



ICMGP 2024
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Hannah Inman, Robert P. Mason, Yipeng He

Speciation and Distribution of Mercury in the
Water Column and Sediments of the Bering and
Chukchi Seas



Climate changes in the Arctic

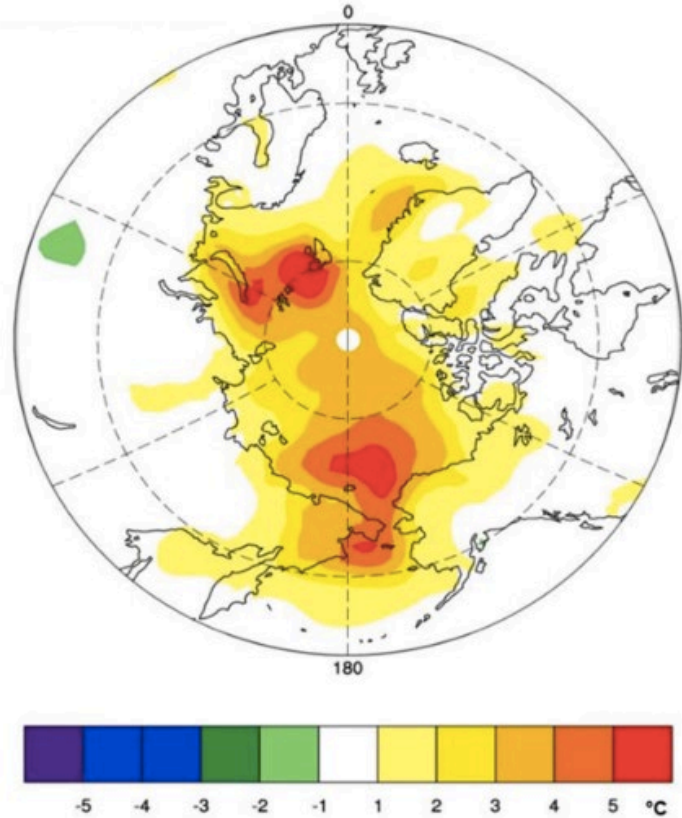
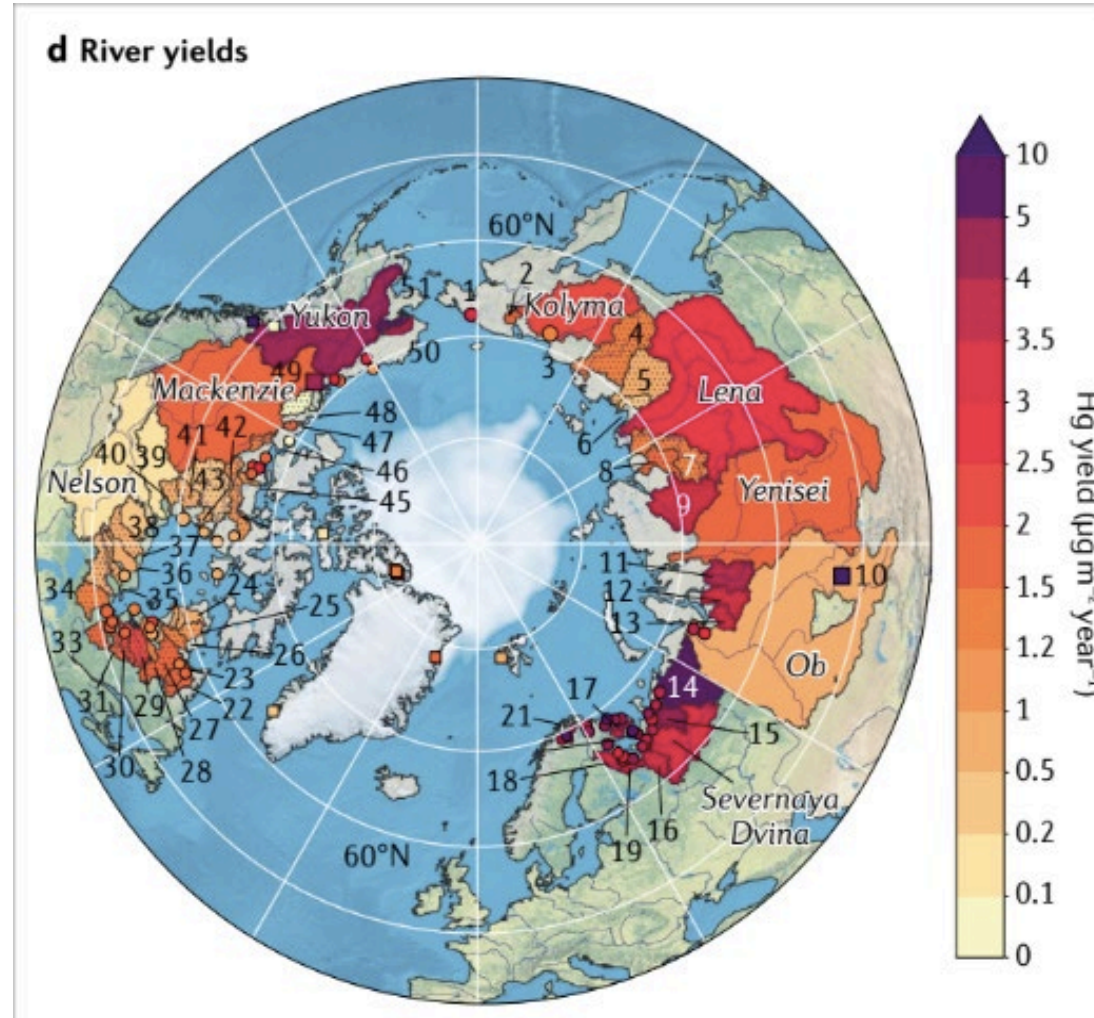


Fig. 2. Annual air temperature anomalies (1981–2010 baseline) for the Arctic October 2017 through September 2018. Values peak over 5 °C. Note the extremes over the marginal seas of the Barents and Kara Seas and north and south of Bering Strait. The pattern signature is primarily from winter. Data from NCEP/NCAR Reanalysis.

