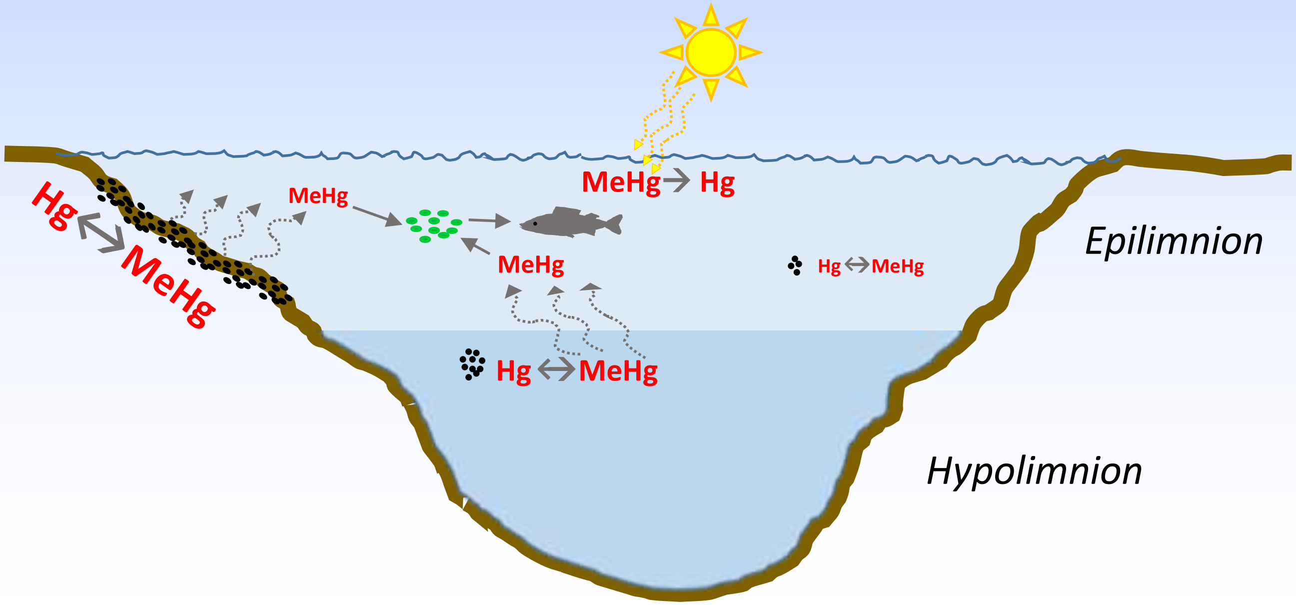
Evaluating mercury methylation rates in Lake Nacimiento

Authors: Chris Eckley[1], Geoff Millard[2], Todd Luxton[2], Jenny Goetz[2], Dave Krabbenhoft[3], John McKernan[2], John DeWild[3]

1. US EPA Region-10; 2. US EPA ORD; 3. USGS Wisconsin Mercury Research Laboratory

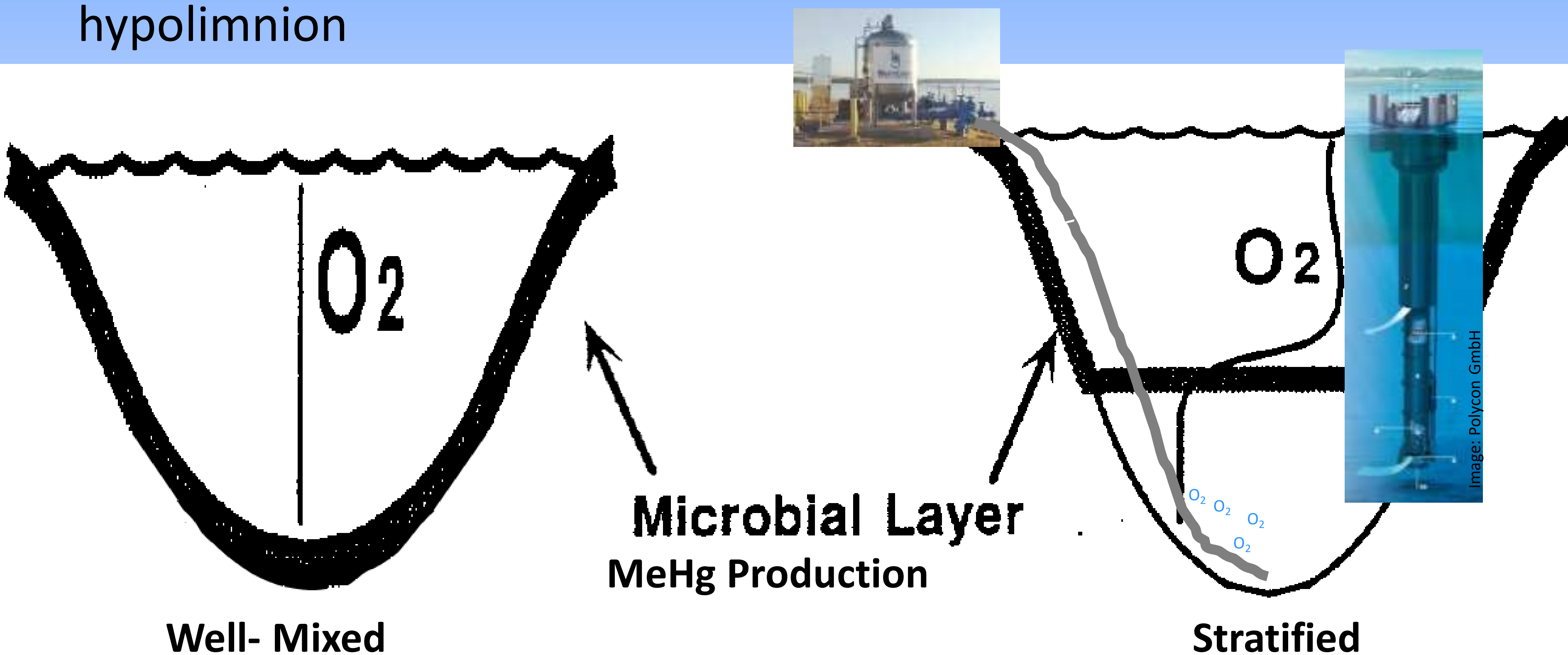
Introduction:

- Hg methylation occurs in the sediment & water column of lakes
- Hg methylation: Sediment > > Water Column
    - ➢ But MeHg produced in the water-column may be more available for uptake into the base of the foodweb
- MeHg demethylation: important to contextualize the net amount of MeHg produced in the water column & sediment



Introduction:

- Highest MeHg production just below the oxic/anoxic boundary
- Seasonal lake stratification affects the zones of MeHg production
- Management strategies can be aimed at reducing an anoxic hypolimnion



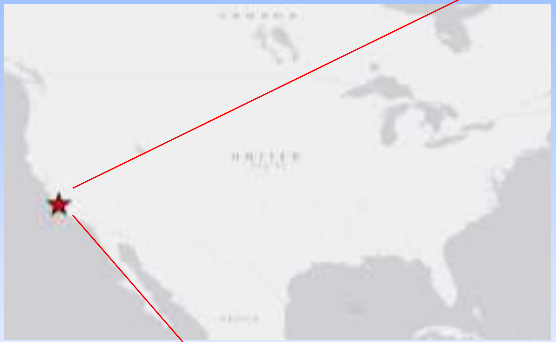
Adapted from: *Watras et al., 1995*

Study Objectives

1) Identify relative importance of MeHg sources

2) Identify how changes in lake stratification affect methylation/demethylation in sediment & water

Study Location:



Klau/Buena Vista Abandoned Hg Mine

Methods:

Samples collected:

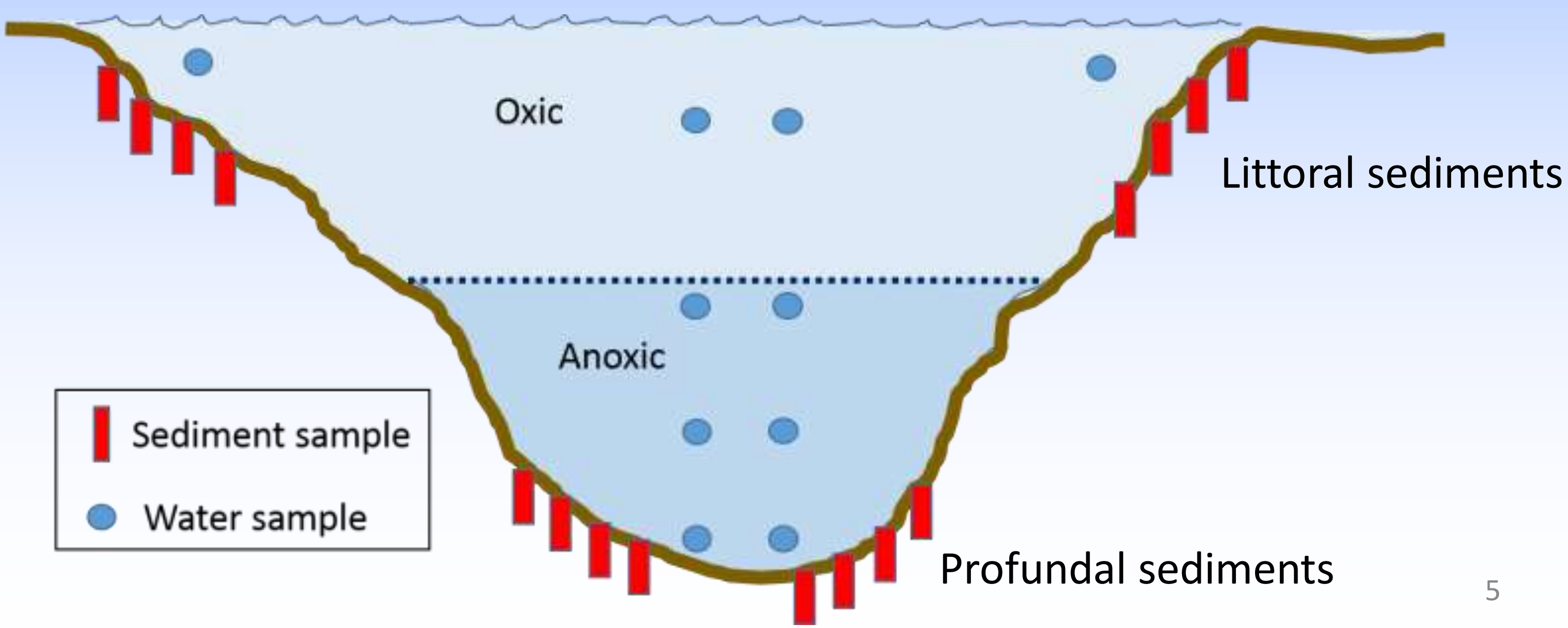
January (Mixed)

May (Stratified)

September (Stratified)

Sample Treatment/Analysis:

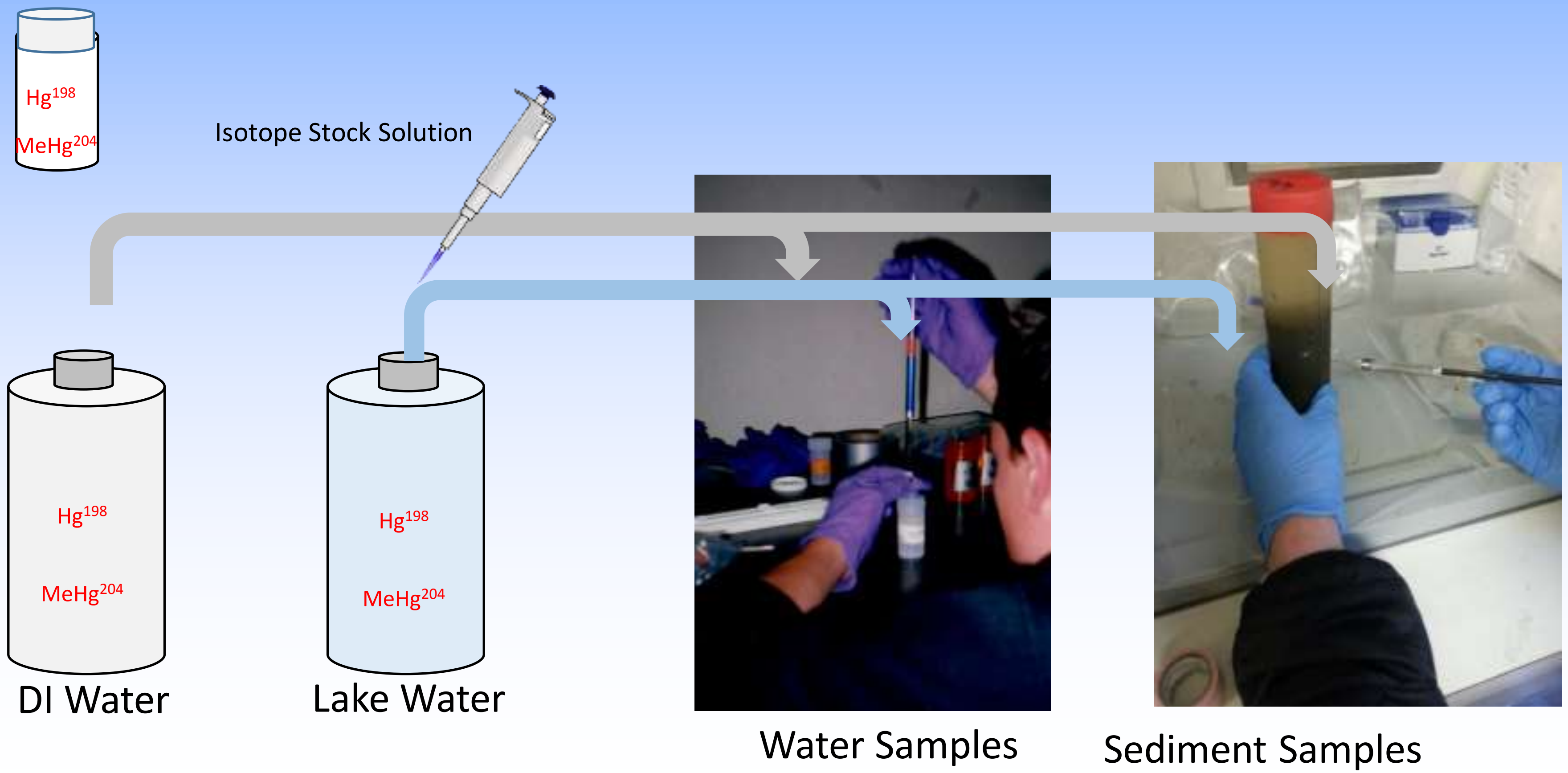
- Water & Sediment isotope addition Meth/Demeth Assays
- Ancillary parameters: sulfate, sulfide, organic carbon, pH, redox, temperature, DO



Methods: Isotope Addition Solution

Question: Does pre-equilibration of the Hg/MeHg spike affect methylation/demethylation rates?

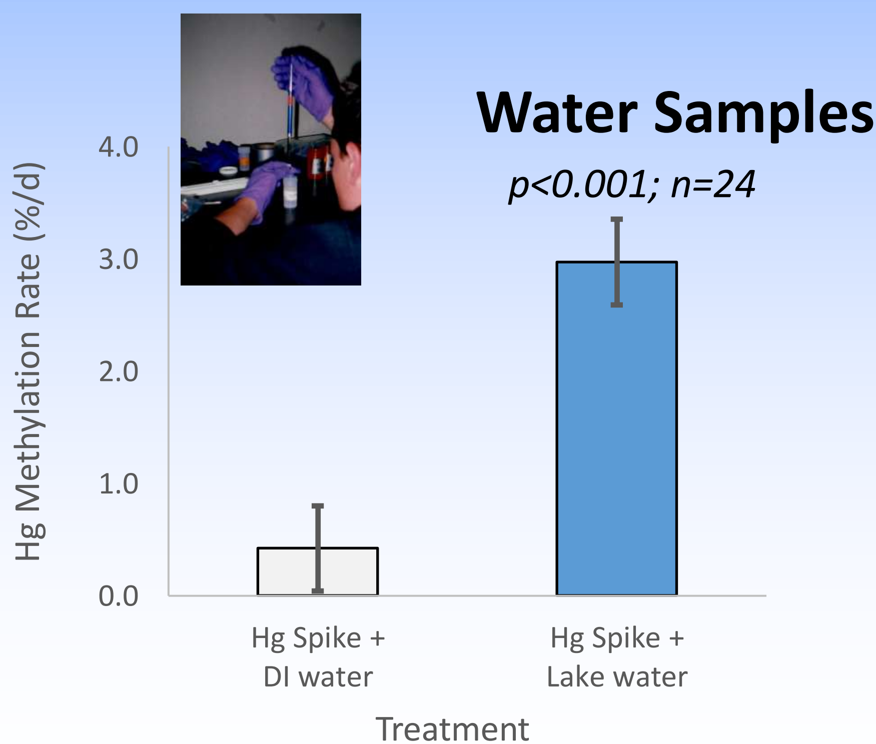
--Spike solutions purged with UHP Nitrogen for 1-hour prior to addition to water/sediment--

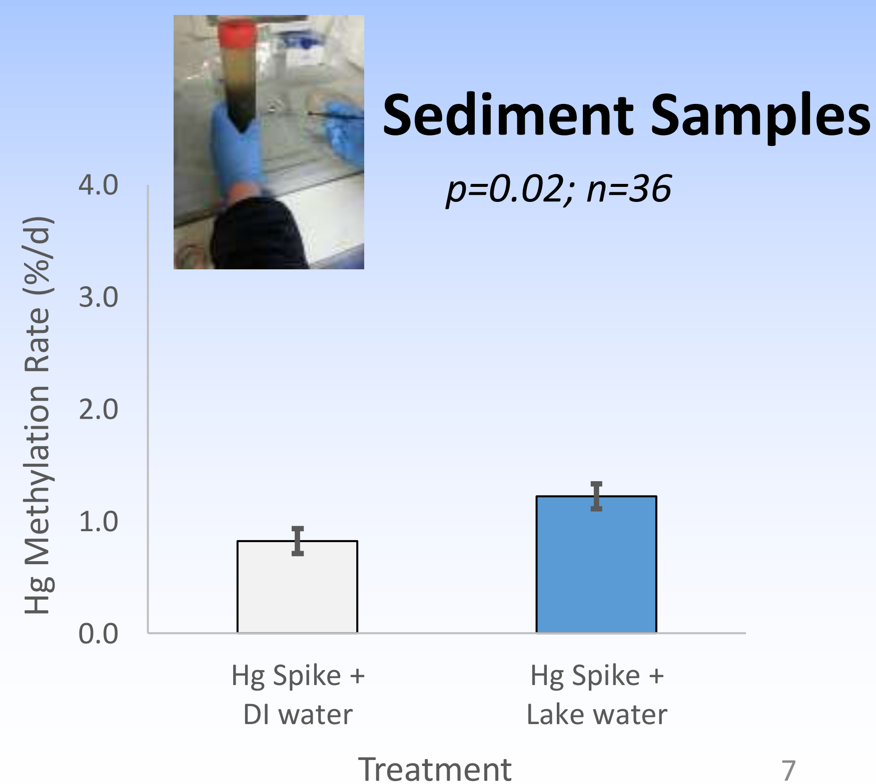


Methods: Isotope Addition Solution

Question: Does pre-equilibration of the Hg/MeHg spike affect methylation/demethylation rates?

