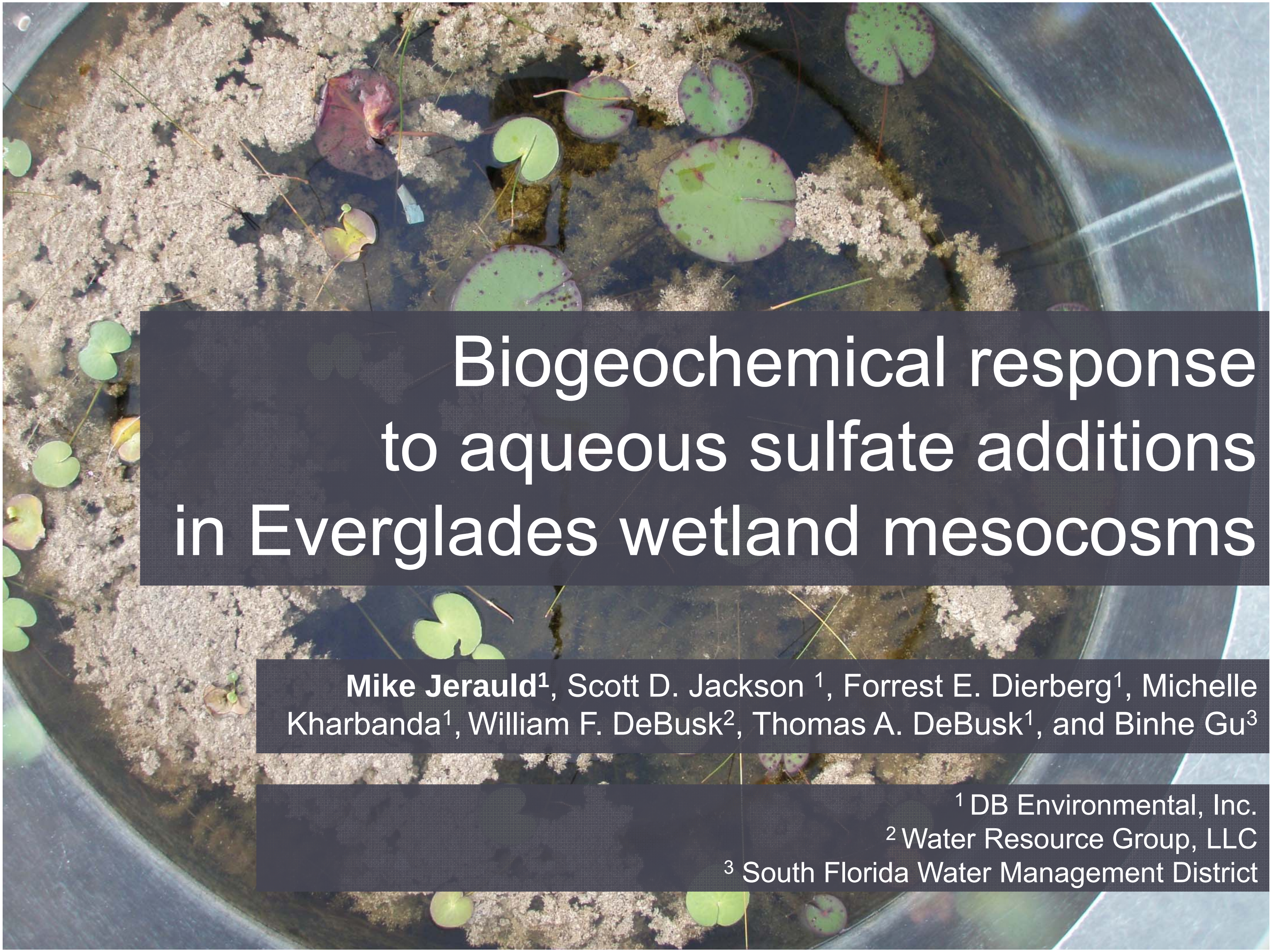
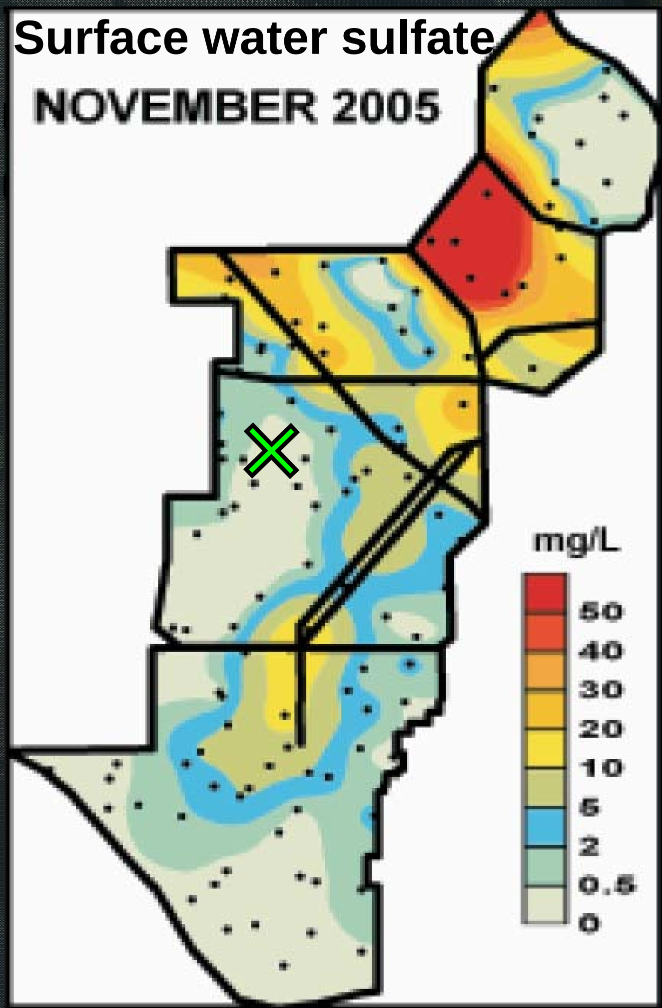


