

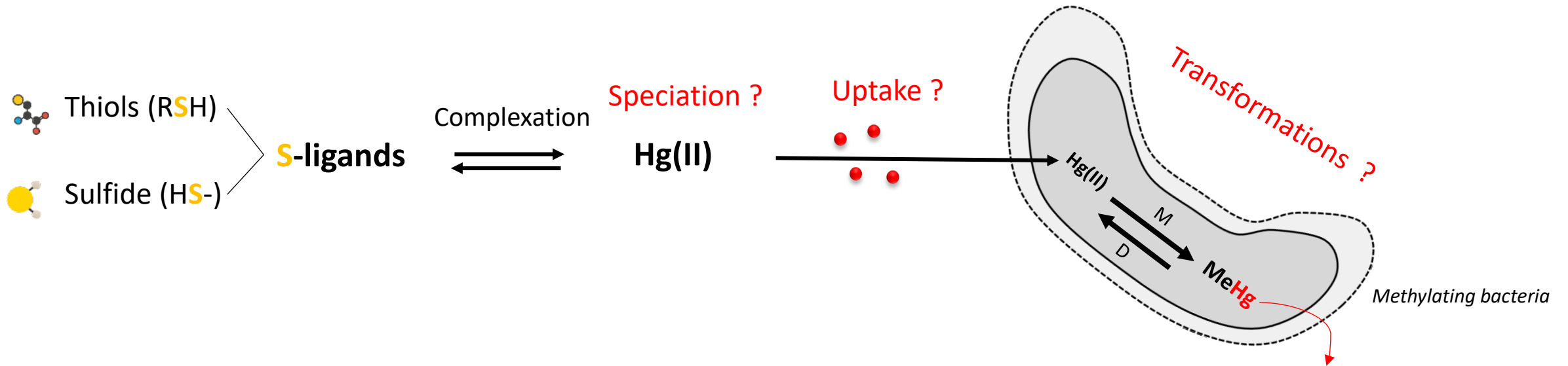
ICMGP 2024
CAPE TOWN • SOUTH AFRICA • 21 - 26 JULY

Mercury Interaction with S-containing Molecules: Implications for Potential Methylation and Demethylation Regulation in a Sulfate Reducing Bacteria

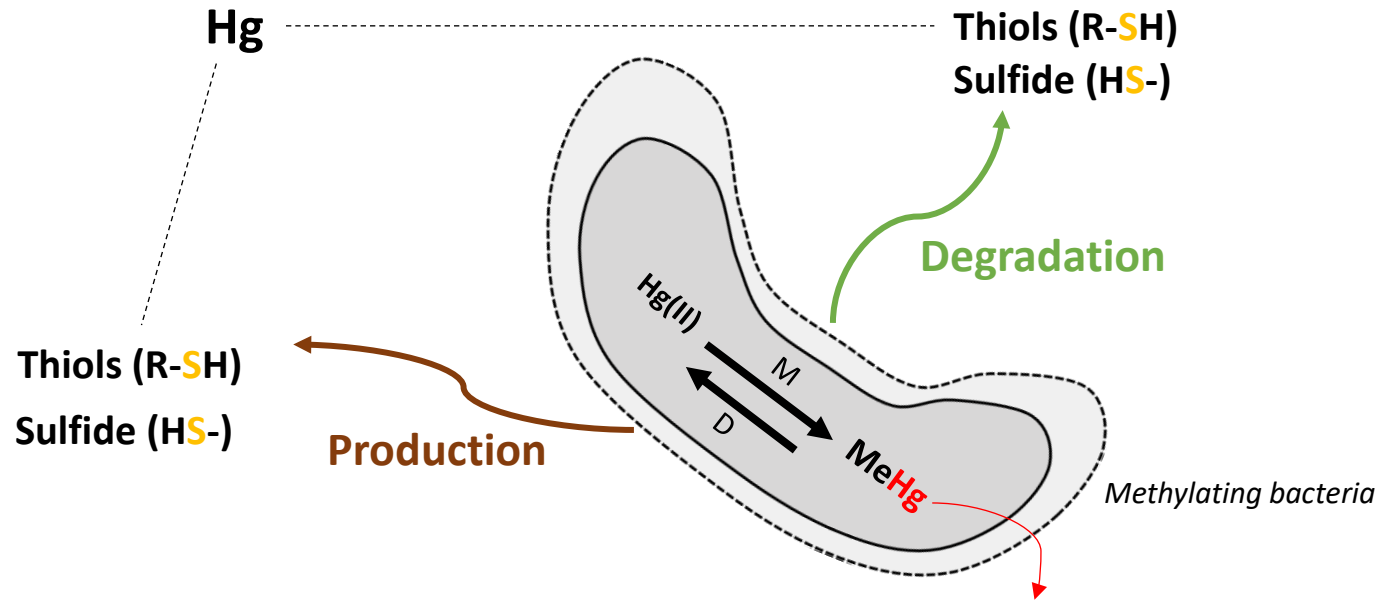
[Ikram Bakour](#), Marie-Pierre Isaure , Sophie Barrouilhet, Marisol Goñi-Urriza,, Mathilde Monperrus



Context



How S- ligands are controlling Hg methylation and demethylation processes ?



Research aim



Study of the speciation and biomolecular transformation of Hg at the cellular level

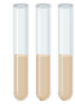
How the addition of S-ligands (Cysteine and sulfide) is controlling :

- **Hg(II) and MeHg speciation**
- **Hg transformations (methylation and demethylation)**

Experimental protocol

Pseudodesulfovibrio hydrargyri
BeroC1
(resting cells, fumarate respiration)

Bacterial culture



⊖ S-ligands



0.01 mM



0.1 mM



0.5 mM

⊕ Cysteine



0.1 mM

⊕ Sulfide

Double spike of IHg and MeHg

0.5 μM of ^{199}IHg and 0.05 μM of $^{202}\text{MeHg}$



Incubation (0, 4, 20, 28, 48 hours)

Filtration (0.2 μm)

Bulk fraction

Extracellular fraction

Quantification of Hg(II) and MeHg concentrations (GC-ICPMS)

Quantification of sulfide (Fluorescence spectroscopy)

Quantification of Hg(II) and MeHg concentrations (GC-ICPMS)

Quantification of Cysteine (LC-MS/MS)

Quantification of Hg species (LC-MS/MS)

+ Chemical modeling (Visual Minteq)

Hg transformations (methylation/demethylation)