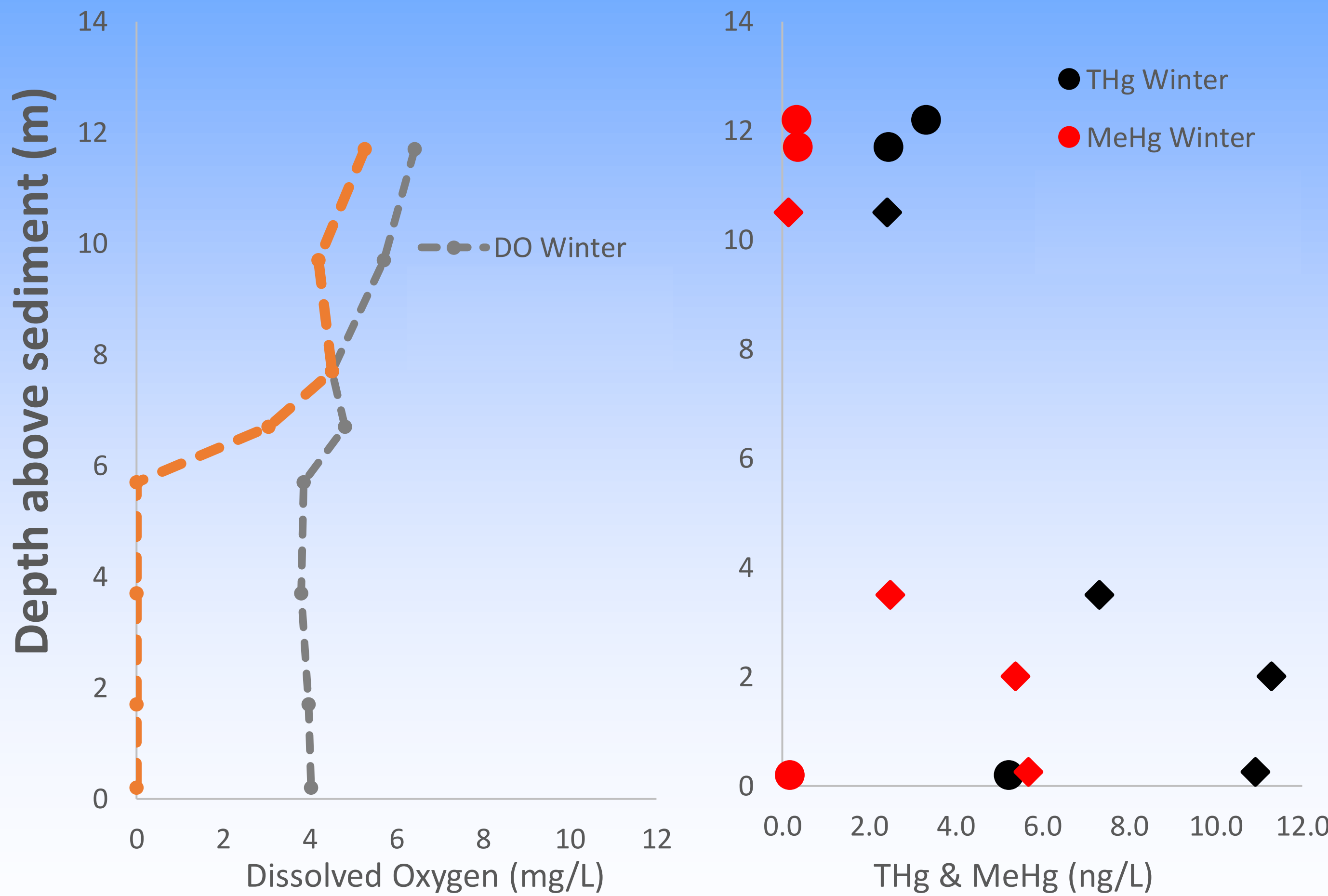
- Pre-equilibration of Hg spike affects **methylation rates**





