

Polycyclic Aromatic Hydrocarbons in ocean sediments from the North Pacific to the Arctic Ocean

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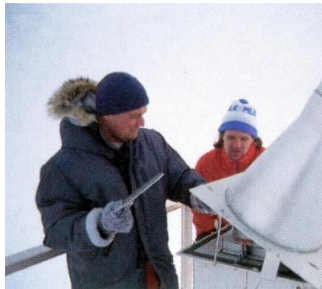
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PAHs – truly ubiquitous contaminants and useful markers of anthropogenic activities

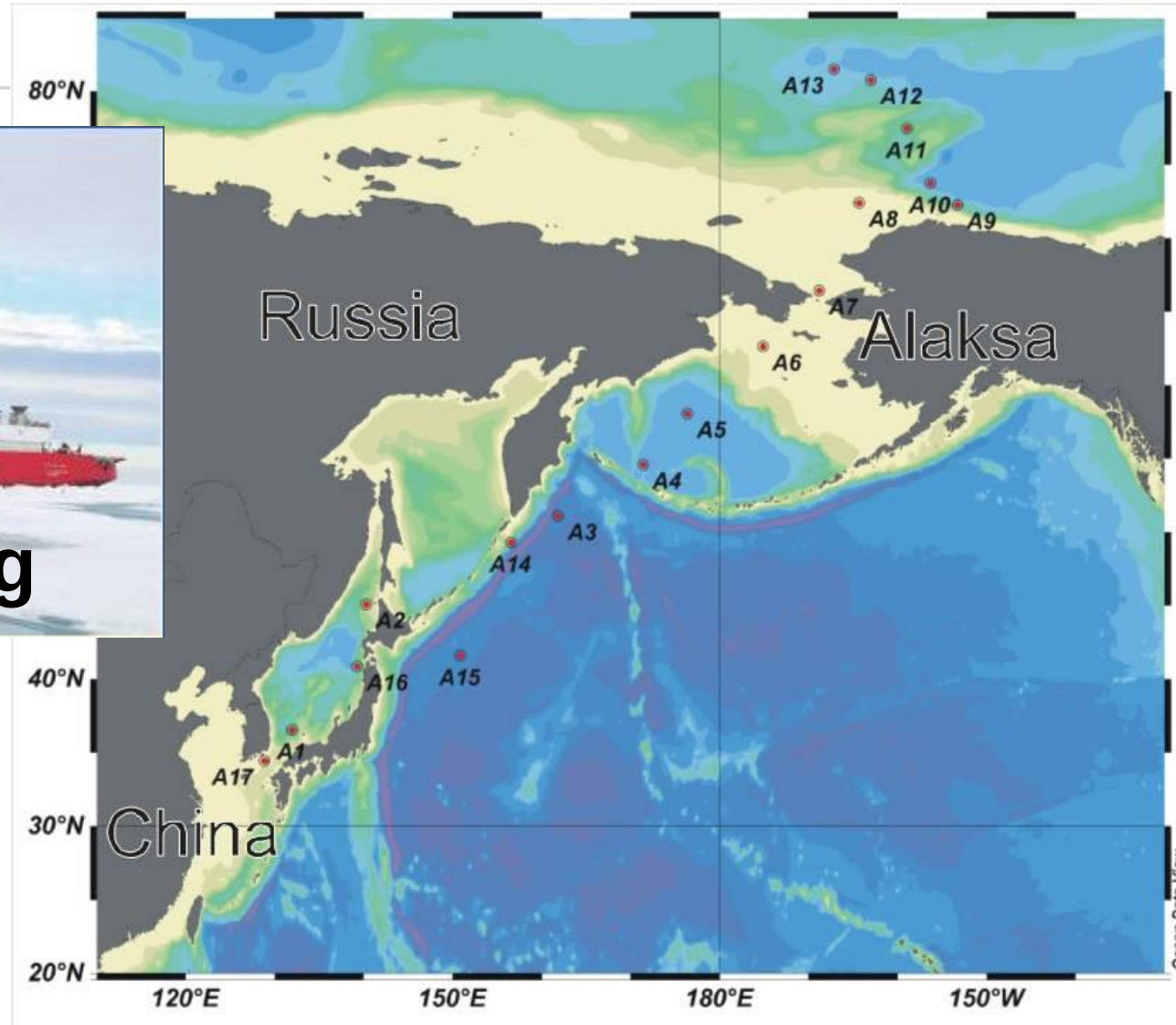


'Snow Dragon' - cruises



R/V Xuelong

Chinese National Arctic
Research Expeditions
(e.g. CHINARE2010, 2012)
East Asia to the High Arctic
(35° N to 82° N).





Deposition of polycyclic aromatic hydrocarbons in the North Pacific and the Arctic

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- *Air*: 1-2 days, ~500 m³,
GFF + PUF/XAD-2

- *Seawater*: 0.5-1 day, ~900 L,
GFF + PAD-3



Σ_{18} PAHs in air (pg m^{-3})