Partitioning of Hg species (cell associated/extracellular)

Microbial degradation and production of S-ligands

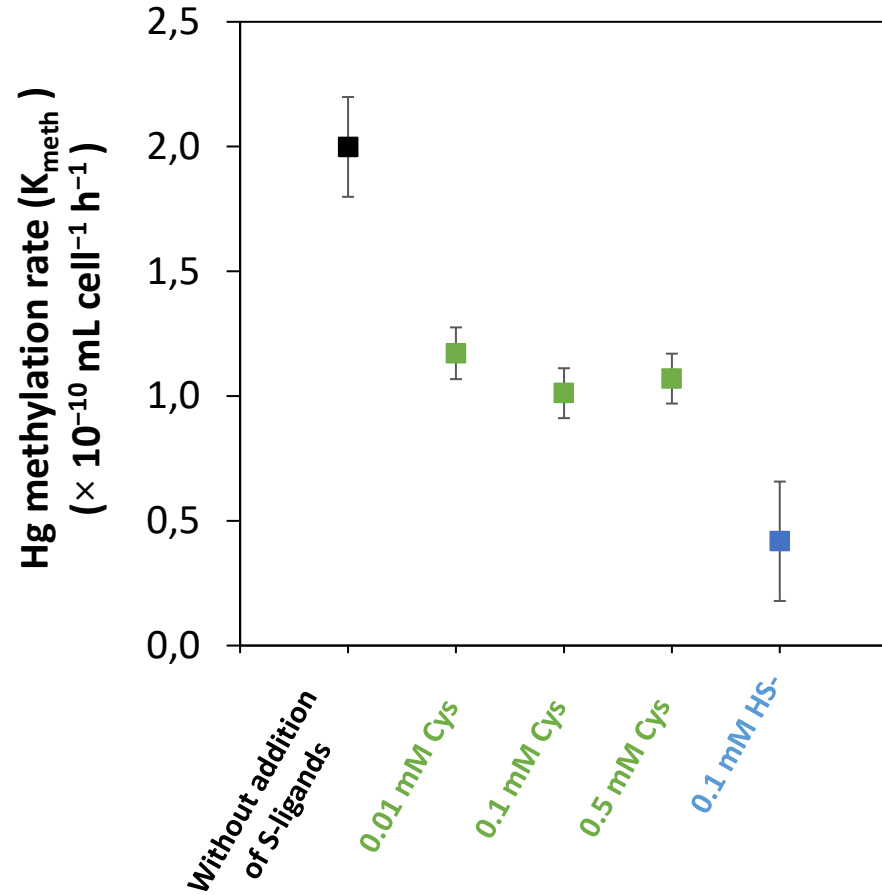
Molecular speciation of Hg(II) and MeHg

Results

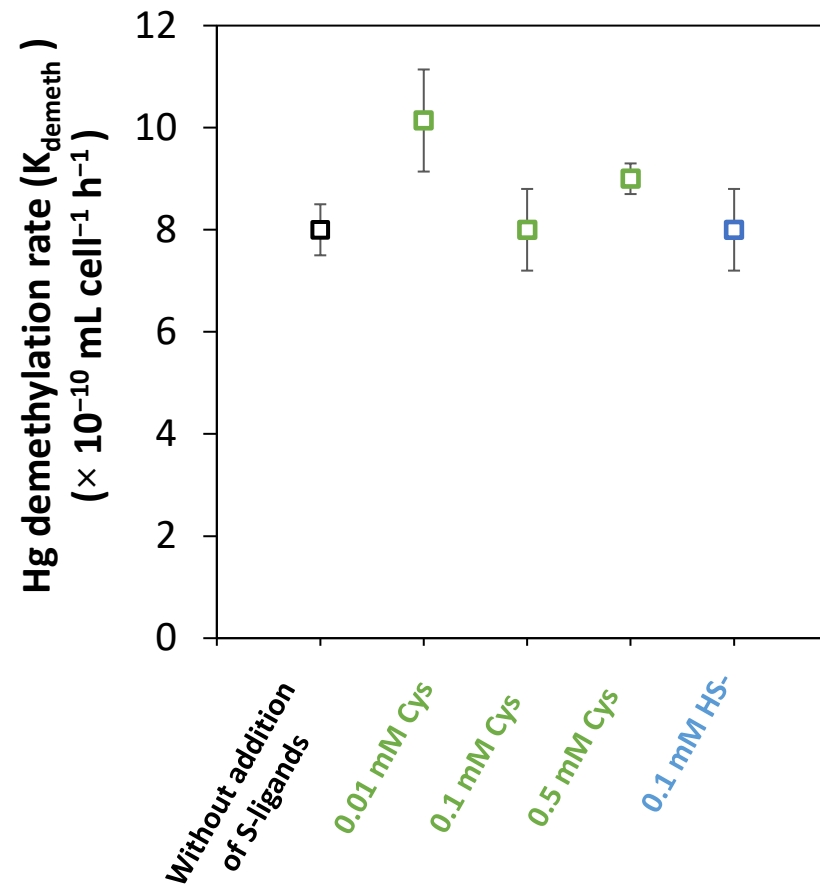
Methylation and demethylation rates

+ Cysteine
+ Sulfide

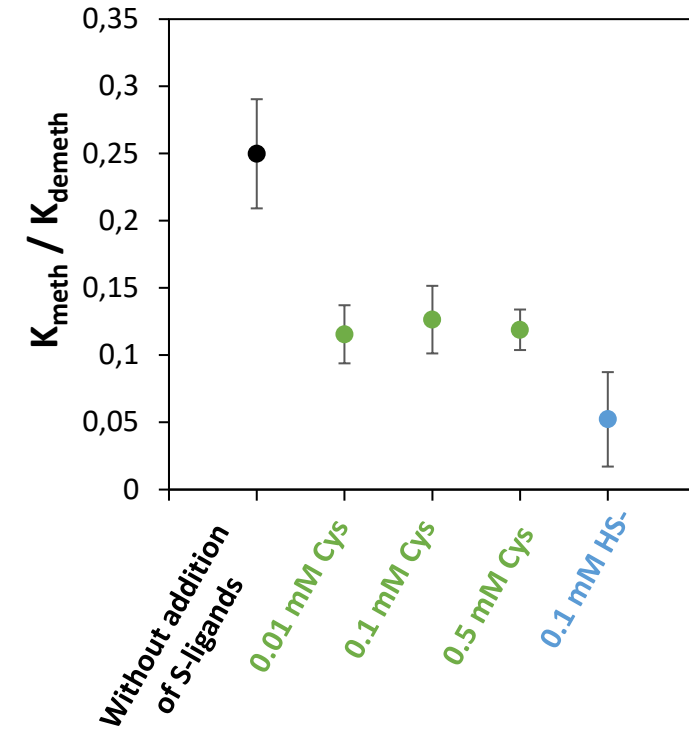