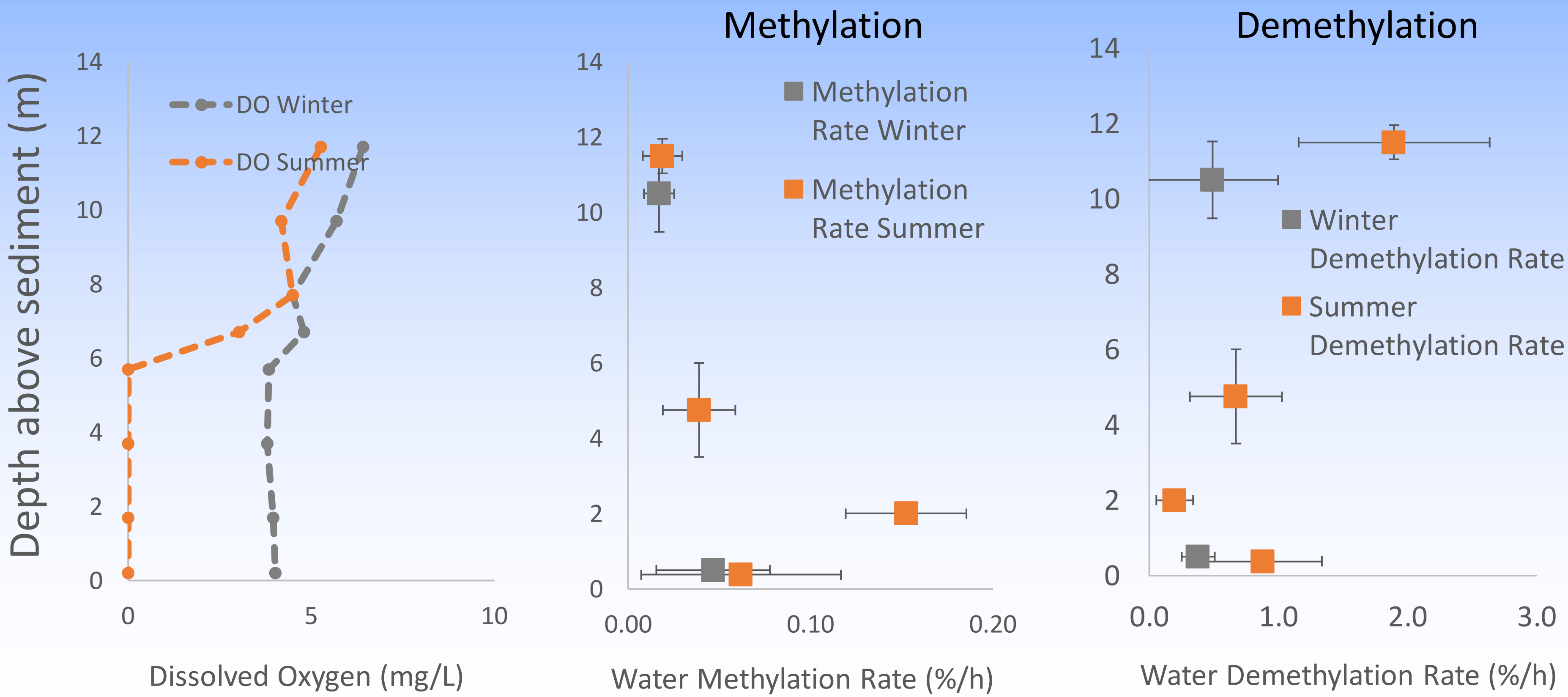
Results: Seasonal D.O., THg & MeHg

- Summer: large increase in THg & MeHg in hypolimnion

