

Bolton Lakes



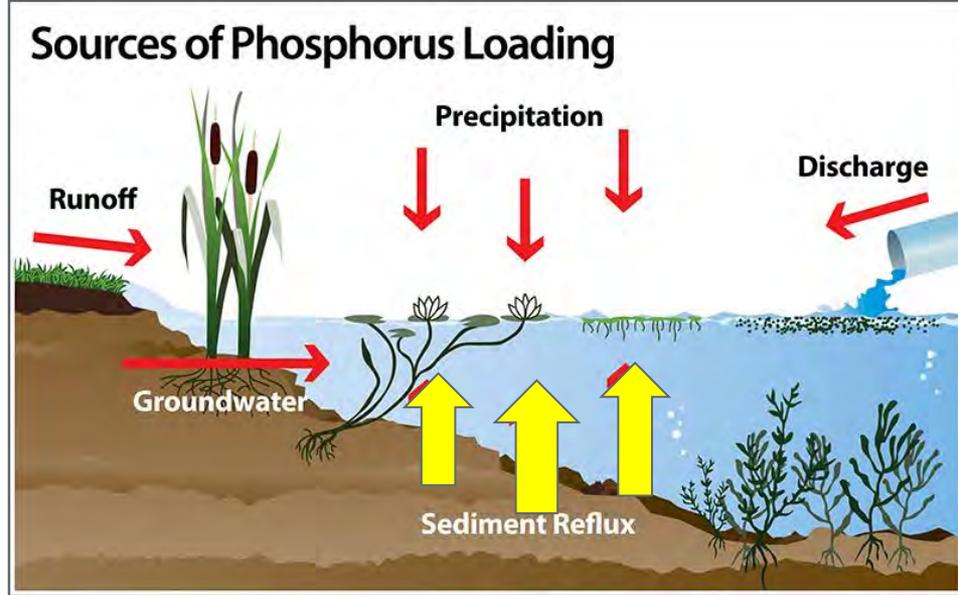
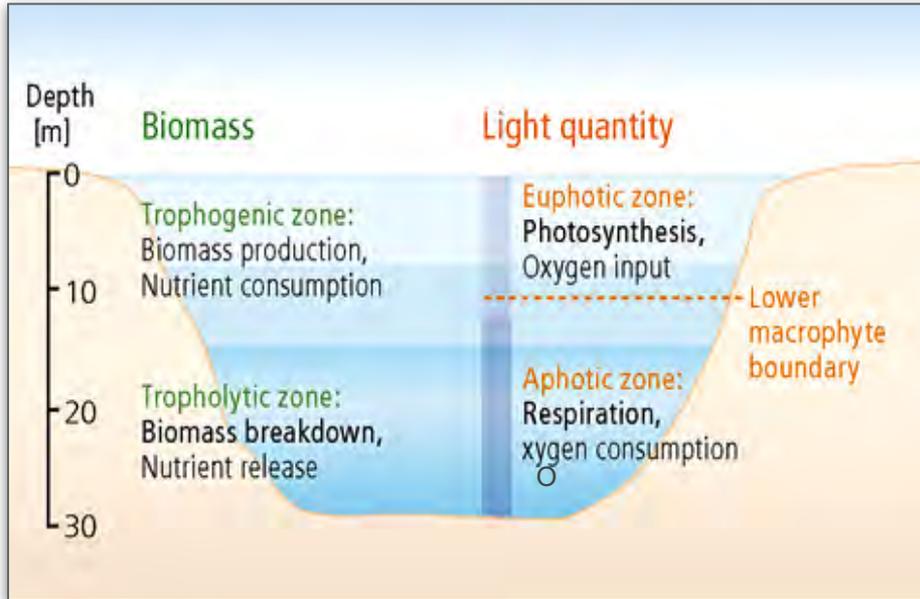
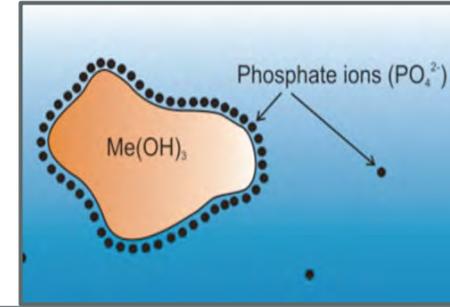
Internal Loading of Phosphorus

Jason Yoo, Owen Rego, Paula Tartell

Wesleyan University
Earth and Environmental Science Department

Introduction to Internal Loading of P

- Role of P in occurrence of algal blooms & lake eutrophication
- **Internal Loading of P:** Tendency to release phosphorus (P) from sediment at lake bottom
- The connection between P and Fe (iron), and organic matter