1-Methylation rate K_{meth}



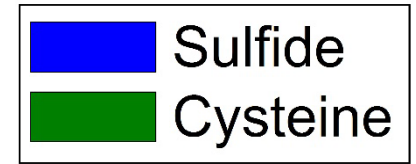
2-Demethylation rate K_{demeth}



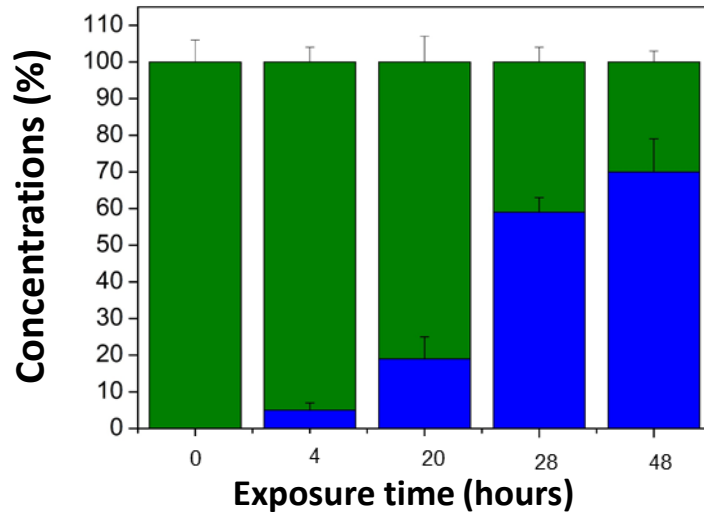
3-Net MeHg production



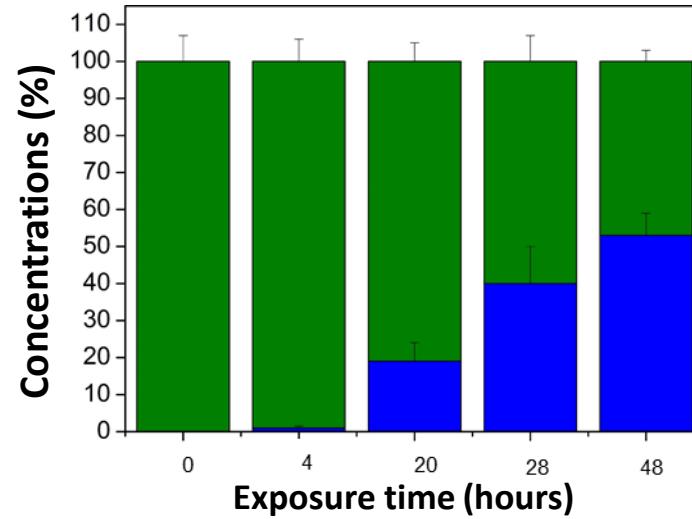
Sulfide and cysteine concentrations



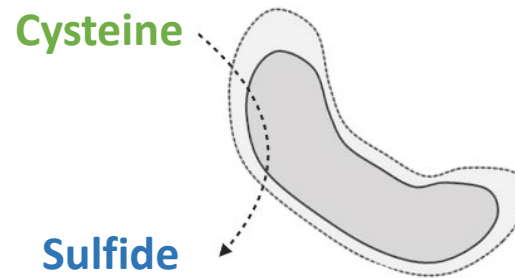
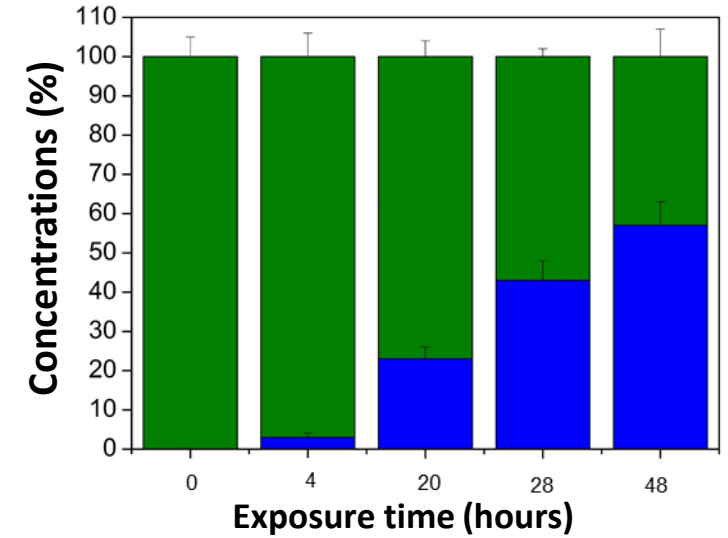
0.01 mM Cysteine