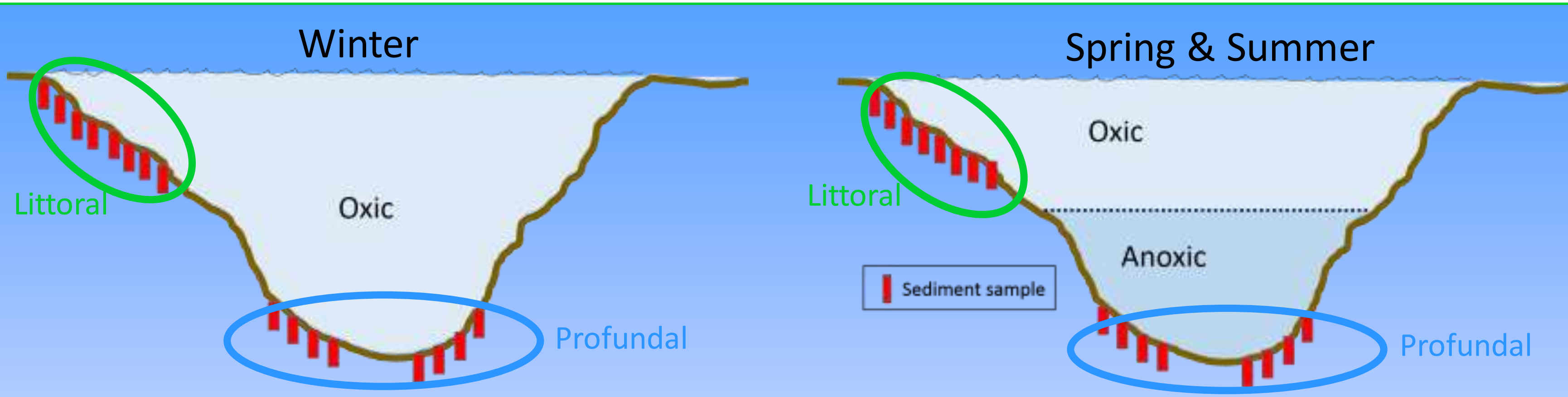


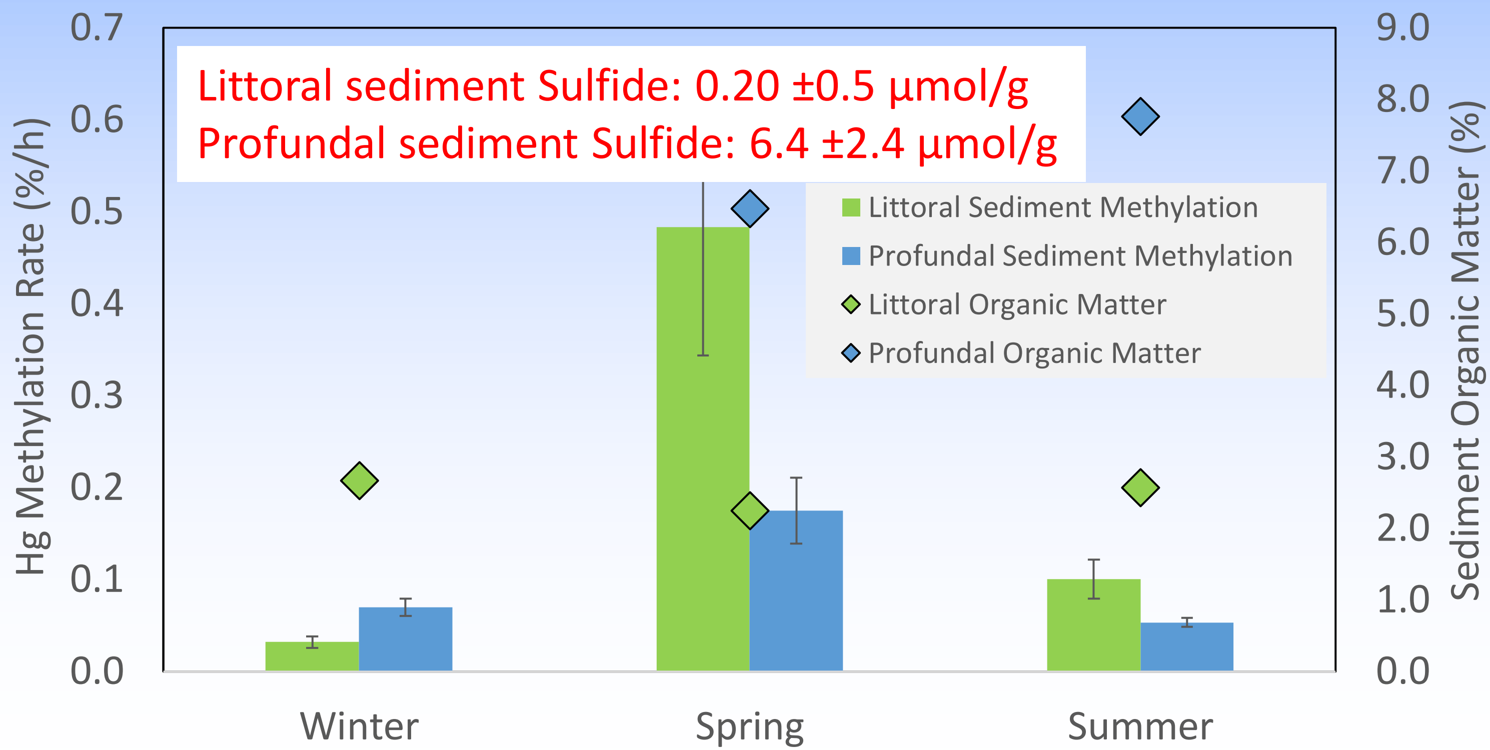
Results: Water-Column Methylation/Demethylation

