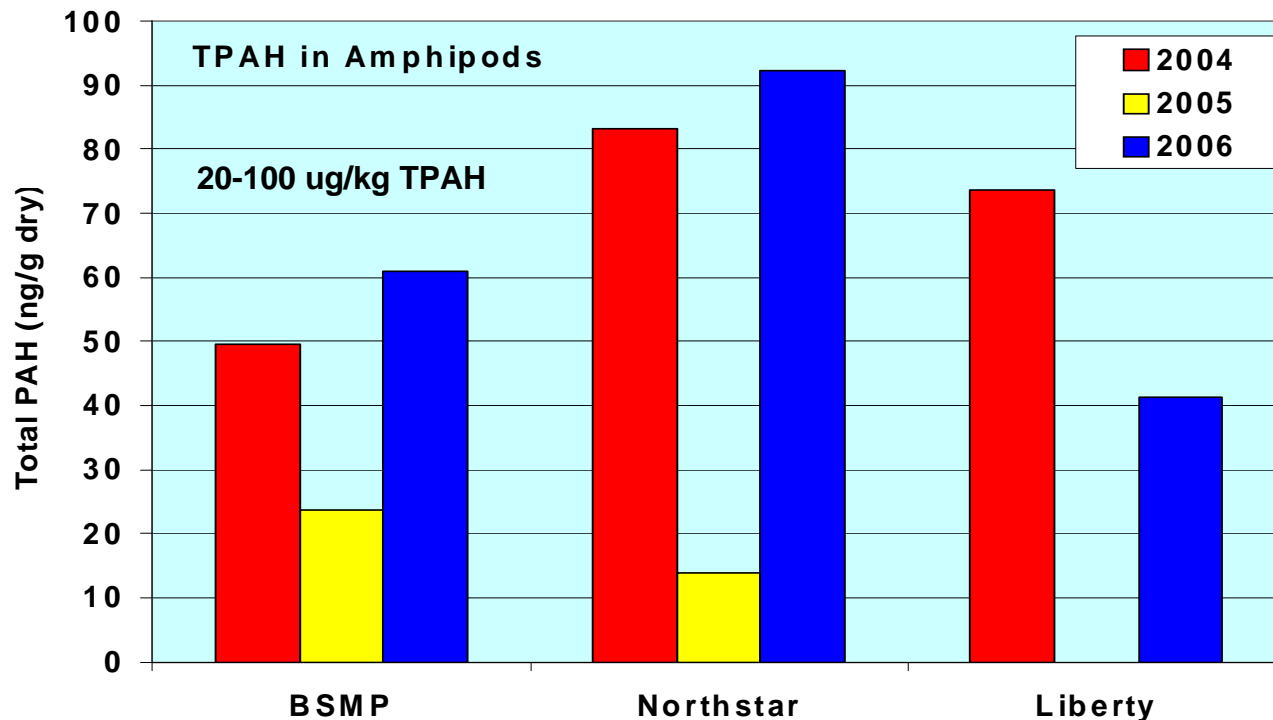
The low sediment HC concentrations are from contributions from mostly similar, natural, source(s)



- Petrogenic HC signal – mostly *not* from regional oil
- Trace-level pyrogenic signal (flaring, ship, other combustion)
- Significant biogenic HC signal
- Sources: rivers (sediment, peat, shale); local and regional combustion; O&G production; oil seeps

