



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



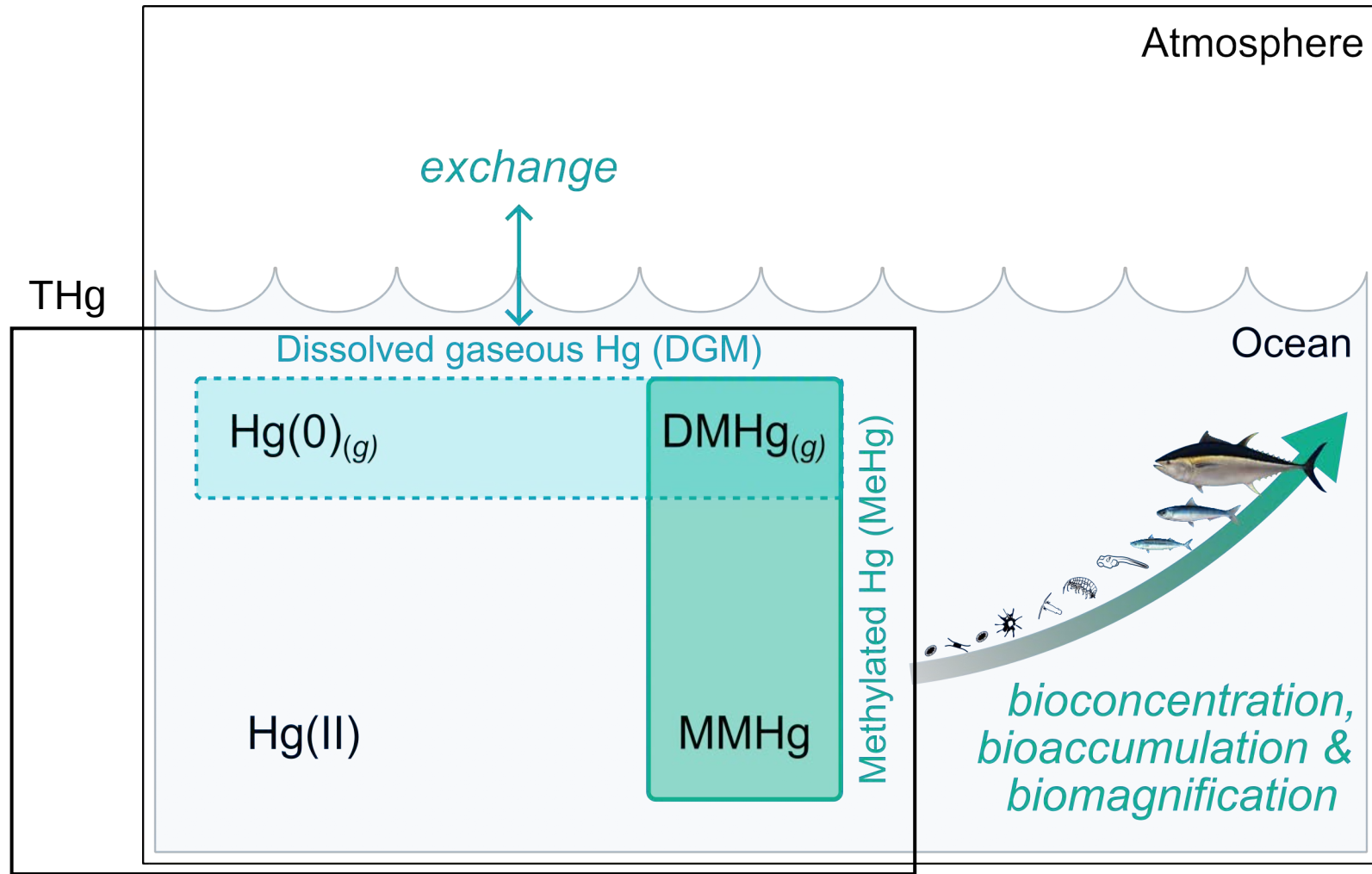
Methylation, Demethylation and Reduction in Coastal Waters of the Mediterranean Sea and Atlantic Ocean

Alina Kleindienst, Emmanuel Tessier, Natalia Torres-Rodriguez,
Océane Asensio, Claire Gassie, Lars-Eric Heimbürger-Boavida, Remy
Guyoneaud, and David Amouroux



WWW.MERCURYCAPETOWN.COM

Mercury (Hg) Species in Seawater

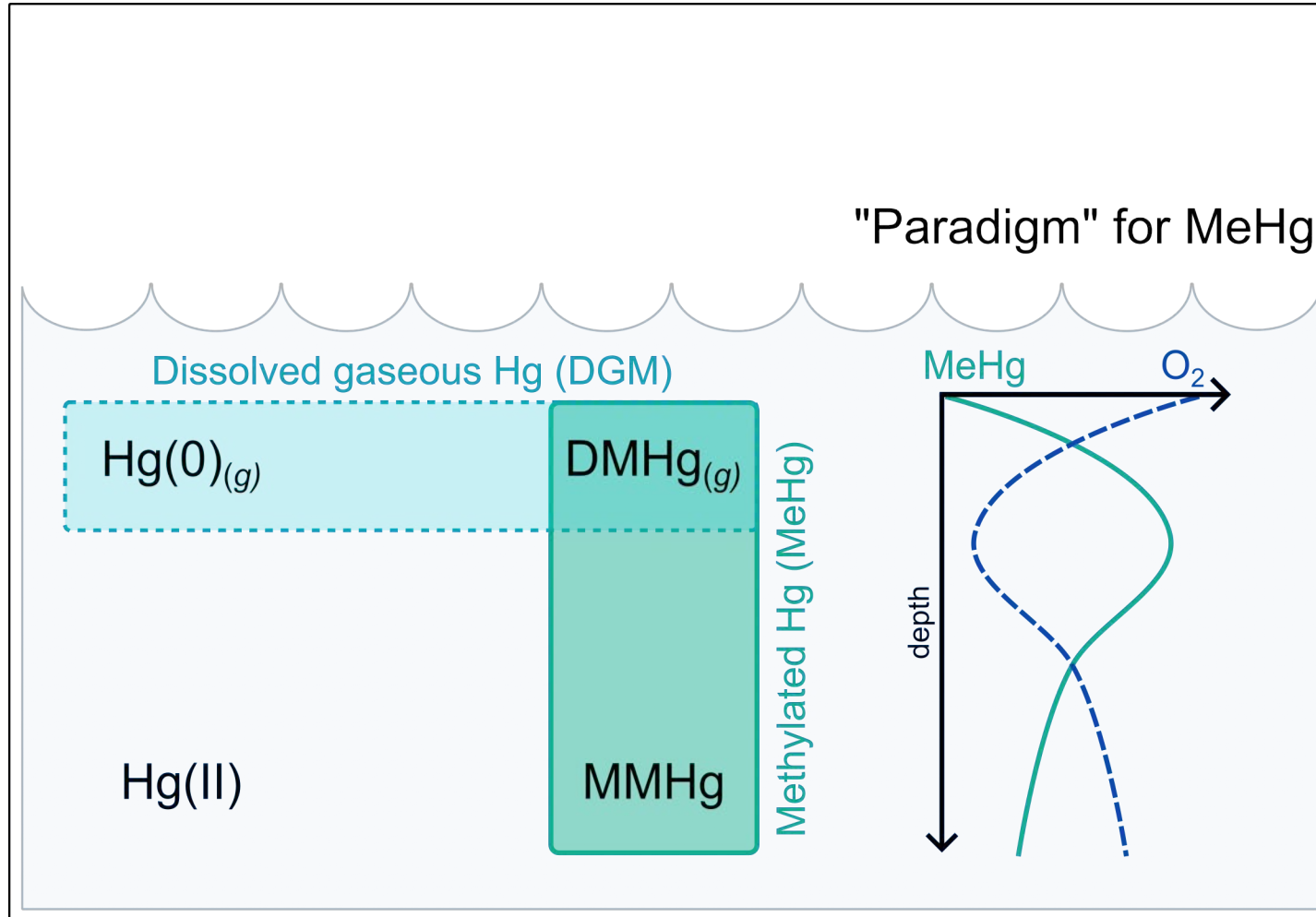


Limitation



- Low concentrations levels (fM)
- Operationally defined “Species”
- Differences in analytical approaches

Mercury (Hg) Species in Seawater



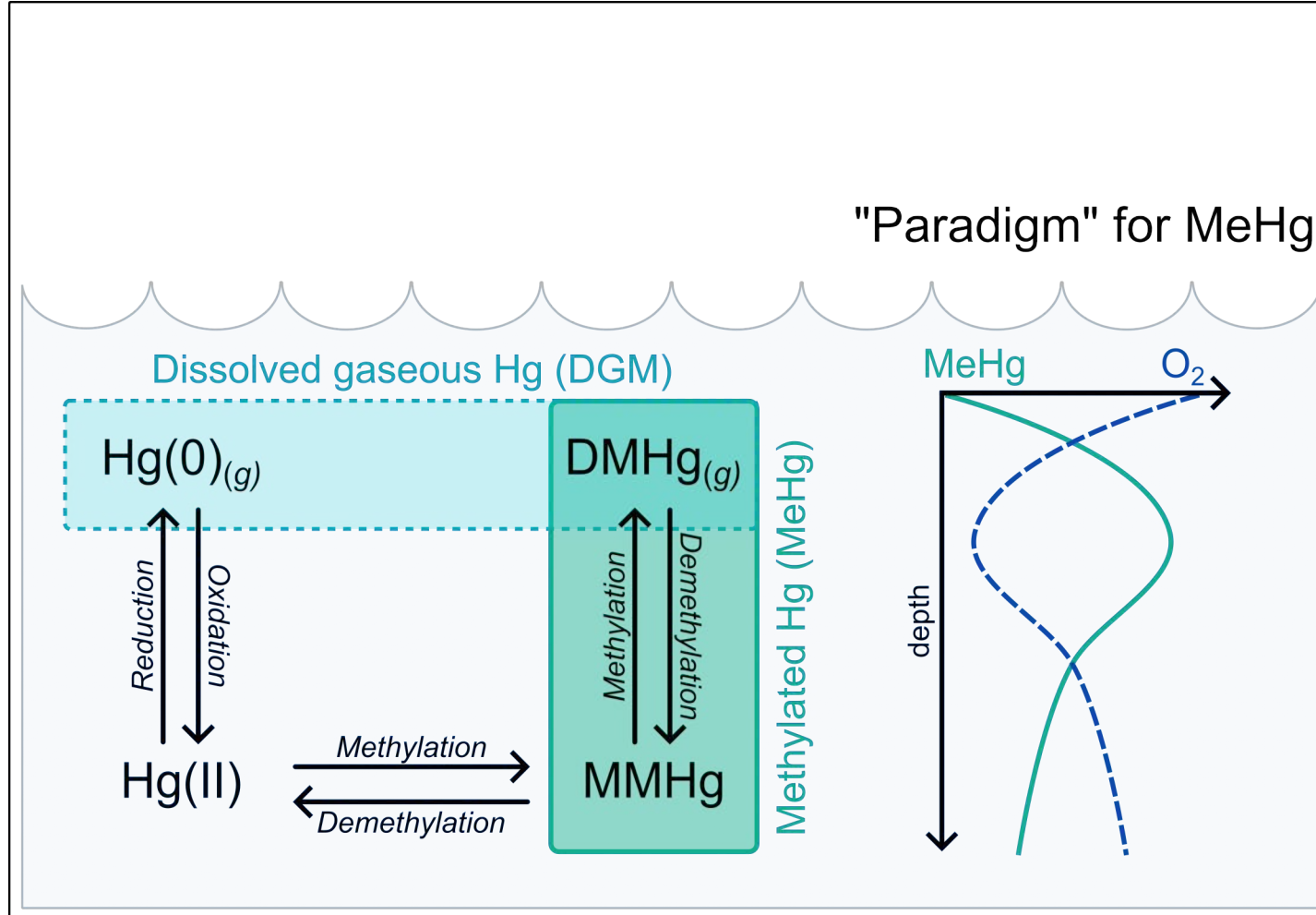
Discrepancy in the
Importance of
DMHg in MeHg pool



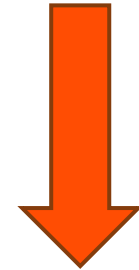
$\text{MeHg} = \text{MMHg} \ll \text{DMHg}$
(Cossa et al., 1994, 2009, 2017; Mason & Fitzgerald 1990; Jiskra et al., 2021;)

$\text{MeHg} = \text{MMHg} \gg \text{DMHg}$
(Horvath et al., 2003; Kotnik et al., 2007; Bowmann et al., 2015)

Mercury (Hg) Species in Seawater



How to explain
MeHg maxima in oxic
Marine Waters?



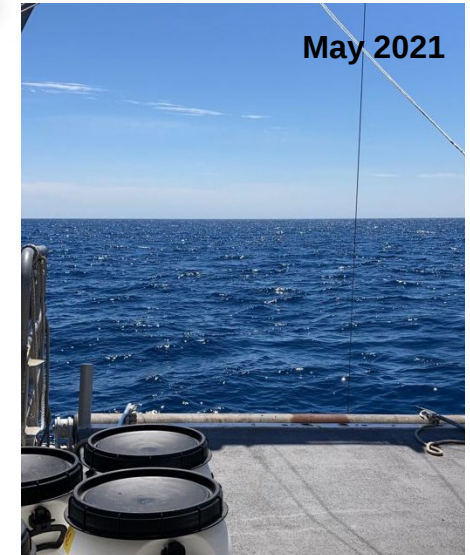
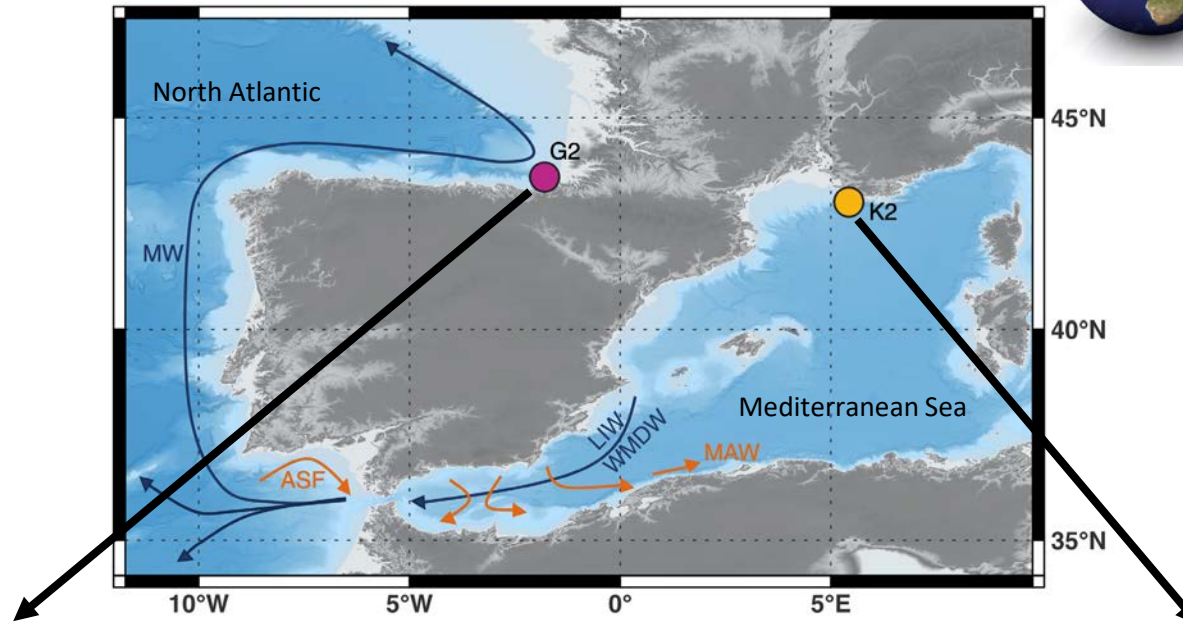
Methylation of Hg(II)
by anaerobic
microorganisms
harvesting
hgcAB gene cluster (Parks et al., 2013)

Research Objective

Investigate the Potential for
Hg Species Transformations
in two Contrasting European
Coastal Seawaters



Two Contrasting Coastal European Study Sites



Northeastern Atlantic (NE ATL)

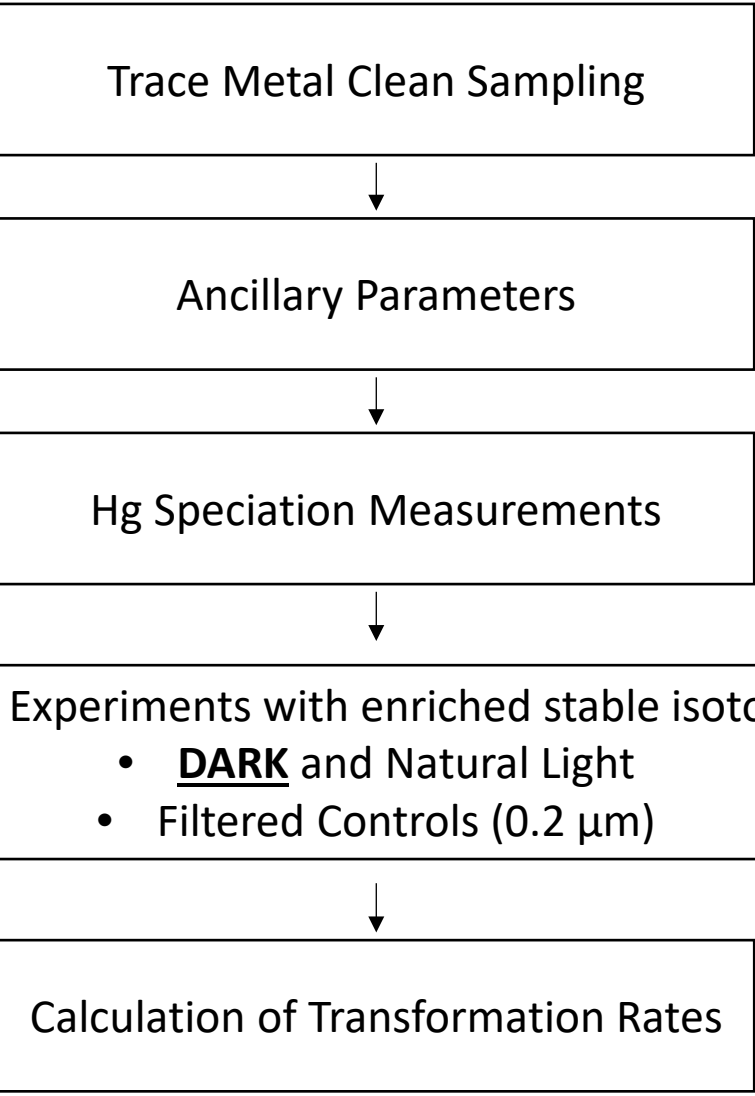
- Mesotrophic System
- Riverine influence
- Station within Canyon