Our Objective

To better understand the internal loading of P in the Bolton Lakes, we analyzed Lower Bolton Lake (LBL) and Middle Bolton Lake (MBL) bottom sediments for:

- 1) P flux into the water column
- 2) Exchangeable + Fe-bound P
- 3) Add on: organic matter content and sources

Methods: Field Sampling

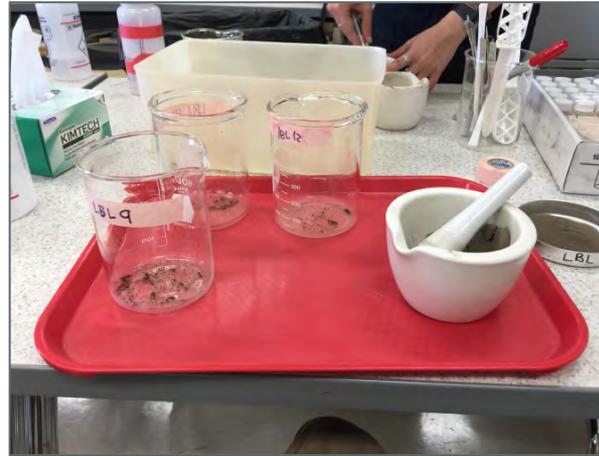
10 grab samples were collected, with our stainless steel “clamshell grab sampler”

- 5 samples collected from Middle Bolton Lake (MBL) on 9/29/17
- 5 samples collected from Lower Bolton Lake (LBL) on 9/15/17



Methods: Laboratory Analyses

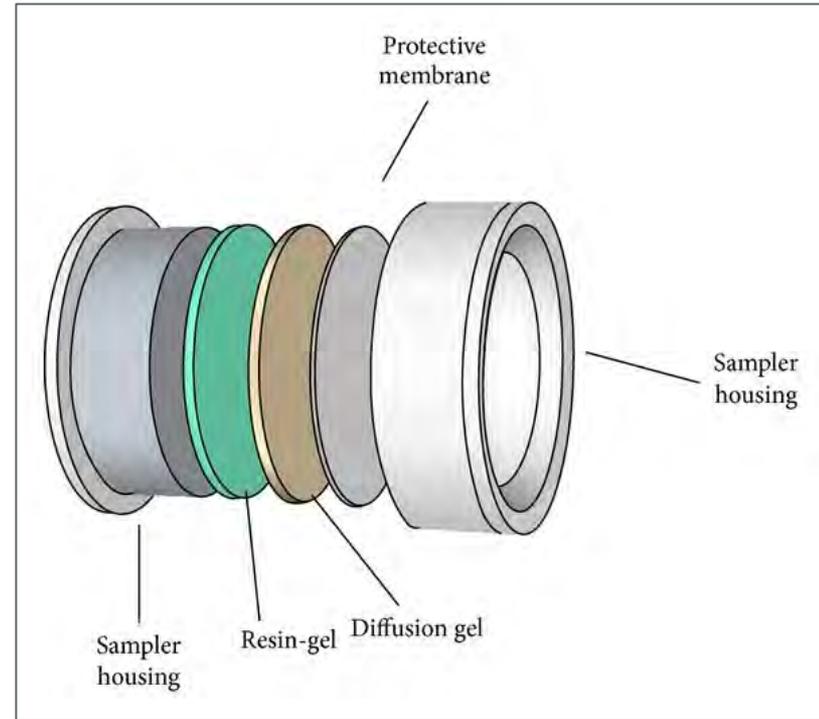
- 1) Iron and Phosphorus DGT analyses (Panther et al. 2013)
- 2) Labile Phosphorus and Fe-P extraction from sediments, organic Carbon and Nitrogen analyses (Pain 2008 and references therein)



Background: DGT Devices

DGT: “Diffusive gradients in thin films”

- Devices that detect elemental metals (i.e Fe), various organic compounds, and key nutrients in environmental samples
- Plastic housing containing gel layers with binding specificity
- Different gel layers target different analytes
- *in situ* concentrations