Biogeochemical response to aqueous sulfate additions in Everglades wetland mesocosms

Mike Jerauld[1], Scott D. Jackson [1], Forrest E. Dierberg[1], Michelle Kharbanda[1], William F. DeBusk[2], Thomas A. DeBusk[1], and Binhe Gu[3]

[1] DB Environmental, Inc.
[2] Water Resource Group, LLC
[3] South Florida Water Management District

Background



Scheidt and Kalla, 2007

Potential deleterious effects of sulfate enrichment:

1. **Internal eutrophication**
2. **Enhanced Hg methylation**
3. Sulfide toxicity

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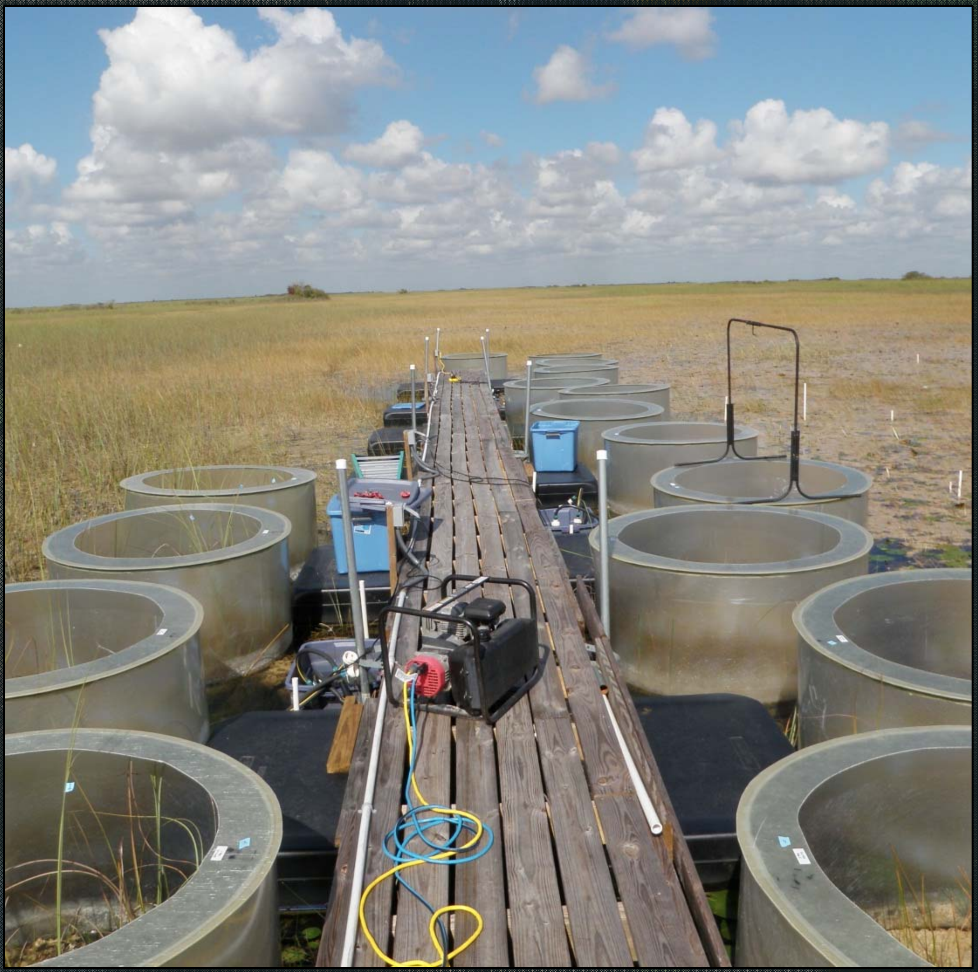
Experimental Design



Treatment groups

- Unenclosed control
- Control enclosure
- +Sulfate 3 mg/L[a]
- +Sulfate 12 mg/L
- +Sulfate 24 mg/L
- +Sulfate 48 mg/L