Summer: Water-column methylation in the hypolimnion
Demethylation (dark conditions) in surface water



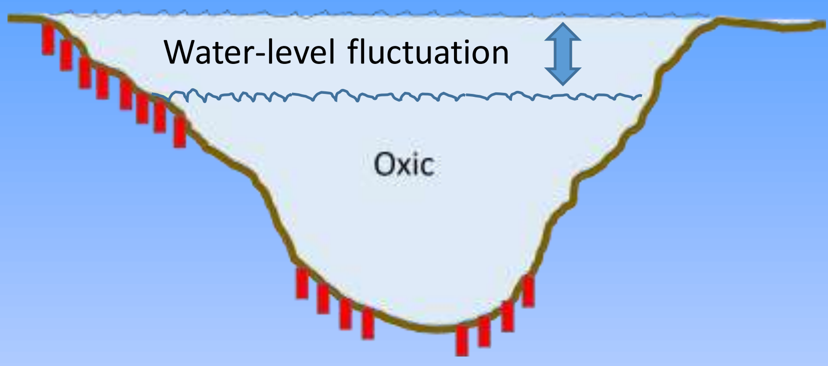
Results: Sediment Methylation

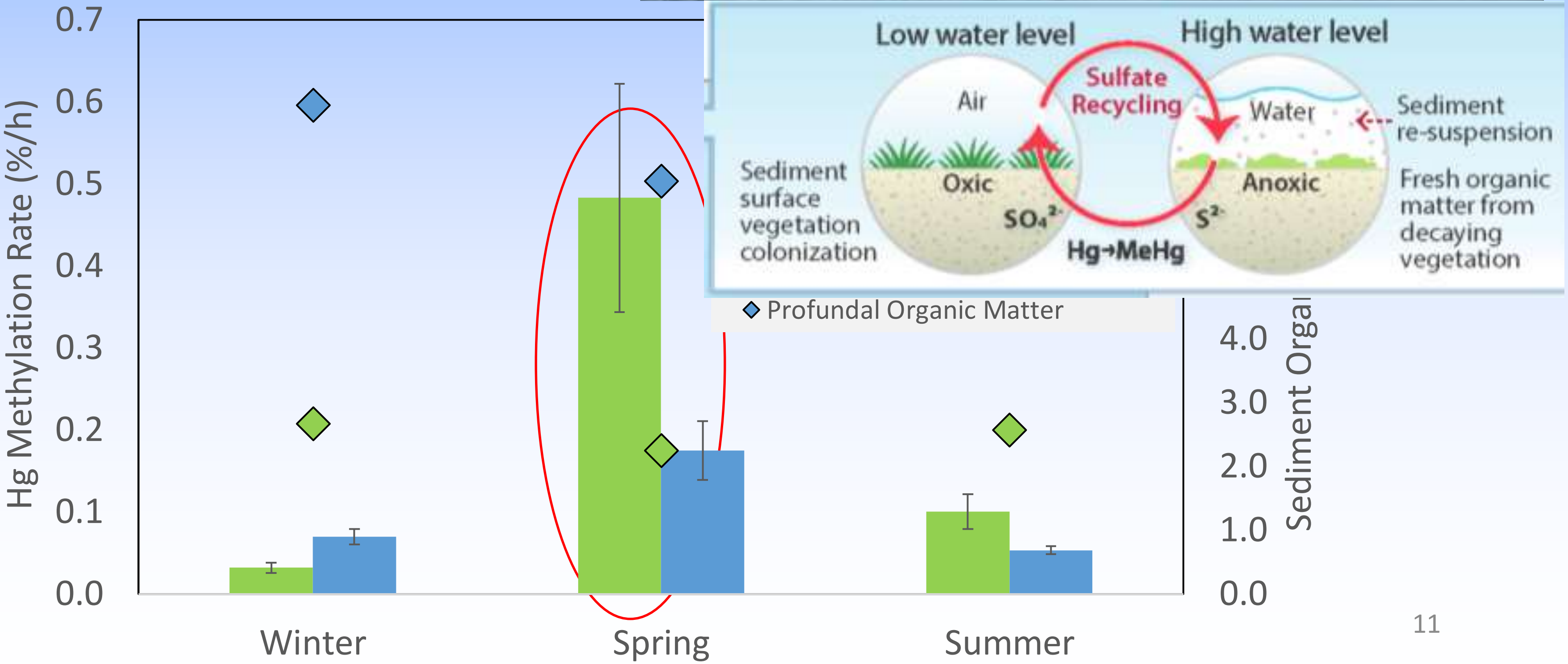




Results: Sediment Methylation

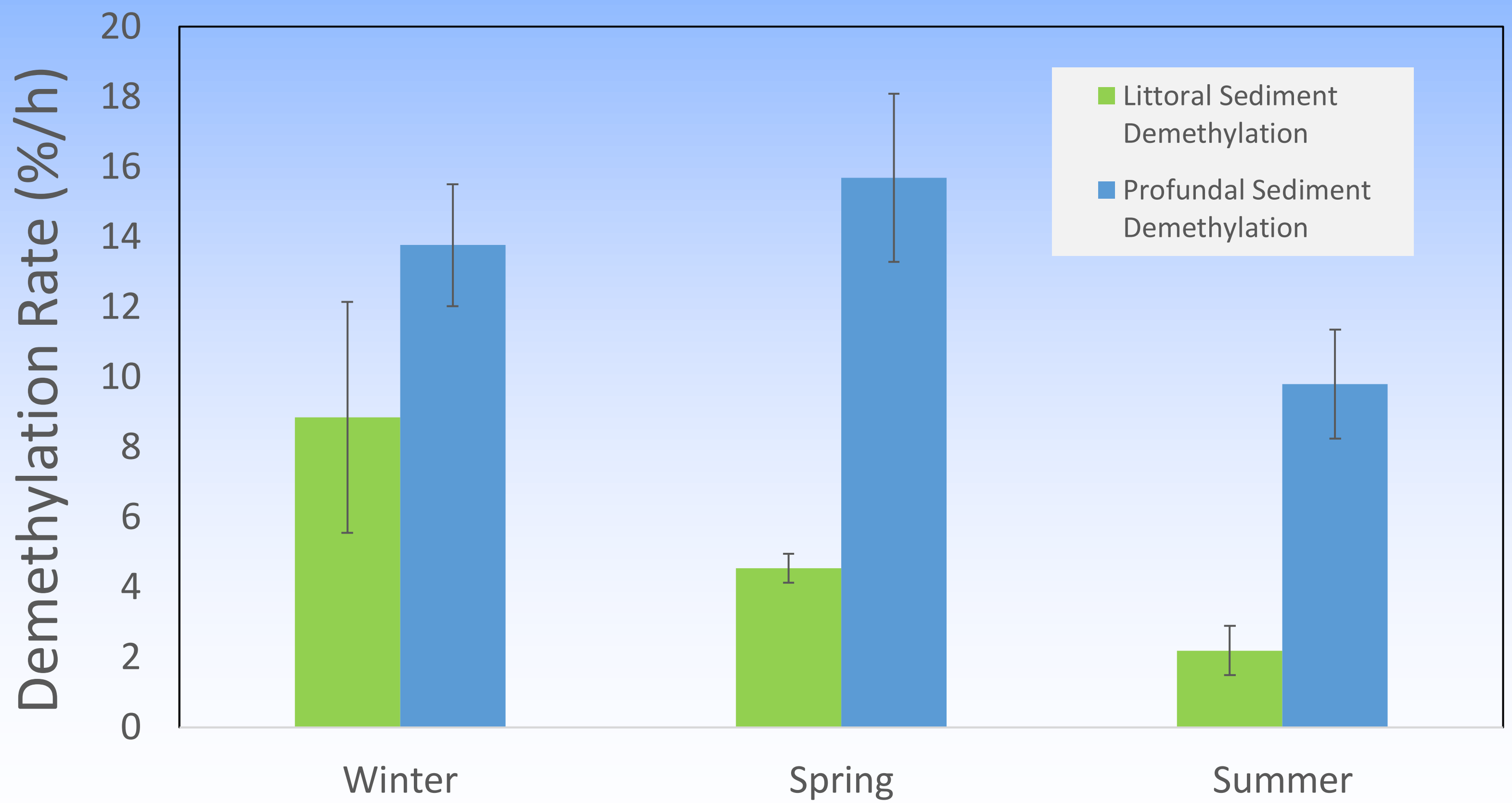
Wetting/Drying of littoral sediments appears to increase MeHg production