Environment
Centre

Lancaster
University

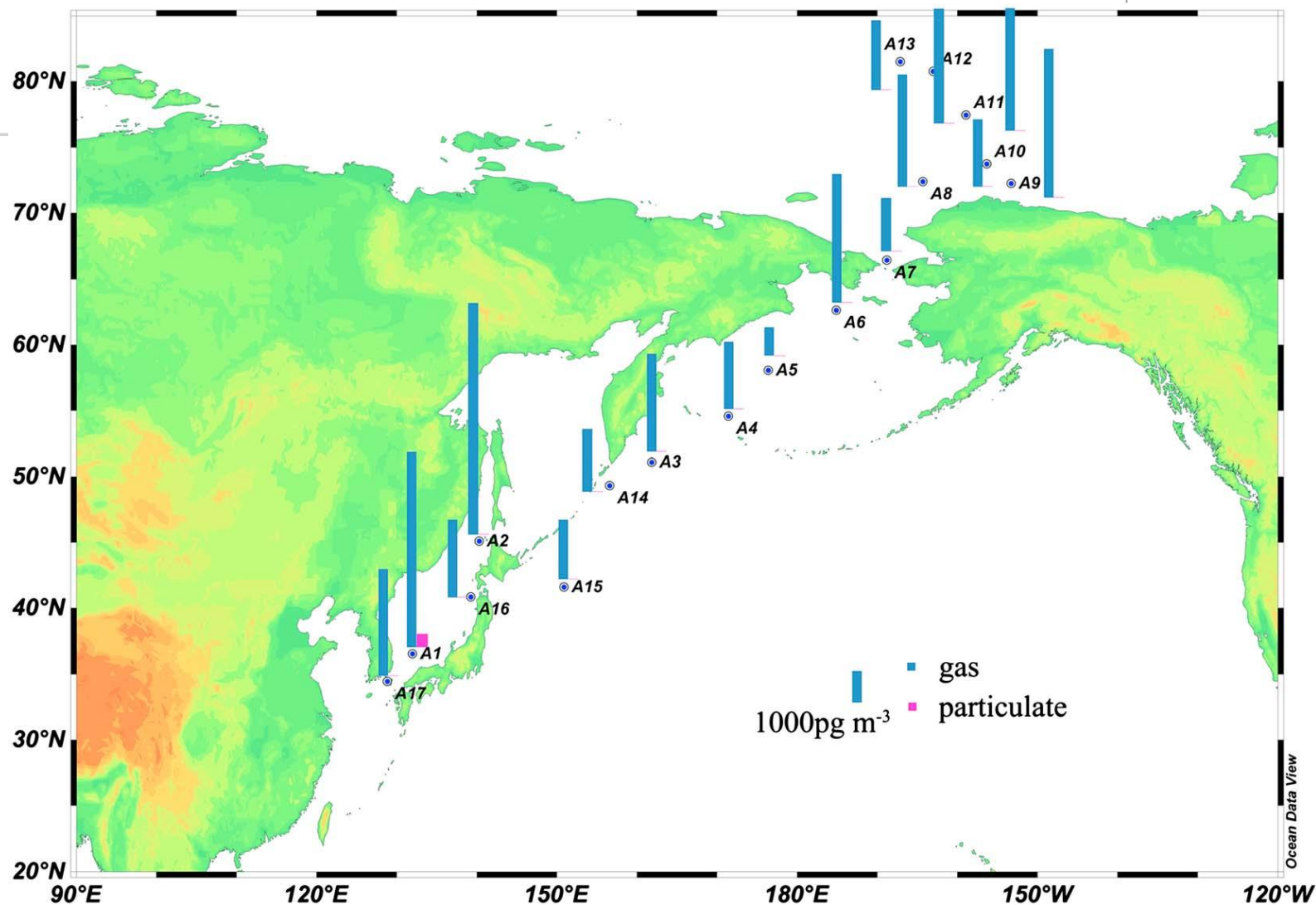


Figure 1. Concentrations of gas- and particulate-phase PAHs in the atmosphere ($\Sigma_{18}[\text{PAHs}]_{\text{atm}}$) along the sampling cruise.