Northwestern Mediterranean (NW MED)

- Oligotrophic System
- Warm Bottom Waters
 - High Salinity

Goldschmidt 2023

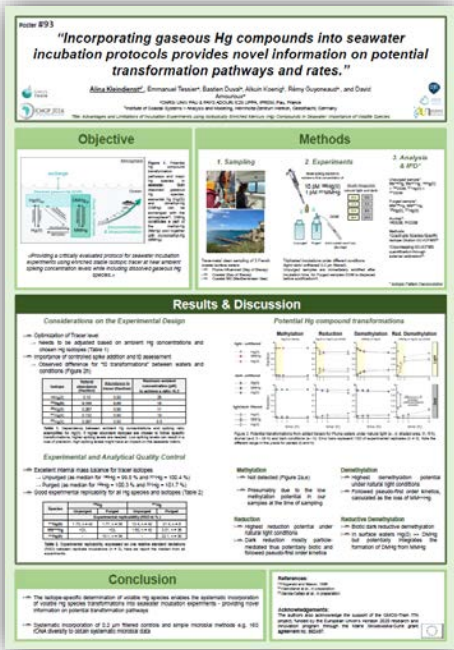
Materials & Methods



e.g. microbial community (16S rDNA)

THg, DGM, DMHg, MeHg, MMHg

4 depths per profile

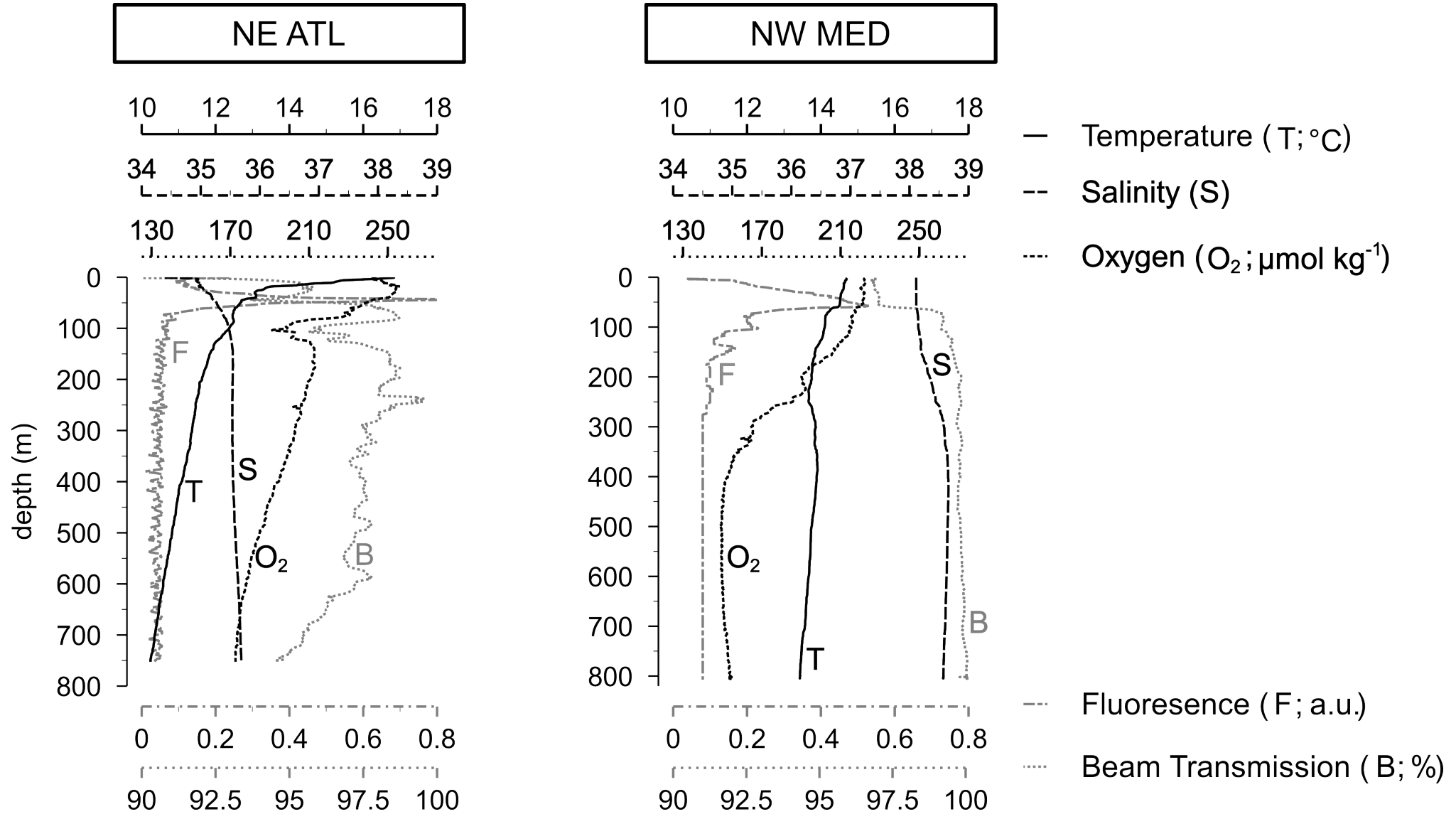


Want to learn more on Incubation Experiments?

→ Poster #93

Environmental Conditions at Time of Sampling

07

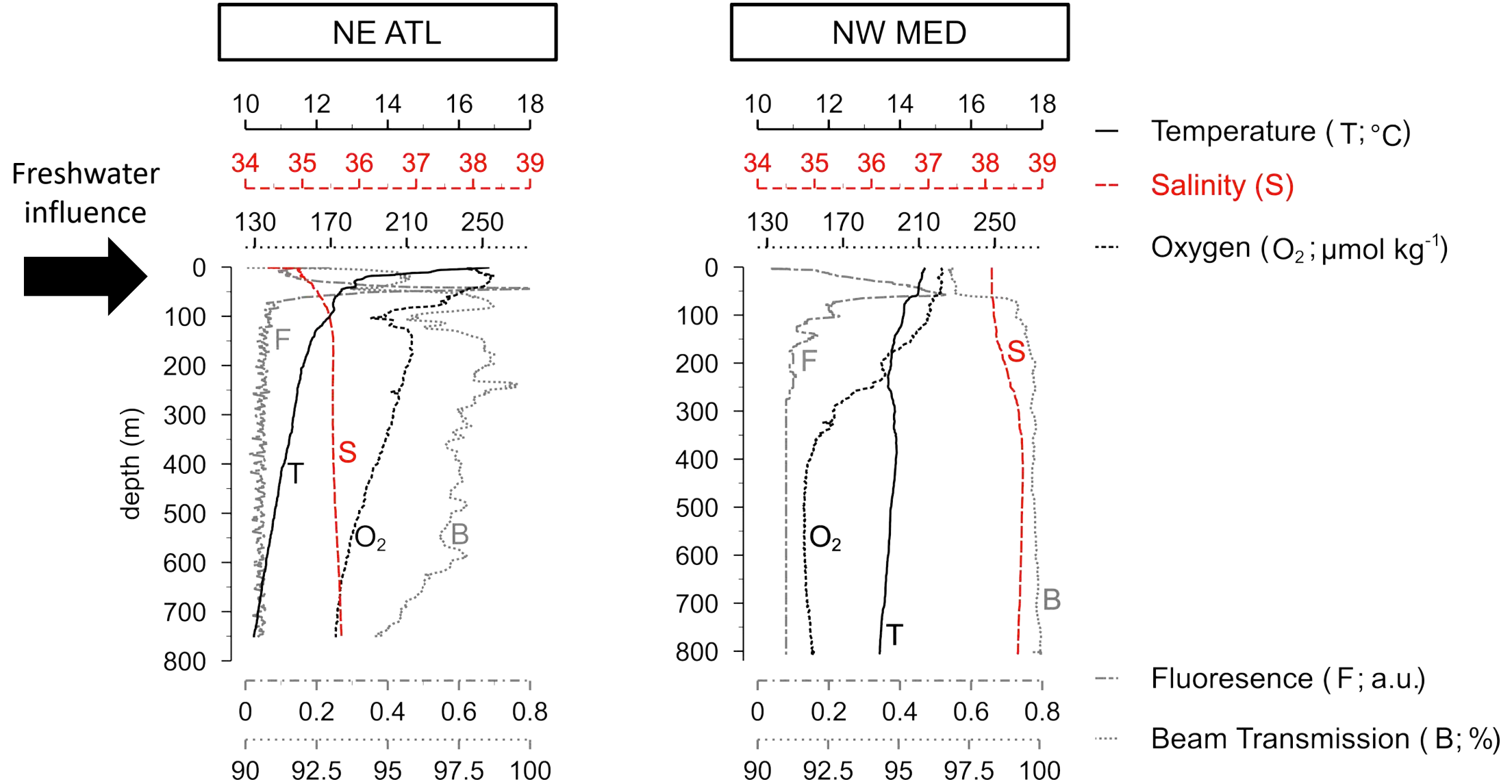


May 2022

May 2021

Freshwater influenced surface waters in NE ATL

07

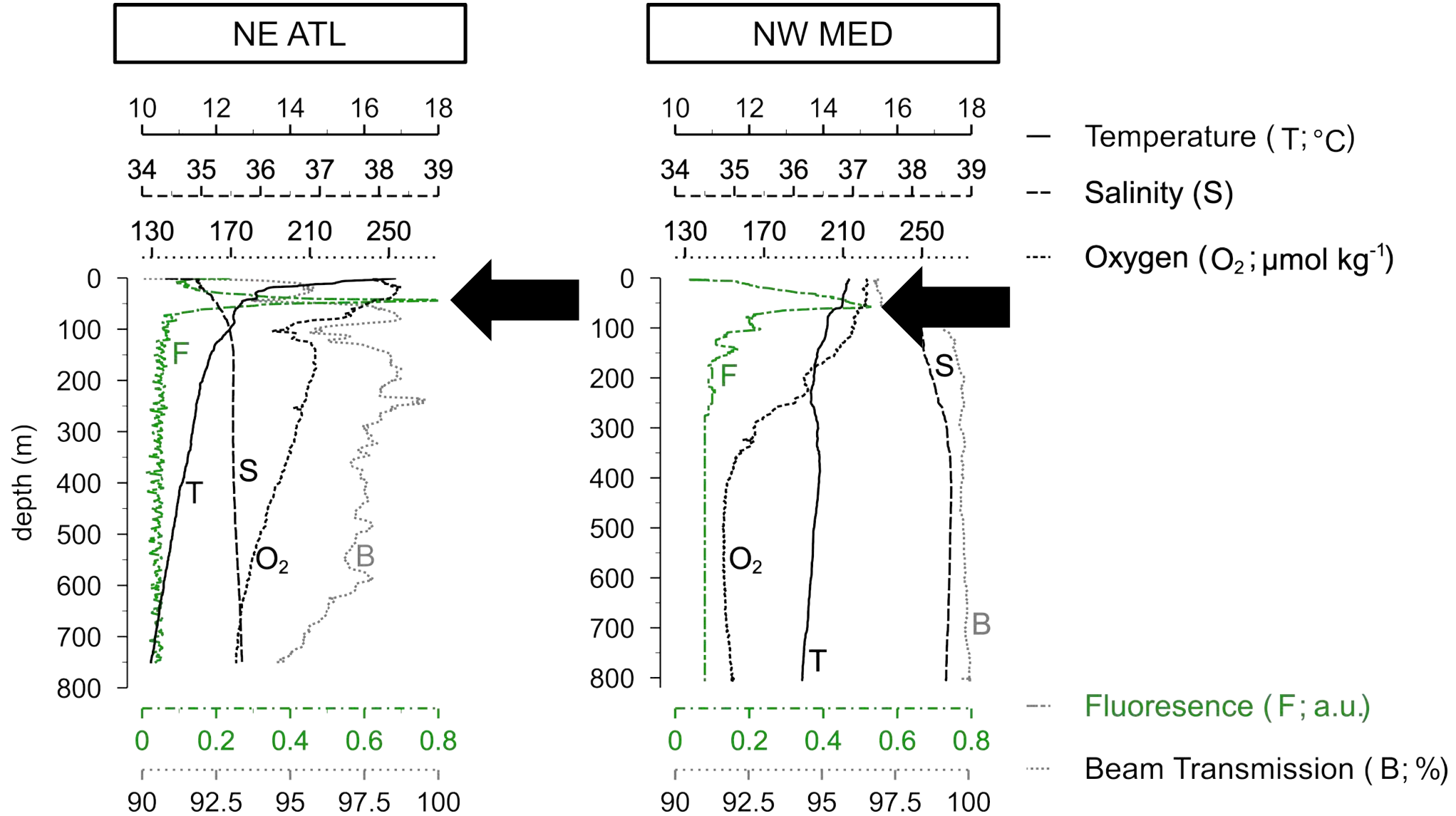


May 2022

May 2021

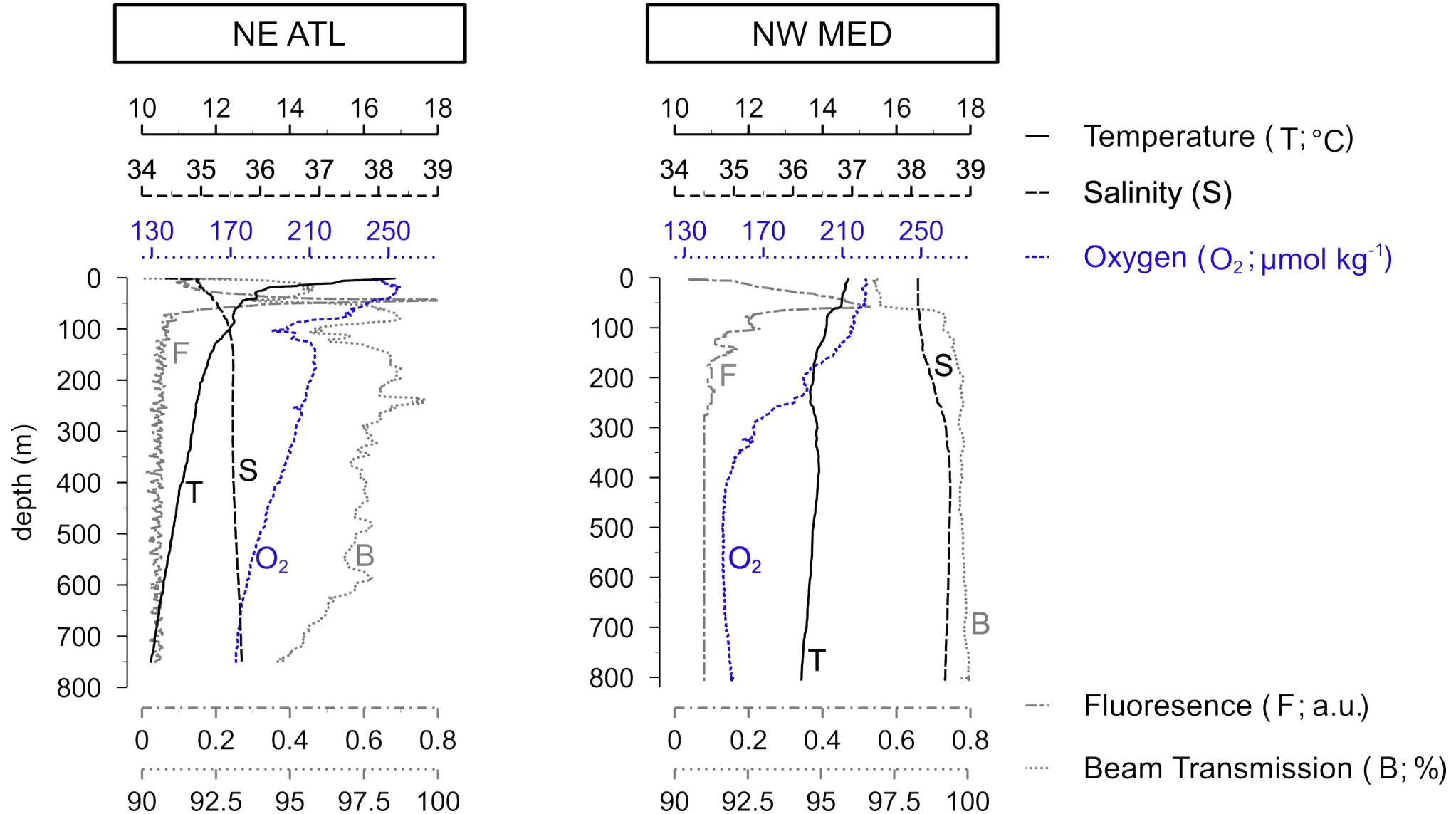
Deep chlorophyll maxima (DCM) during time of sampling