[a] Seasons 2 and 3 only

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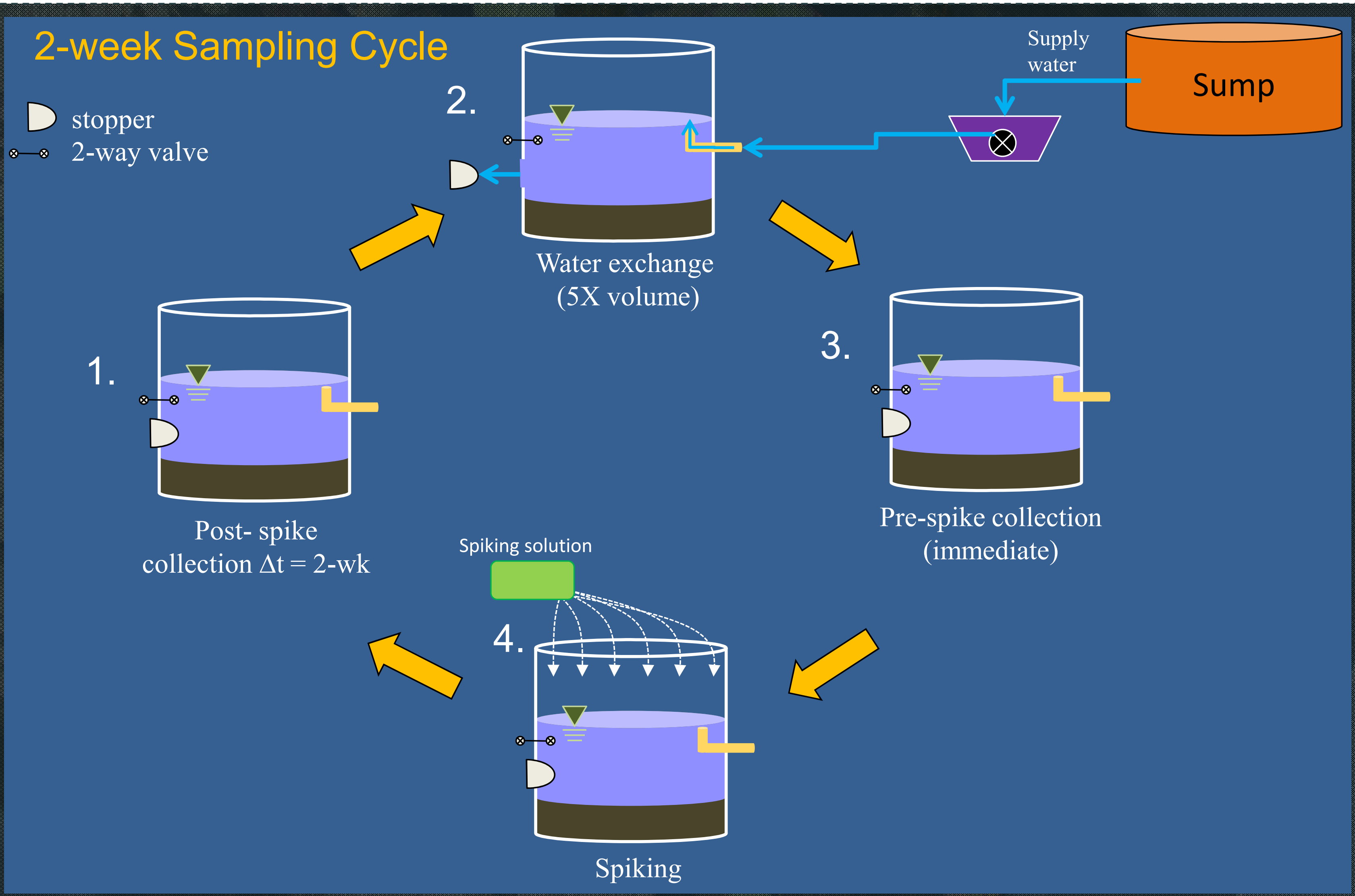
Mesocosm Operation



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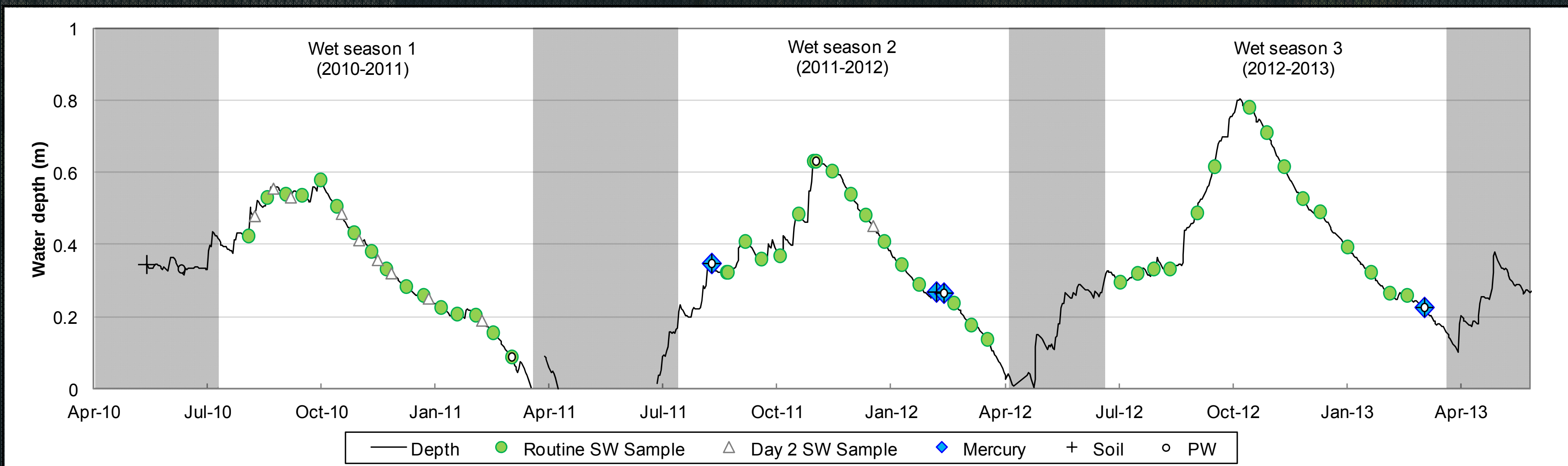
Monitoring