5-6 ringed PAHs in air

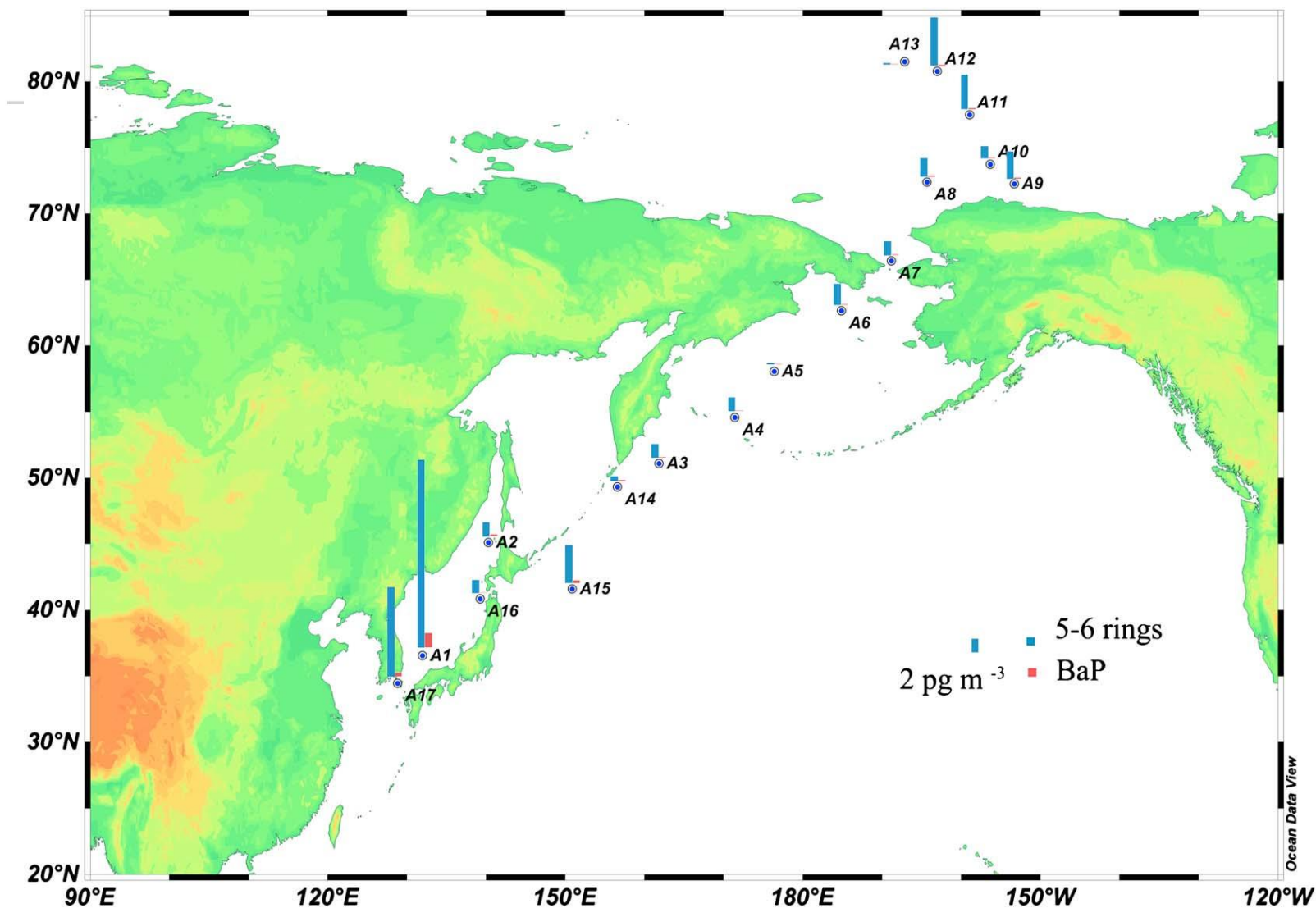
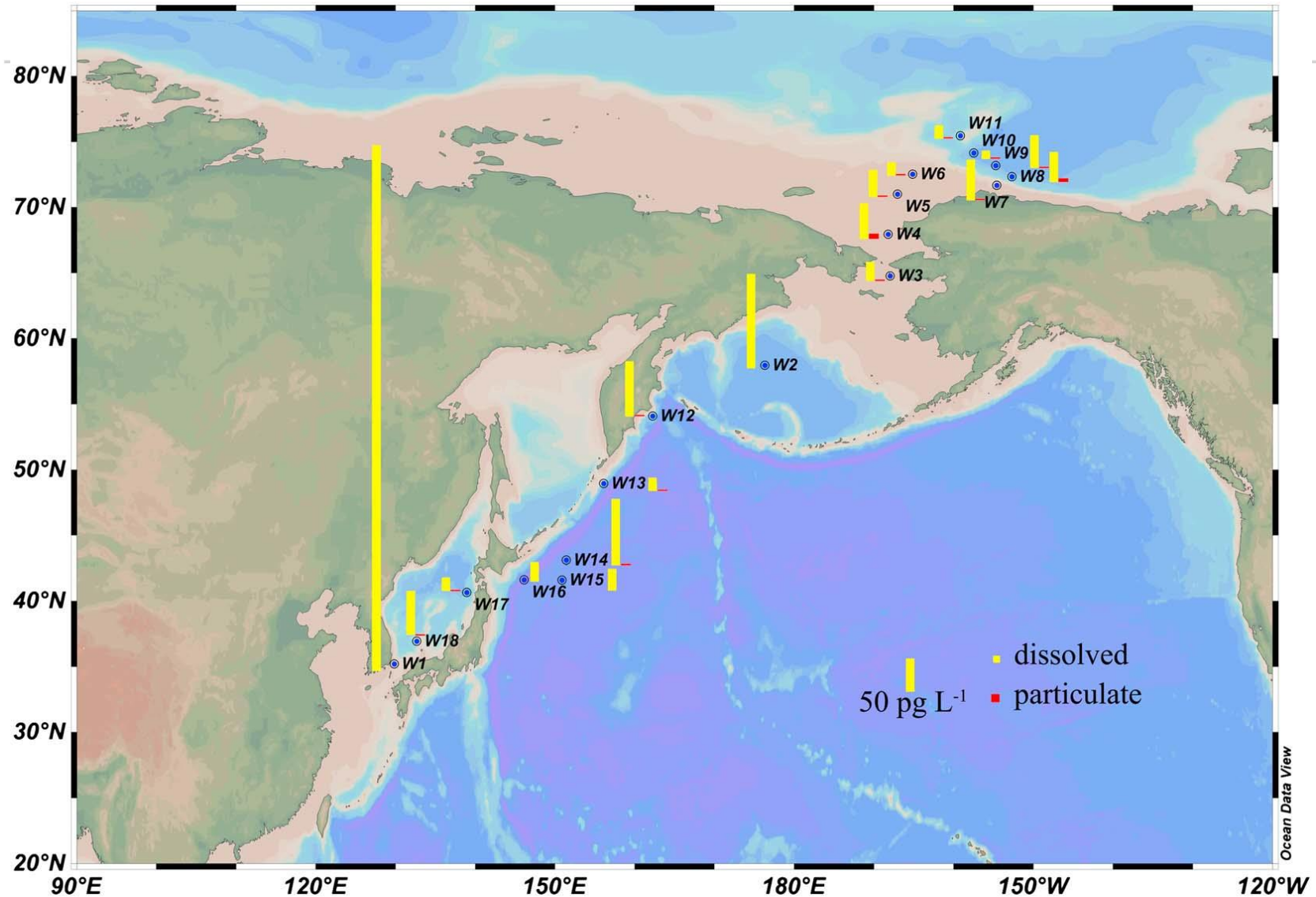


Figure 2. Concentrations of five- to six-ringed particulate-phase PAHs and BaP in the atmosphere along the sampling cruise.