07



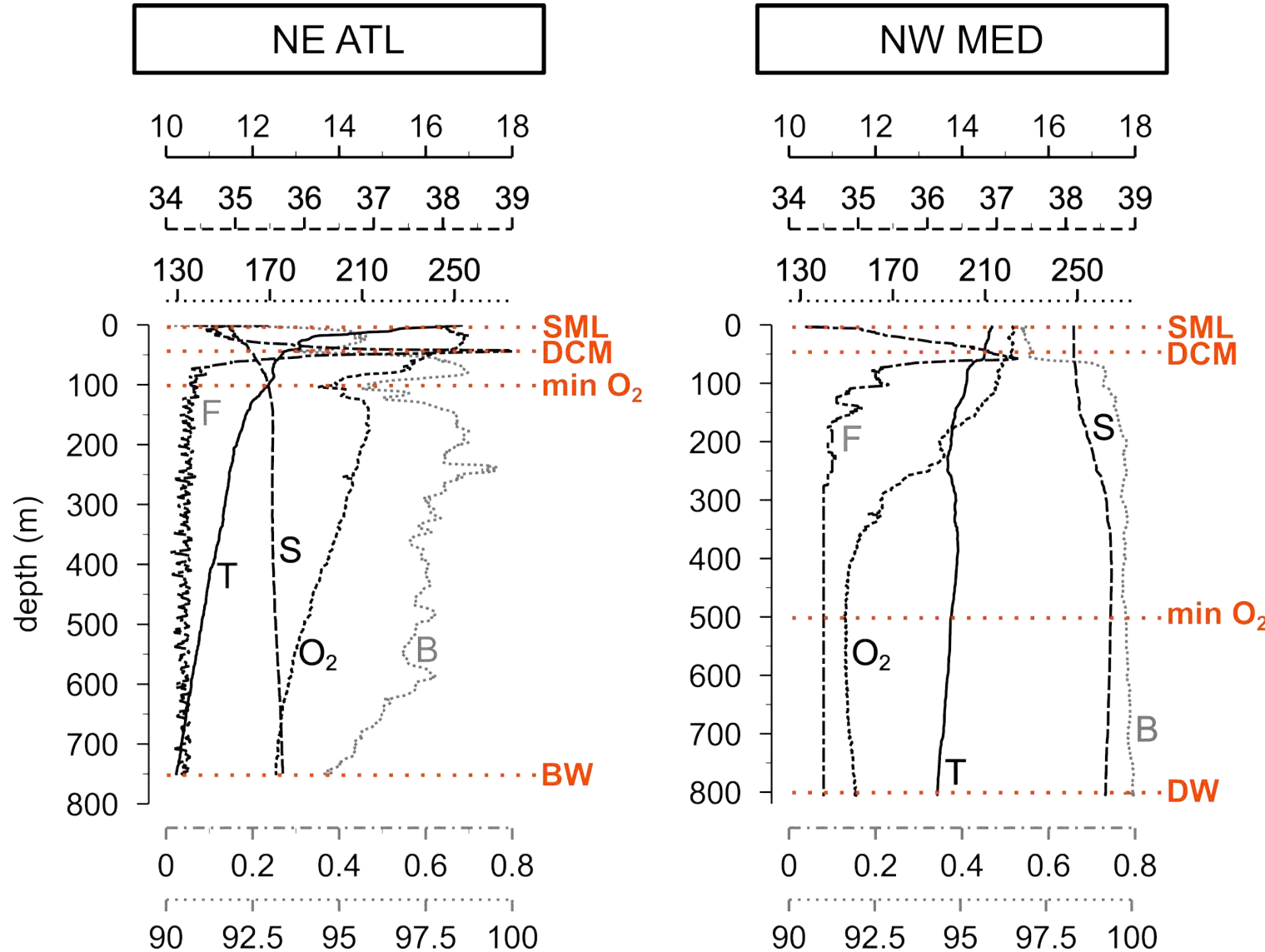
May 2022

May 2021



Water depths chosen for incubation experiments

07



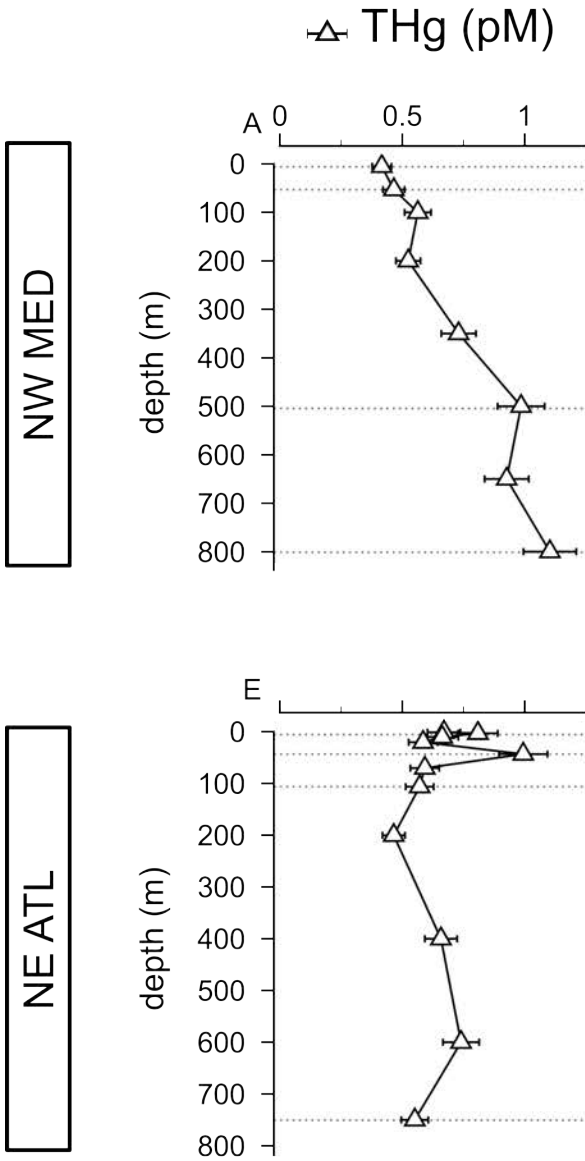
Incubation samples –
In-situ oxygen saturation
always >60 %