Sample collection

- Surface water (t = 2wk)
- Porewater (1/season)
- Soils (initial and final)
- Mercury (selected events)

Analytes

Sulfate
Sulfide
P species
THg & MeHg
Alkalinity
Diss. Iron
DOC & optical
Ammonia-N
pH & Eh & D.O.



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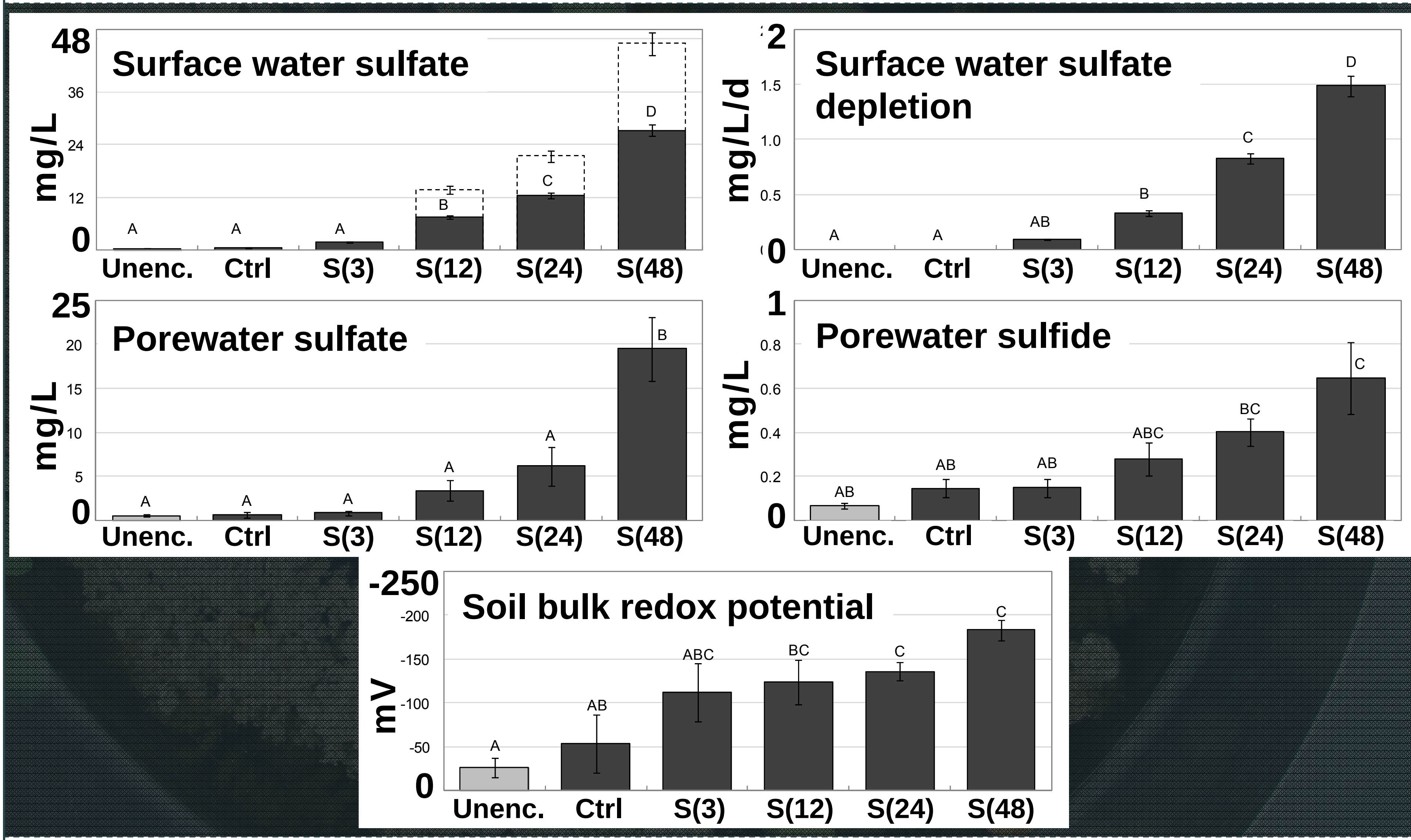
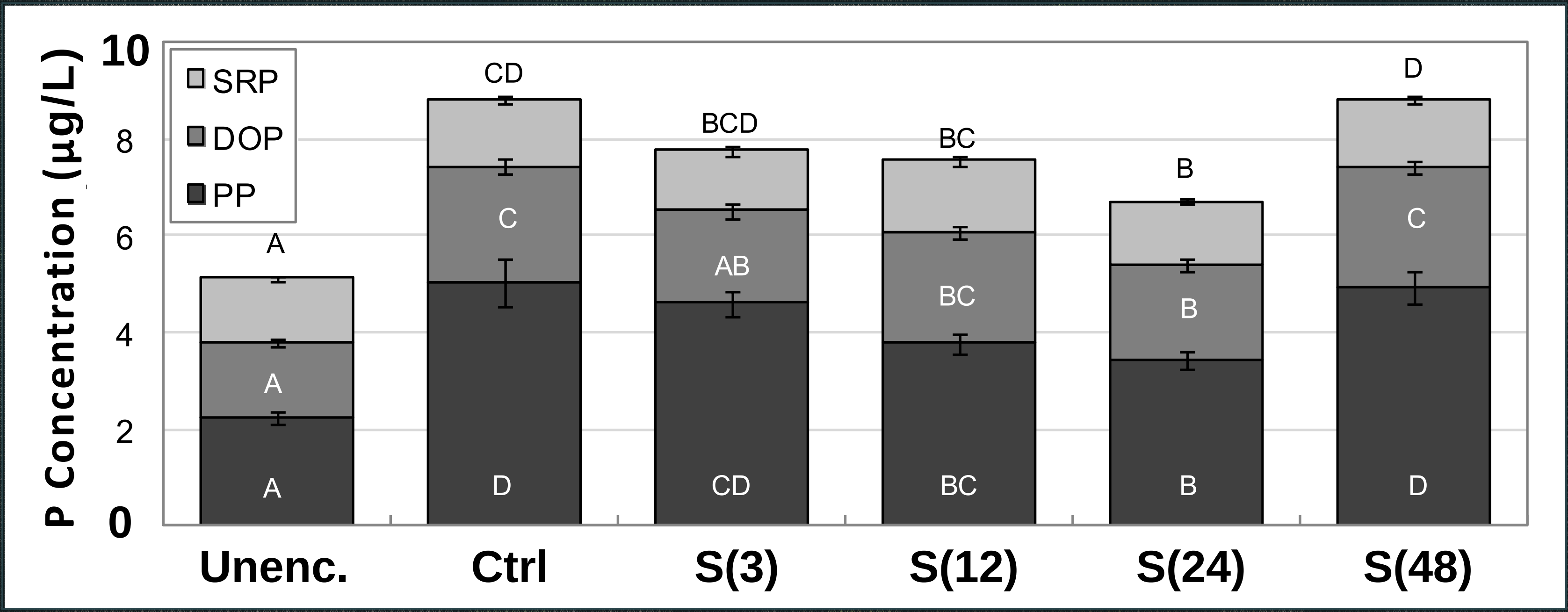
Results – Sulfur Chemistry