Σ_{18} PAHs in water (pg L^{-1})



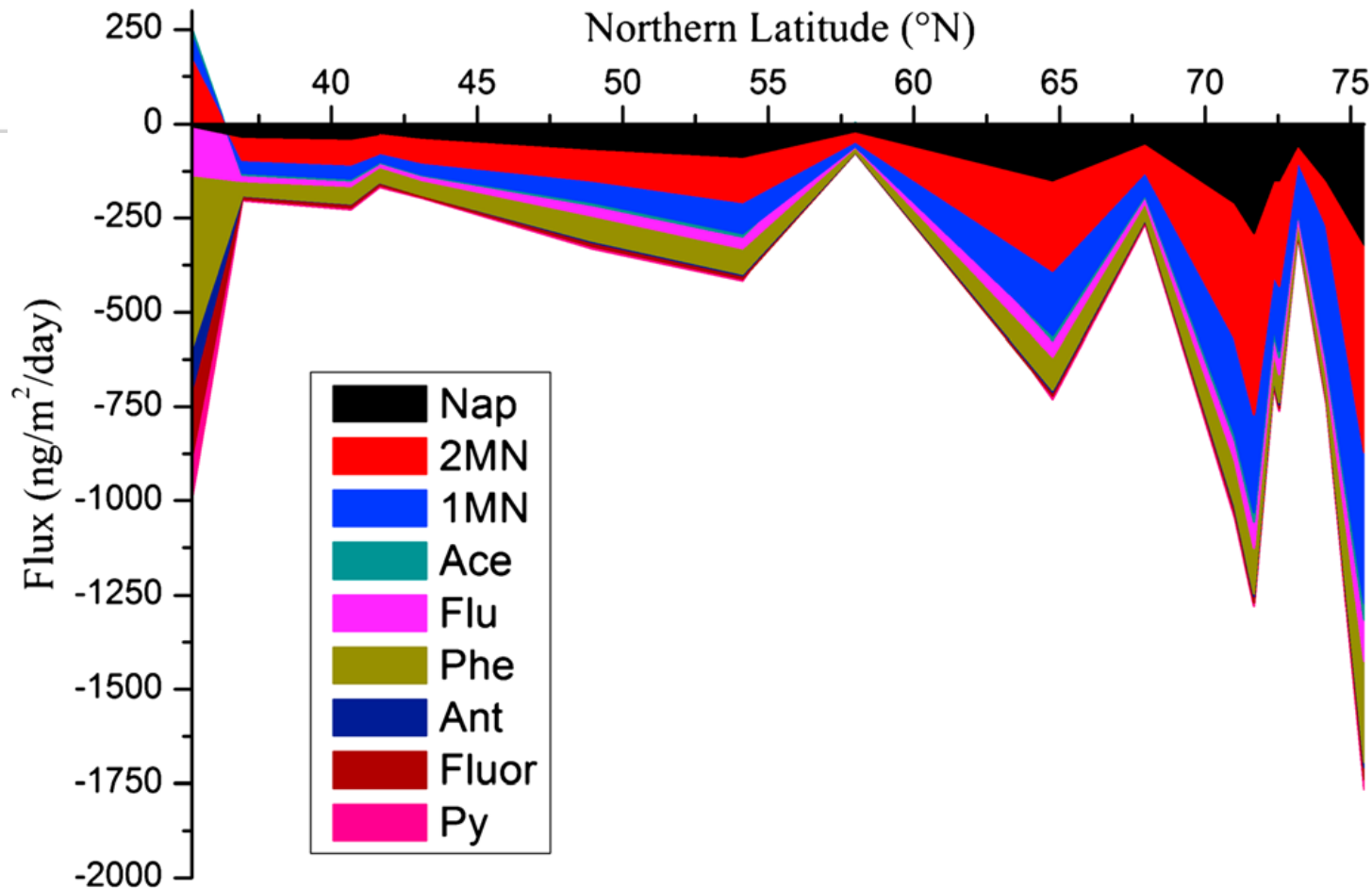


Figure 5. Accumulated (sum) air-sea gas exchange fluxes of top nine PAHs versus latitude along the sampling transect. Negative (–) flux indicates deposition into the water column.



RESEARCH ARTICLE

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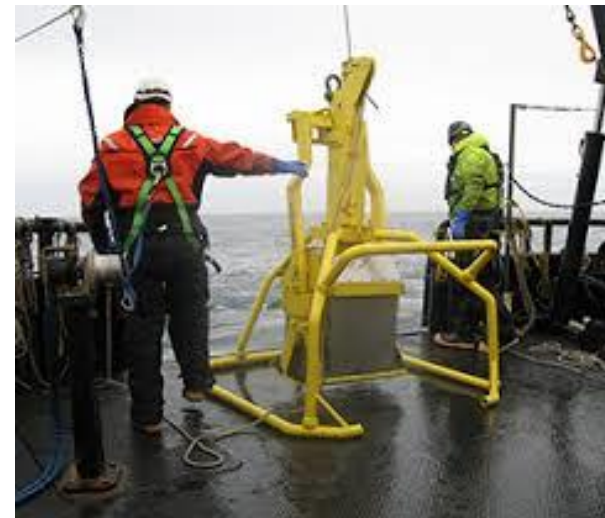
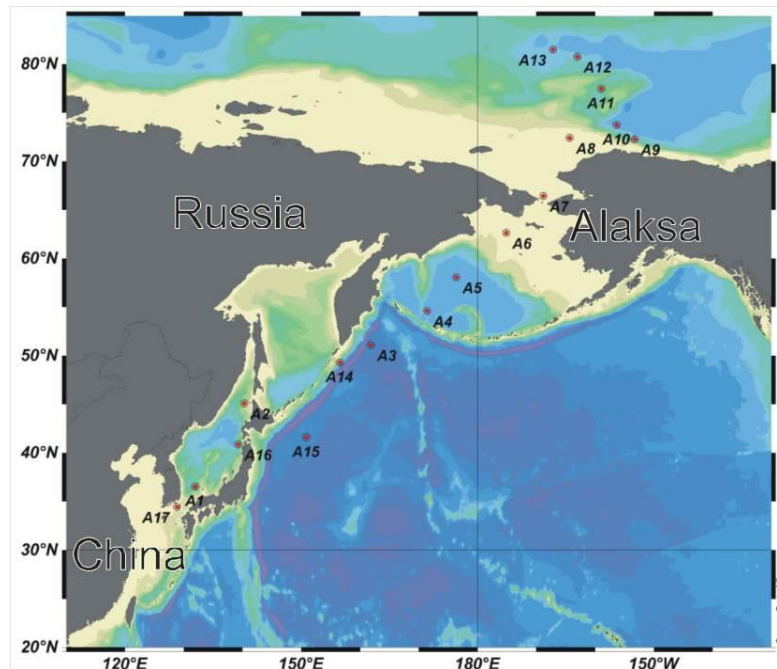
Persistent organic pollutants in ocean sediments
from the North Pacific to the Arctic Ocean