# Results - Biota

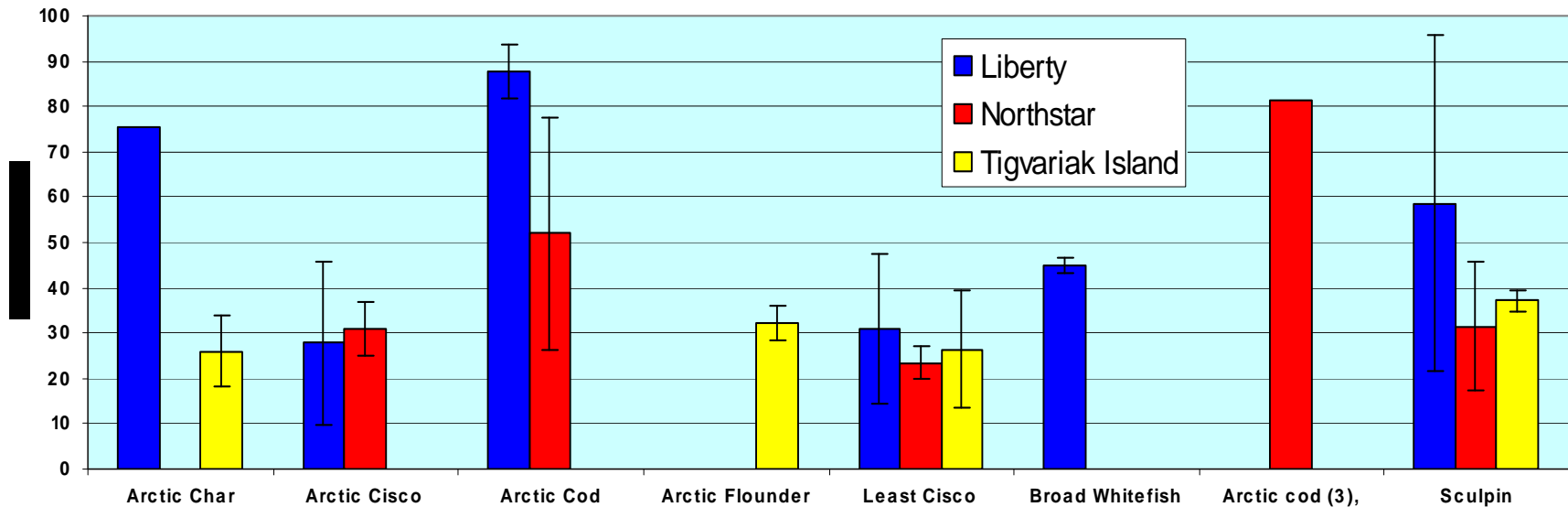
The low and uniform biota tissue HC concentrations, and the chemical composition, suggest they are mostly from regional background source(s)



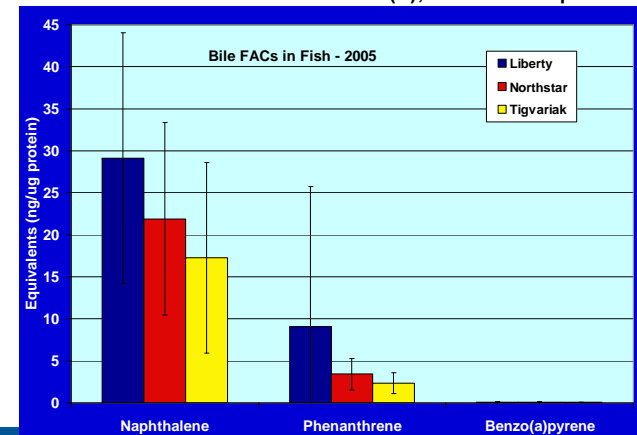
Deployed mussels (and clams) integrate water-column concentrations w/o metabolizing; dissolved and some particle adsorbed contaminants are captured.

# Results - Biota

The low fish HC concentrations indicate low regional background level exposure and effective metabolism