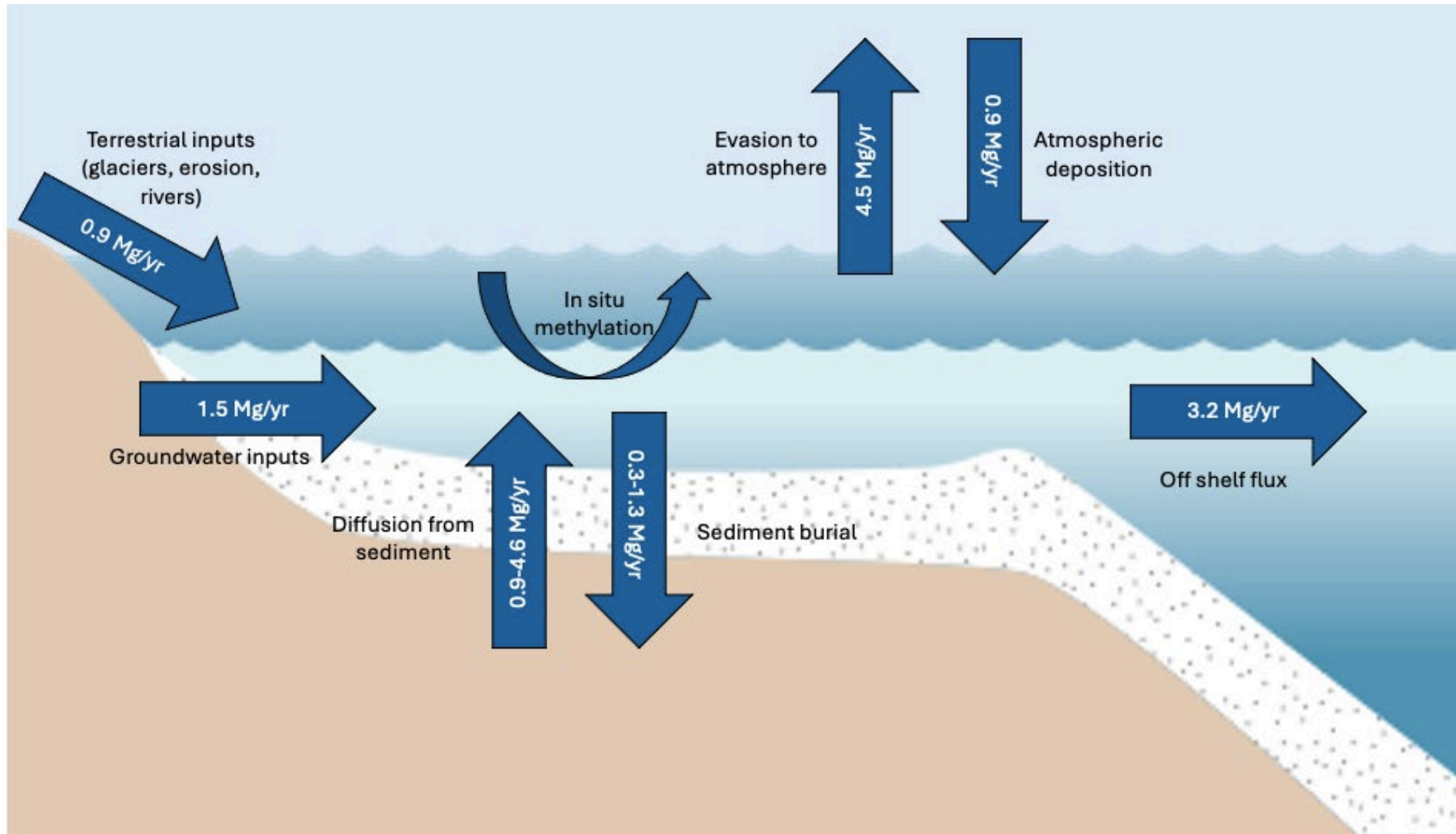
Overland et al. 2020



River inputs expected to increase in the future (permafrost thaw, glacier melt, increased rainfall, soil erosion)
Dastoor et al. 2022



Arctic shelf MeHg budget



Large range in values in sediment processes

Shelf processes are more important in the Arctic than other oceans; **nearly 50% over continental shelf** compared to 10% average across all oceans

Inputs expected to increase in the future due to climate change (ie. riverine and erosion inputs, increased deposition due to sea ice melt, etc.)

Groundwater inputs: Bullock et al., in review

All other values: Jonsson et al. 2022

Illustration adapted from: <https://ian.umces.edu/media-library/coastline-2d-sea-level-rise-with-continental-slope/>



Cruise overview

May-June 2021

Collected:

Hg(0)

DMHg

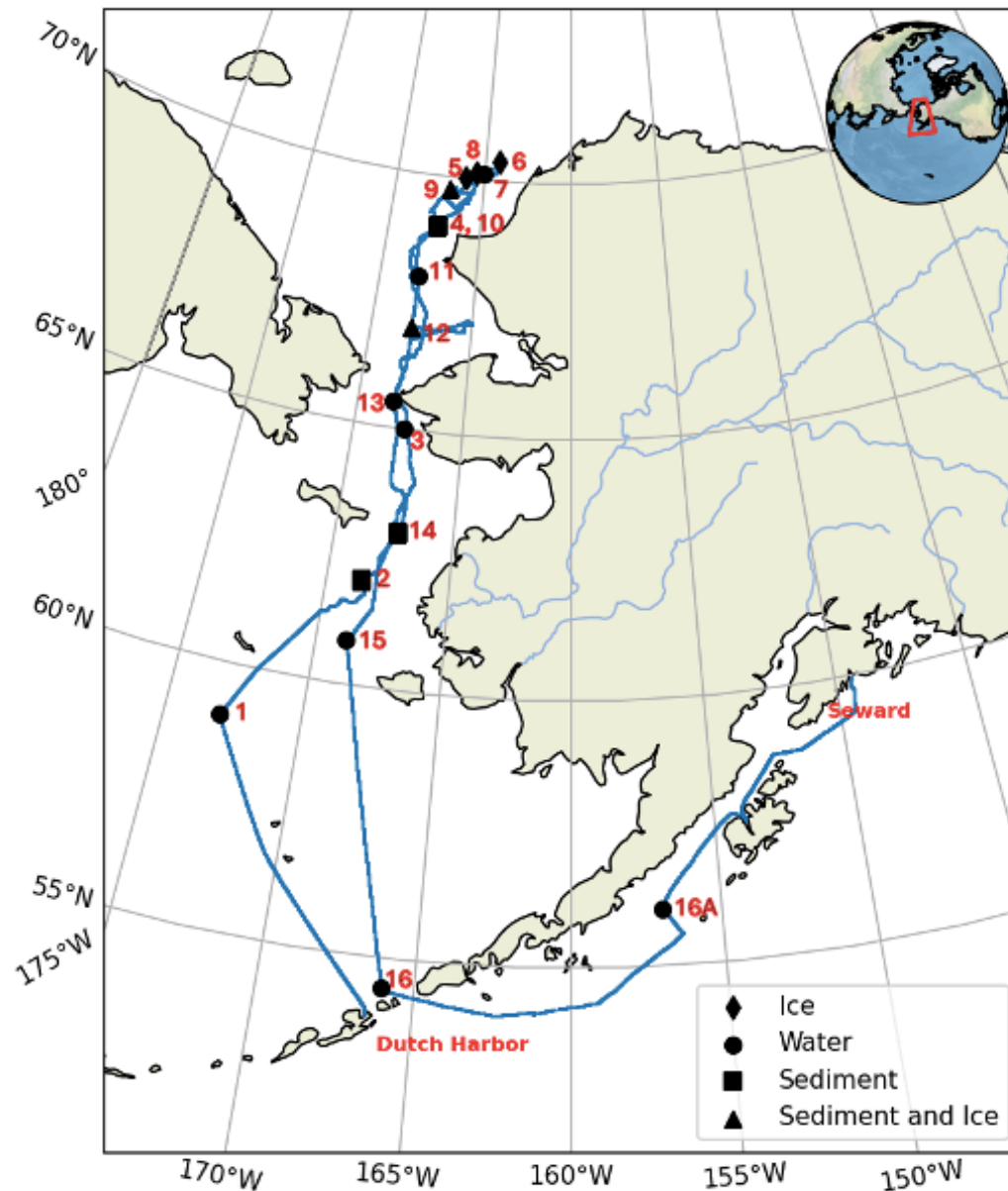
Bulk THg

Bulk total MeHg

Particulate THg

Particulate MeHg

Ancillary variables (Carbon chemistry from Vlahos lab, nutrients and AOU from Juranek)