Key Points:

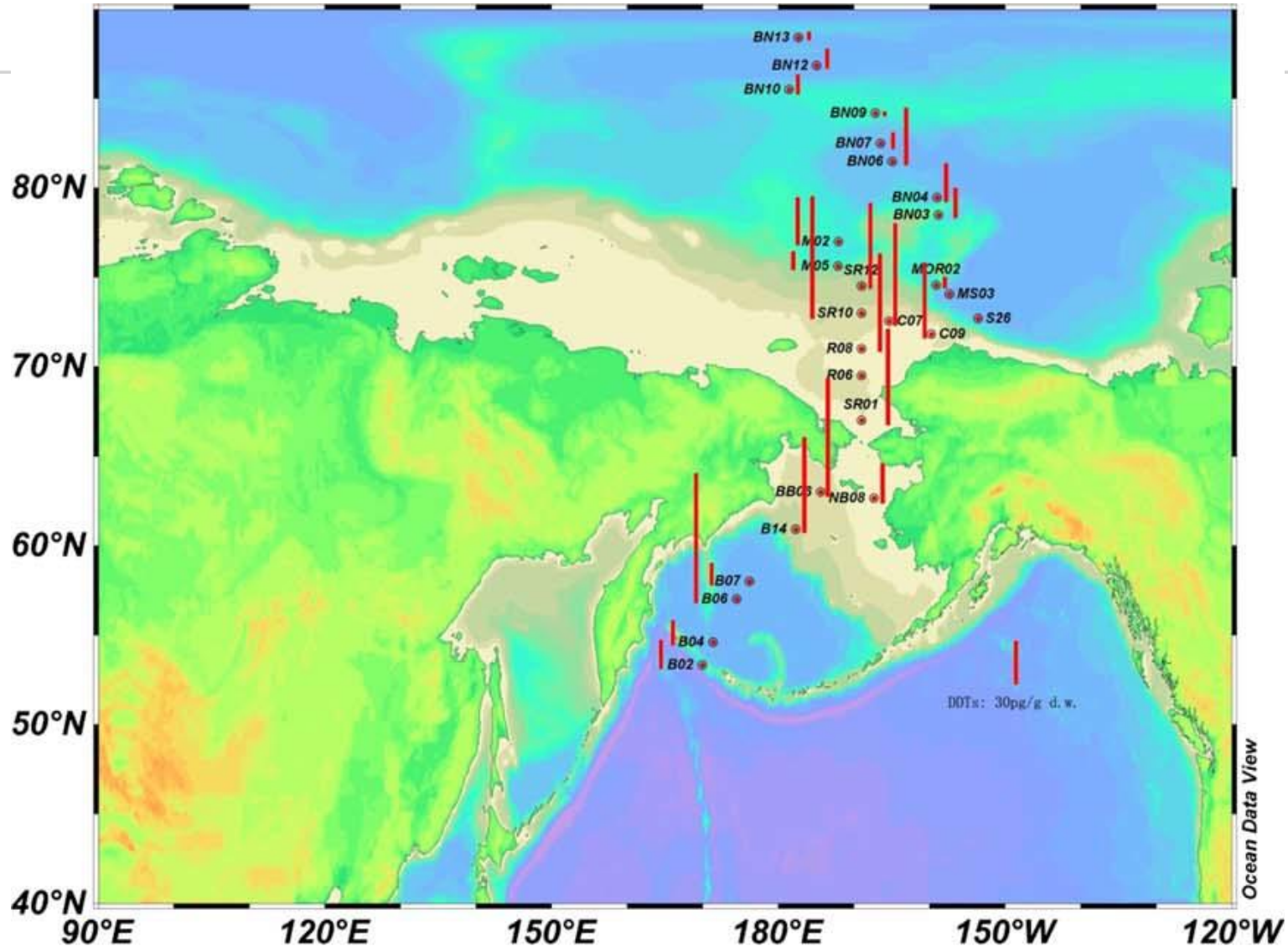
- Bering-Chukchi shelf sediments are an important regional sink for POPs
- Different chemical concentrations between shallow and deeper ocean regions
- Substantial chemical processing between surface waters and benthic sediments