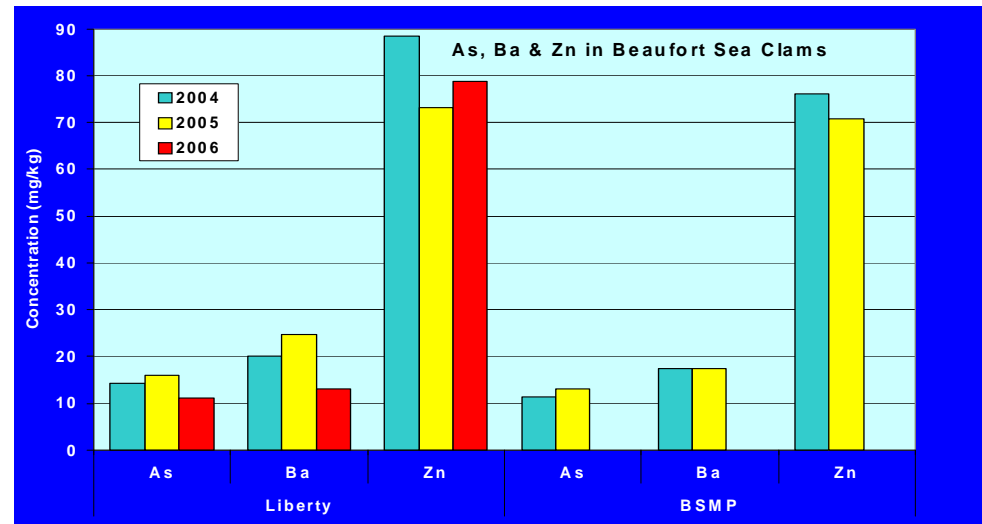
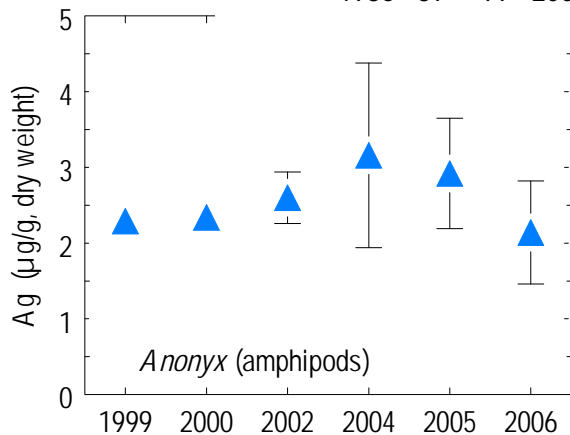
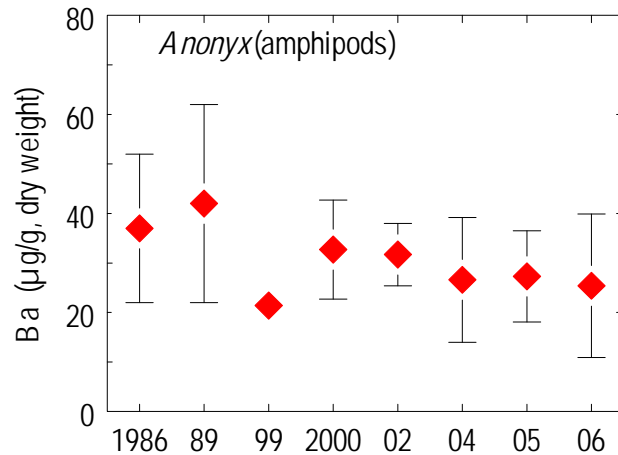


- Consistent PAH and metabolite levels in biota
- PAH and metabolites suggest a mixture of petrogenic and pyrogenic sources
- Abundance of naphthalenes suggest (1) higher bioavailability of lower MW PAH, (2) oils as one source of fish PAH, and/or (3) metabolism of higher MW PAH by MFO system.