0.1 mM Cysteine



0.5 mM Cysteine



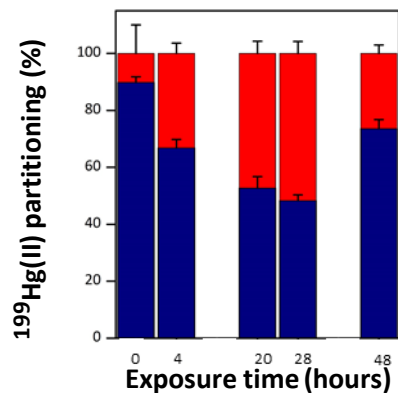
Pseudodesulfovibrio hydrargyri BerOc1

Results

Partitioning of added $^{199}\text{Hg(II)}$

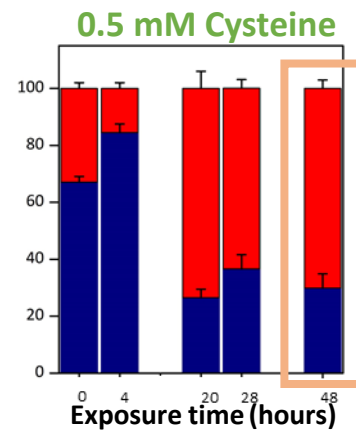
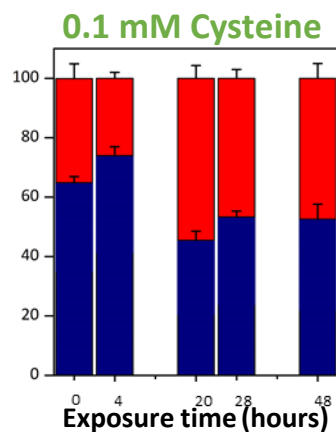
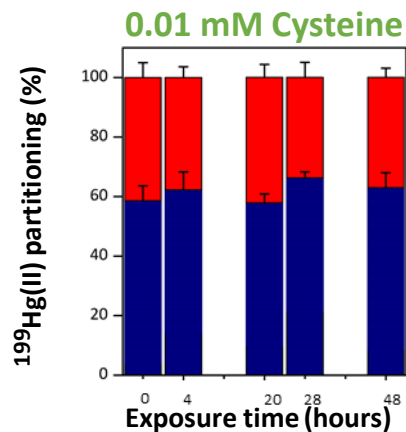
Cell-associated/particulate fraction
Extracellular fraction

Without the addition of S-ligands



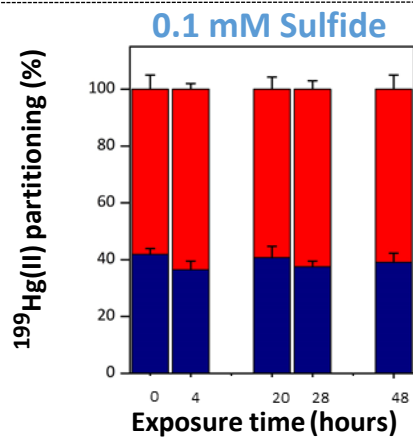
Hg(II) is mostly extracellular

+ Cysteine



70% of Hg(II) is associated to cells /particulate fraction

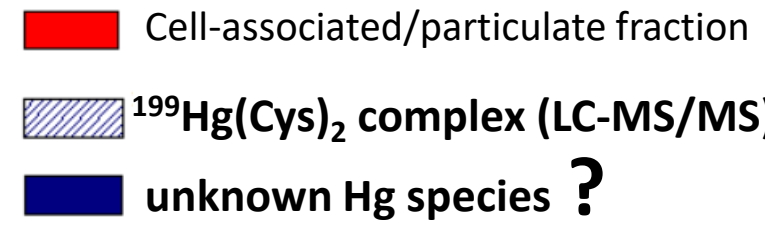
+ Sulfide



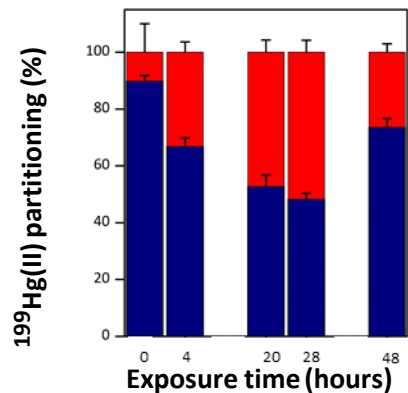
Hg(II) is mostly associated to cells /particulate fraction

Results

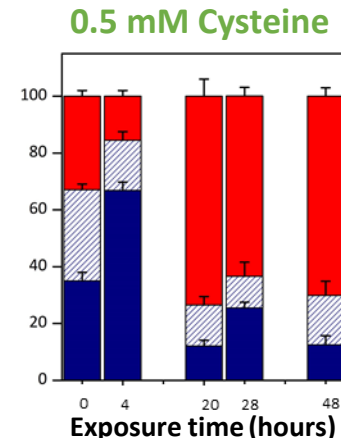
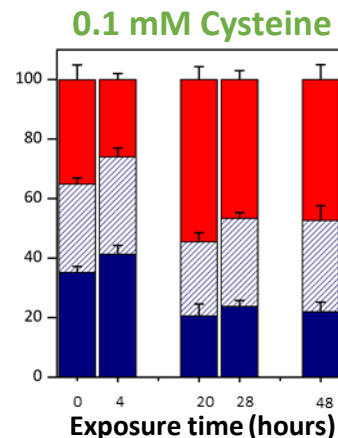
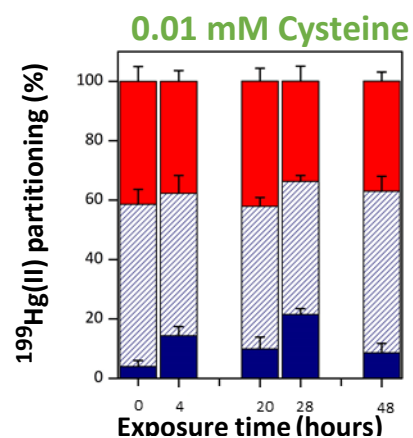
Speciation of added $^{199}\text{Hg(II)}$