Results – Phosphorus



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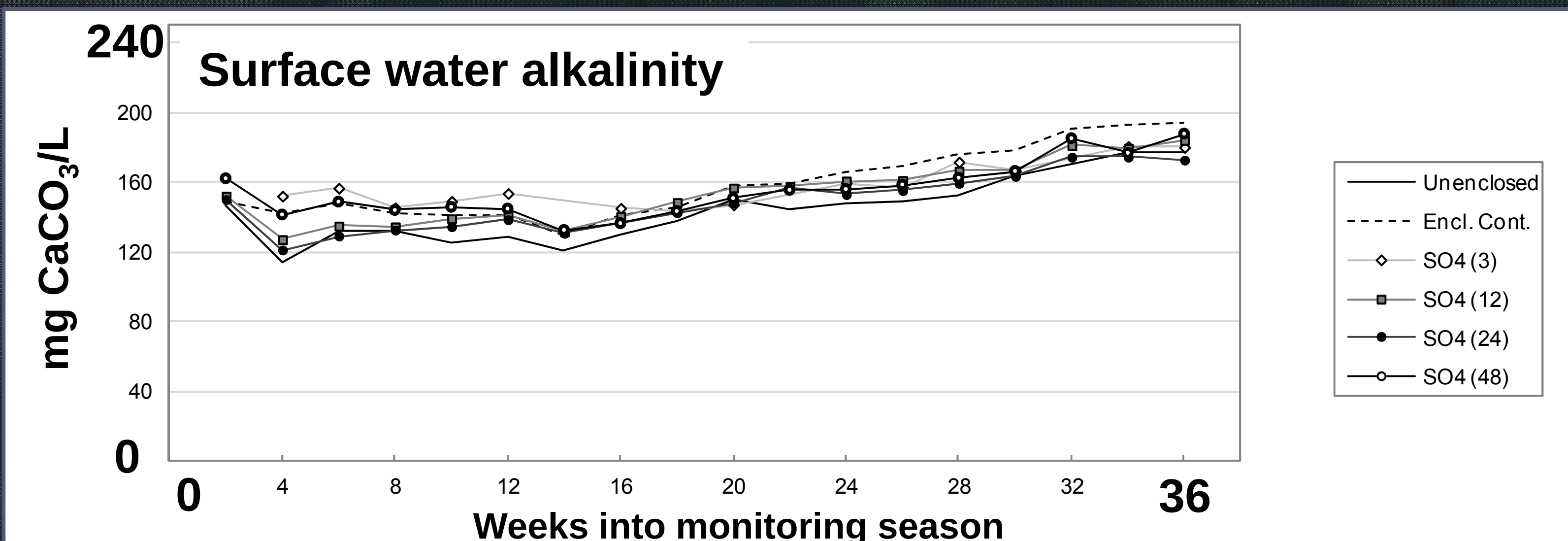
Internal Eutrophication (Smolders et al., 2006)