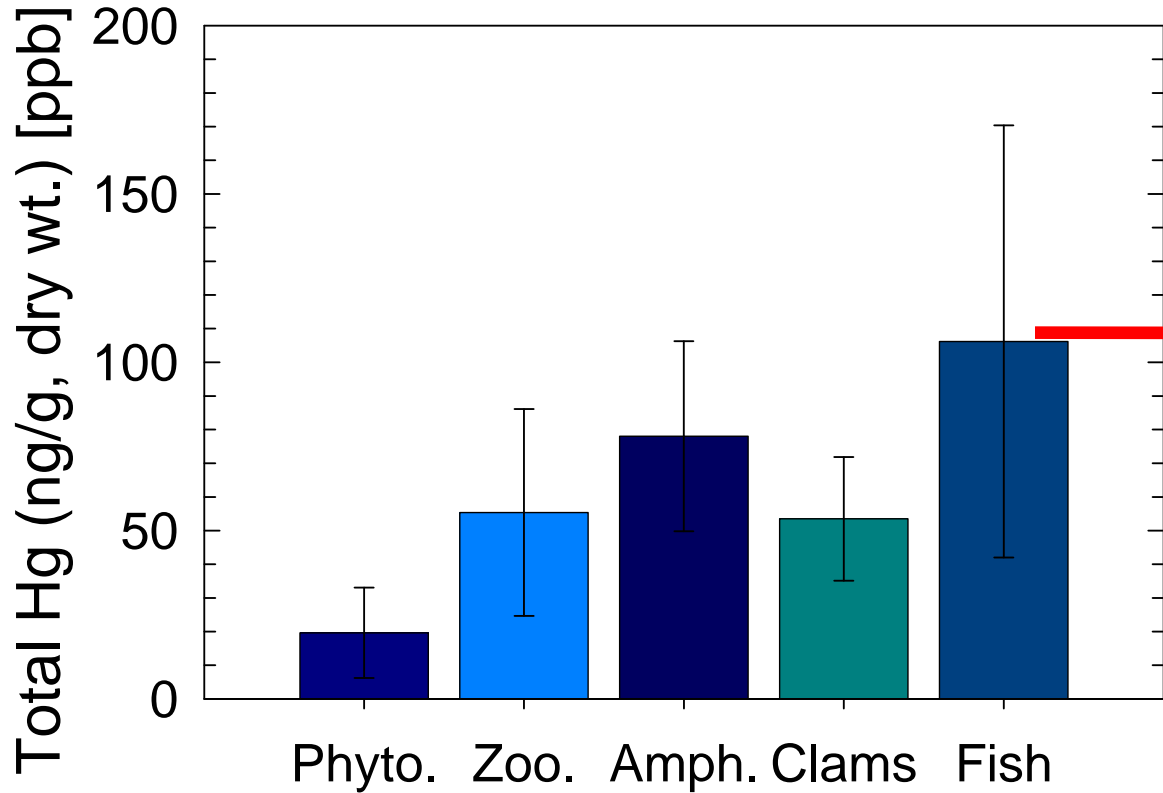


# Results - Biota

Biota trace metal concentrations were similarly uniform, between years and across the study area, indicating no change in contaminant input