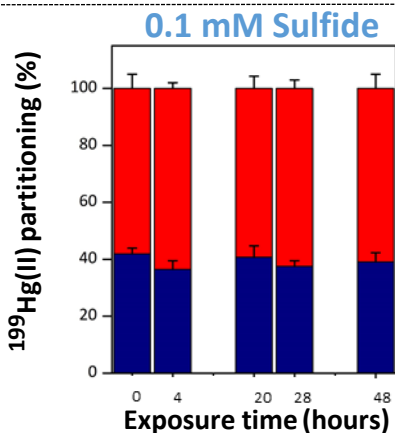
Without the addition of S-ligands



+ Cysteine



+ Sulfide

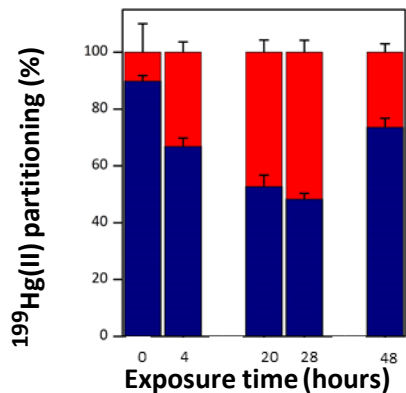


Results

Speciation of added $^{199}\text{Hg}(\text{II})$

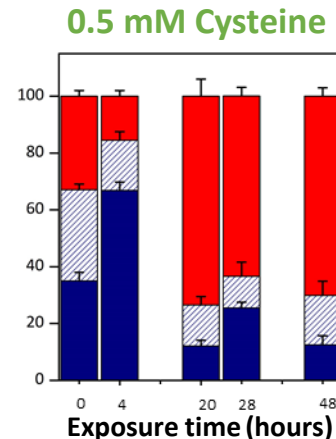
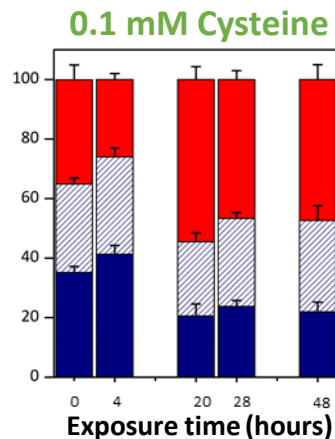
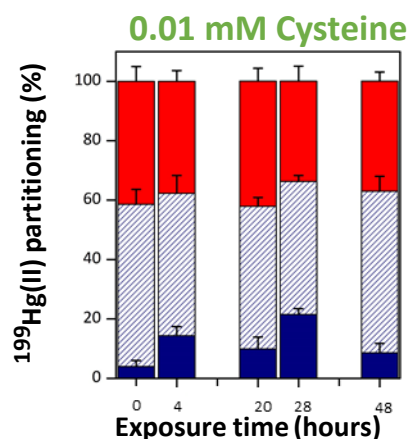
Chemical modeling using Visual Minteq