Incubations performed
within <24 h of Sampling

Ambient Hg Speciation

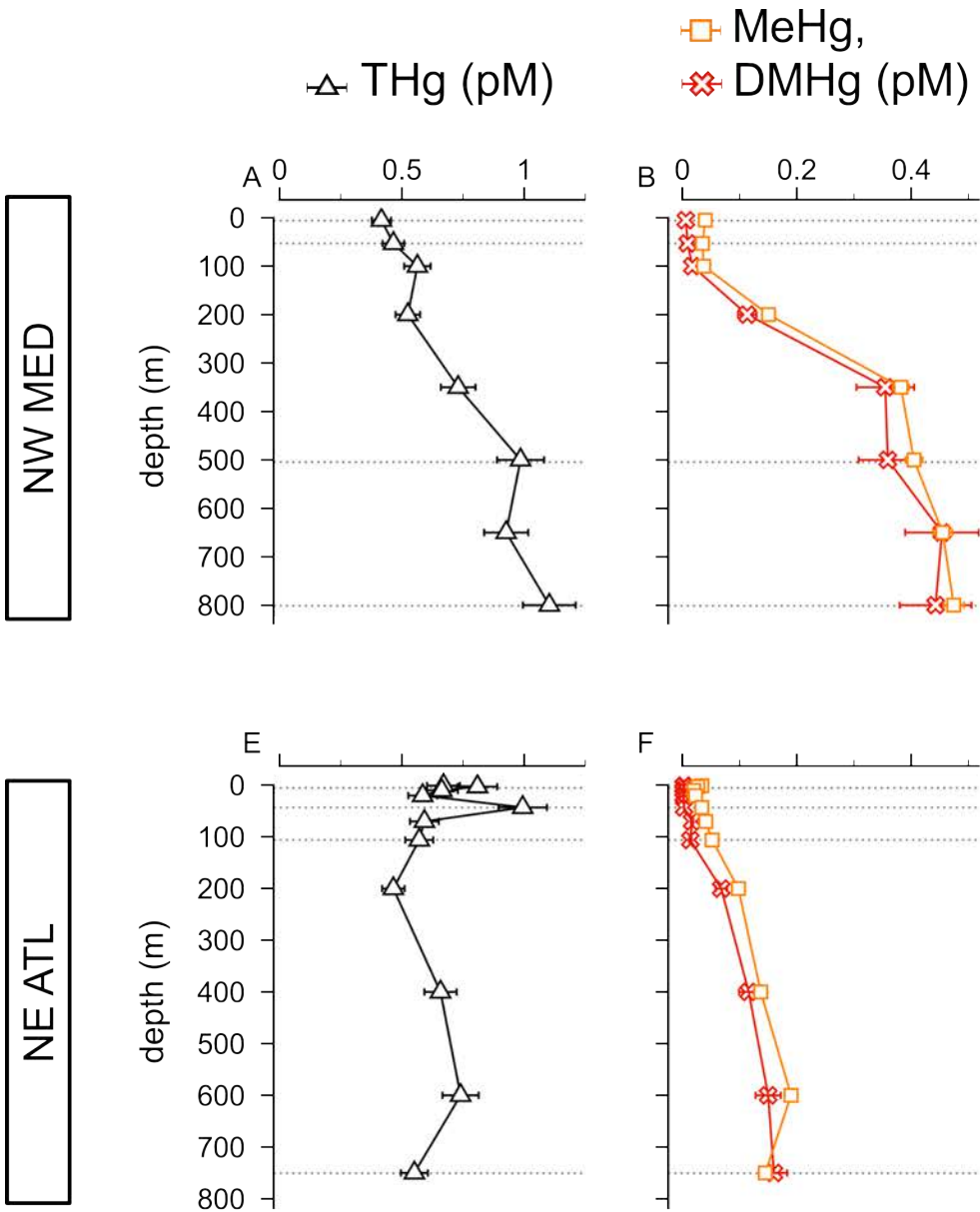
Ambient Hg Speciation

08



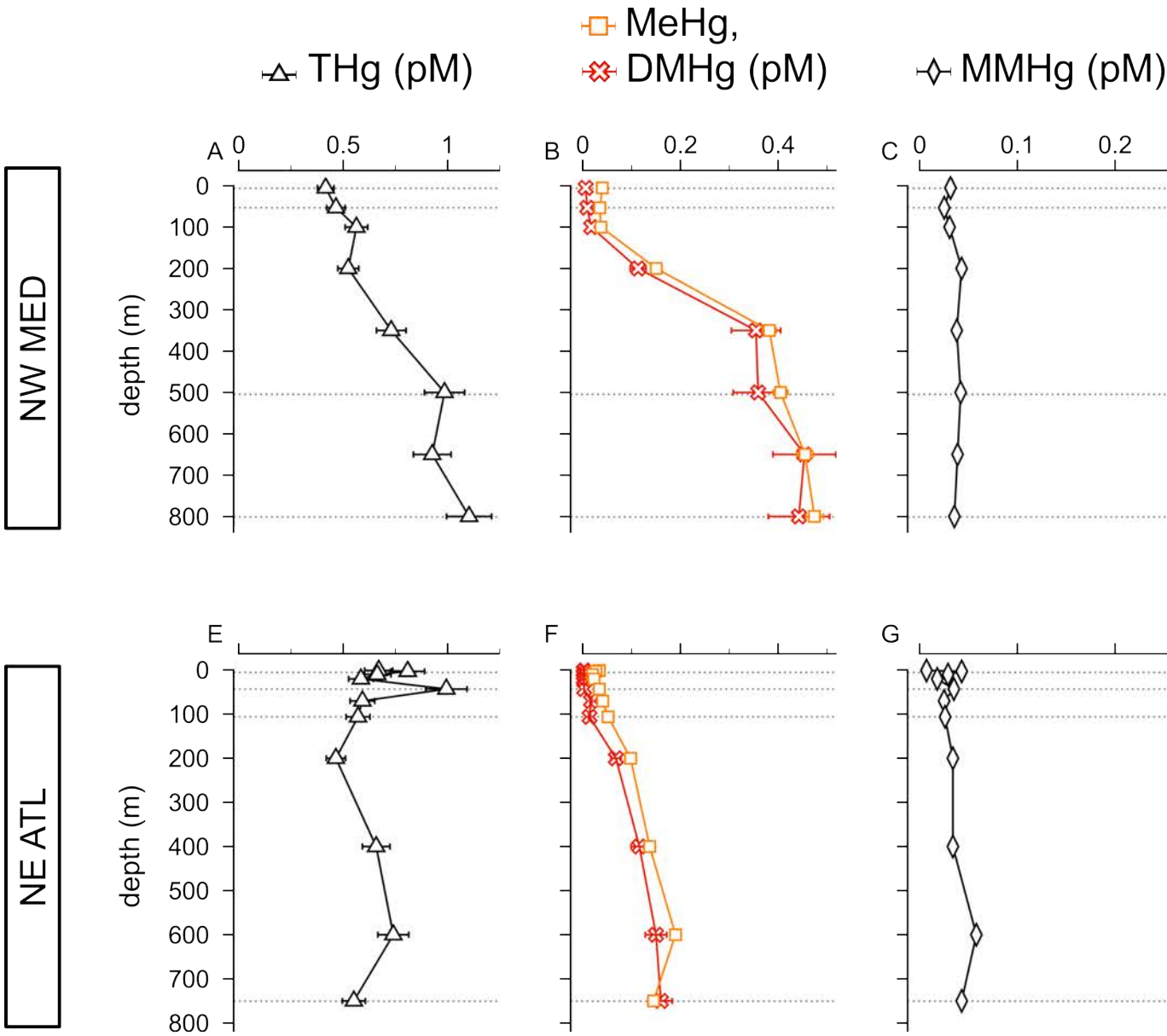
Ambient Hg Speciation

08



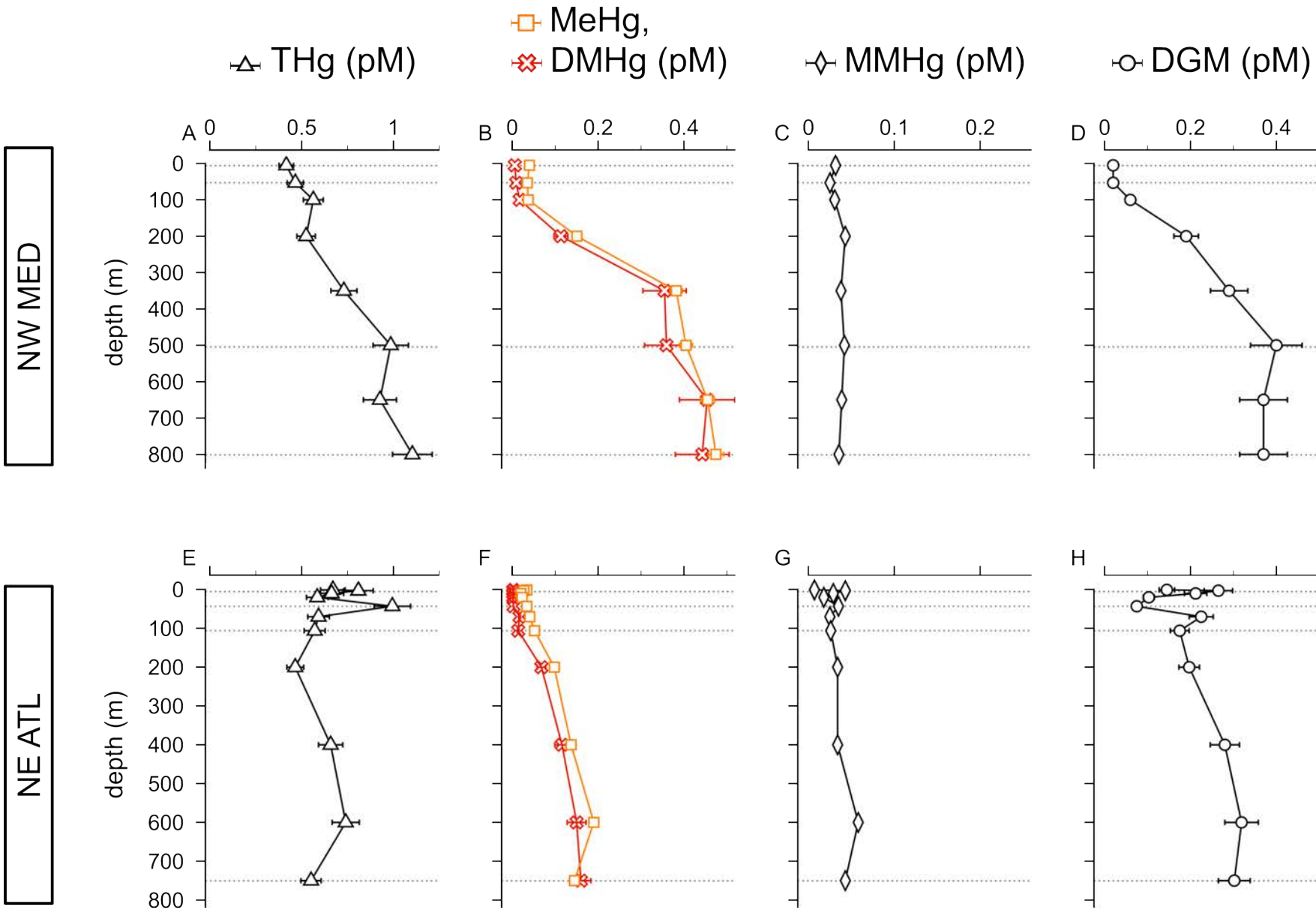
Ambient Hg Speciation

08



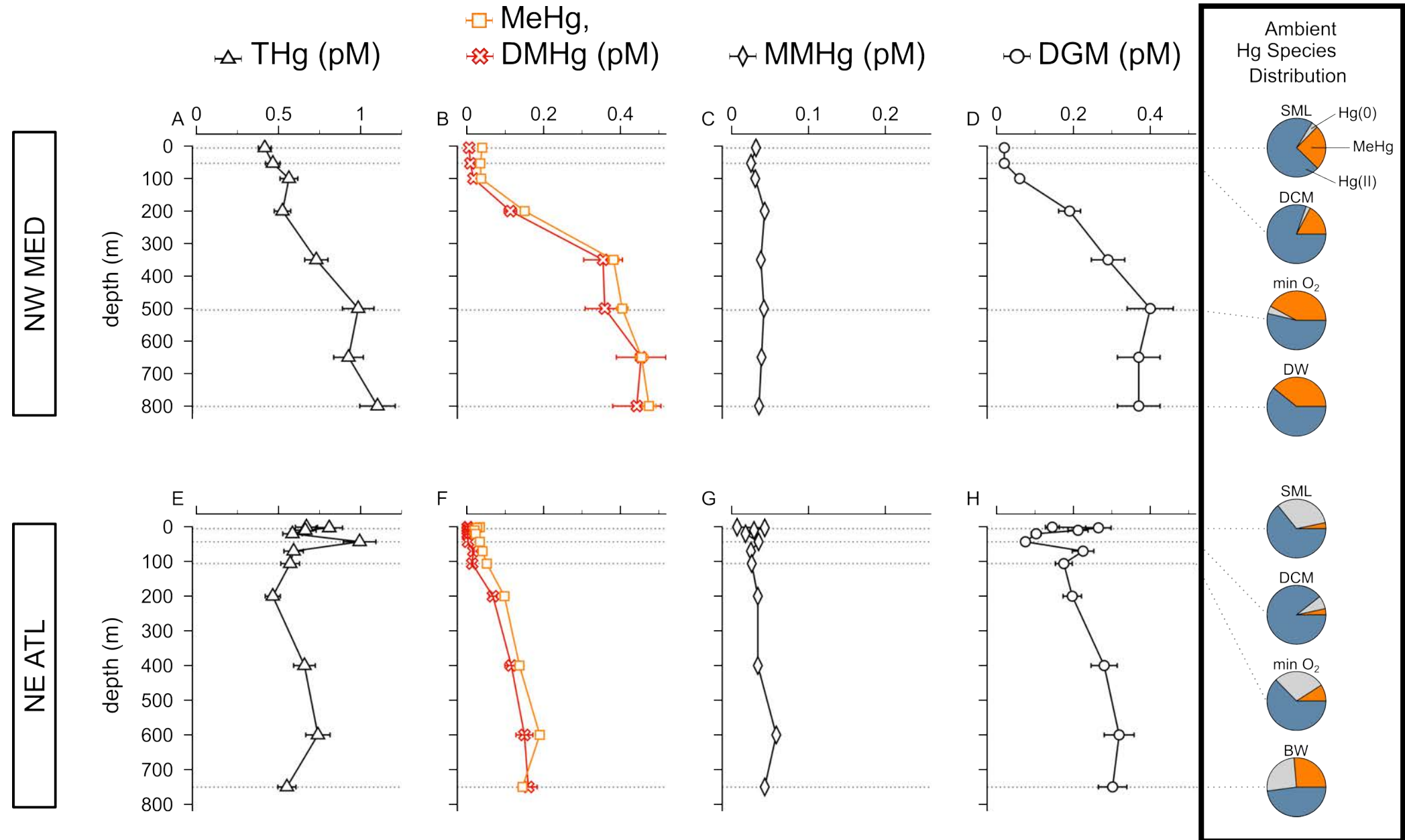
Ambient Hg Speciation

08



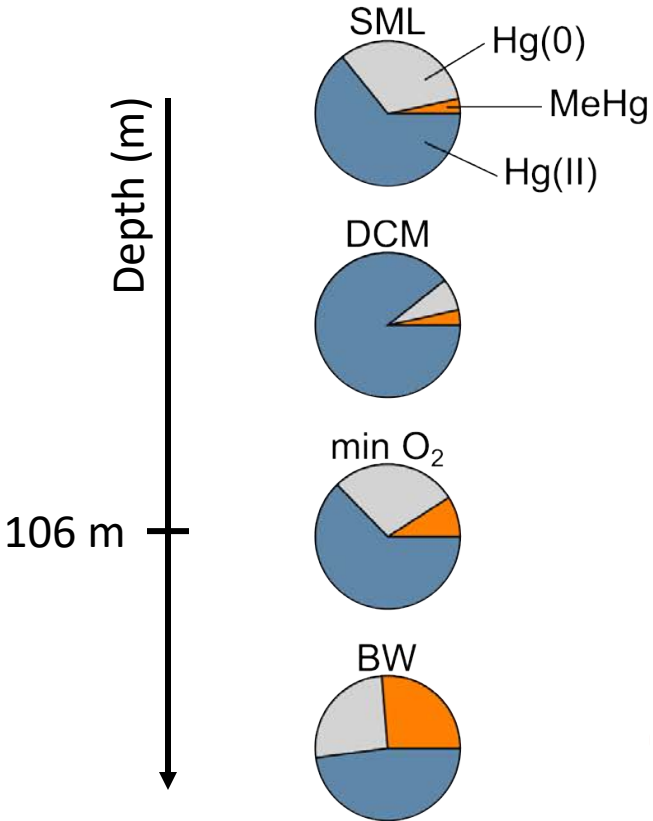
Ambient Hg Speciation

08



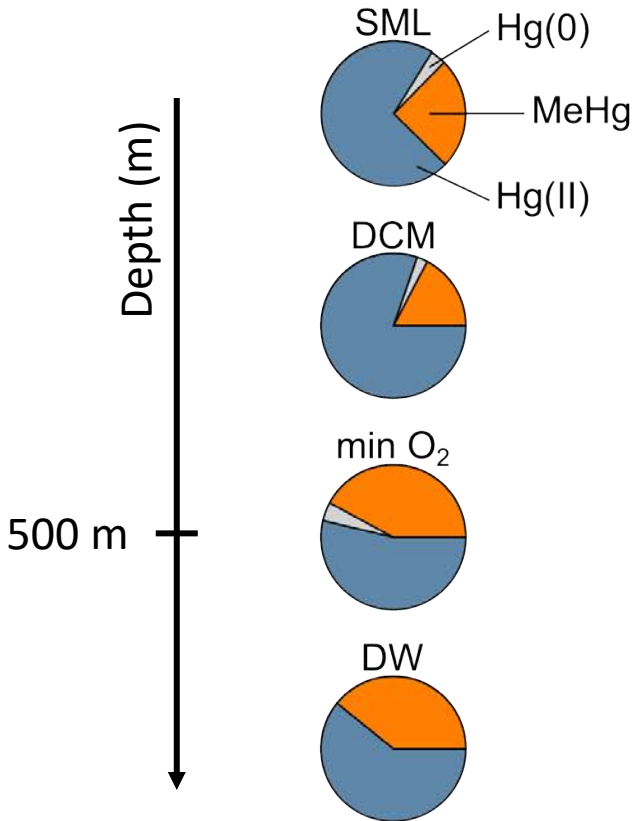
NE ATL

Ambient
Hg Species
Distribution



NW MED

Ambient
Hg Species
Distribution



NE ATL

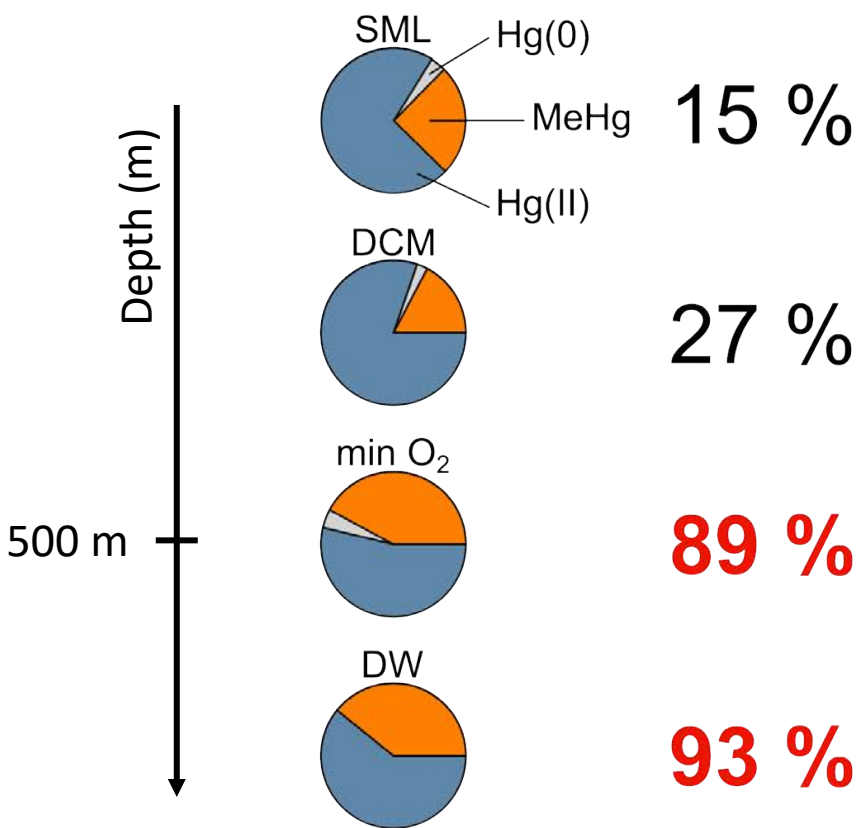
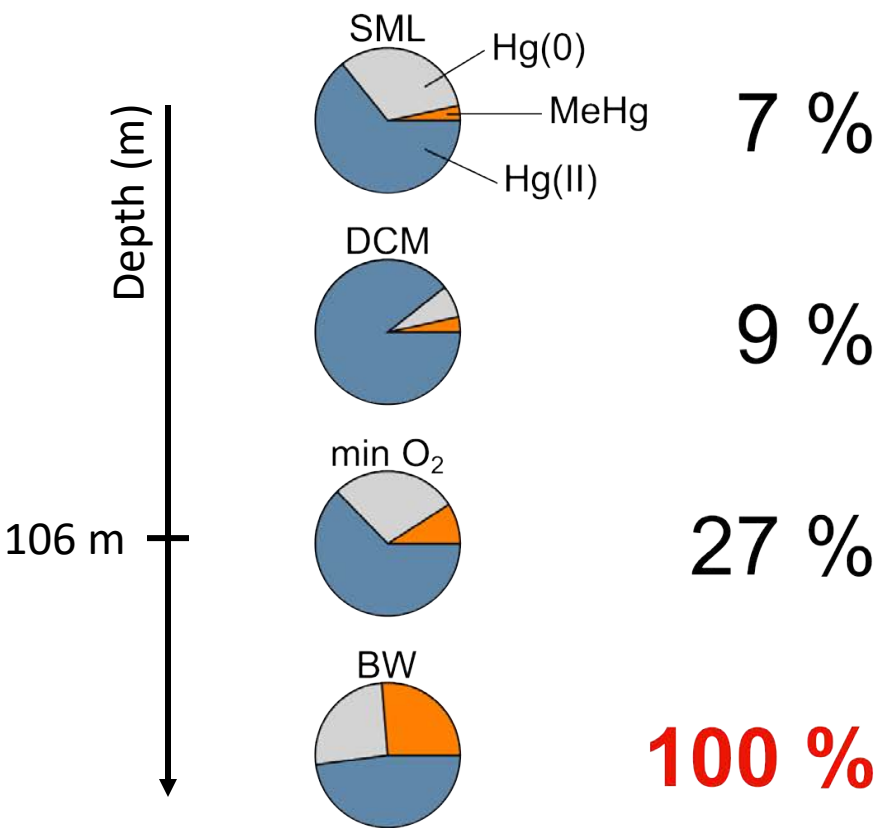
NW MED

Ambient
Hg Species
Distribution

DMHg in MeHg

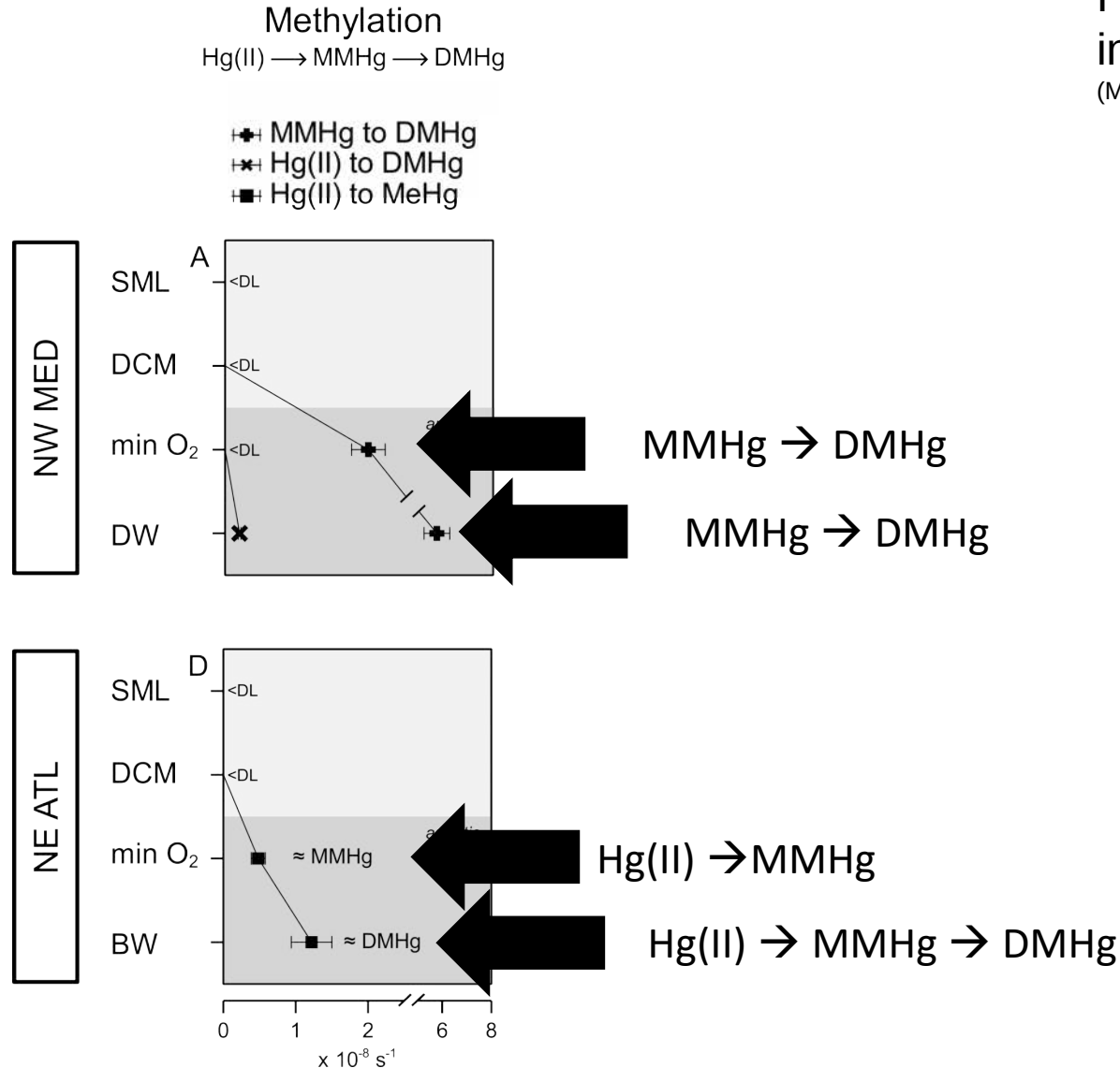
Ambient
Hg Species
Distribution

DMHg in MeHg

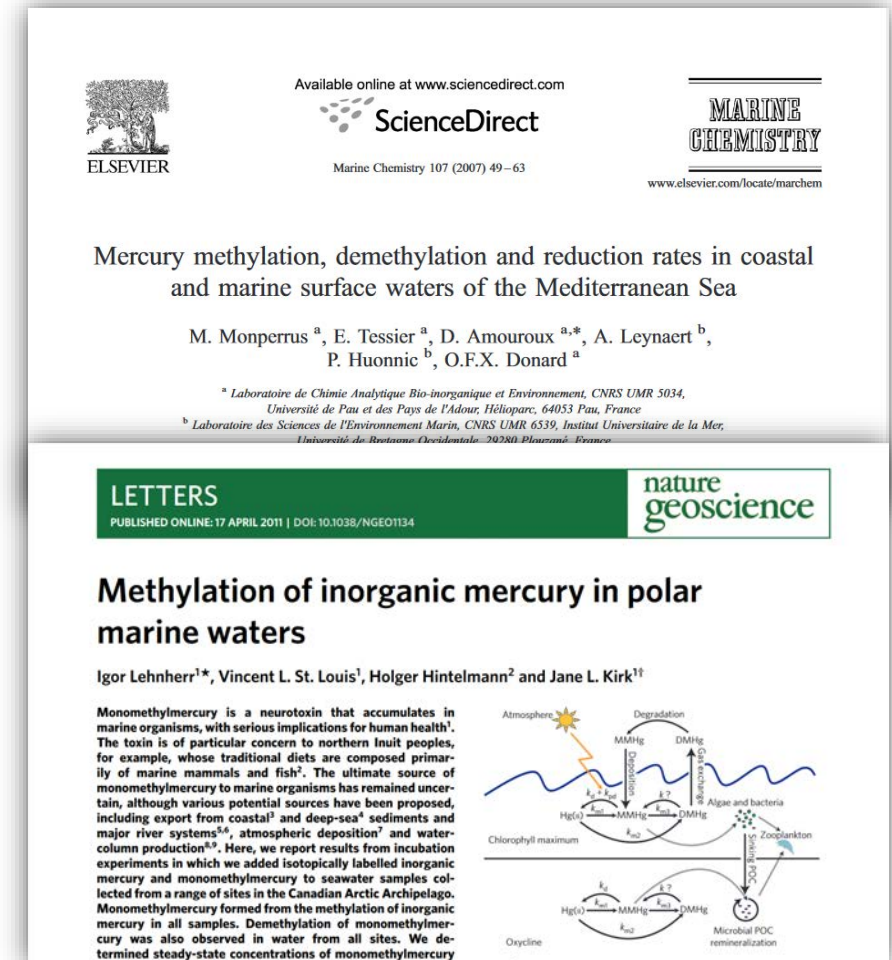


Potential Hg species transformations

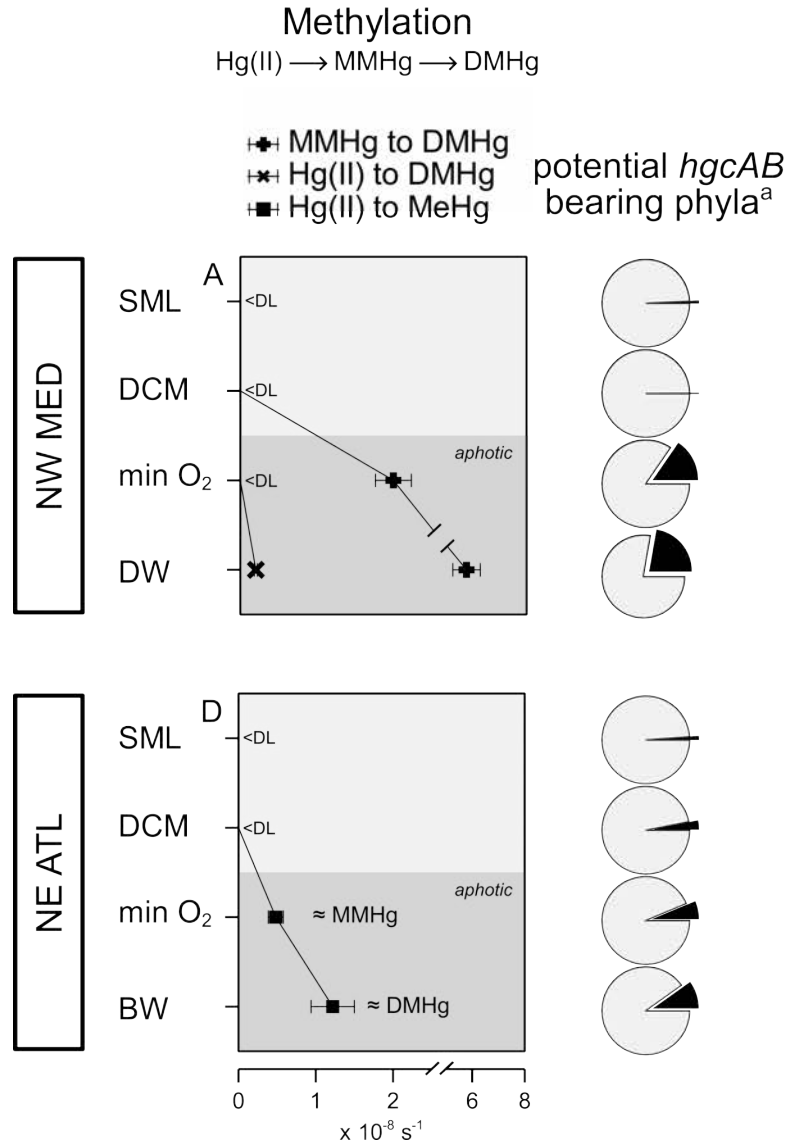
Methylation only observed in presence of particles