Methods: DGT Prep Work

1) DGT degassing

2) DGTs embedded in sediment samples

a) MBL DGTs ~ 47 hours

b) LBL DGTs ~ 24 hours

3) DGT binding layer excision

4) Preparation of 1M nitric acid (HNO_3) and sodium hydroxide (NaOH) solutions

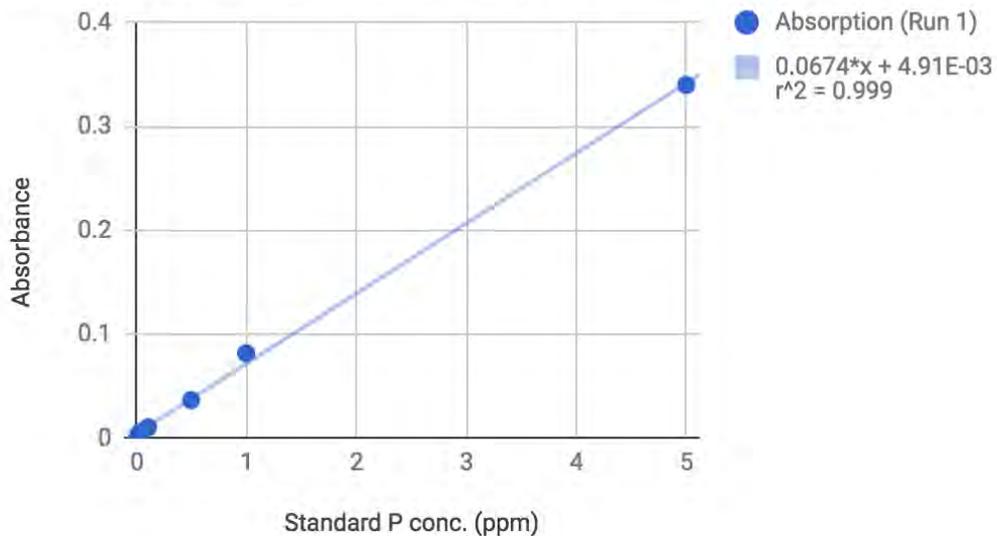
(Following *Panther et al.* and references therein)