Without the addition of S-ligands



100 % HgOH_xCl_y

+ Cysteine

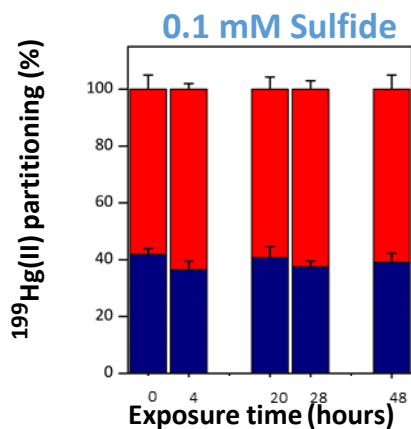


% $\text{Hg}(\text{Cys})_2$



% $\text{HgS}_{(s)}$

+ Sulfide

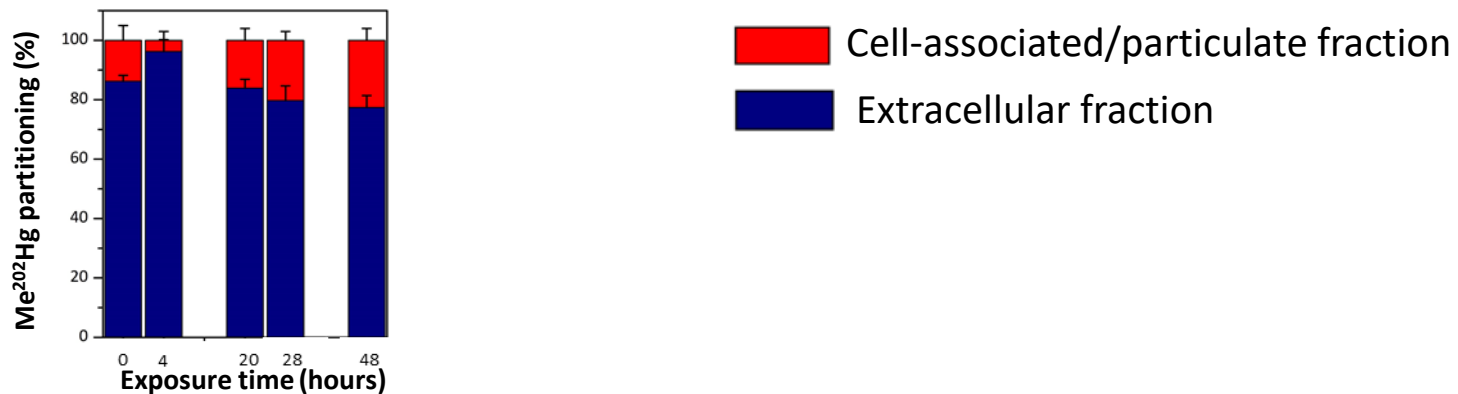


100 % $\text{HgS}_{(s)}$

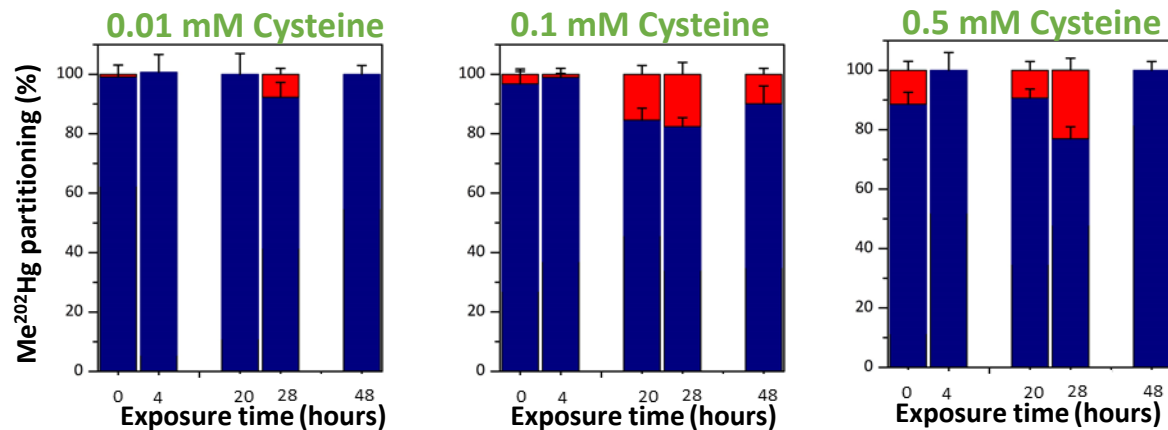
Results

Partitioning of added $^{202}\text{MeHg}$

Without the addition of S-ligands

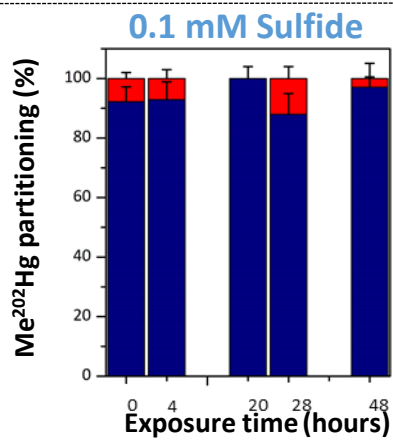


+ Cysteine



MeHg is extracellular in all conditions

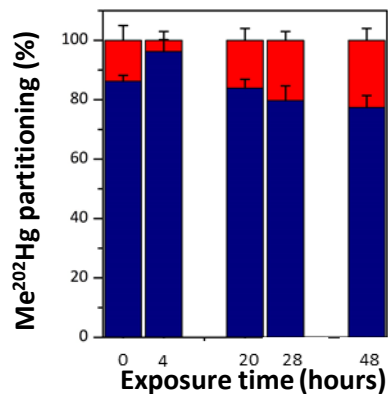
+ Sulfide



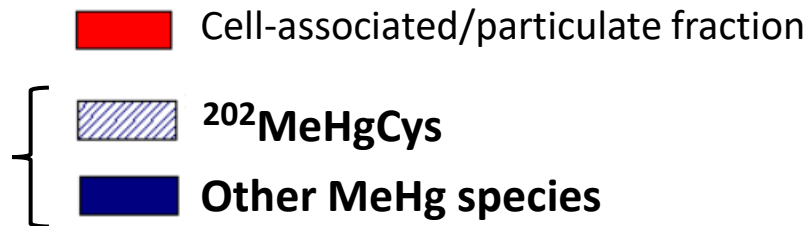
Results

Speciation of added $^{202}\text{MeHg}$

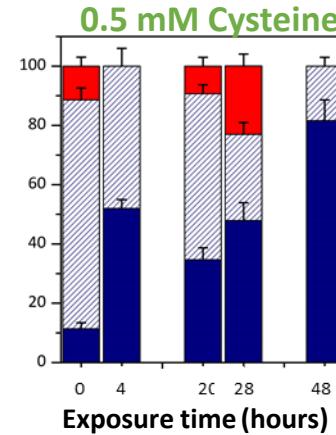
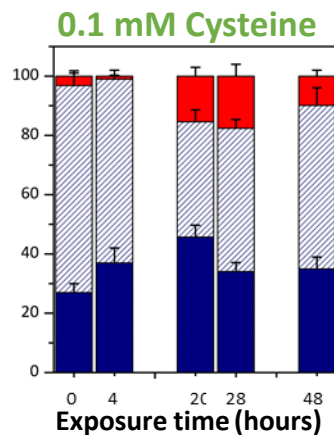
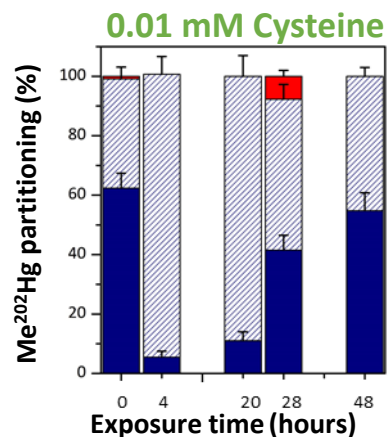
Without the addition of S-ligands



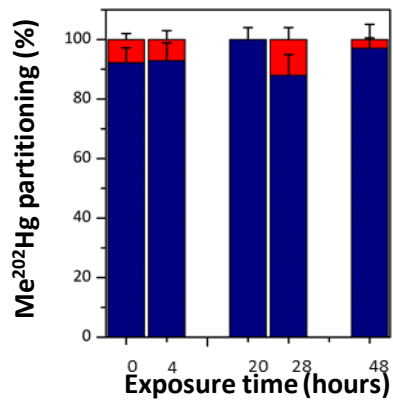
Extracellular fraction



+ Cysteine



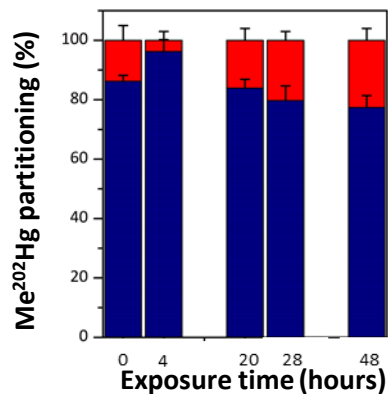
+ Sulfide



Results

Speciation of added $^{202}\text{MeHg}$

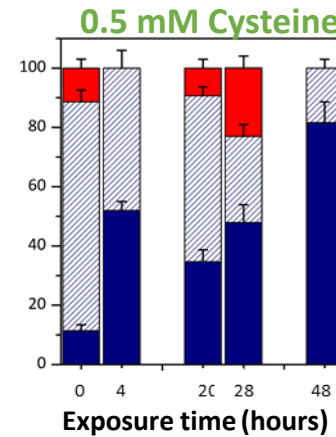
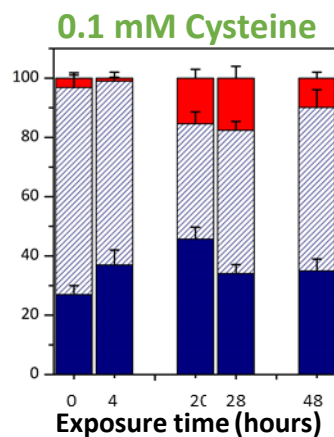
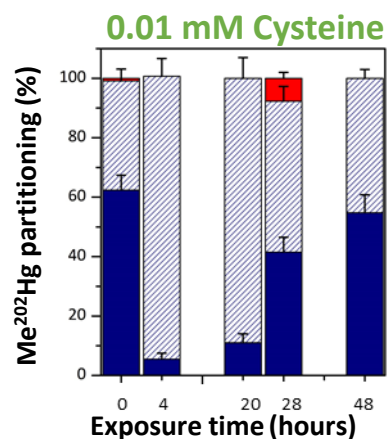
Without the addition of S-ligands