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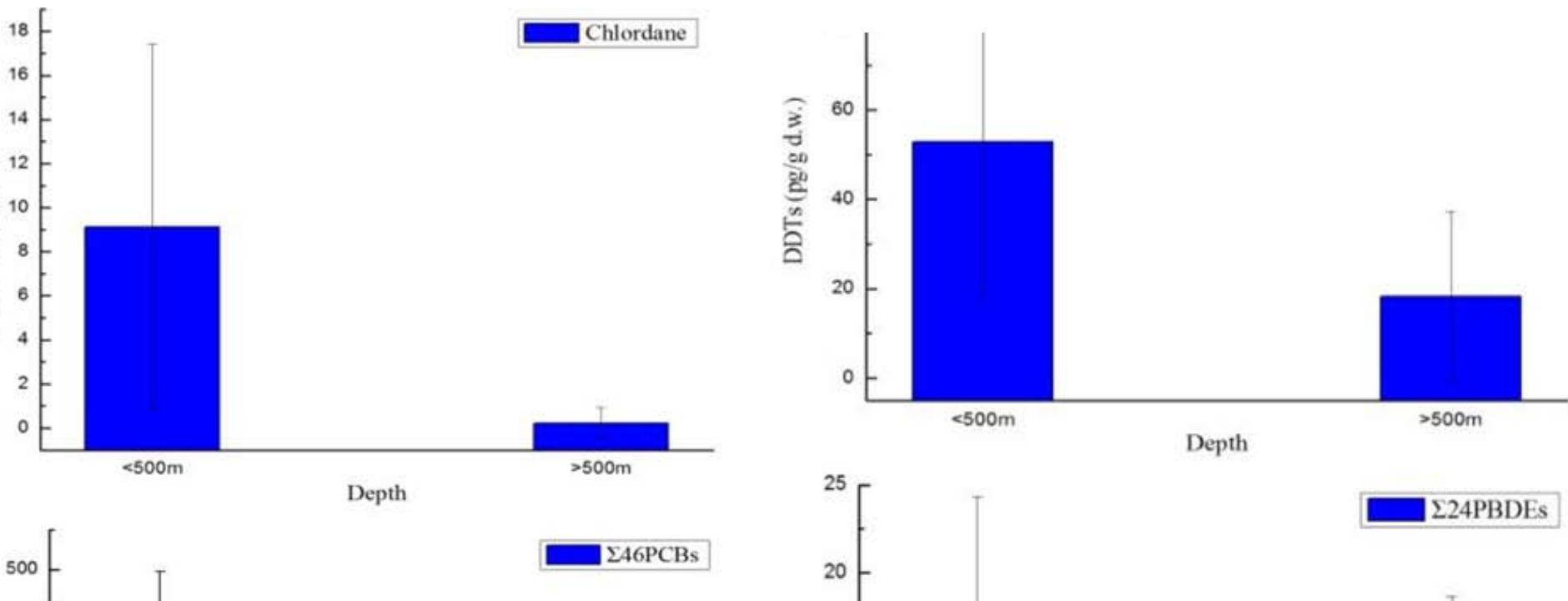


DDTs in surficial ocean sediments (pg/g dw)





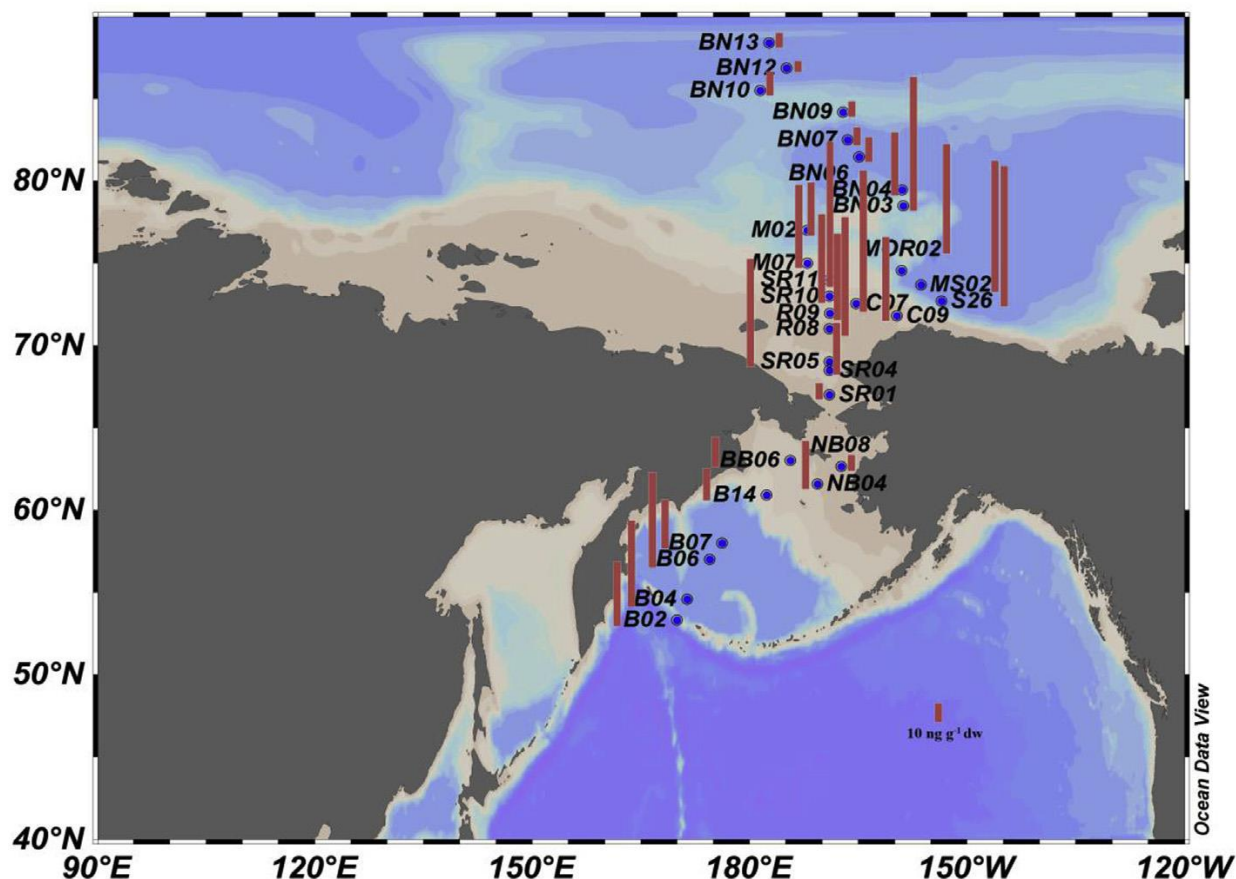
Sediment depth and TOC content



A weak correlation is observed between organochlorine/PAH concentrations and organic carbon content of marine sediments