Potential for formation of DMHg in seawater incubation experiments previously reported (Monperrus et al., 2007; Lehnher et al., 2011)



Highest methylation potential in waters from aphotic zone

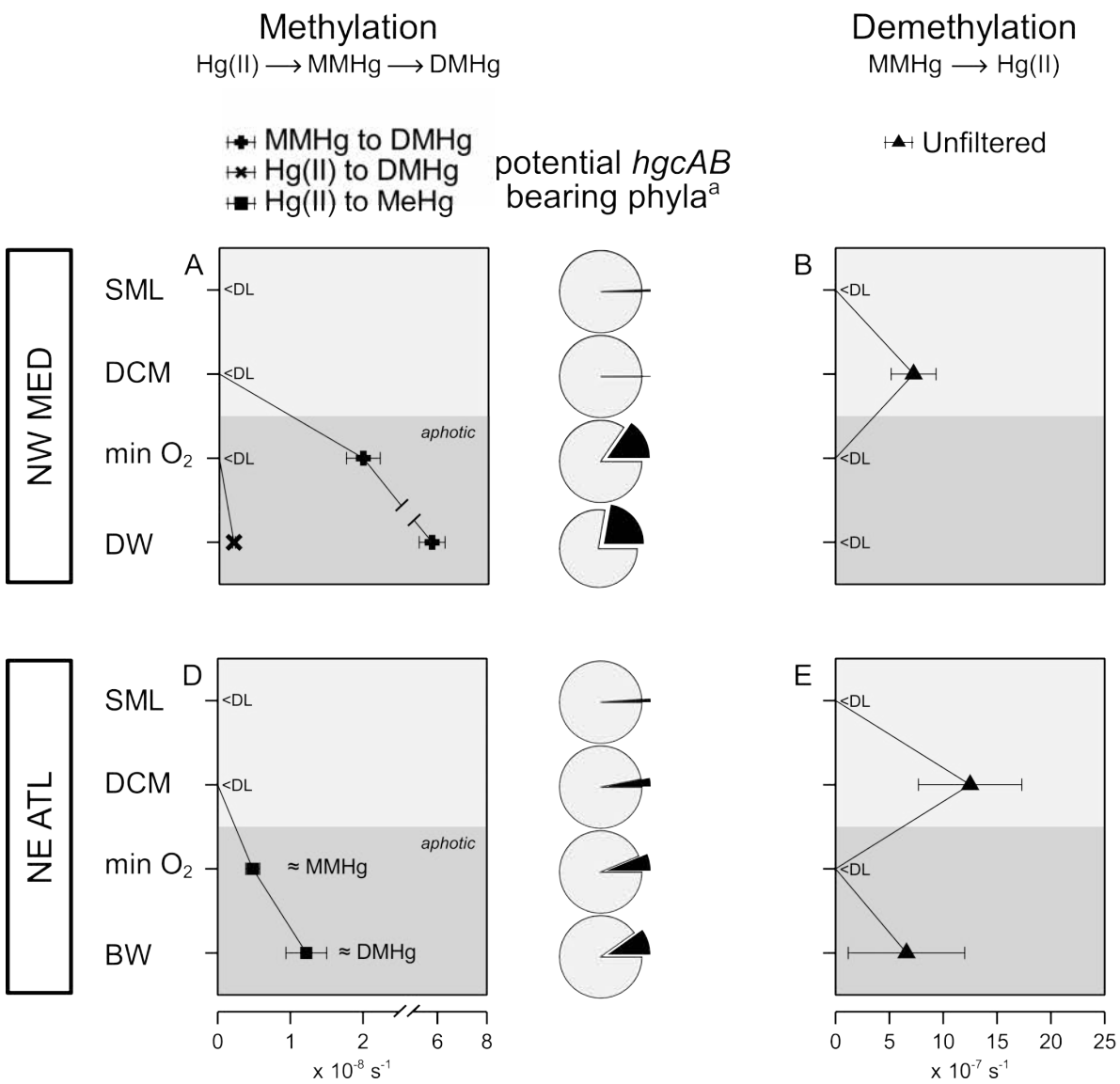


Error bars represent 1SD of triplicate experiments

^aDesulfobacterota, Marinimicrobia, Nitrospina, SAR324 clade, Chloroflexi, Firmicutes

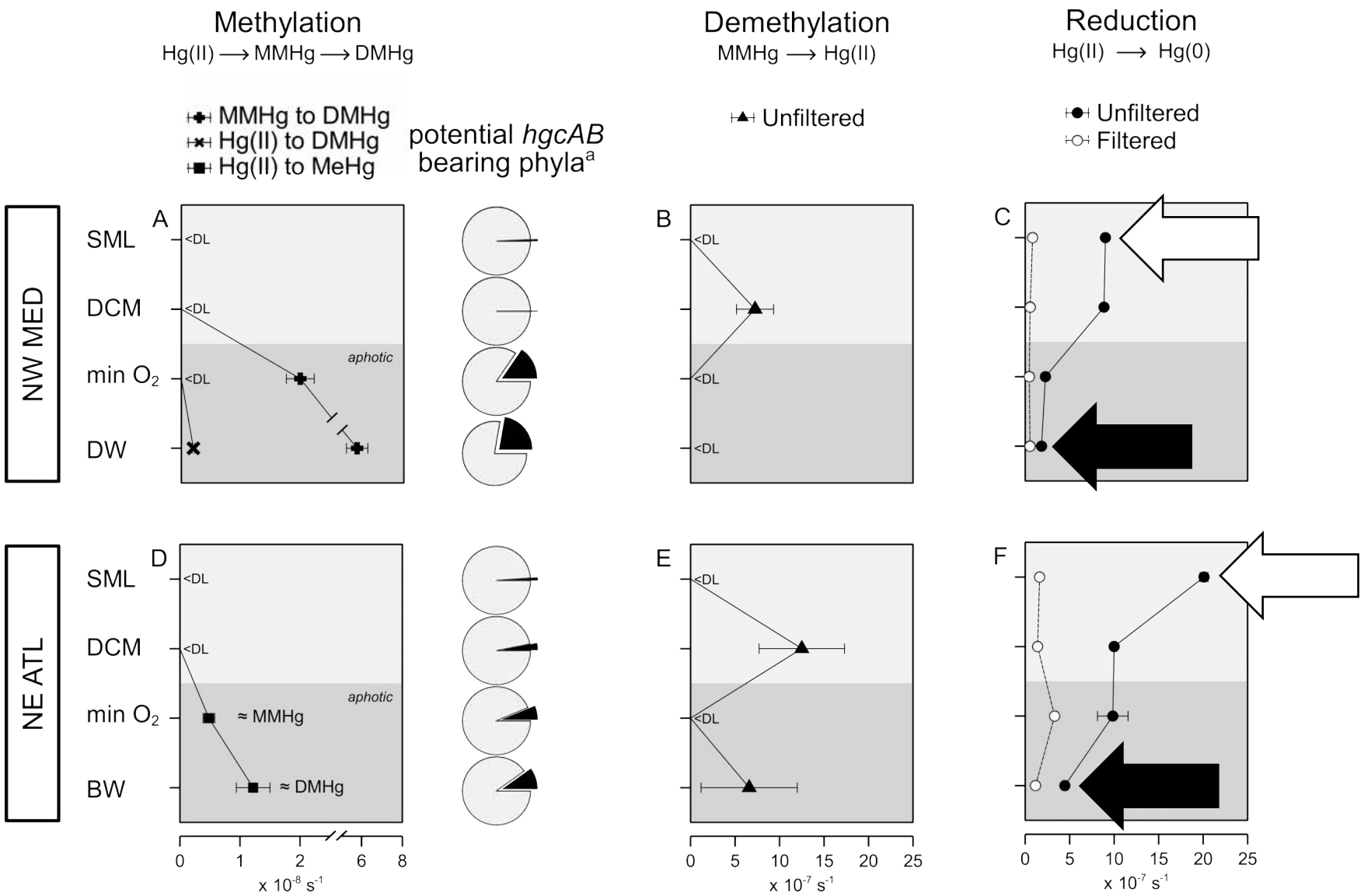
^bRhodobacterales

Demethylation only in presence of particles

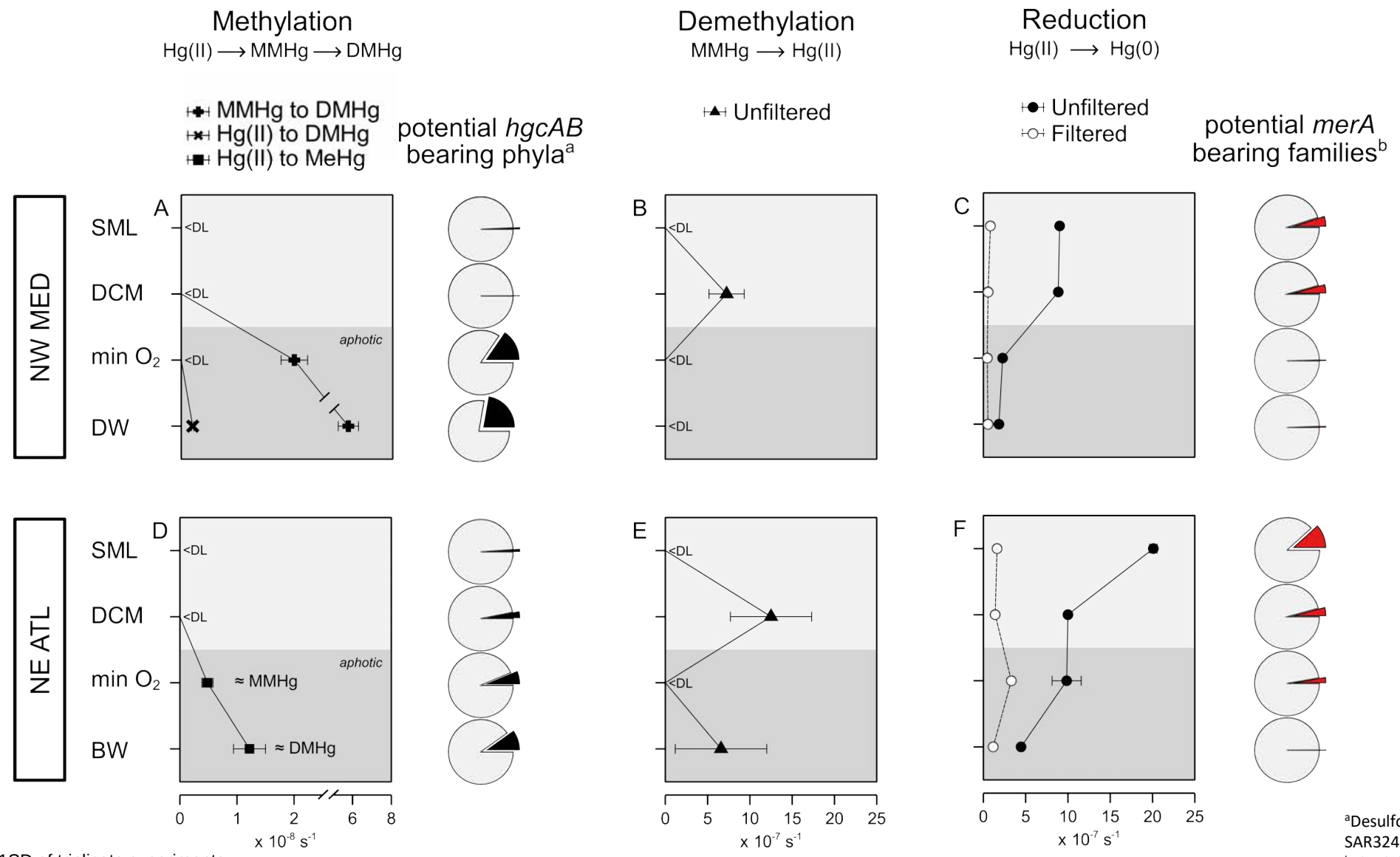


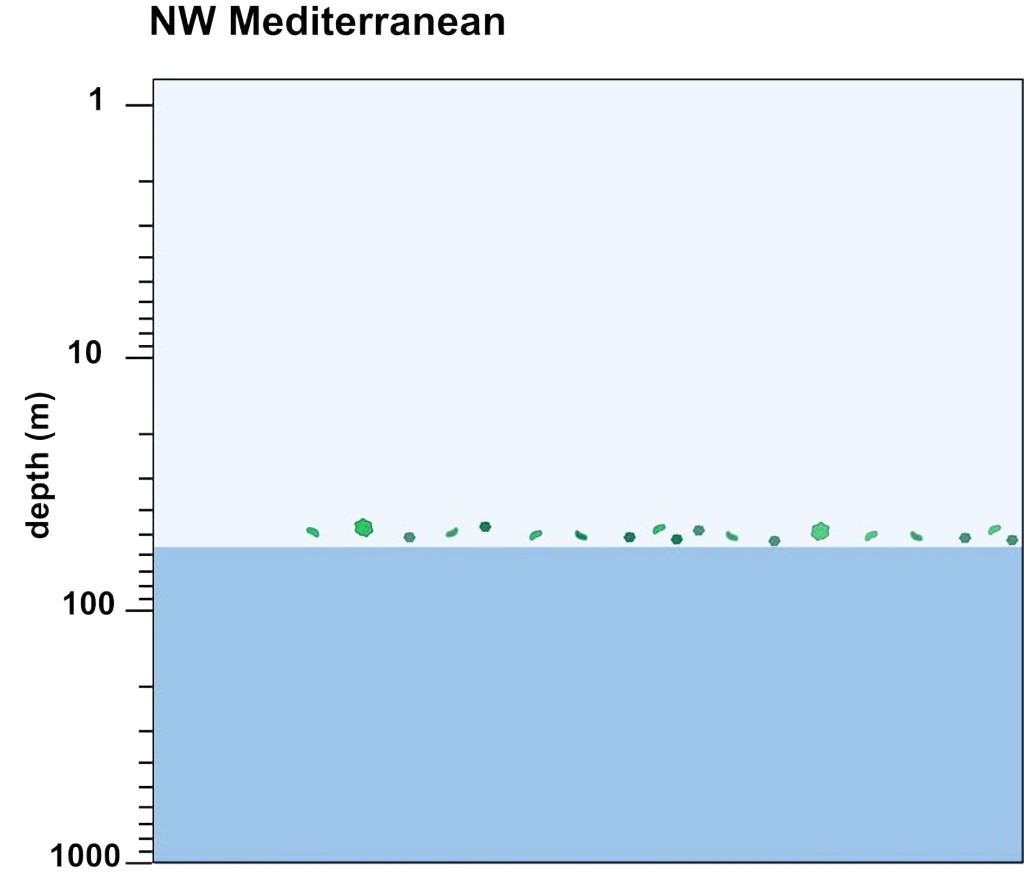
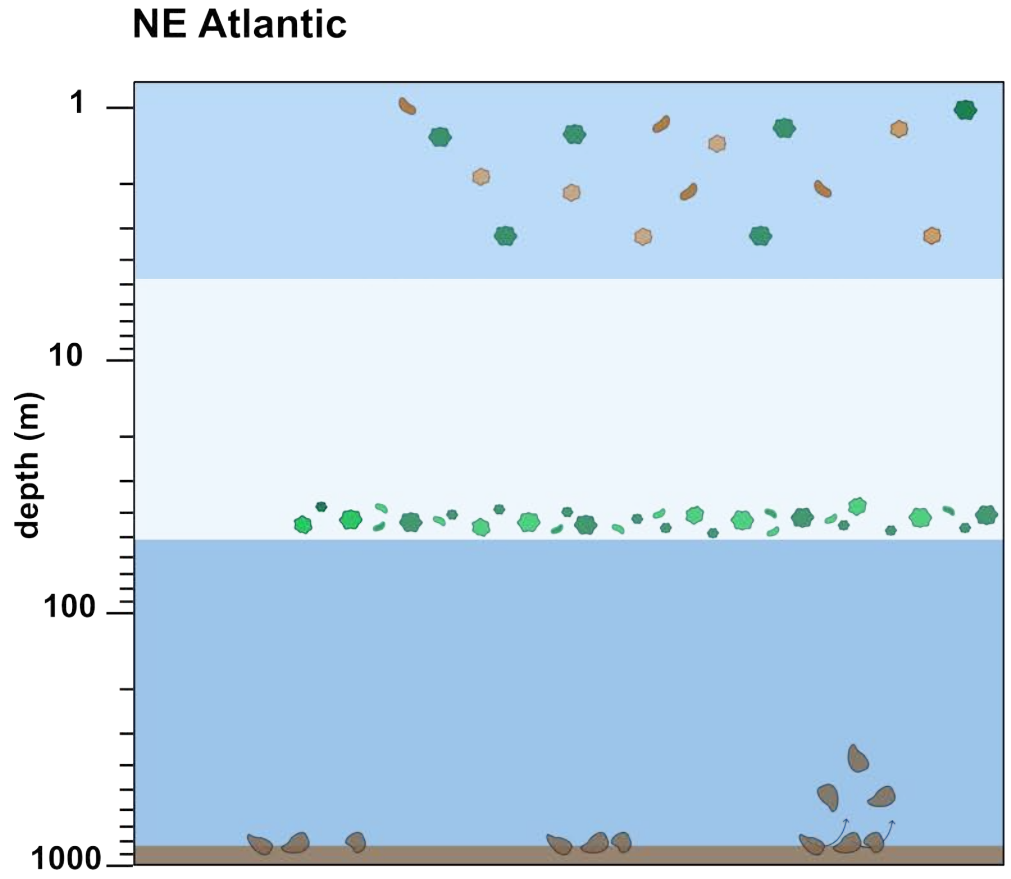
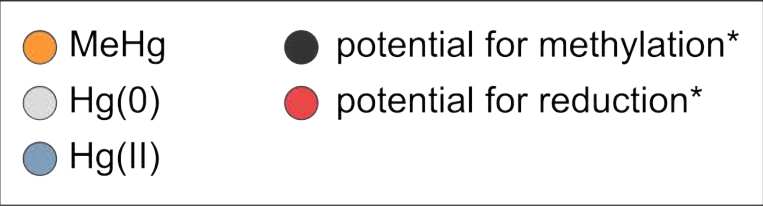
Error bars represent 1SD of triplicate experiments