Cruise overview

May-June 2021

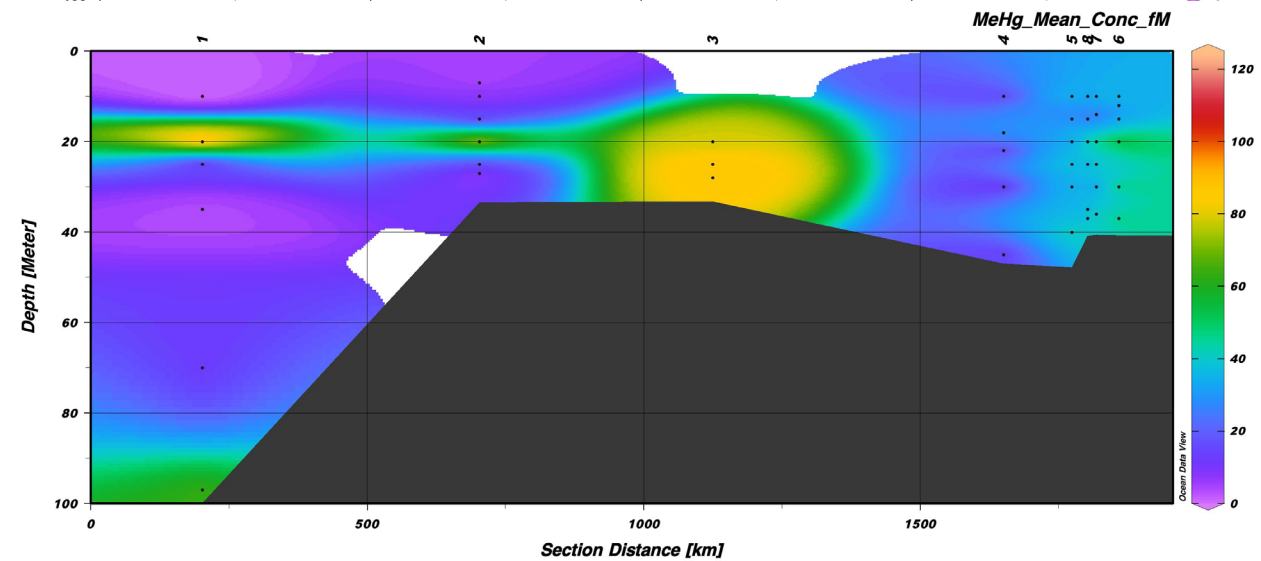
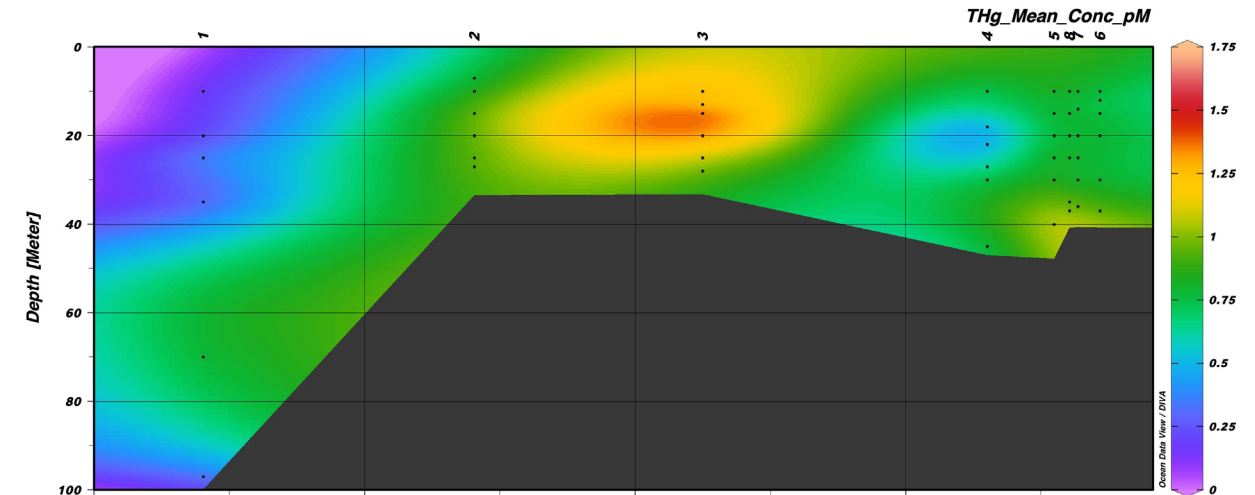
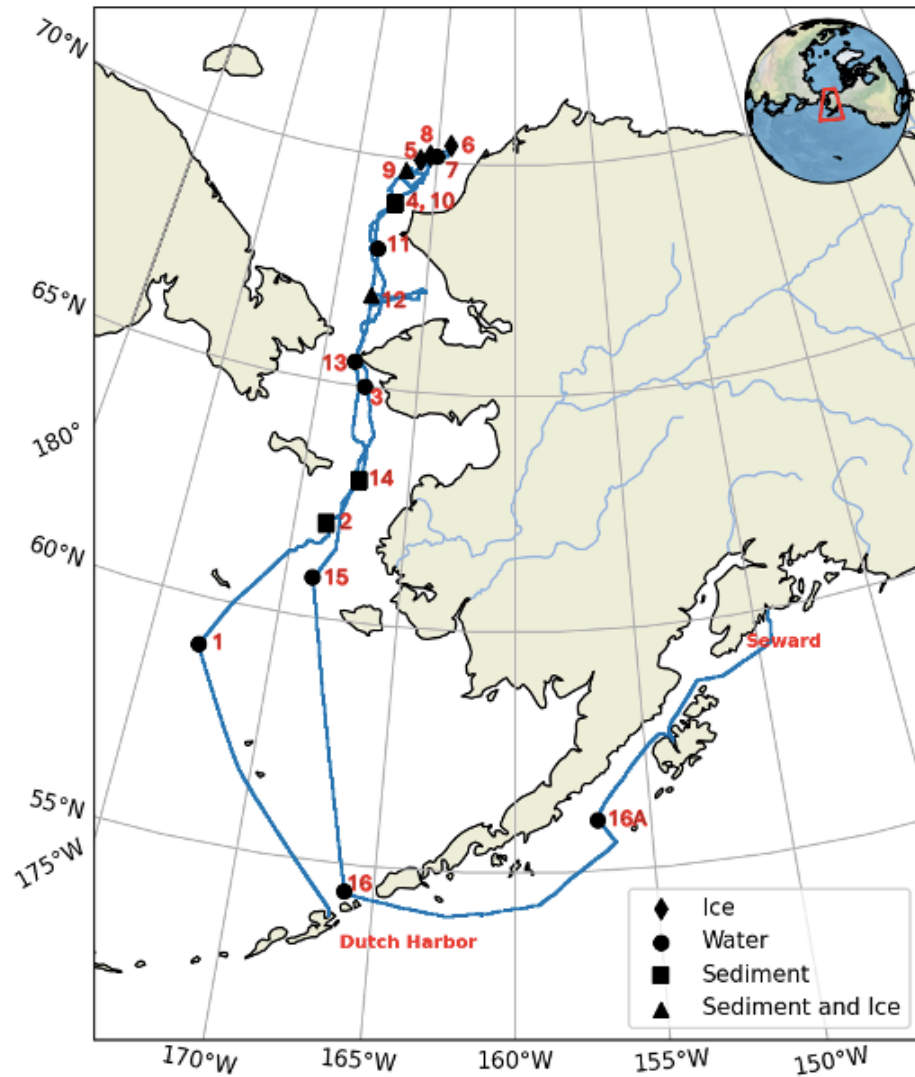
Seawater	
Parameter	Average concentration
Bulk THg	1.41 ± 0.01 pM
Bulk MeHg	73.95 ± 6.48 fM

Sediments	
THg	32.59 ± 4.16 ng/g
MeHg	0.08 ± 0.01 ng/g
THg (porewater)	10.90 ± 0.82 ng/L
MeHg (porewater)	0.23 ± 0.05 ng/L