1. Anion exchange

   Unlikely: Generally uncommon. Soil ion-extractable P was only 0.2 mg/kg (0.05% of soil TP).

2. Alkalinization

   Unlikely: High native alkalinity, biological alkalinity buffering



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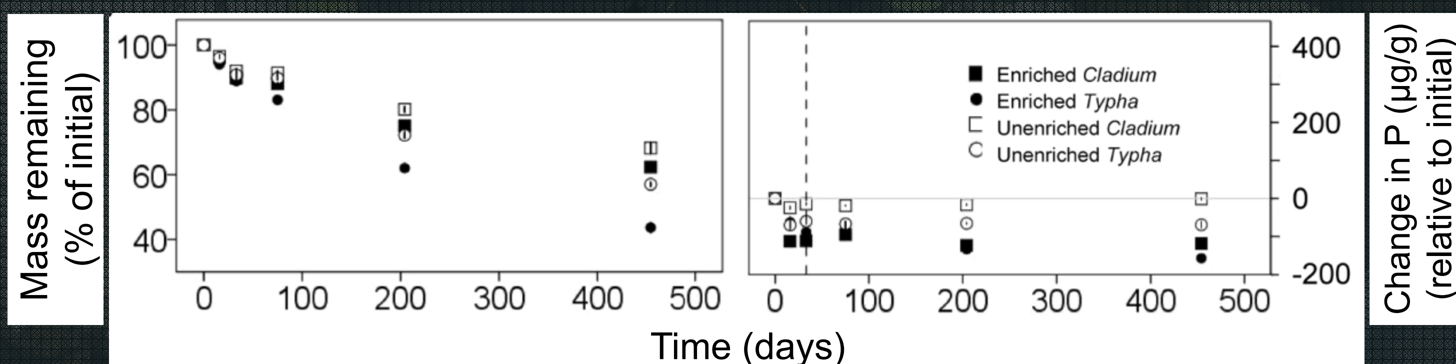
Internal Eutrophication (Smolders et al., 2006)

3. <u>Mineralization of organic P</u>

Unlikely: P conserved during decomposition

- Soil TOC:TP = 700-1000
- 30% soil TP as microbial biomass



Cheesman et al., 2010

Internal Eutrophication (Smolders et al., 2006)

4. Mobilization of iron-bound P

Unlikely: Pools of P were small compared to iron stores

- Soil iron-bound P: 10-20 mg/kg (2.5-5% of TP)

Iron:P ratios	Threshold for P release (Guerts et al., 2008)	Mesocosms
Soil	18	20-25
Porewater	6.3	150-500