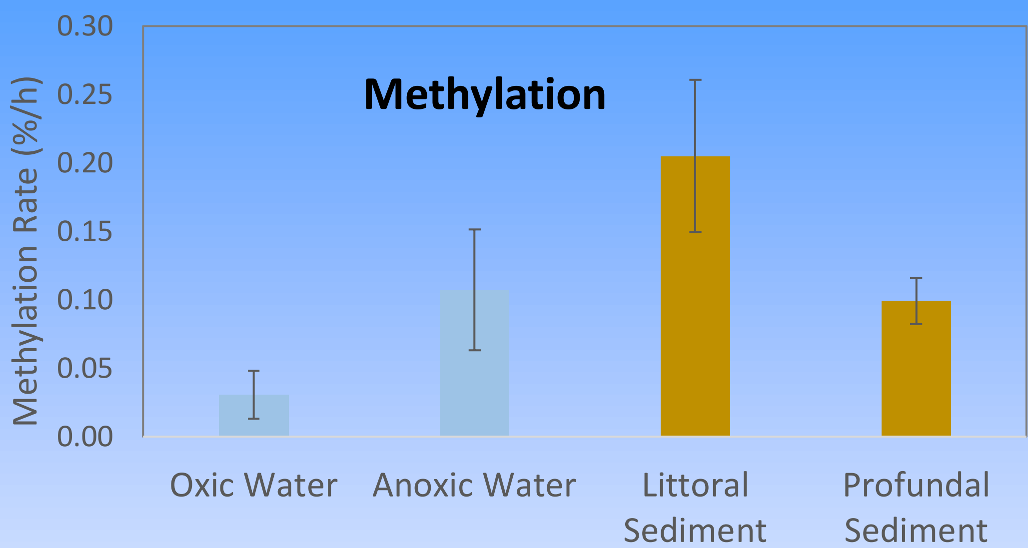


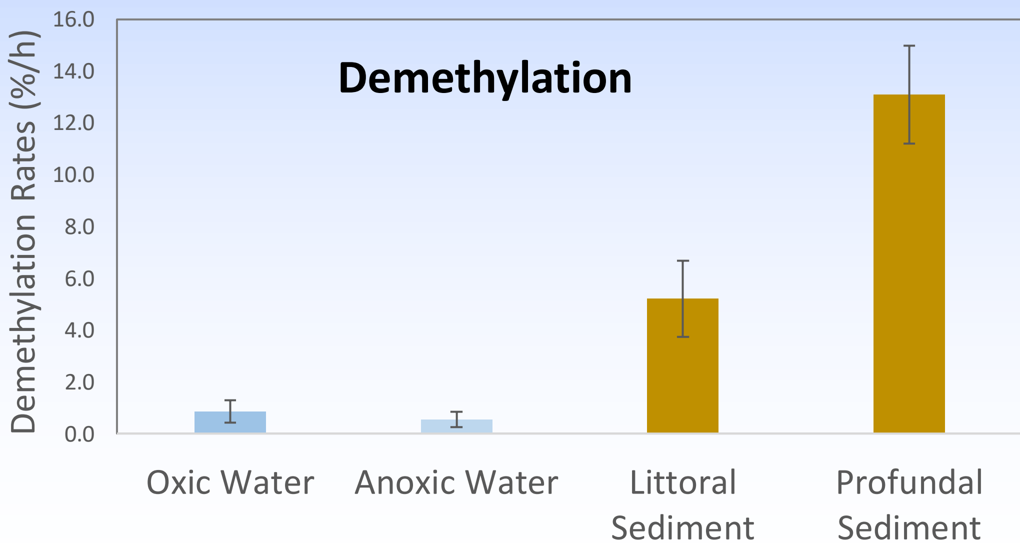
Results: Sediment Demethylation

- Sediment demethylation rates higher in profundal sediment than littoral sediment



Summary: Methylation & Demethylation





Methylation

Water: higher in anoxic water
Sediment: higher in littoral sediment

Similar magnitude of rates in water & sediment

Demethylation

Water demethylation (under dark conditions) much lower than in sediment.

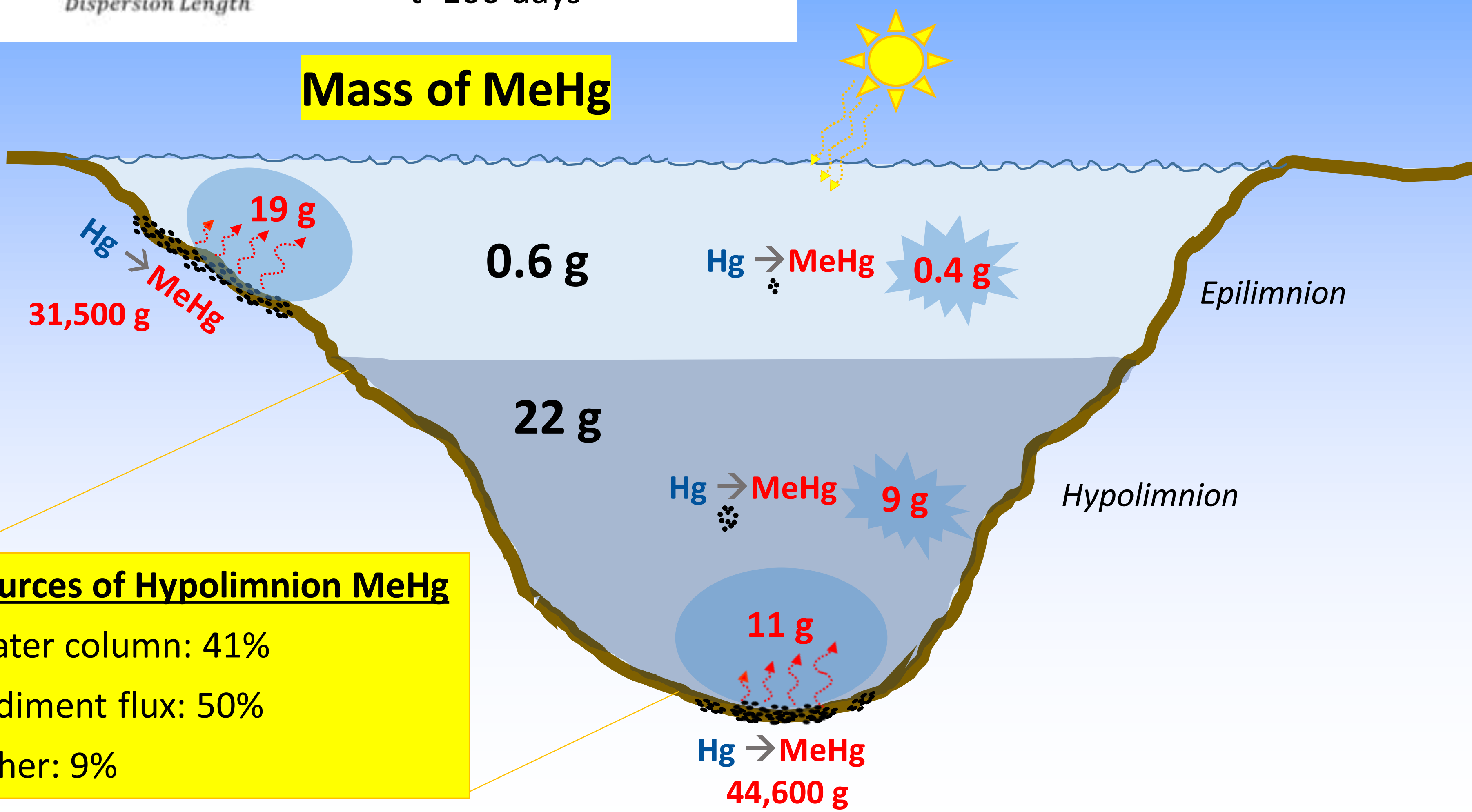
Highest demethylation in profundal sediment

Model: Scaled MeHg Sources

$$MeHg_t = K_m * K_{dm} * Hg_i^{2+} * (1 - e^{-k_{dm}*t})$$

$$Load = \frac{Dispersion*[MeHg]}{Dispersion\ Length}$$

t=100 days



Sources of Hypolimnion MeHg

Water column: 41%

Sediment flux: 50%

Other: 9%

Conclusions:

1) Sediment & water-column methylation contribute similar amounts MeHg to the water of Lake Nacimiento

Important variables:

- Bioavailable pools of inorganic Hg
- lake bathymetry
- Climate
- reservoir water level management

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2) Remediation goals aimed at reducing MeHg in fish may require actions targeting sediment & water column processes

Important variables:

- Relationship of hypolimnetic MeHg mass to biotic exposure
- Uptake of MeHg into the base of the foodweb
- Biota foraging behavior

Questions:

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