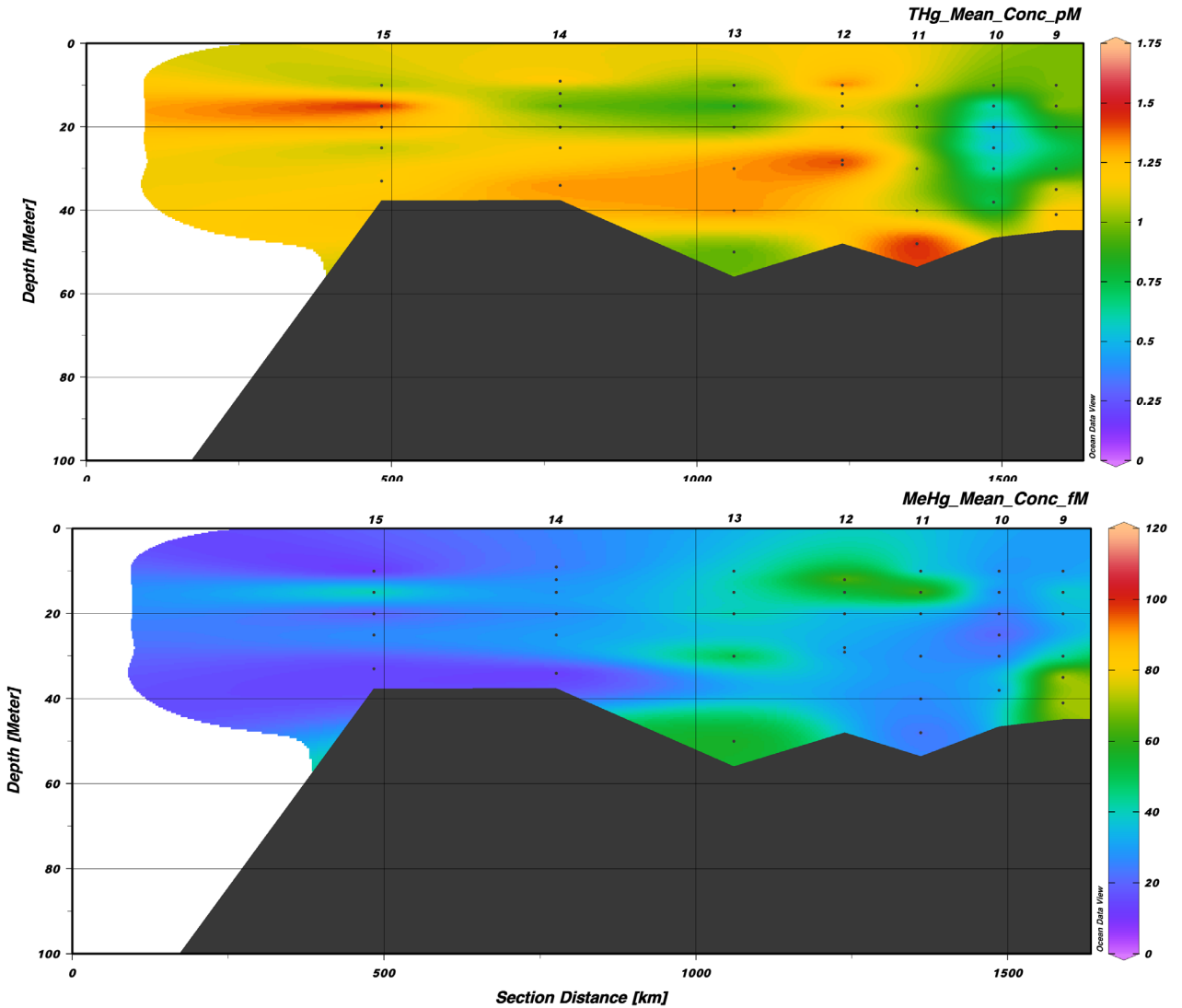
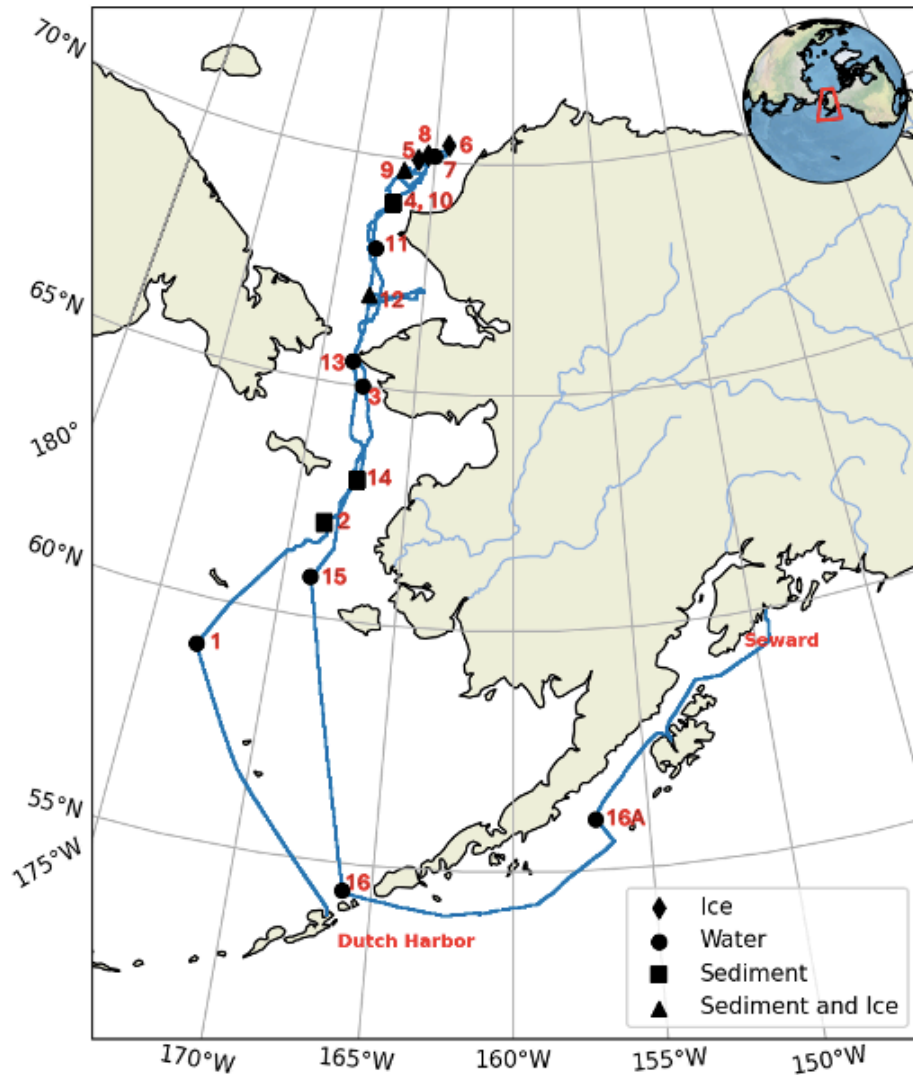
Ice core	
THg	2.94 ± 0.23 pM
MeHg	0.06 ± 0.01 pM



