Does seagrass stimulate the bioavailability of mercury in contaminated sediments in a brackish fjord in Norway?

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......and what happens if we cap the sediments and the seagrass?
Gunnekleivfjorden
Telemark, Norway
Area of fjord: 750 000 m² (after landfill: 500 000 m²)
Area of seagrass: 70 000 m²

Dominated by
Pondweed
Potamogeton crispus

Watermilfoil
Myriophyllum sp.

Max depth 10 m
Salinity: ~ 3 - 5 ‰
Known mercury contamination in the fjord

Norsk Hydro: total discharges of 80 tonnes Hg (1947-1988)

Biota (Fish): - 1,55 µg Hg/g ww (1989)
Water: 20-60 ng Hg/l (1988)
Sediment: 1.6 - 72 mg Hg/kg (1997)

Met-Hg

> 0.5 ppm
Class V
Class V

Photo: NIVA
Scope of new project

- Bioavailability of Hg
- Bioaccumulation of Hg
- Biomagnification of Hg
- Remediation strategy

? Stimulation of mercury methylation within seagrass area?

? Capping enhance methylation?

? Remediation or not in seagrass area?

- Bioavailability and bioaccumulation of dioxins
- Analysis of stable isotops in foodweb
- Flux in-situ and in box-cores
- Contamination of new sedimenting material
- Relative contribution from vegetated/non-vegetated areas
- Effect of different capping materials
## Preliminary results

<table>
<thead>
<tr>
<th></th>
<th><strong>Tot-Hg</strong> ng L$^{-1}$</th>
<th><strong>Met-Hg</strong> ng L$^{-1}$</th>
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</thead>
<tbody>
<tr>
<td>Water, surface</td>
<td>1.7 – 6.1</td>
<td>0.02 – 0.06</td>
</tr>
<tr>
<td>Water, bottom</td>
<td>2.2 – 13.1</td>
<td>0.02 – 0.1</td>
</tr>
<tr>
<td>Porewater, outside seagrass</td>
<td>2 537 – 11 740</td>
<td>2.3 – 33.9</td>
</tr>
<tr>
<td>Porewater, inside seagrass</td>
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<td>To be continued....</td>
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<tr>
<td>Sediment concentrations and flux</td>
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<td>To be continued....</td>
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<tr>
<td>Biota/Foodweb concentrations</td>
<td></td>
<td>To be continued....</td>
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<tr>
<td>Effects of capping</td>
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<td>To be continued....</td>
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</tbody>
</table>
Water profiles
H$_2$S and Eh profiles in sediment cores:

- $7.1 < \text{pH} < 10.3$
- $9.1 < \text{pH} < 10.2$
- $6.5 < \text{pH} < 7.4$
Preliminary indications:

- Tot-Hg gradient in water indicates mercury flux from sediment to water
- No Met-Hg gradient indicates low flux of MetHg from sediments to water (??)
- Low values of MetHg in water indicates little methylation in water column (outside seagrass area)
- Redox gradient in sediments in seagrass area and not outside might indicate favorable conditions for methylation in seagrass area
- High H$_2$S at «root-depth» in sediments indicates high rates of bacterial activity; conditions for methylation
The seagrass area a major source?

«..presence of live plants enhanced microbial rates of mercury methylation by 20 – 669% compared to de-vegetated plots.»

Windham-Myers, L., Marvin-DiPasquale, M., Stricker, C.A., Agee, J.L. Kieu, L. and Kakouros E.

Ecological value of seagrass area

Biotop classified as area of national value
Ecological consequences of capping?
Since placement of an in-situ cap will induce anaerobic conditions that are known to be favorable for the growth of sulfate reducing bacteria, there is justifiable concern that capping could increase mercury methylation in underlying sediments.

Nathan William Johnson, University of Minnesota
Management implications

Scenarios:

**Capping entire fjord:**
- Reducing flux of mercury
- Enhance methylation by capping?
- Destroying national value seagrass area
- Restitution time?

**Capping non-vegetated area only:**
- Reducing flux of mercury in parts of fjord
- Protect national value seagrass area
  (..and keeping major methyl mercury source for foodweb uptake..?)
...to be continued......
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Thank you!

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