Polycyclic aromatic hydrocarbons in ocean sediments from the North Pacific to the Arctic Ocean[☆]

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Ralf Ebinghaus^c, Guoping Gao^{a,**}



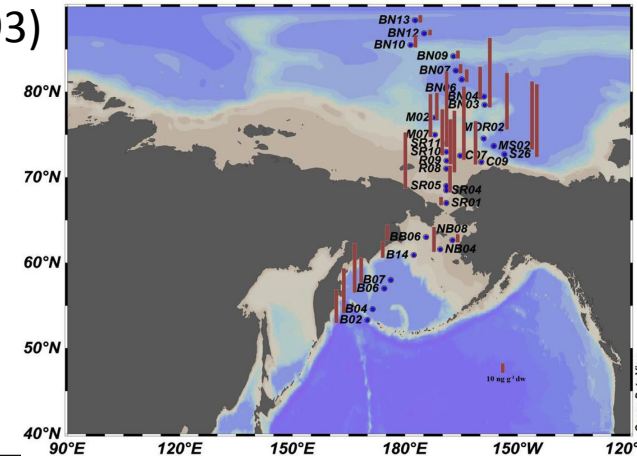


Σ_{16-20} PAHs concentrations in marine sediments

North Sea ($700\text{--}2700 \text{ ng g}^{-1}$) Klammer & Fomsgaard (1993)

Baltic Sea ($9.53\text{--}1870 \text{ ng g}^{-1}$) Witt (1995) Mar. Poll. Bul.

Σ_{18} PAHs concentrations along the cruise transect (ng g^{-1}) -this study



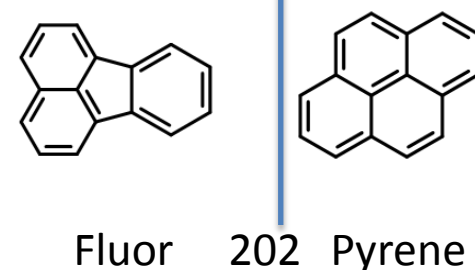
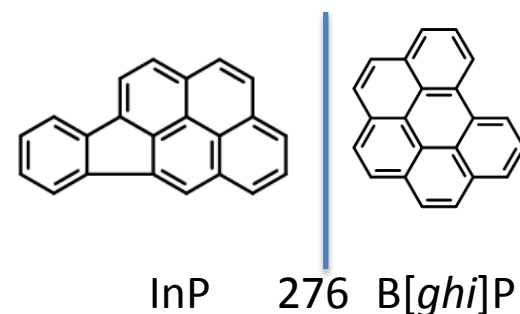
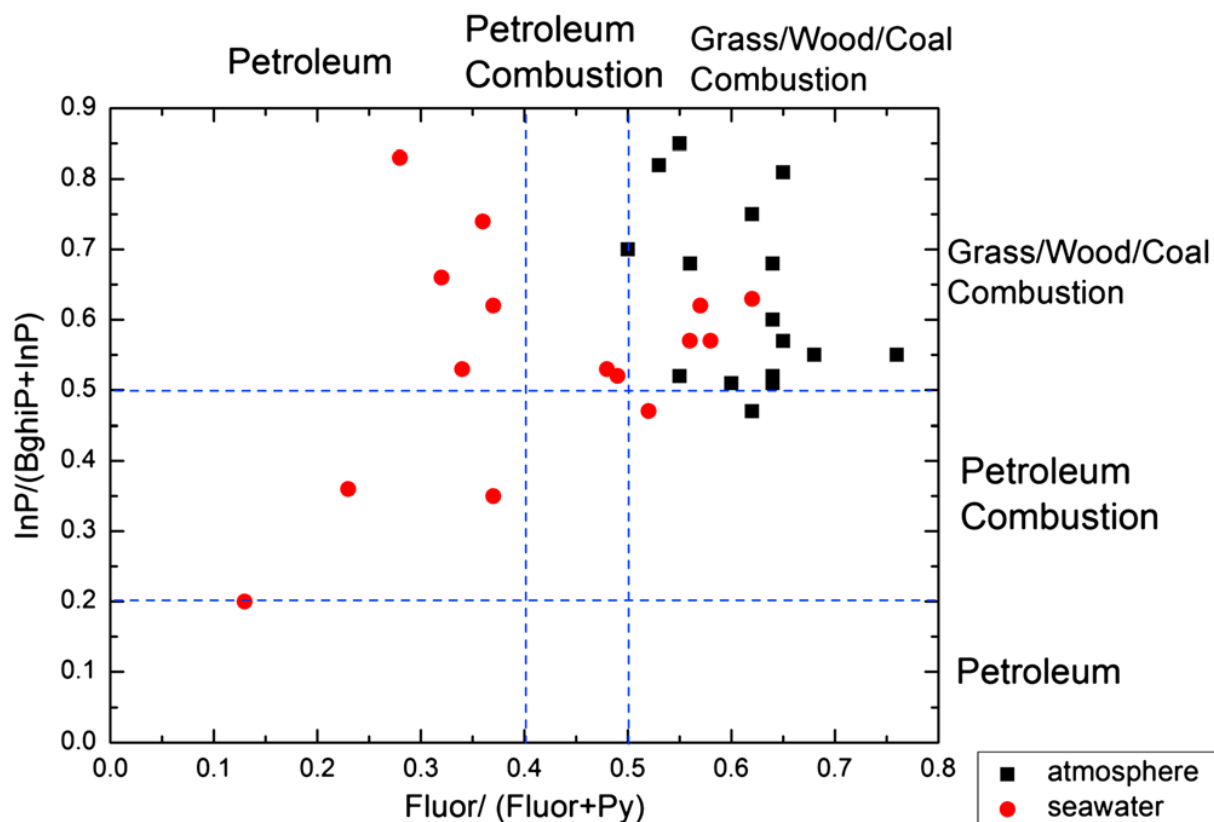
	Range	Median	Mean
Bering Sea	26.2–51.2	40.4	39.5
Bering Strait	8.5–25.8	16.5	16.8
Chukchi Sea	8.8–78.3	47.0	49.7
Canada Basin	58.9–75.5	70.5	68.3
Central Arctic Ocean	5.8–33.9	9.7	13.1
Entire Cruise	5.8–78.3	34.2	37.3