Northbound water column: bulk THg and bulk MeHg



Southbound water column: bulk THg and bulk MeHg



THg sediments

Bering Sea

Chukchi Sea

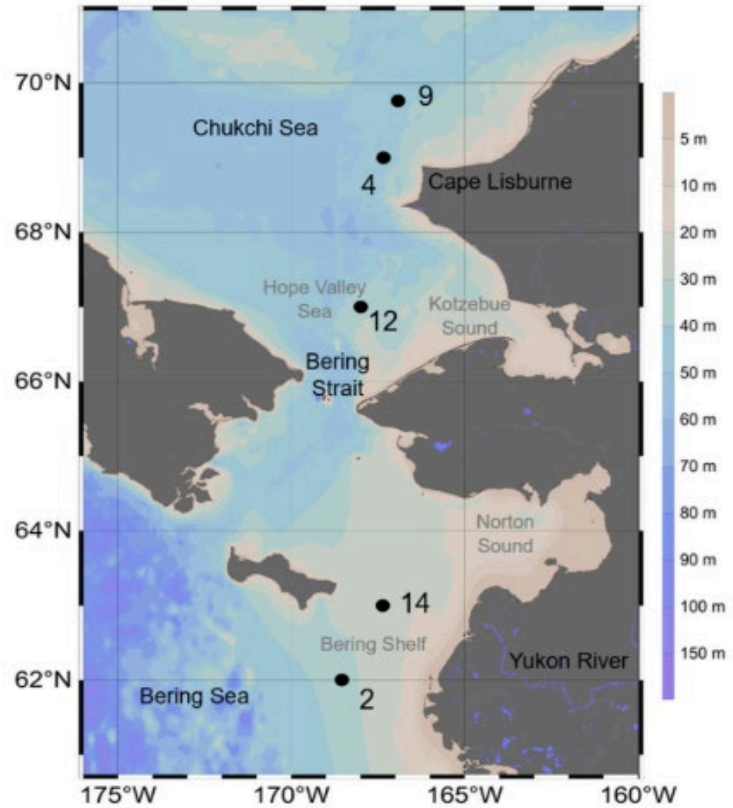


Fig. 1. Sediment core locations with station and regional identifiers from cruise SKQ2021-08 S. Bathymetry shown by the color scale is from the etopo1 dataset (Armante and Eakins, 2009). The map was generated using Ocean Data View version 5.6.3 (2022).

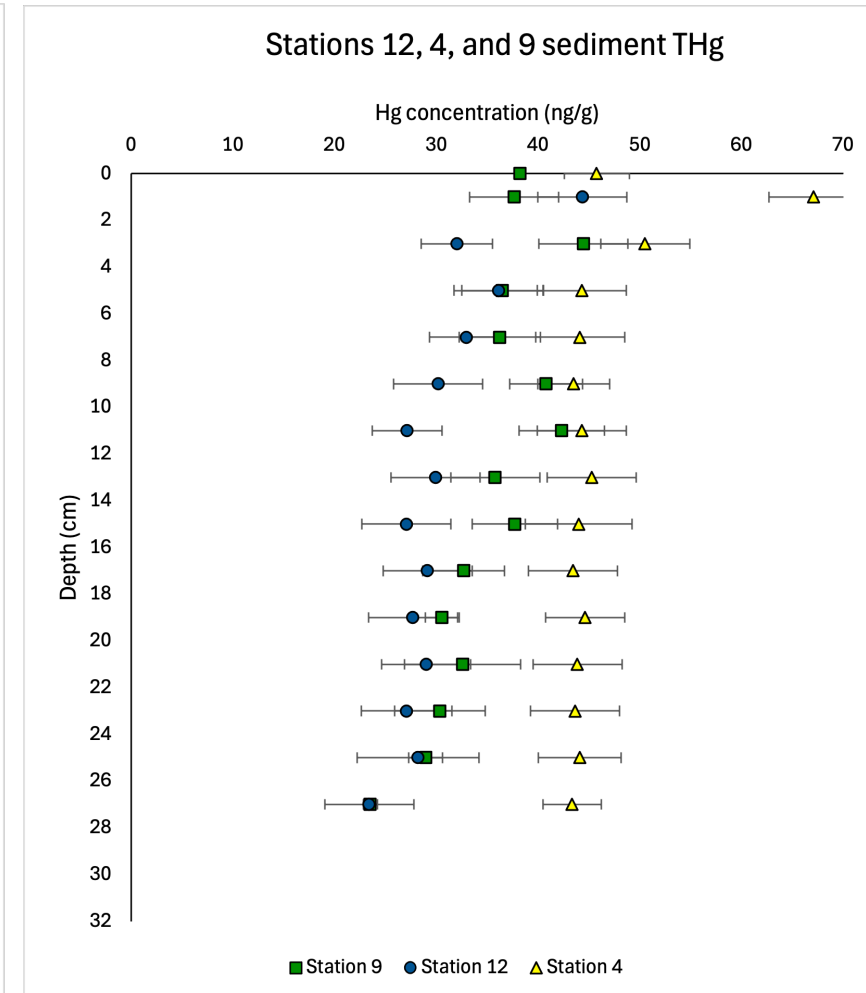
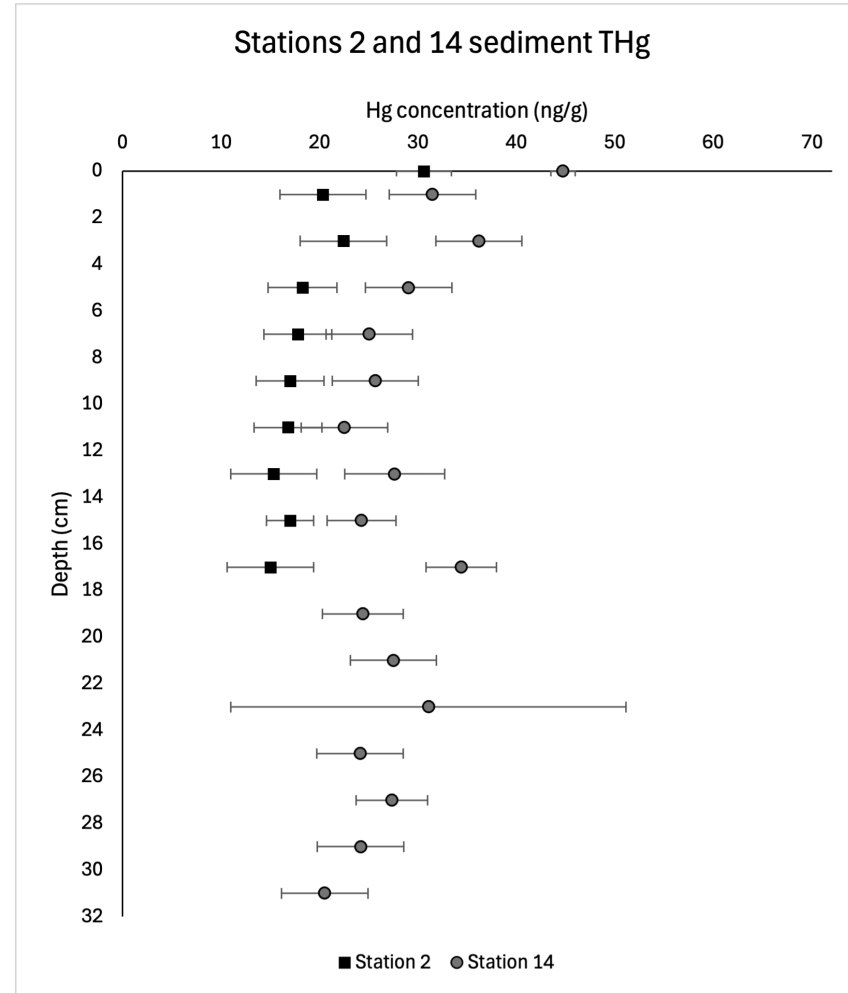