ATL – Higher reduction potential

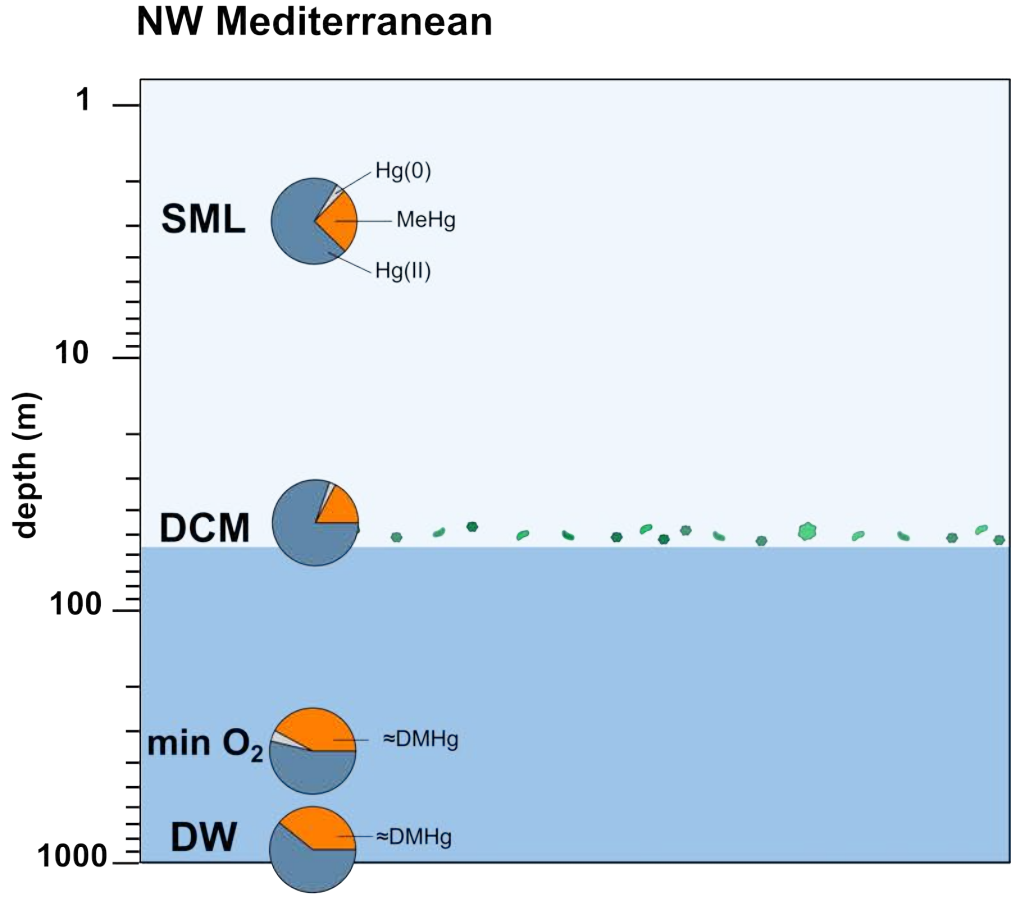
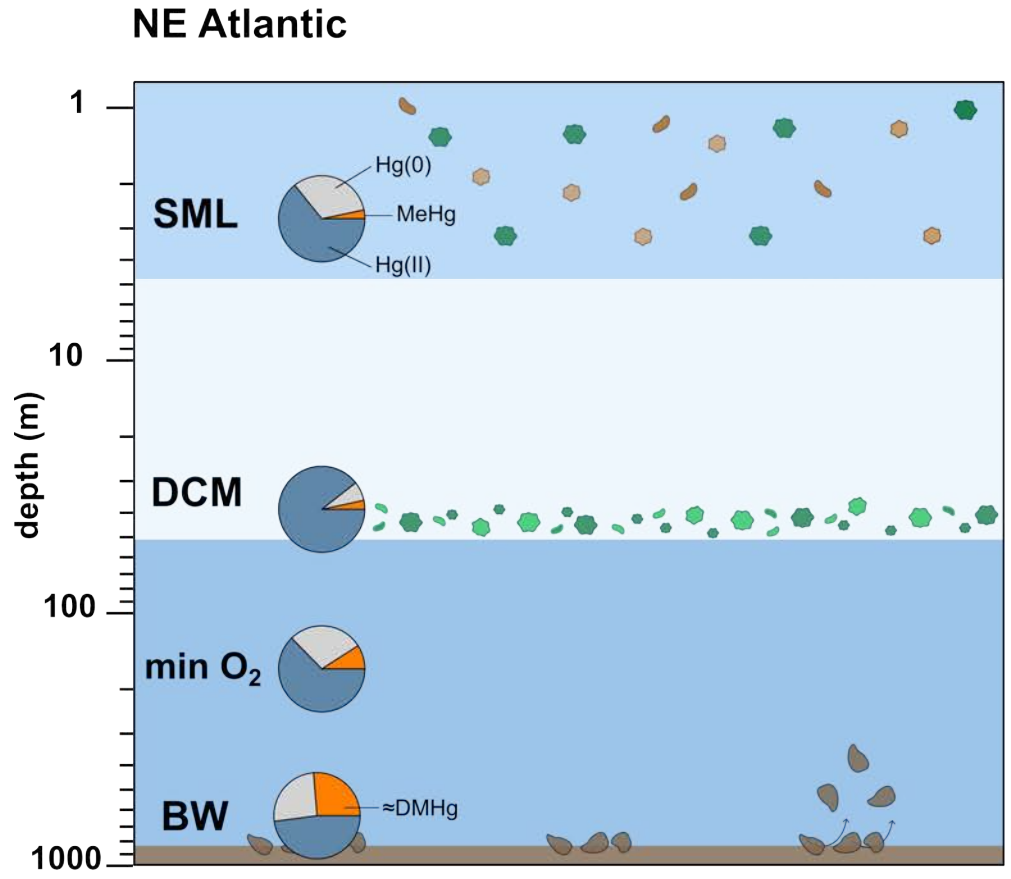
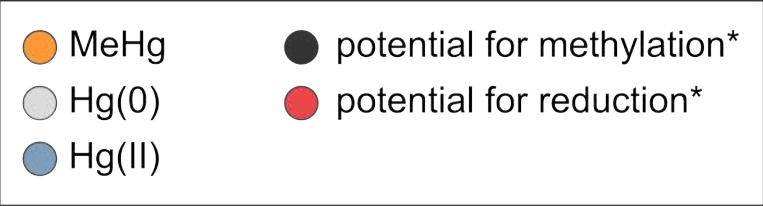


Overall highest Reduction Potential in Surface Waters

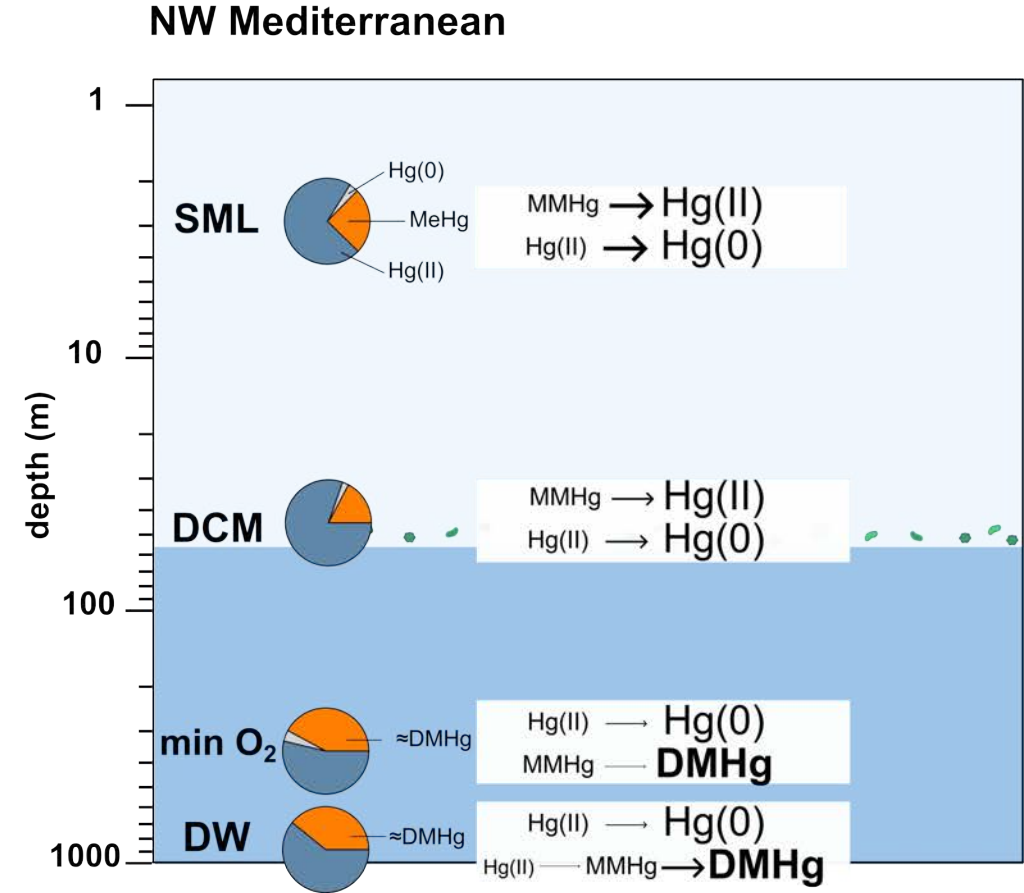
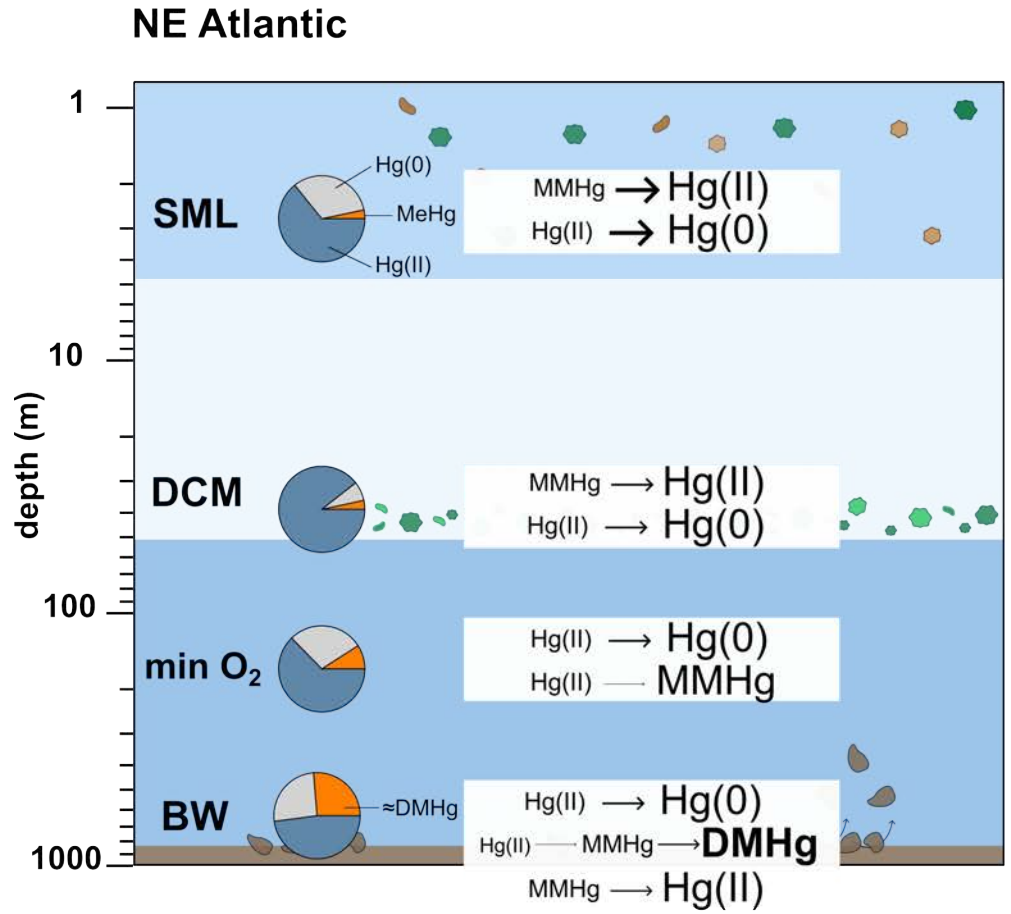
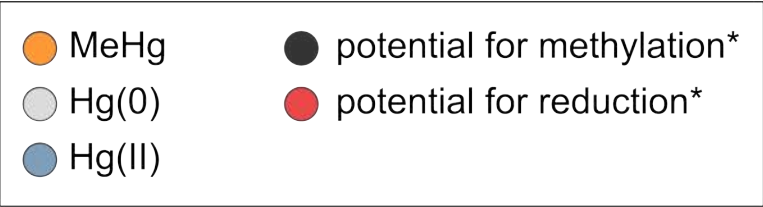