Svalbard coastal sediments ($25\text{--}38 \text{ ng g}^{-1}$)

Use of PAH ratios for source discrimination

Critical appraisal: Galarneau, E. (2008) Atmos. Environ. 42, 8139

Yunker, M. et al (2002) Org. Geochem. 33, 489



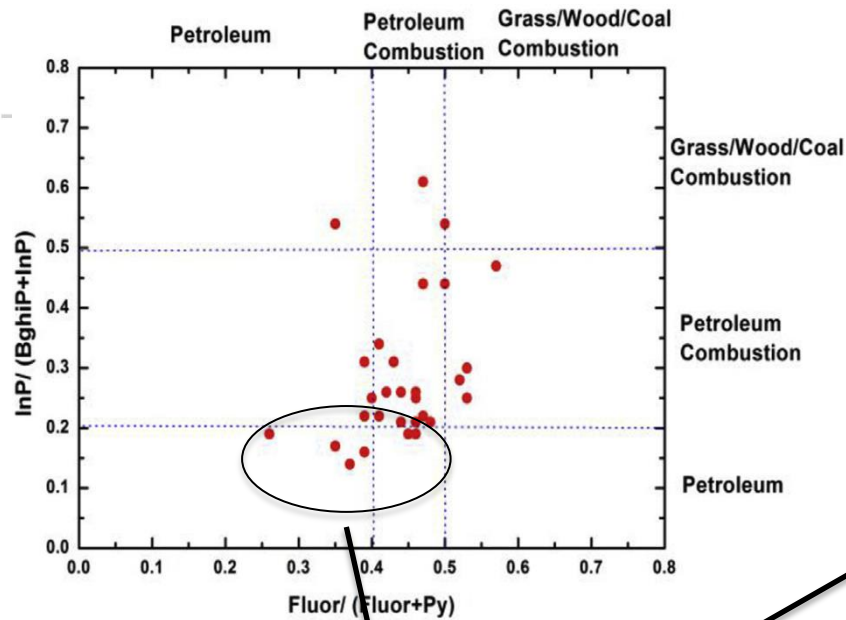
Indeno[1,2,3-cd]pyrene (InP)

Benzo[ghi]perylene (B[ghi]P)

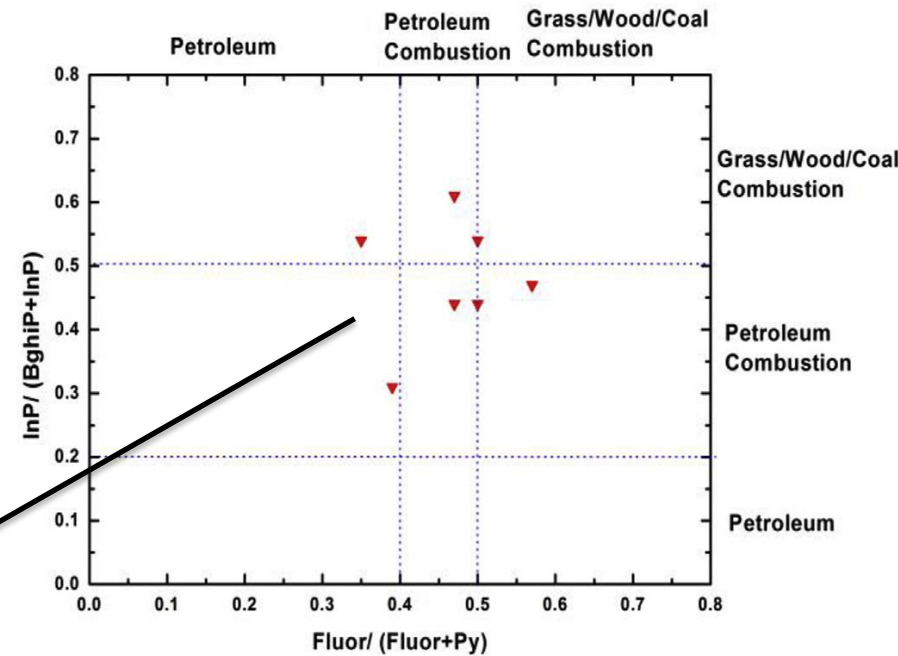
Fluoranthene (Fluor)

Pyrene

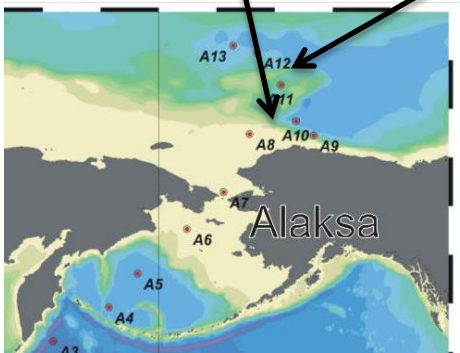
PAH isomer ratios as indicators of sources



entire cruise



central Arctic Ocean



Exposed coal seams
on Ellesmere Island
'allochthonous' coal

Summary

- PAHs in air and surface marine waters at lower latitudes reflect anthropogenic combustion processes, but the picture is blurred at much higher latitudes (central Arctic Ocean) due to biomass combustion during the cruise period (summer).
- In the coastal seas of the Chukchi/Beaufort Sea region petrogenic sources dominate the PAH profile in sediments, whereas in the deeper Arctic Ocean the profile differs.
- Better engagement between geochemists ('sediments') and pollution scientists ('air/water')!