Figure credit: Barrett et al. 2023



MeHg sediments

Bering Sea

Chukchi Sea

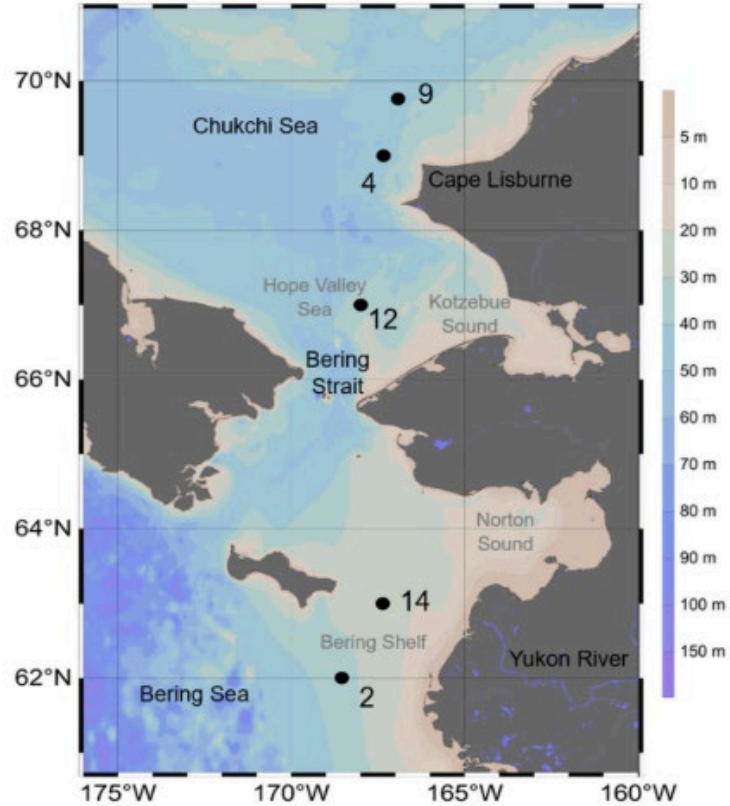


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