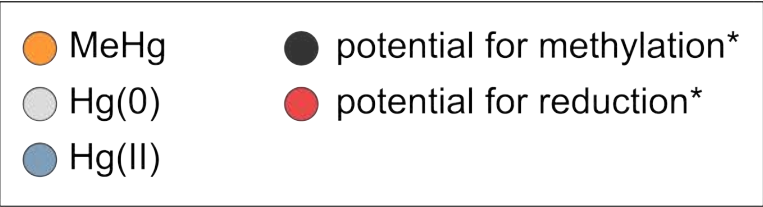
*based on microbial diversity



*based on microbial diversity

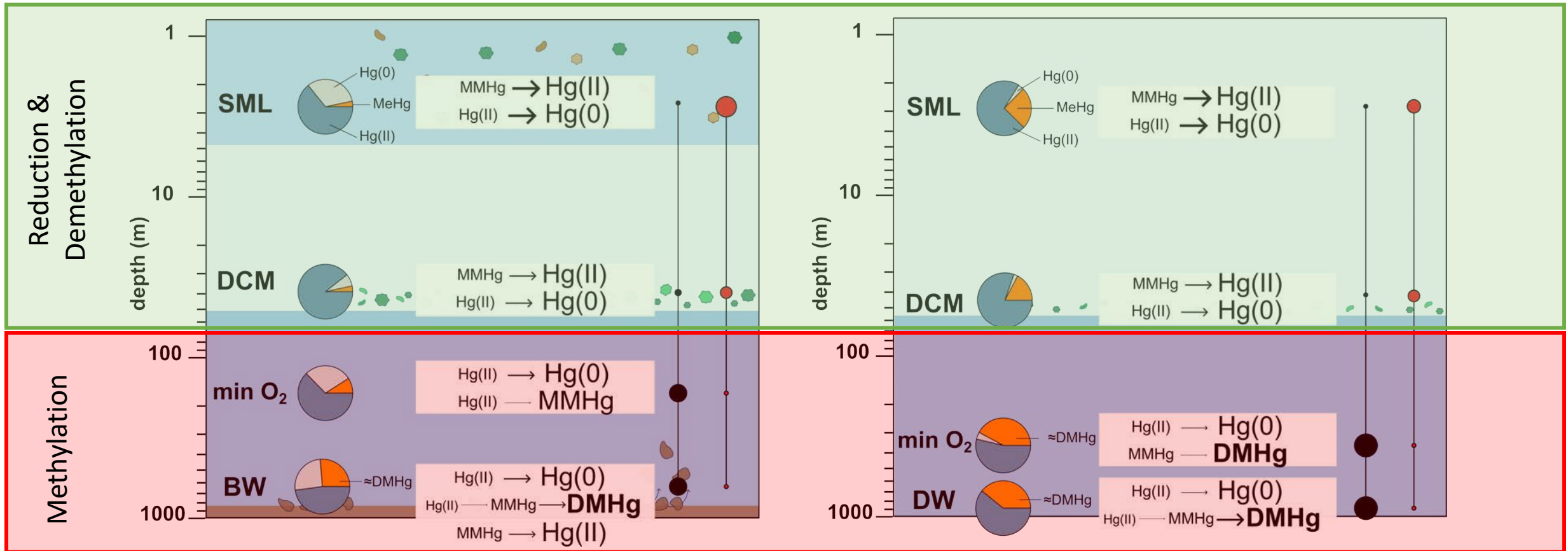


*based on microbial diversity



NE Atlantic

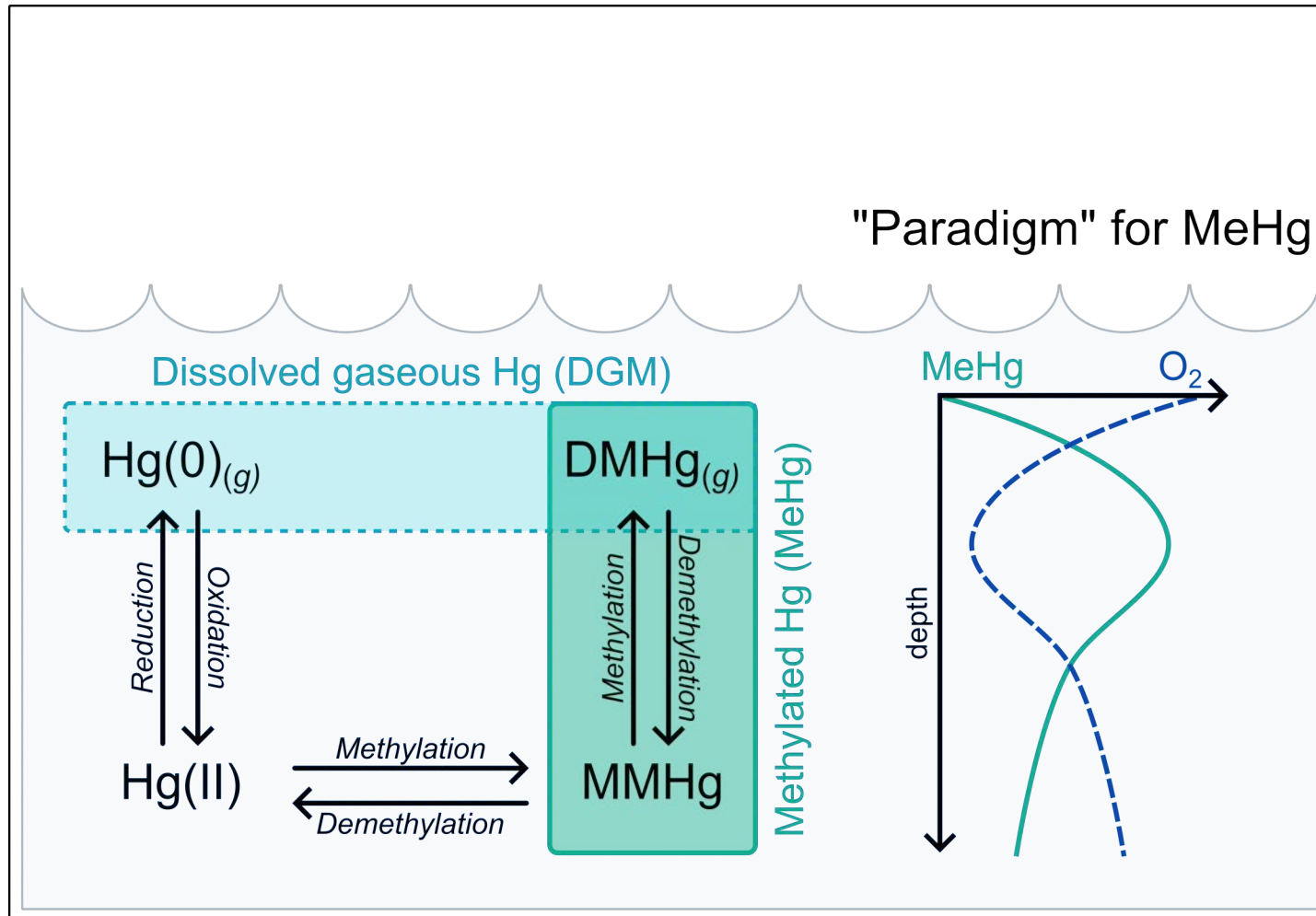
NW Mediterranean



*based on microbial diversity

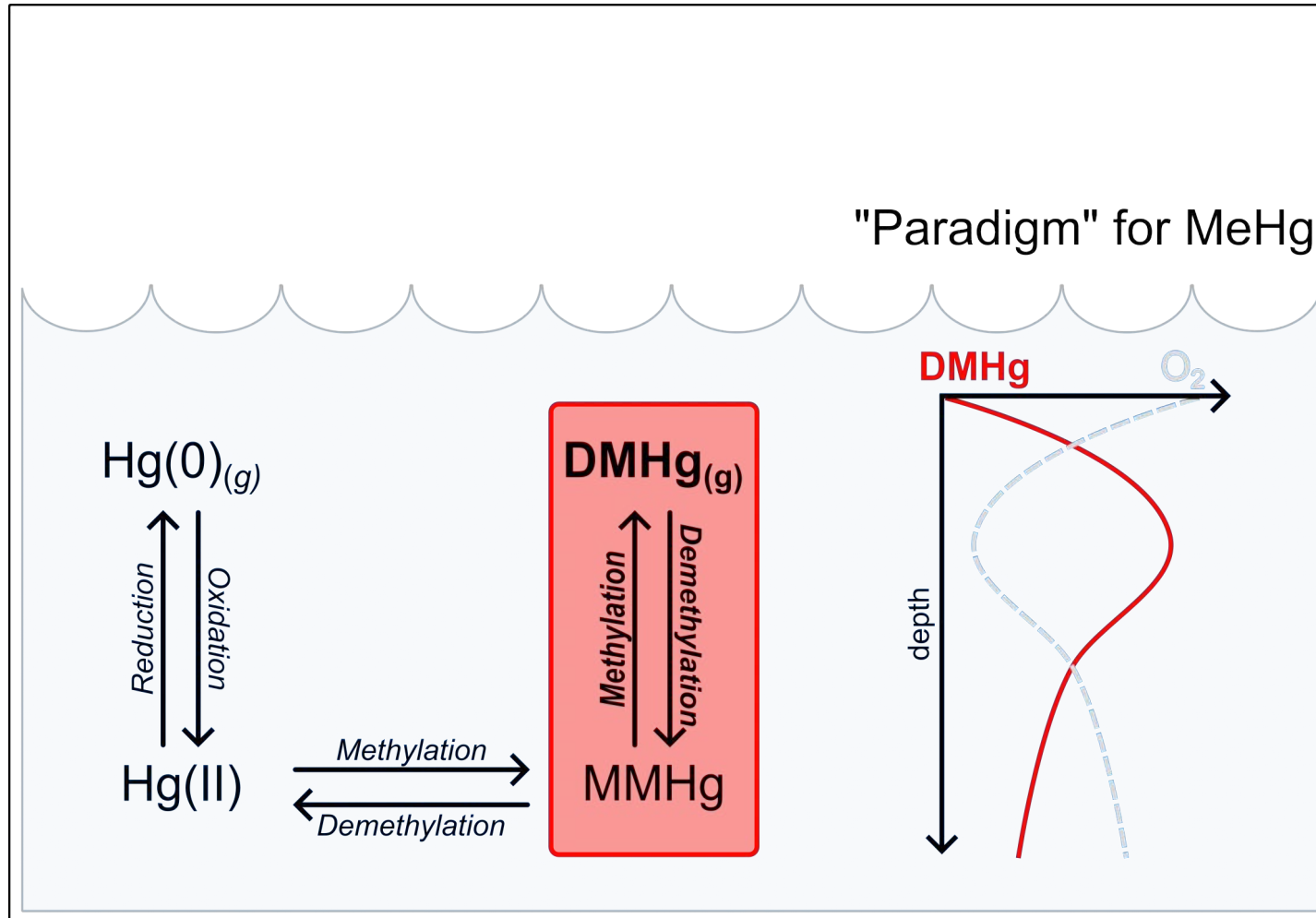
Conclusions

DMHg IS important



Conclusions

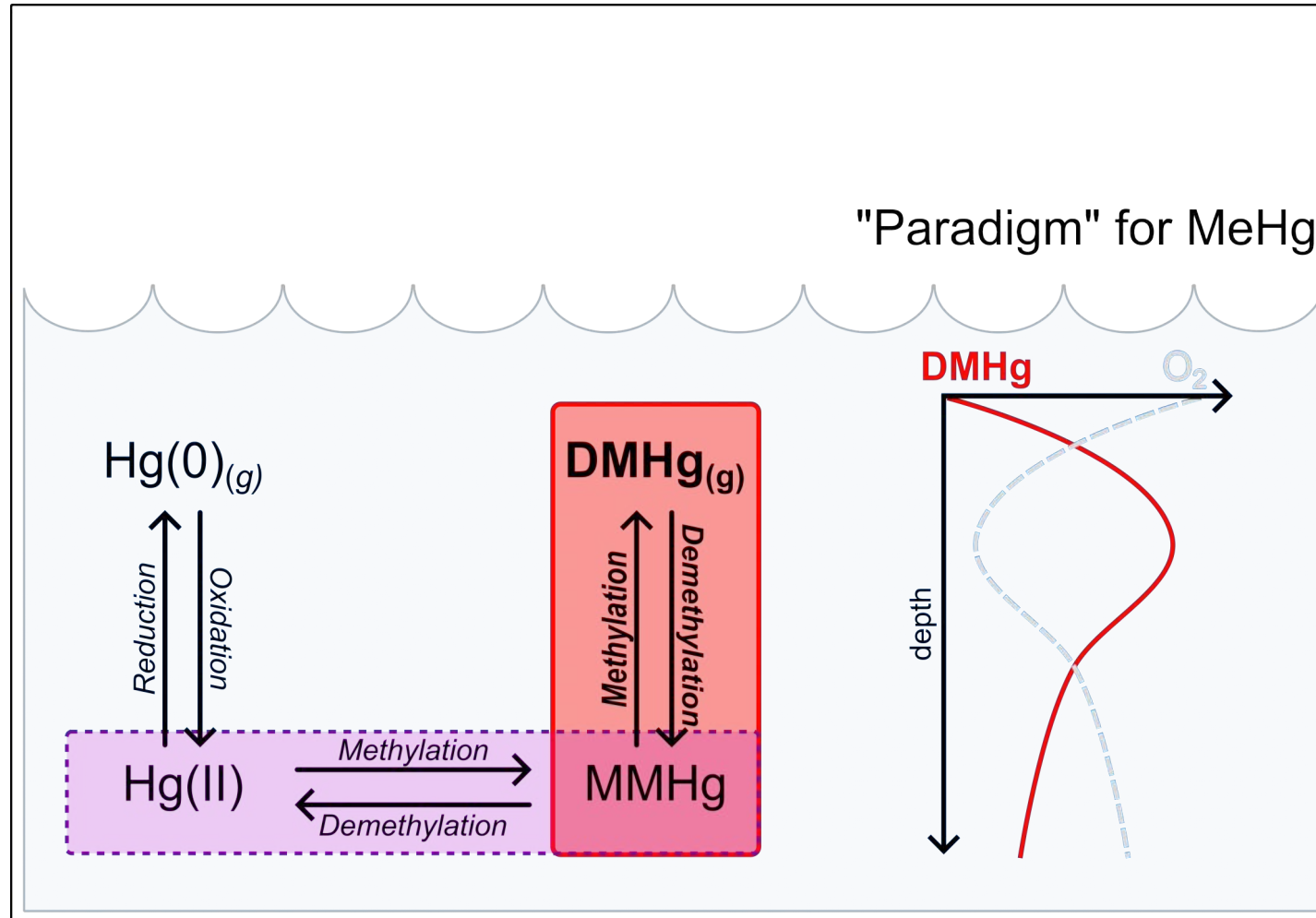
We need to investigate Stability and Fate of DMHg



- DMHg potentially stable in seawater from the Mediterranean Sea (West et al., 2023)
- Fate: Gaseous DMHg vs. particle reactive MMHg → ?
 - Implementation into Models

Conclusions

The need to disentangle MMHg and DMHg formation



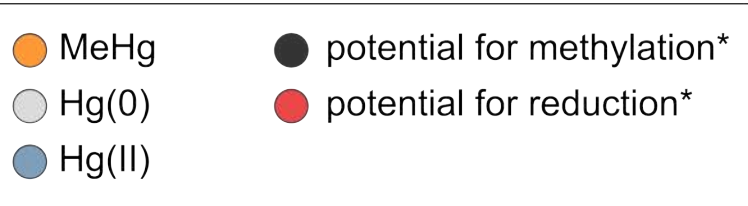
THANK YOU FOR YOUR ATTENTION

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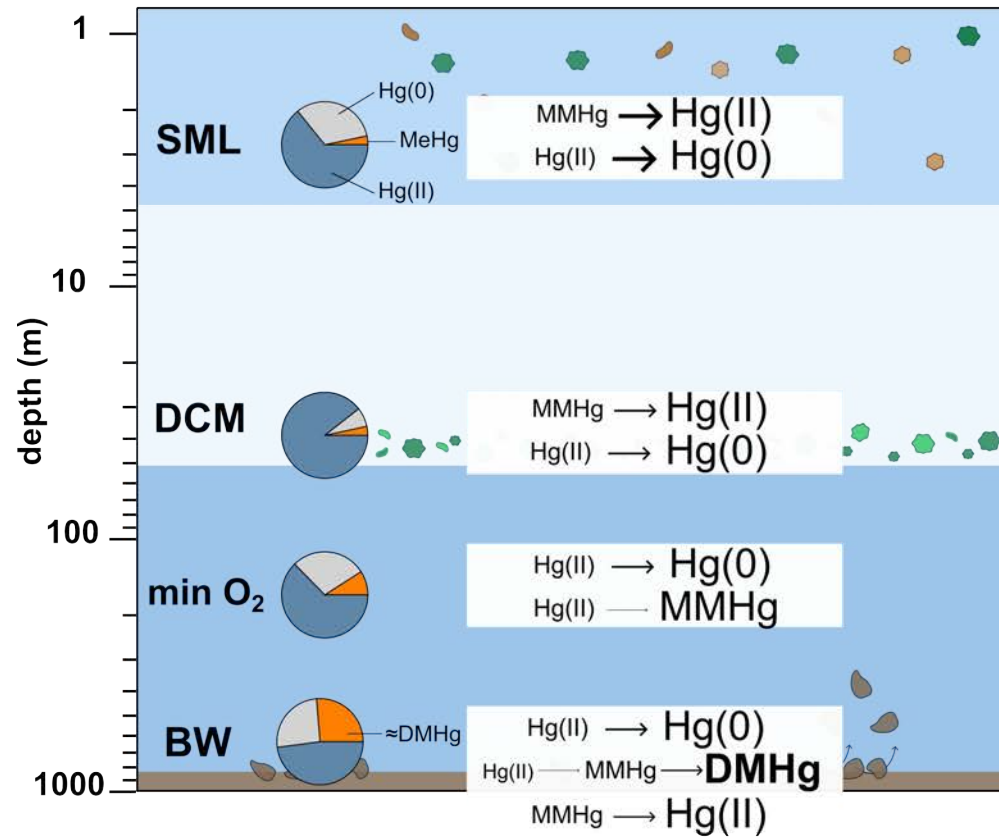
I thank all collaborators for their contributions to this work. I thank Oceane Asensio and Bastien Duval for assistance in analytical work, Deny Malengros and the crew of RV Antedon and RV Cote de la Marche for technical assistance and help.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the **Marie Skłodowska-Curie grant agreement no. 860497**