100 % MeHgCl

Chemical modeling using Visual Minteq

+ Cysteine

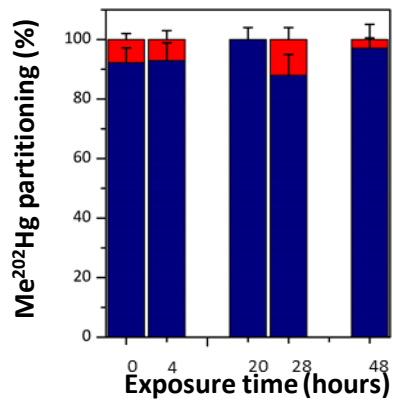


% MeHgCys



% S(MeHg)₂

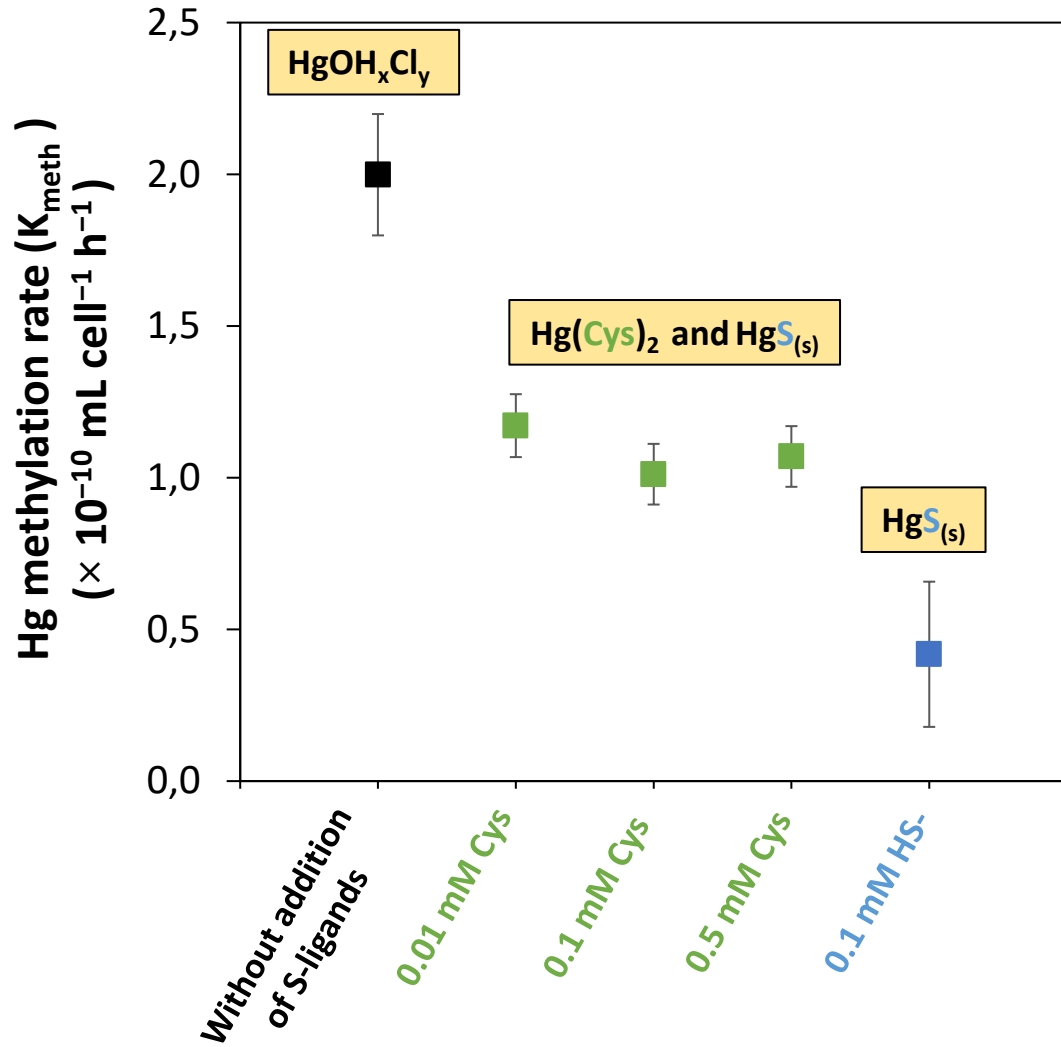
+ Sulfide



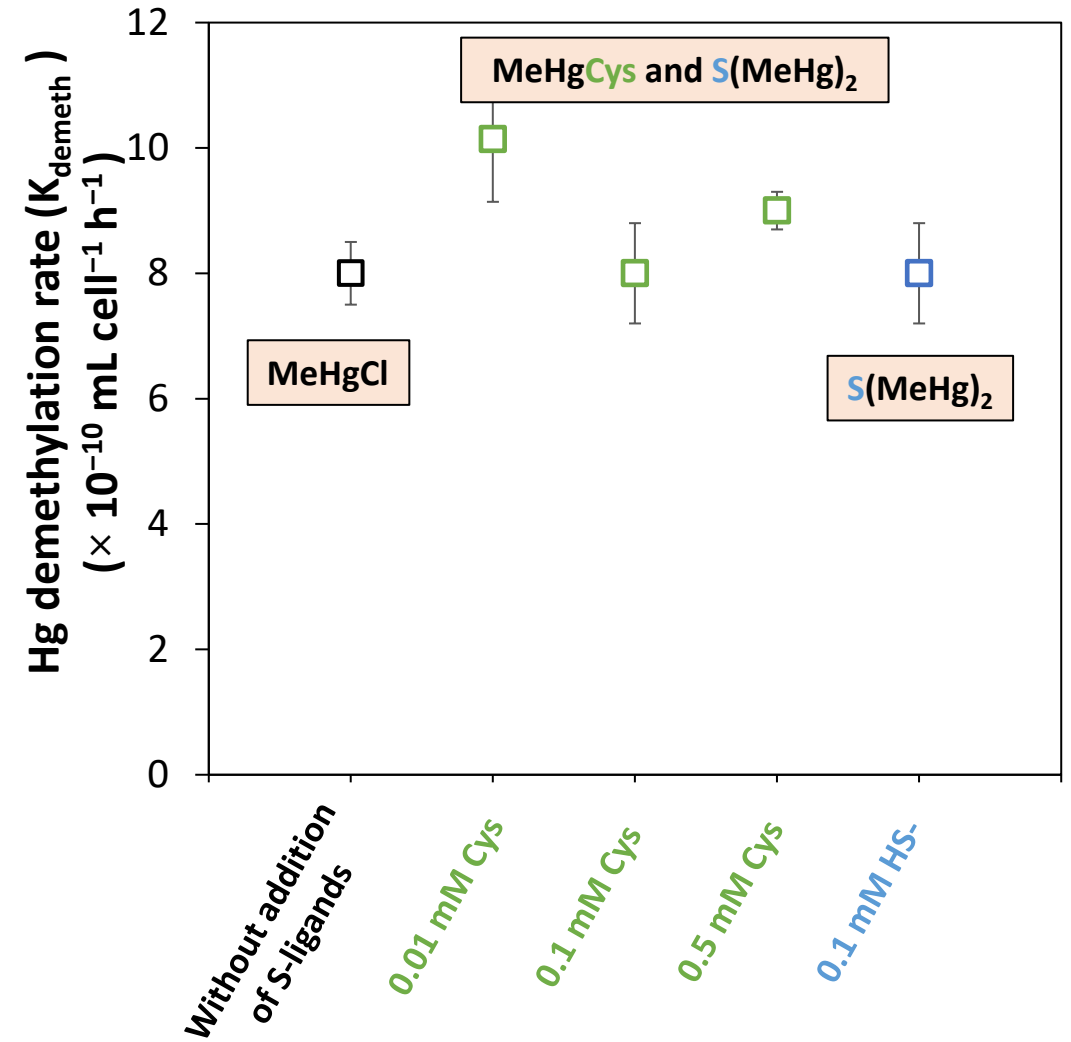
100 % S(MeHg)₂

Results

Methylation of Hg(II)

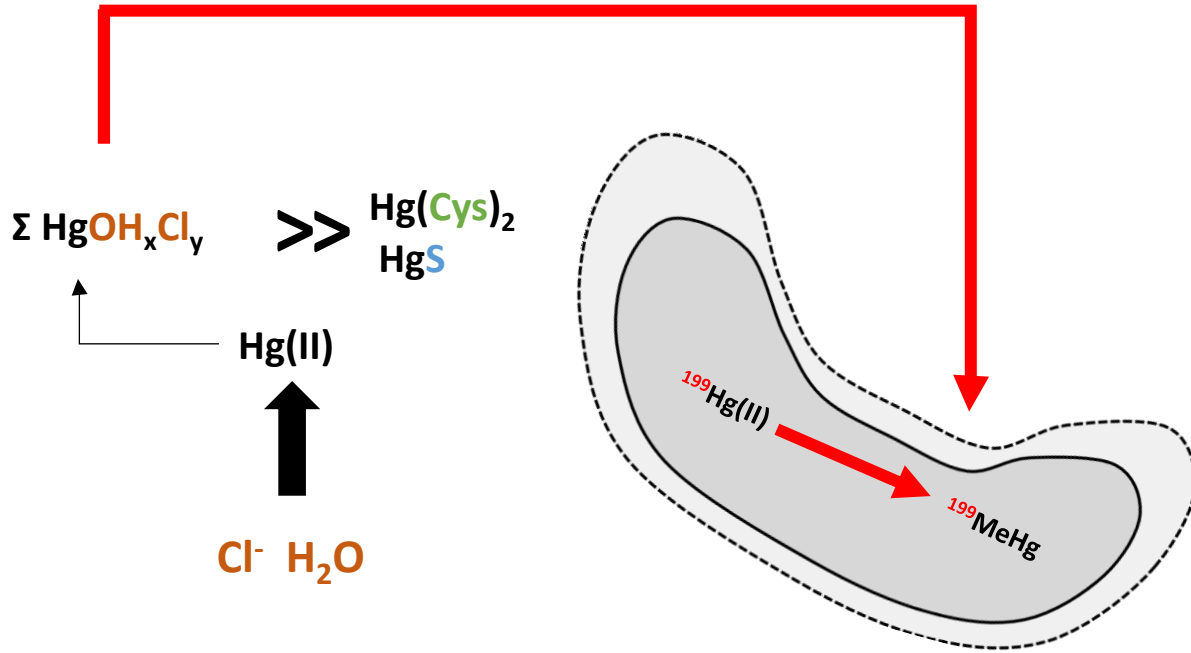