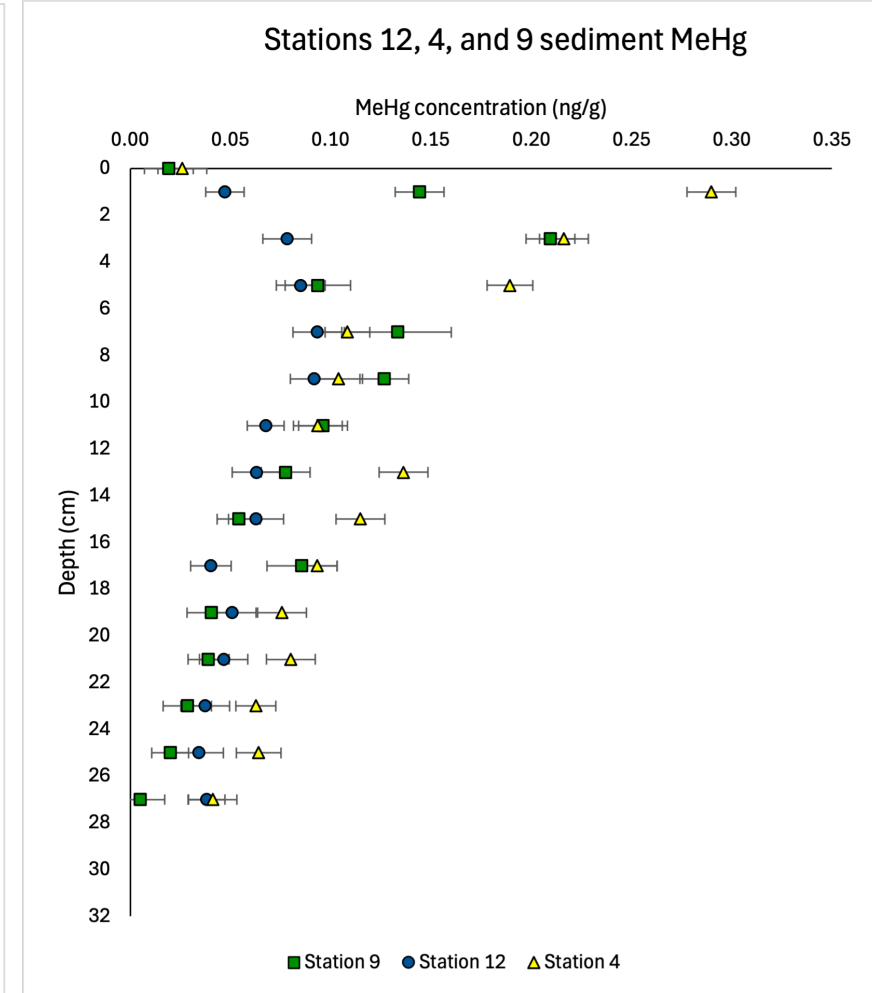
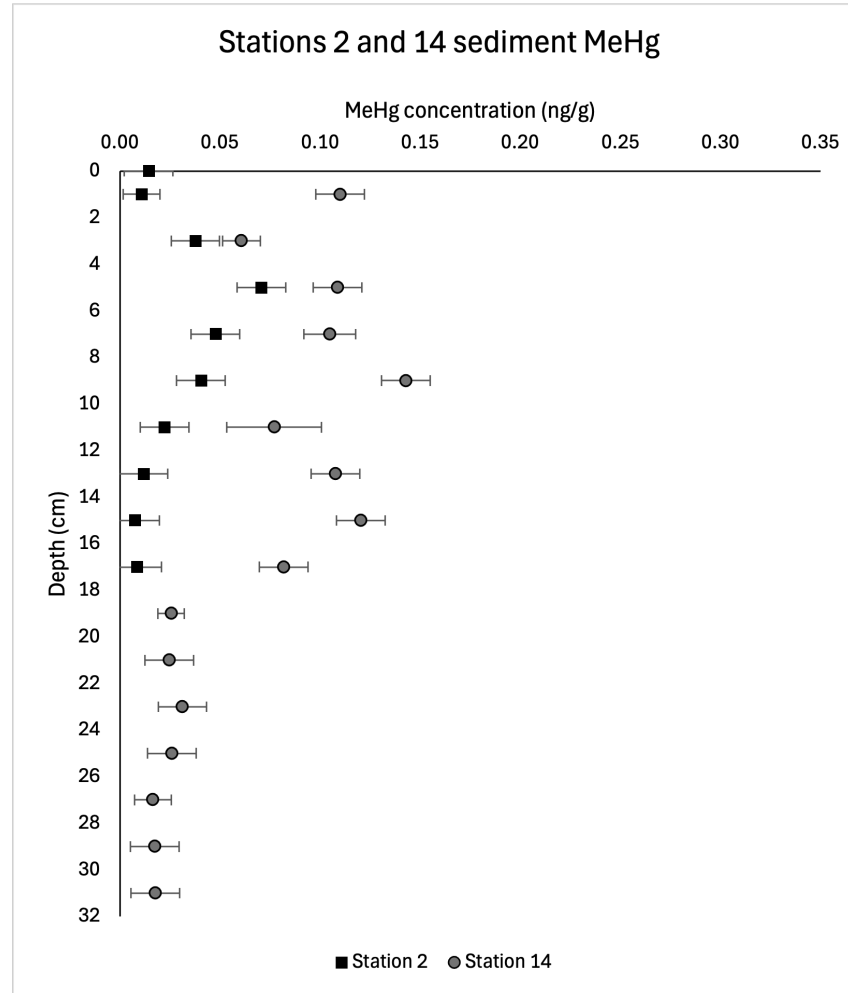
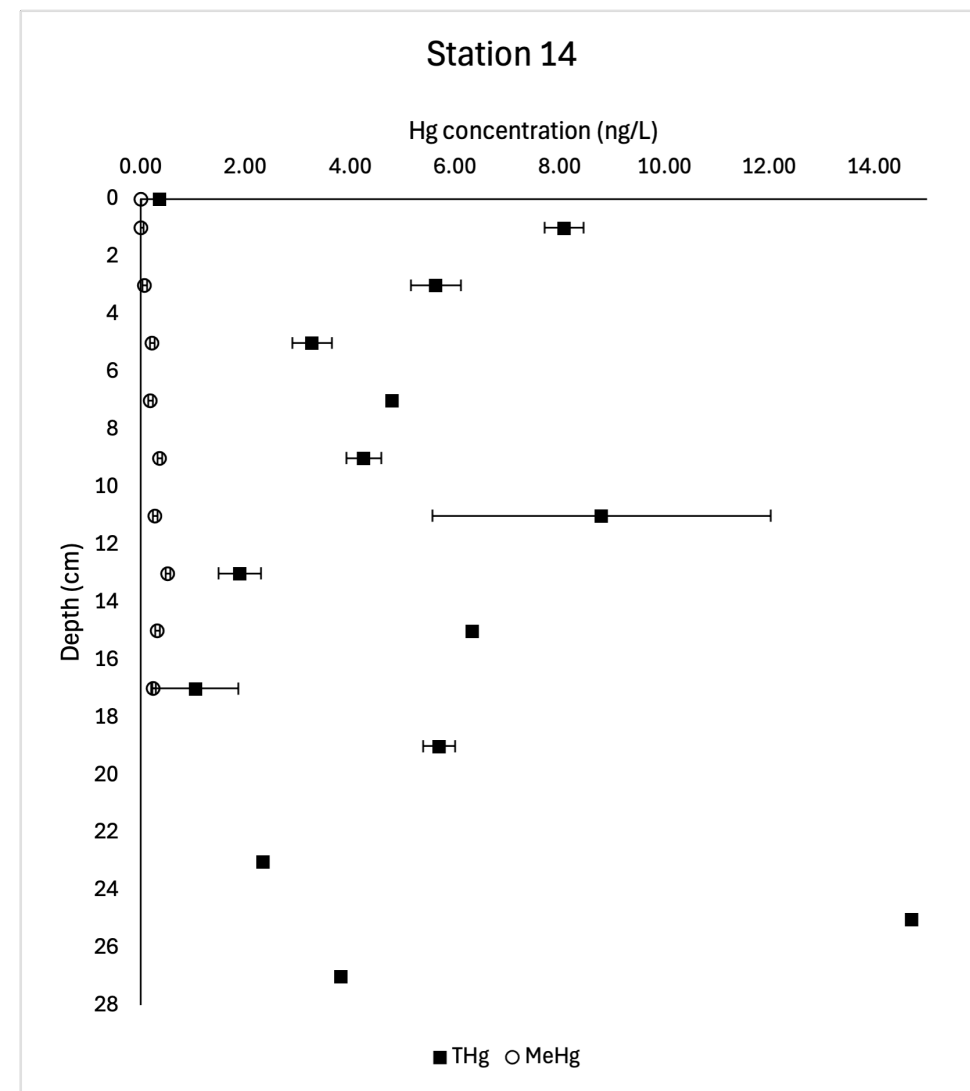
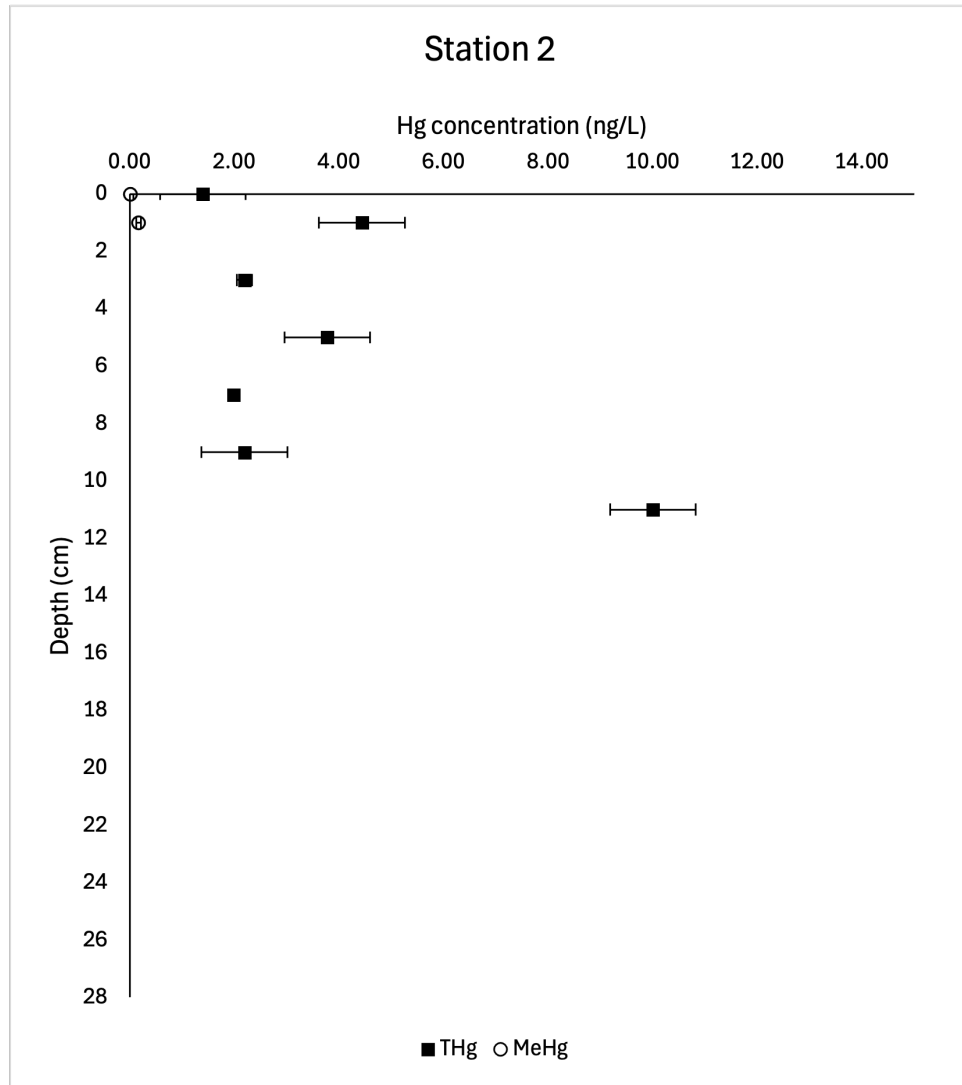


