Biogeochemical Processes Driving Mercury Cycling in Estuarine Ecosystems

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Jeju, South Korea
Lake Melville: Subarctic Estuarine Fjord
Two sampling campaigns in Aug/Sept 2012 and June 2013.

- Sediment
- Water
- Biota
- Atmospheric

→ Construct a budget for MeHg cycling in the system

→ Assess the impact of hydroelectric development and climate driven changes on MeHg cycle
Lake Melville: Subarctic Estuarine Fjord

Mol a⁻¹

Water

Rivers 5
Ocean 39

Settling 6
Resusp 1
Burial 2

Photo. 1

Atm. 0.4

Outflow 47

Diff 0.5

Active Sediment
Buried Sediment

5
Potential sources of MeHg:

- Sediment methylation and diffusion
- Highly variable seasonal riverine input
- Water column production
Lake Melville: Subarctic Estuarine Fjord

Mol a\(^{-1}\)

Water

Rivers 5

Ocean 39

Settling 6

Resusp 1

Burial 2

Active Sediment

Buried Sediment

Atm. 0.4

Photo. 1

Diff 0.5

Hg\(\text{II}\)

MeHg

Outflow 47

23
Sources of MeHg to Lake Melville

- Sediment

- Riverine input

- Water column production
Sources of MeHg to Lake Melville

Water column production

A

Legend

River sampling sites

Surface
Mid

Methylation rate [% day⁻¹]

Nitrate [µM]

R² = 0.90
p < 0.01

Schartup et al. PNAS in review
Lake Melville: Subarctic Estuarine Fjord

Mol a⁻¹

Water

Rivers 5
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Settling 6
Resusp 1
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Active Sediment

Buried Sediment

Atm. 0.4

Photo. 1

38
Hg⁺⁺
MeHg

29

Diff 0.5

Outflow 47

Rivers 5
Ocean 39

Settling 6
Resusp 1
Burial 2

Active Sediment

Buried Sediment

Atm. 0.4

Photo. 1

38
Hg⁺⁺
MeHg

29

Diff 0.5

Outflow 47
Oxic Water Column Methylation

- Ortiz, Ward & Mason 2015, *Marine Chemistry*

- Implications for biota?

→ Order of magnitude higher MeHg content in plankton from stratified areas of the system.

Schartup et al. PNAS in review
Impact of Industry

14 fold increase in MeHg in overlying waters

Diffusion: 120-170 pmol m\(^{-2}\) day\(^{-1}\)

6-8 mol a\(^{-1}\) for the entire development area

→ Up to 200% increase in riverine MeHg input to Lake Melville
• Show oxic water column methylation with modeling and experimental work

• MeHg production and accumulation is driven by density gradients
  ➔ Arctic Ocean (Heimbürger et al. 2015)

• Industry can lead to a switch from in situ to riverine sources

• Combining measurements and modeling to inform sampling and laboratory experiments
  ➔ Applying similar approach in 5 estuaries
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