Demethylation of MeHg

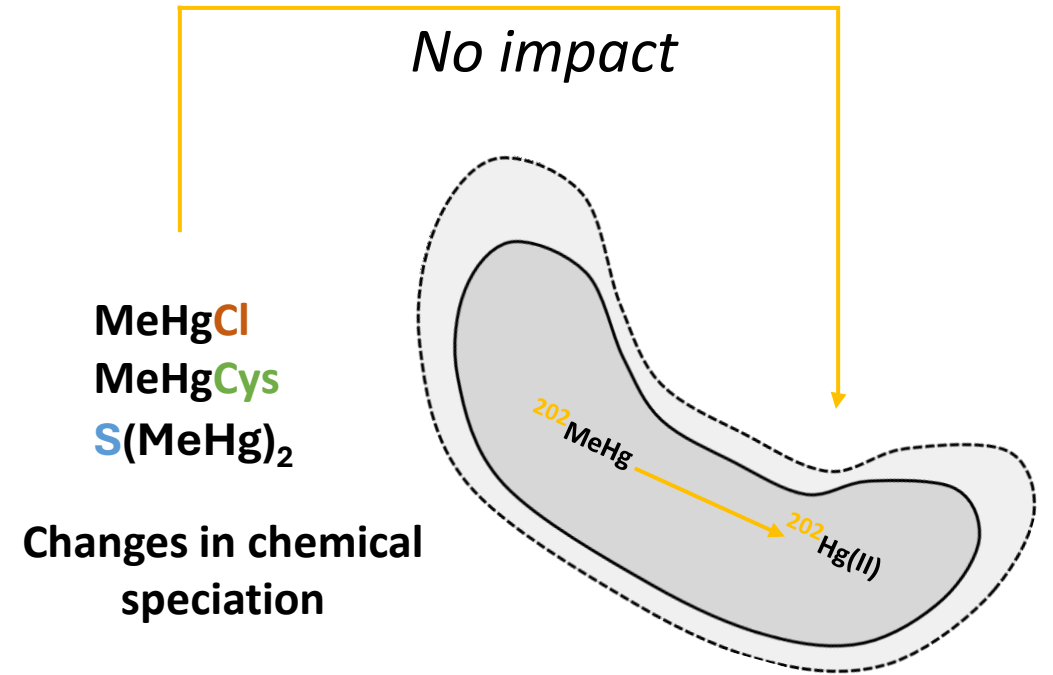


Conclusion

Methylation



Demethylation



The net production of MeHg by BerOc1 is controlled by the complexation of Hg(II) with S-ligands and methylation, as demethylation is not impacted



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Thank you for your attention