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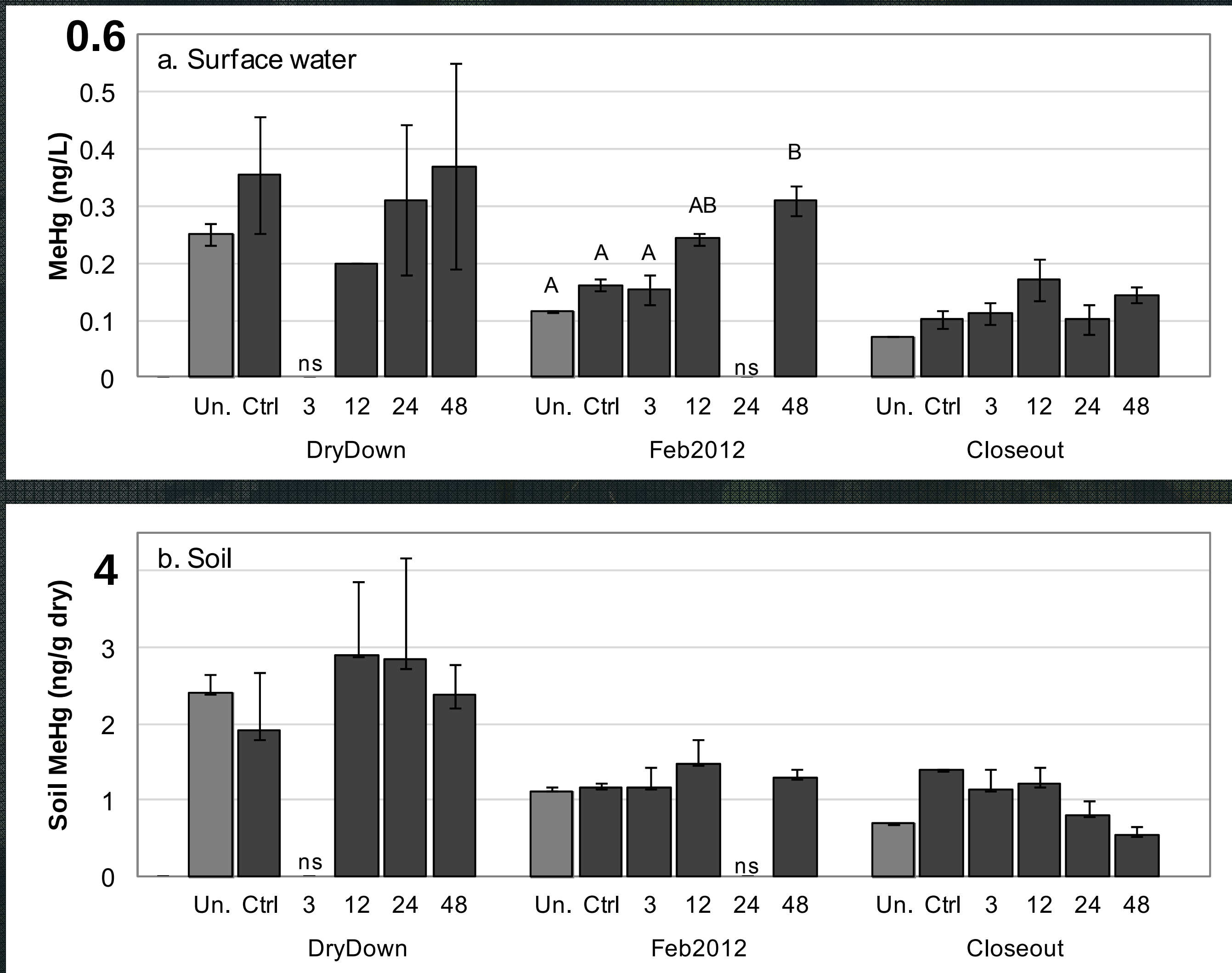
Results – Methylmercury



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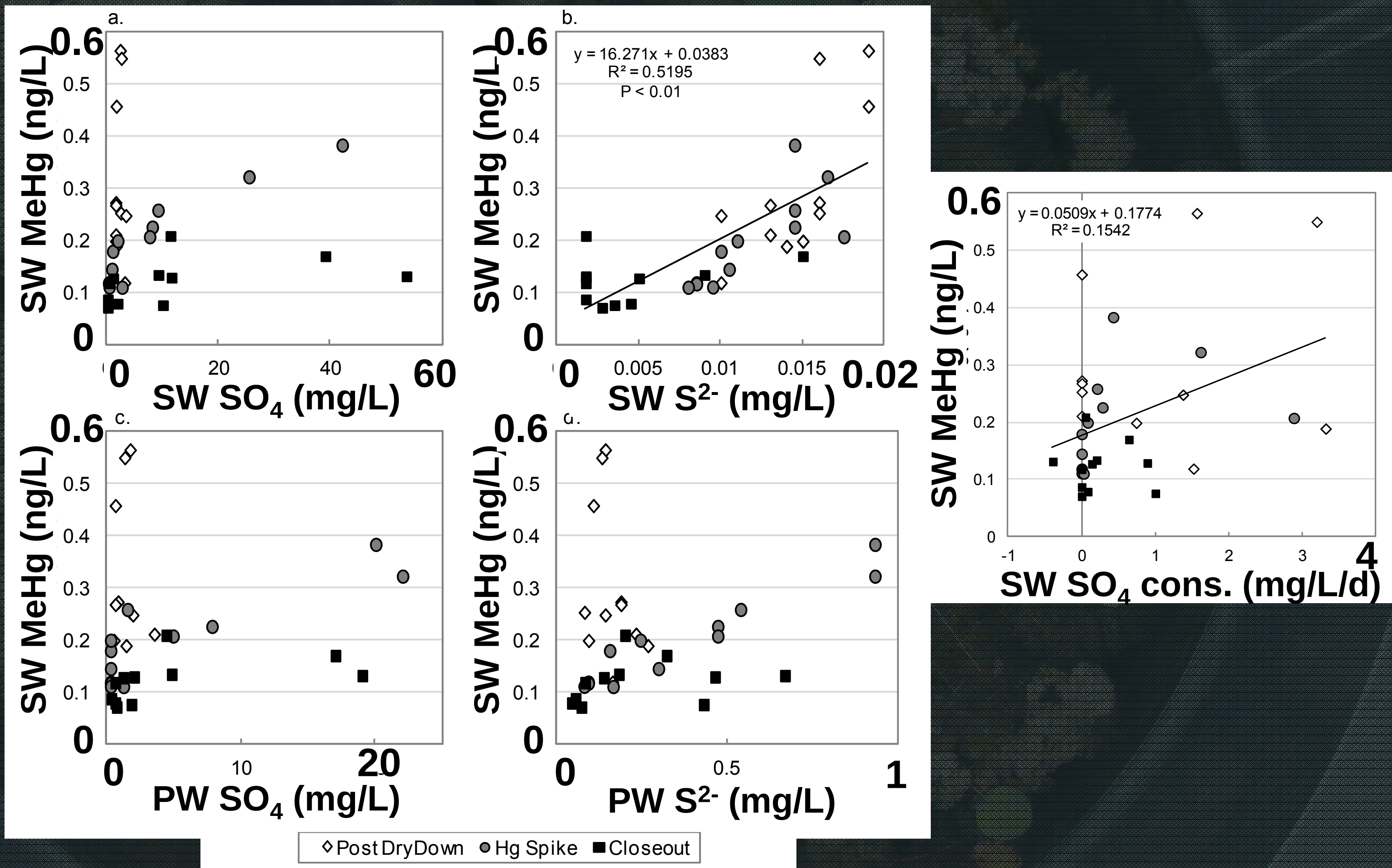
Results – Methylmercury