# Results - Biota



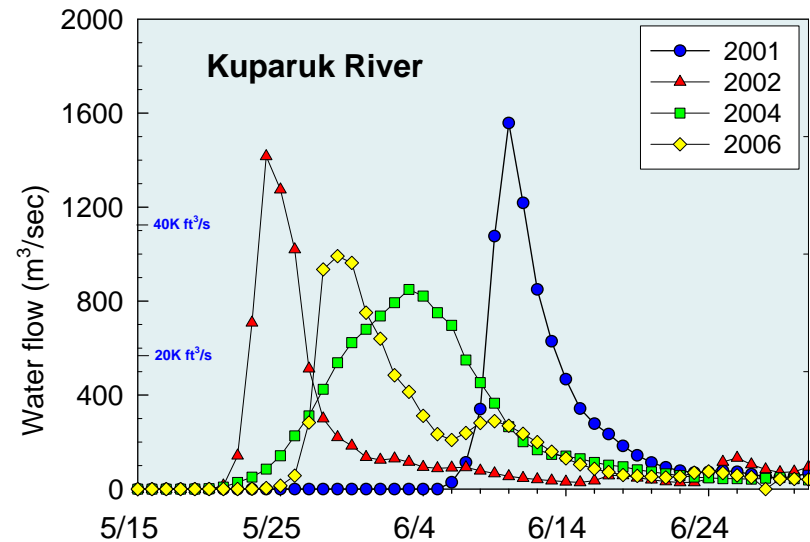
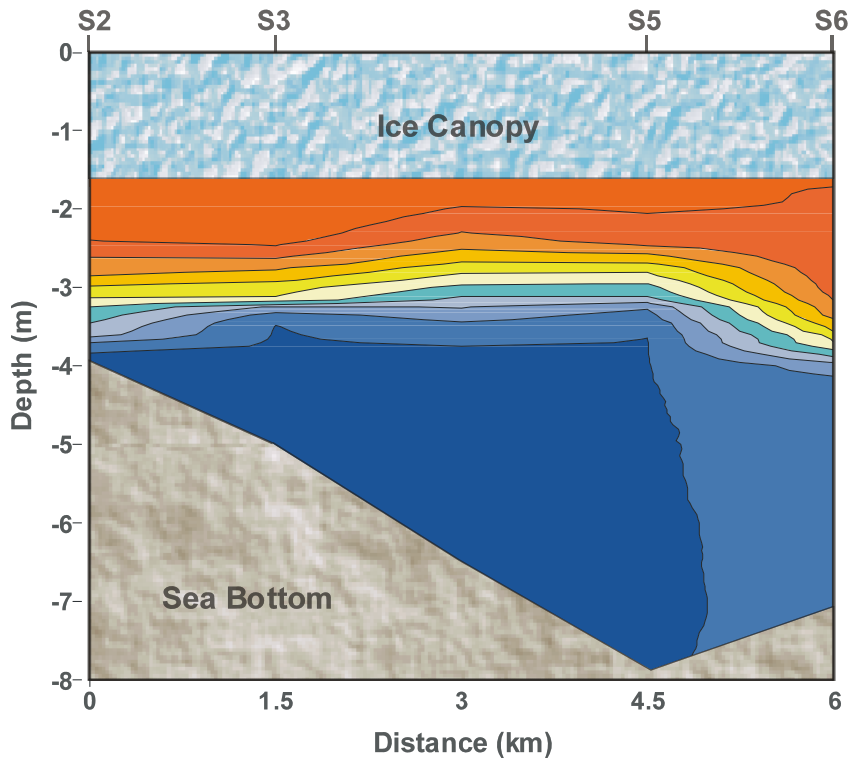
**0.10  $\mu\text{g}$  Hg/g dry wt.  
@ 80% water  
= 0.02  $\mu\text{g}$  Hg/g wet wt.**

**FDA limit of  
1.0  $\mu\text{g}$ /g wet wt. (ppm)**

**Human could eat 2.3 pounds of fish per day and be below minimum risk level of Agency for Toxic Substances & Disease Registry (ATSDR) of the U.S. Department of Health and Human Services.**

# Results – Sources and Fate

**Primarily natural sources of HCs and metals to the Beaufort Sea.**  
**Suspended Solids and DOC: control source, fate/transport, and dissolution & bioavailability of metal and organic contaminants**



**Majority of flow and DOC, >80% of suspended sediments, and >50% of metals and organics are delivered to Beaufort Sea from rivers in 2-3 week spring melt**

# Summary and Conclusions

cANIMIDA environmental monitoring indicate that the O&G activities in Beaufort Sea have not contributed contamination that would adversely impacted the offshore environment

- Sediment contaminant levels are *low* and relatively *uniform* throughout Beaufort Sea, with only subtle point source signals.
- Tissue contaminant levels are also quite uniform and below levels of concern, with no impact or response to stress being observed.
- Contaminant levels in sediment and biota have remained fairly constant over the past 15 years.
- HC and metals signatures in sediment and biota reflect mainly natural sources; anthropogenic sources to Beaufort Sea are small.
- Most of HC and metals input to Beaufort Sea is with suspended solids from the rivers during the spring runoff (~80% in 2-3 weeks).

# Reporting

- MMS Alaska OCS Region Web Site: <http://www.mms.gov/alaska/>
- Final Consolidate Reports for each cANIMIDA task
- “cANIMIDA Data Management Platform”
  - Data that can be queried/downloaded
  - Simple GIS interface
  - Document Repository
    - Project documents/reports (ANIMIDA and cANIMIDA)
    - Other related documents/reports
    - Journal publications
    - Conference presentations