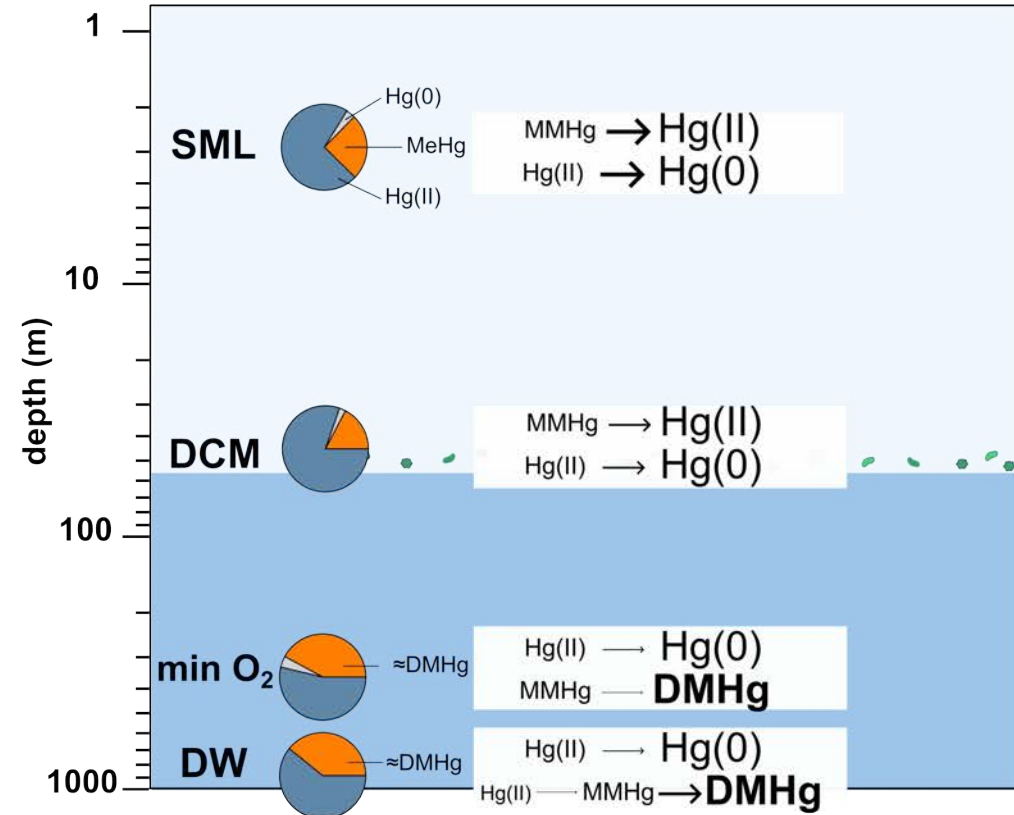




NE Atlantic

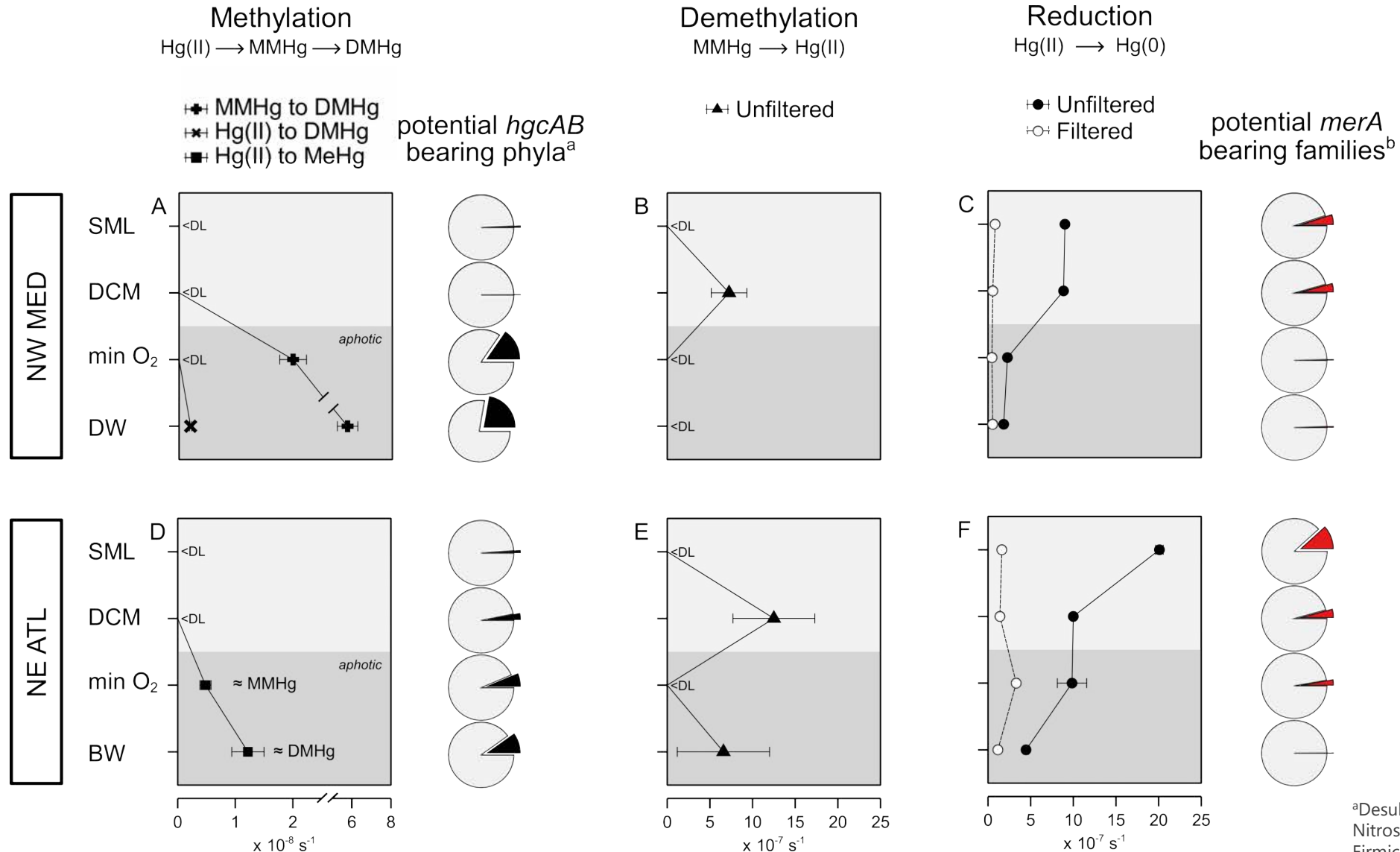


NW Mediterranean



*based on microbial diversity

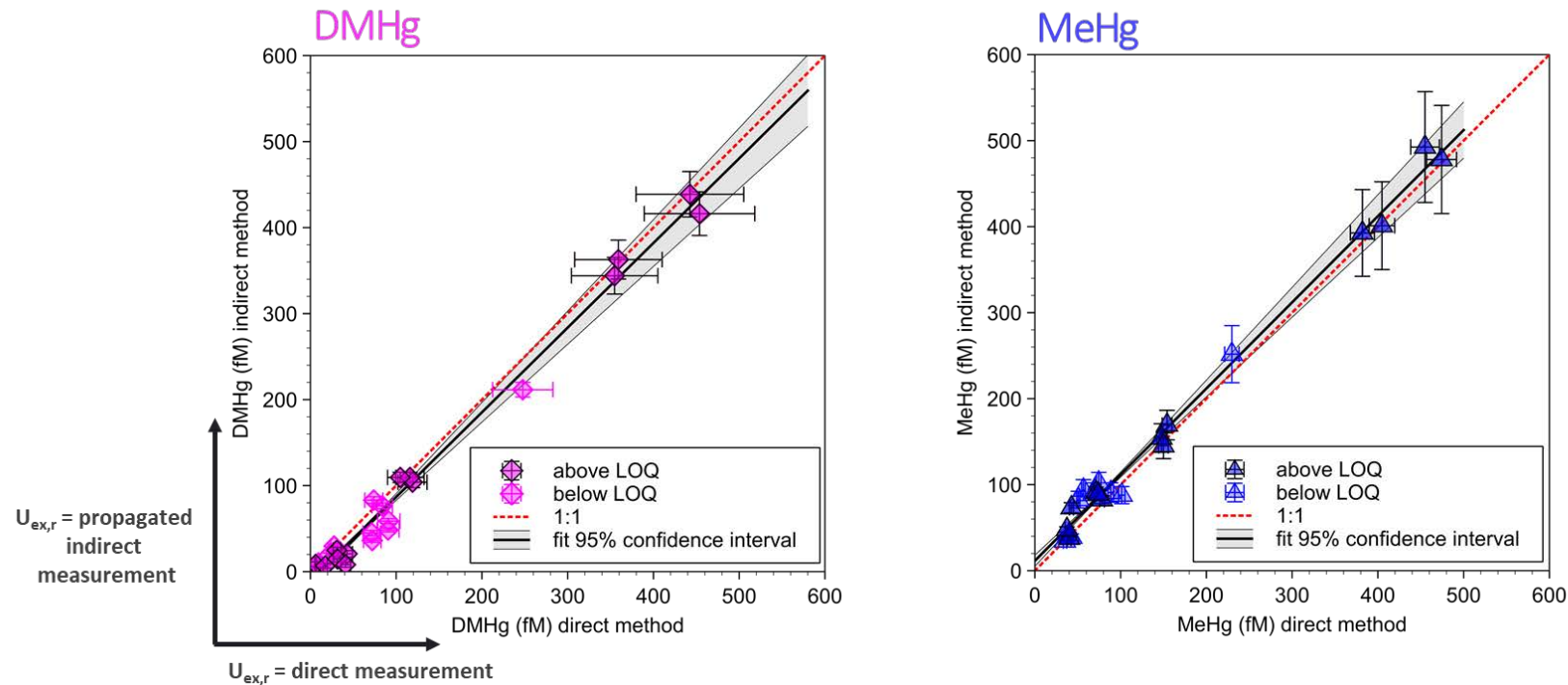
Overall highest Reduction Potential in Surface Waters



Error bars represent 1SD of triplicate experiments

Assessing comparability and uncertainty of analytical methods for methylated mercury species in seawater

Published in Analytica Chimica Acta

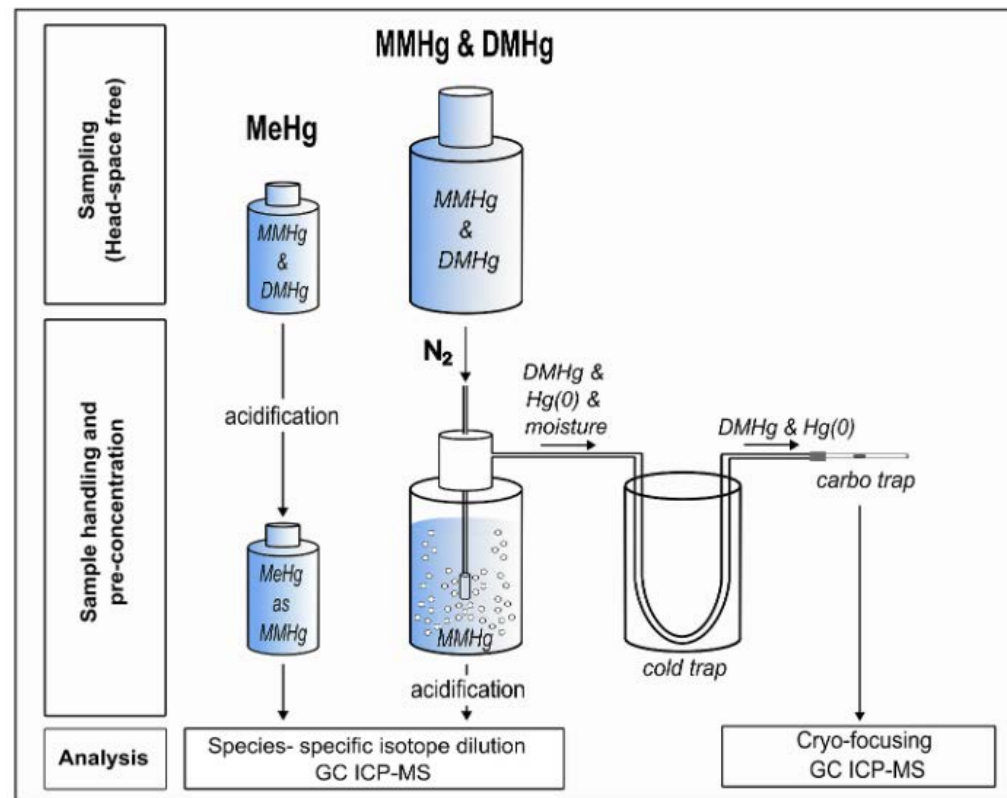


Kleindienst et al., 2023

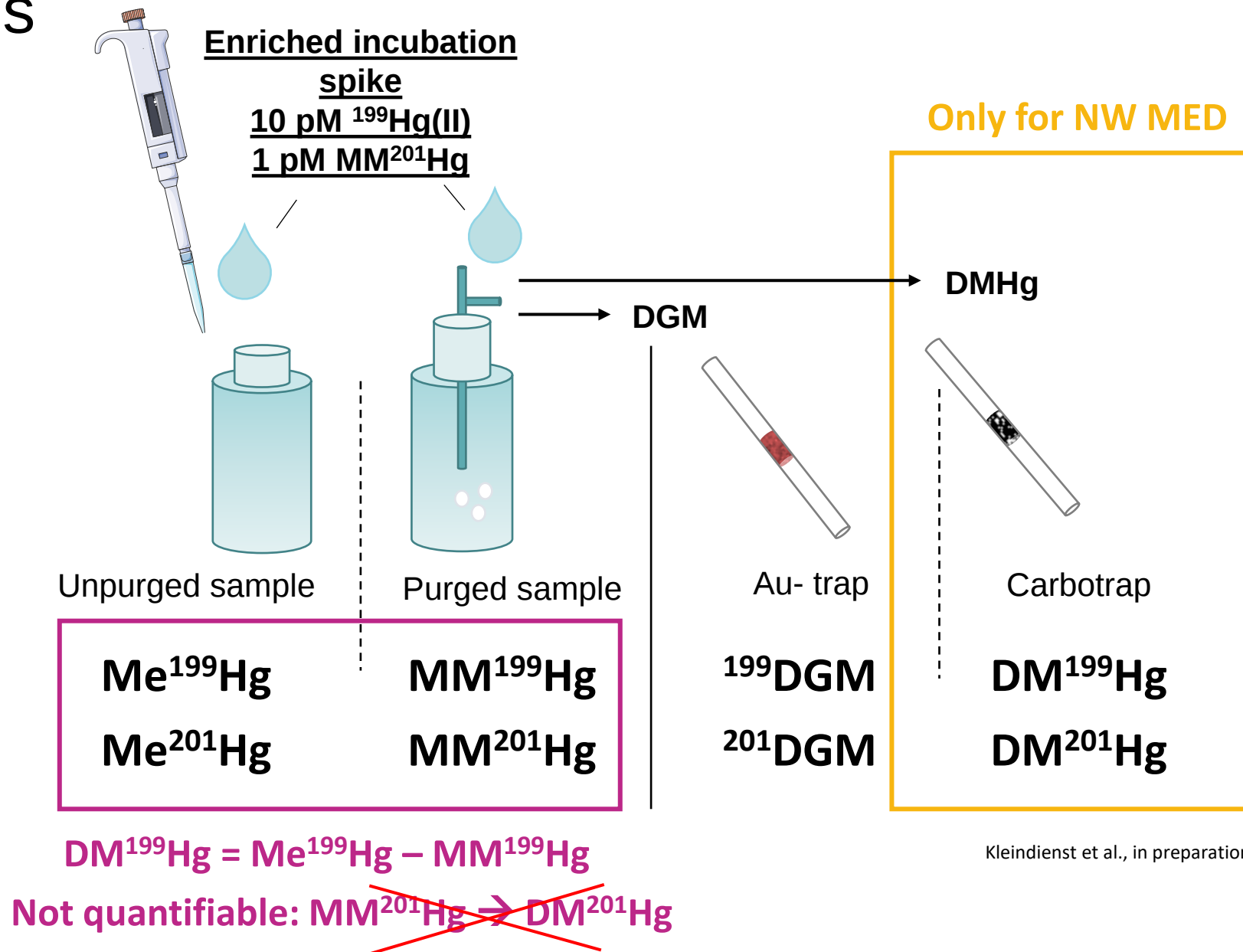
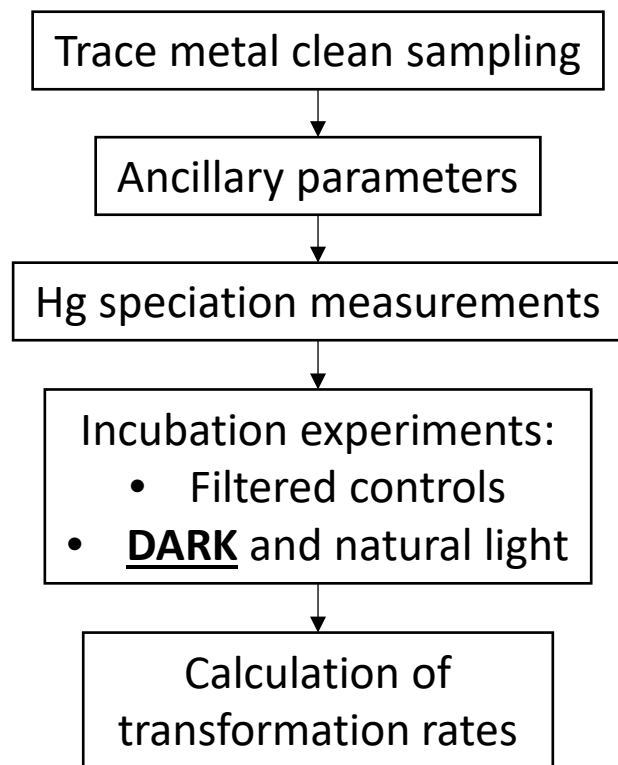
We could establish the comparability of direct and indirect measurement methods for DMHg and MeHg

Assessing comparability and uncertainty of analytical methods for methylated mercury species in seawater

Published in Analytica Chimica Acta



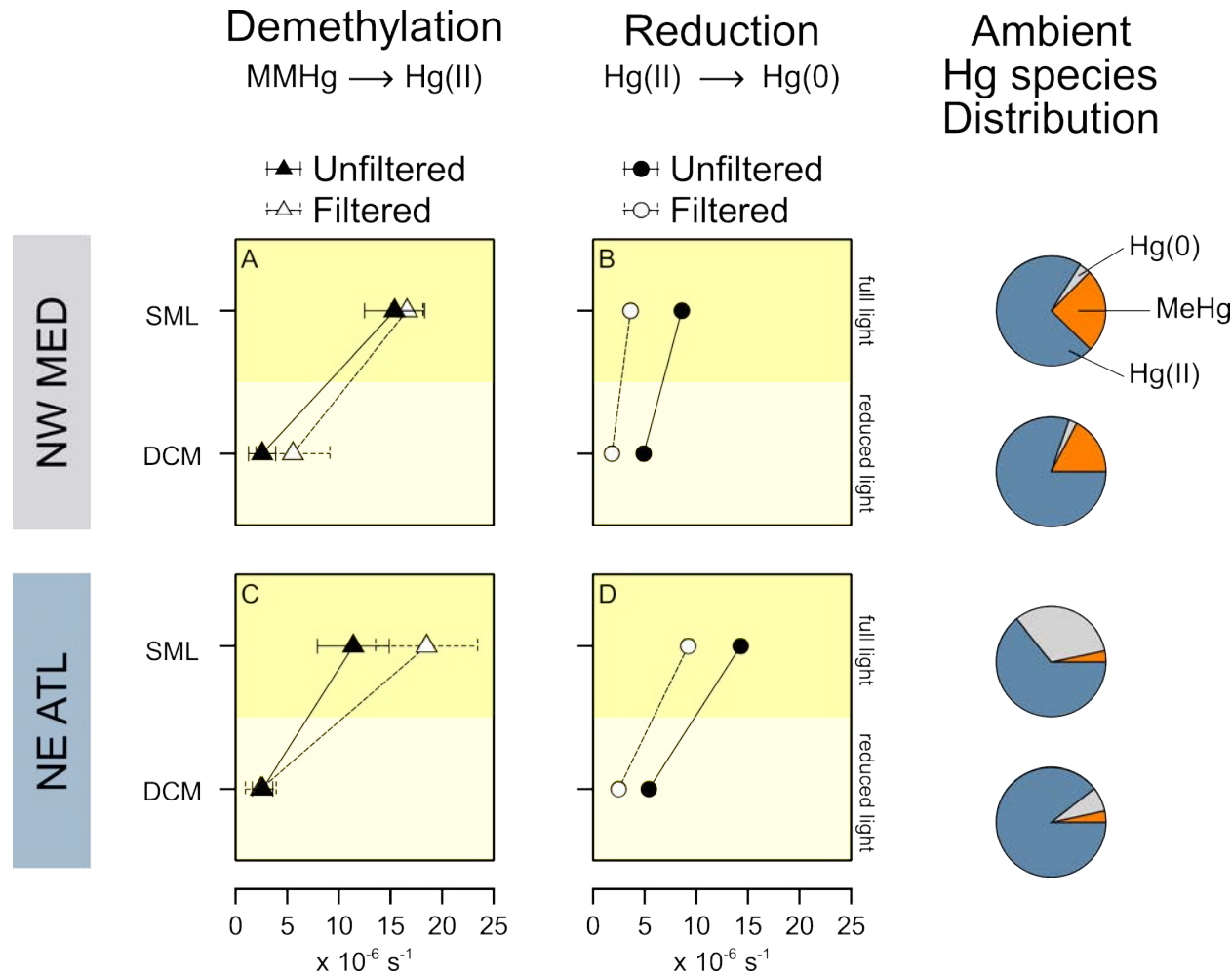
Material & Methods



Want to learn more on
Incubation Experiments?

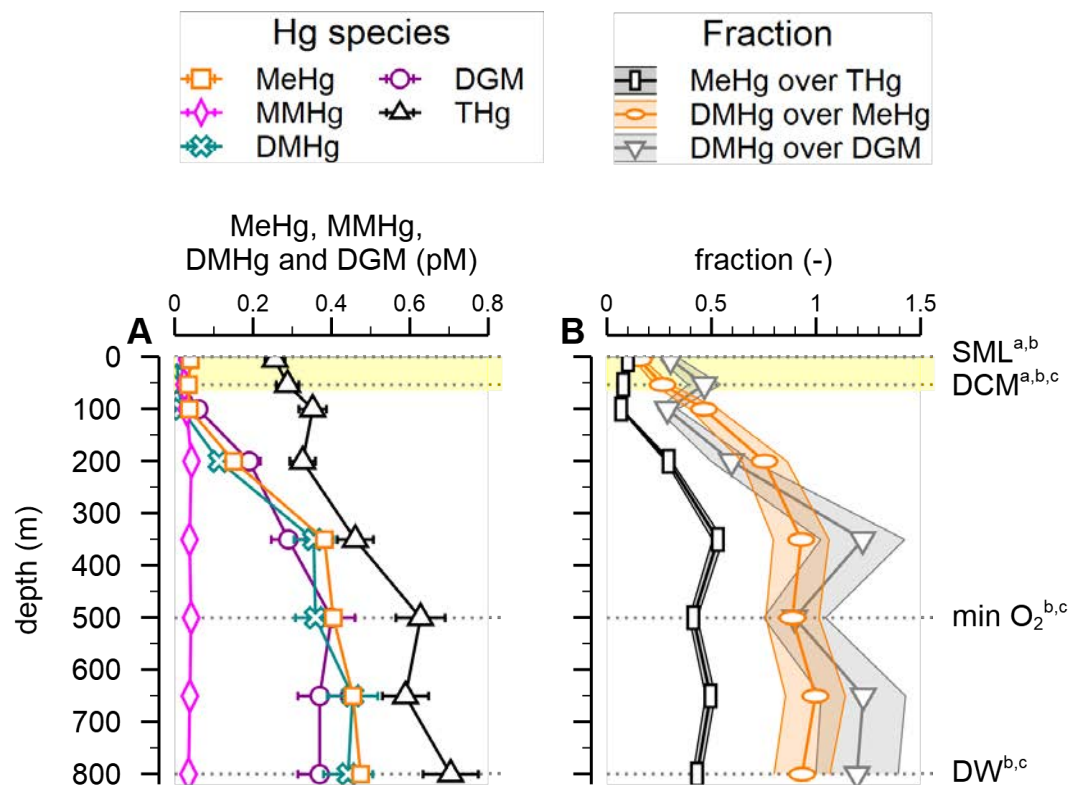
→ Poster #93

Light-induced transformations in the euphotic zone



- Methylation not detected
- Biotic, light-dependent reduction
- Light-induced reaction rates $\gg$ dark reaction rates

Gulf of Lion



Bay of Biscay