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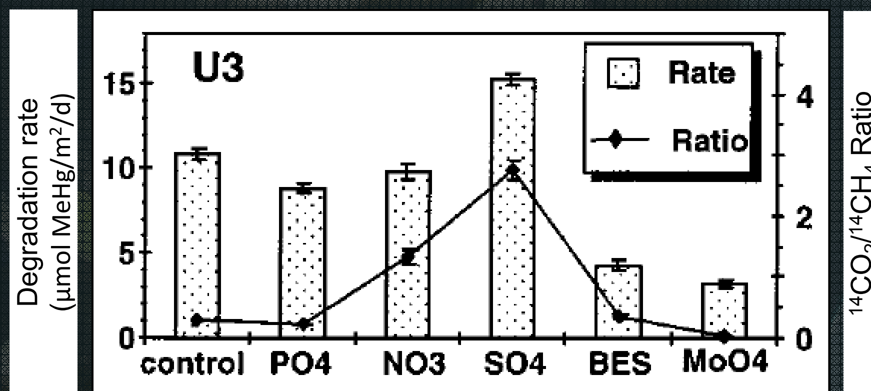
Controls on Mercury Methylation

Net methylmercury accumulation was not tightly coupled to sulfate reduction in this experiment

Stimulatory effect of drydown cycle, as observed by previous investigators.

Possible alternative controls

1. Hg bioavailability
   - Observed by other investigators (e.g. Gilmour et al., 2007) and other DBE laboratory experiments
2. Demethylation
   - Microbial syntrophy (Bae et al., 2014)



Marvin-DiPasquale and Oremland, 1998

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Conclusions

1. **This and previous studies* show sulfate enrichment is not a significant contributor to eutrophication in the Everglades**

2. **The role of sulfate as a contributor to methylmercury production and accumulation in the Everglades is less clear than previously believed**

*Dierberg et al., 2011; 2012

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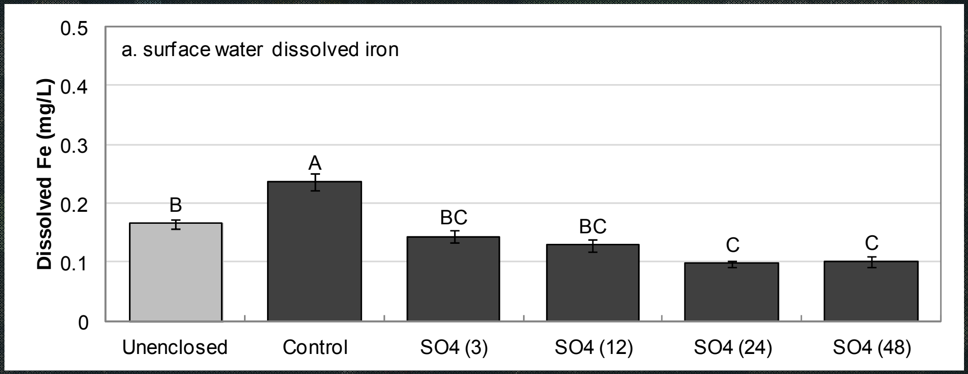
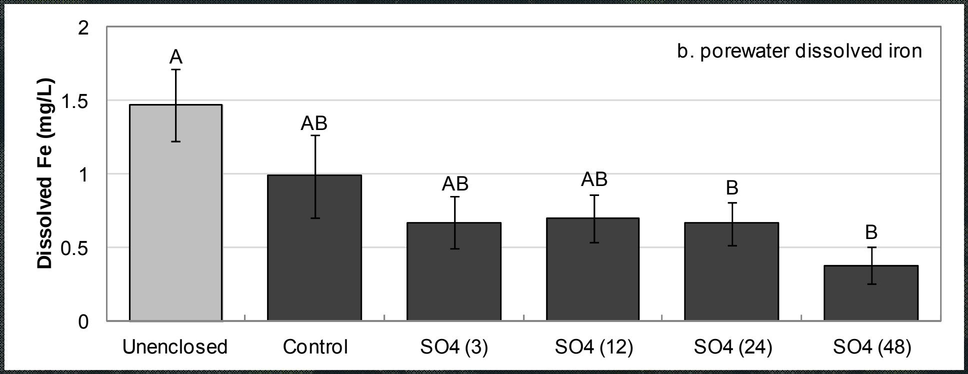
Results – Iron Chemistry





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