Figure credit: Barrett et al. 2023



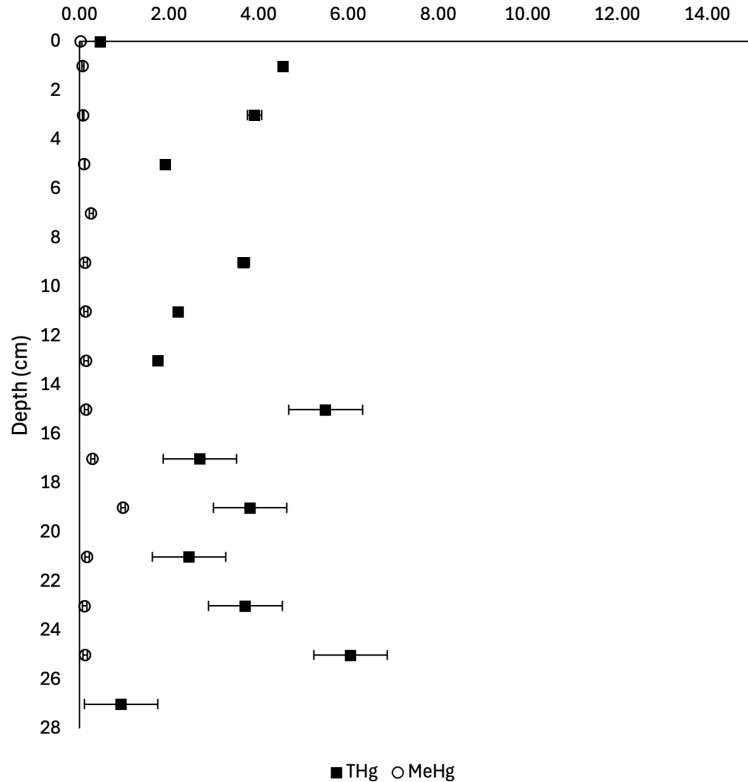
THg and MeHg: Bering Sea porewater



THg and MeHg: Chukchi Sea porewater

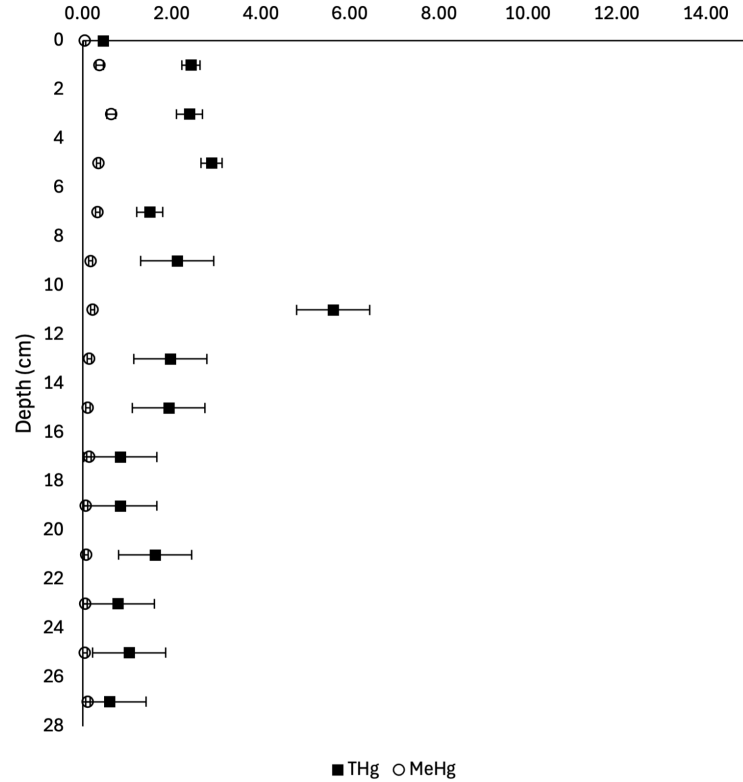
Station 12

Hg Concentration (ng/L)



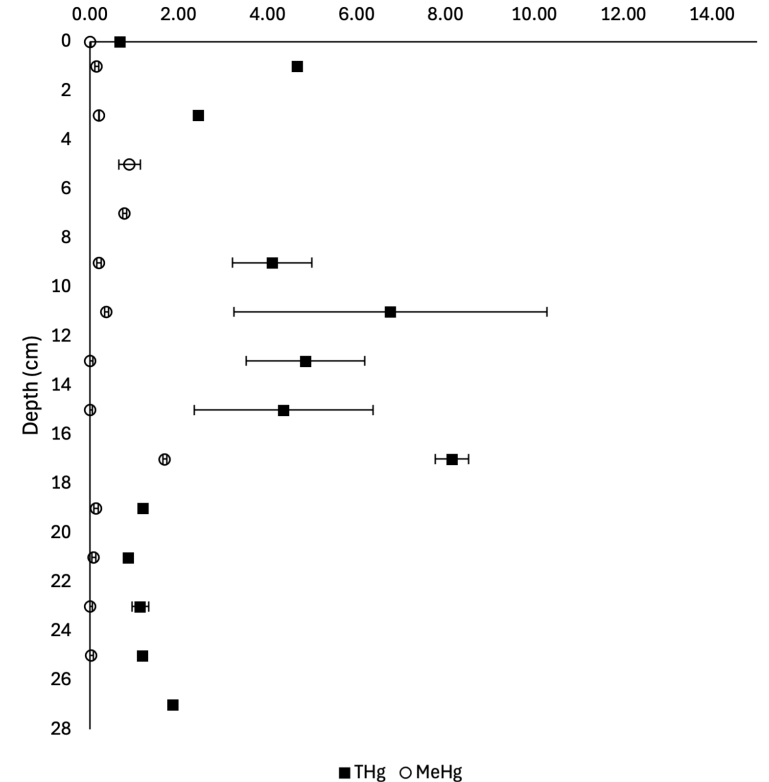
Station 4

Hg Concentration (ng/L)



Station 9

Hg concentration (ng/L)



Sediment-water fluxes

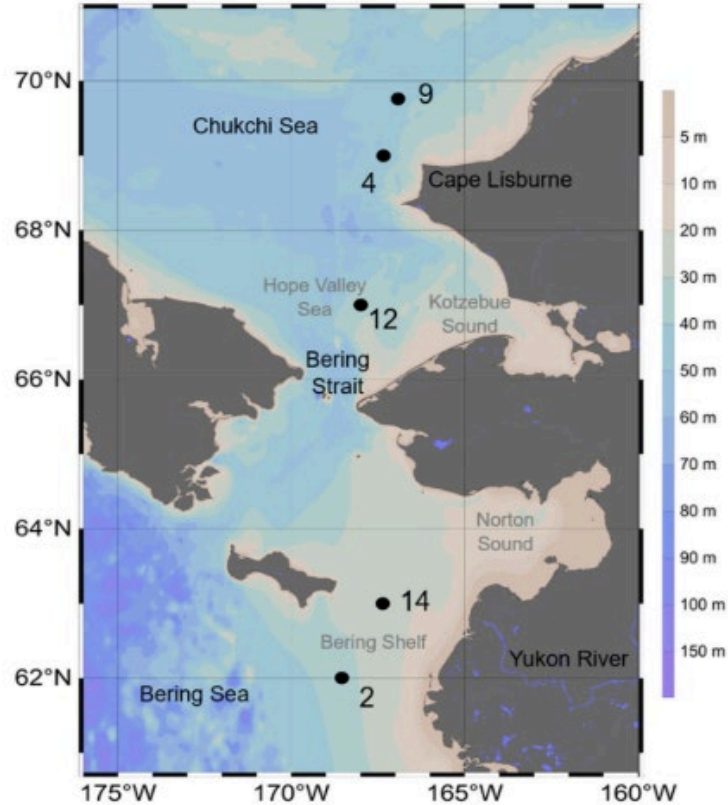


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Station	THg flux (pmol/m ² /d)	MeHg flux (pmol/m ² /d)
Station 2	17.3	0.86
Station 14	8.8	0.01
Station 12	4.6	0.05
Station 4	2.2	0.39
Station 9	4.5	0.16

Equation to calculate tortuosity

$$\theta^2 = 1 - \ln(\phi^2)$$

Equation to calculate diffusive flux (Hollweg et al. 2009)

$$F = - \frac{\phi D_w \partial C}{\theta^2 \partial x}$$

Porosity data from Meng et al. 2015

Flux estimates are for diffusive flux only. Sediment concentrations and fluxes are lower than estimates by Kim et al. (2020) for the East Siberian Shelf (average MeHg flux 20 pmol/m²/d) and more comparable to the estimate in Soerensen et al. (2016).

Figure credit: Barrett et al. 2023



Conclusions

- Bulk MeHg in the water column is lower than 20 fM, except at higher latitude stations
- Sediment THg concentrations are higher in the Chukchi Sea relative to the Bering Sea
- Decrease in the THg flux in Chukchi Sea cores is likely related to lower rates of benthic respiration due to lower light penetration
- MeHg flux does not seem to be affected by the same factors as THg



Questions?

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Aguilar-Islas Lab and Marissa Despina

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