Results: Standard Curve

DGT Absorbance Standard Curve

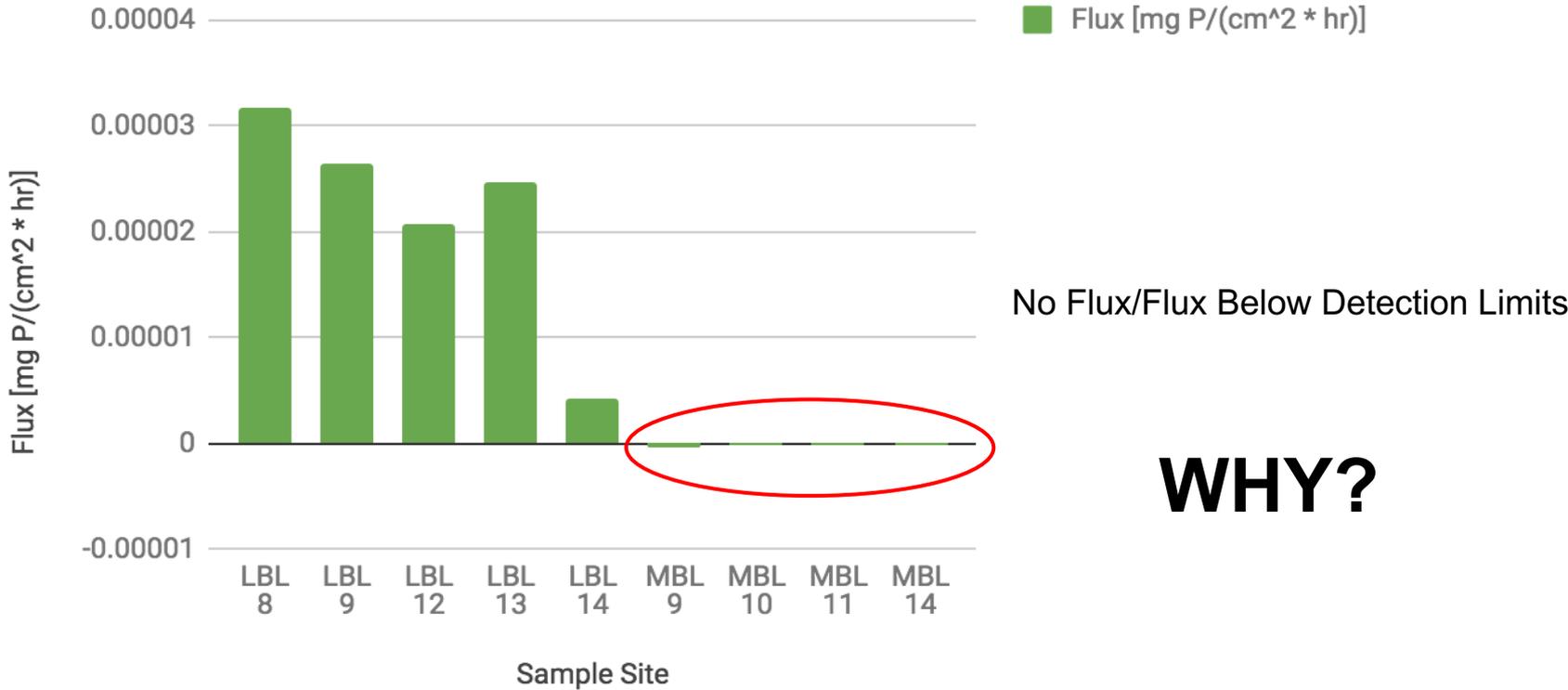


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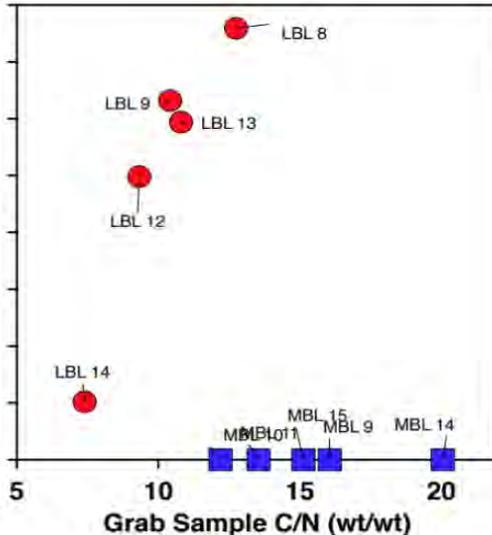
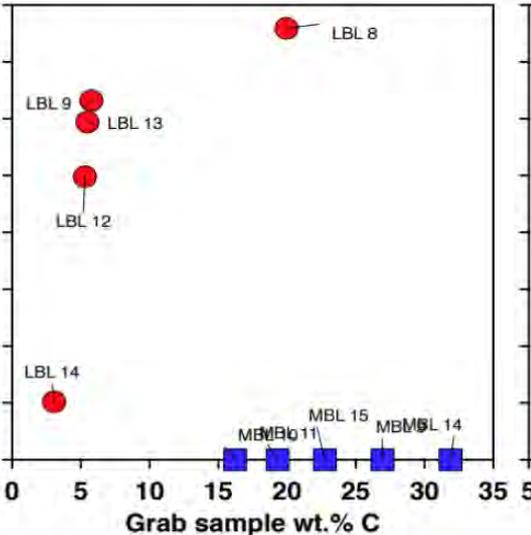
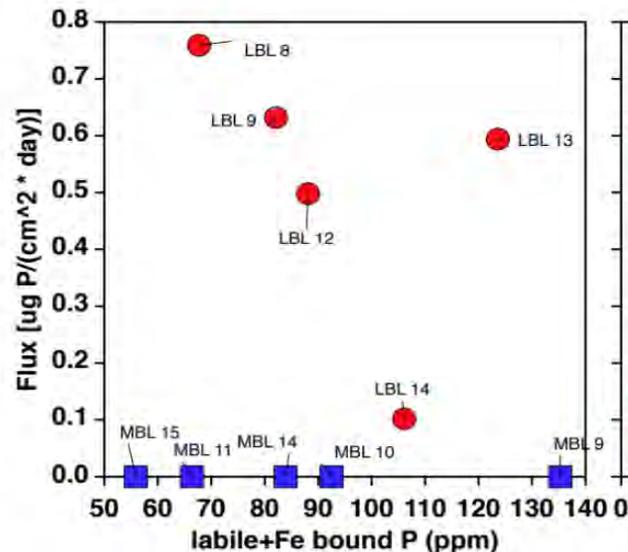
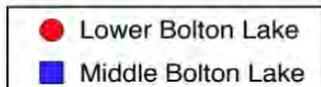


Results: Flux Data

Flux Rates for Bolton Lakes



Possible Explanations



ScienceDirect.com



canva.com



Pbs.org



istockphoto.com

Conclusion

- Range of Internal Loading Fluxes of P in LBL sites is [0.102, 0.759] $\mu\text{g}/\text{cm}^2$ per day, varies by a factor of 1~ 6
- Average daily LBL phosphorus flux: 0 .517 ug/cm^2
- Total Daily P Flux of 175 Acre LBL*: 20.93g of P per day
- **No Measurable Internal Loading Flux of P in MBL!**
- LBL flux independent of FeOH concentration or total carbon
- Flux may be correlated with organic matter source (terrestrial vs. algal)
- Further studies could examine Fe concentrations, collect data from more sites/seasons

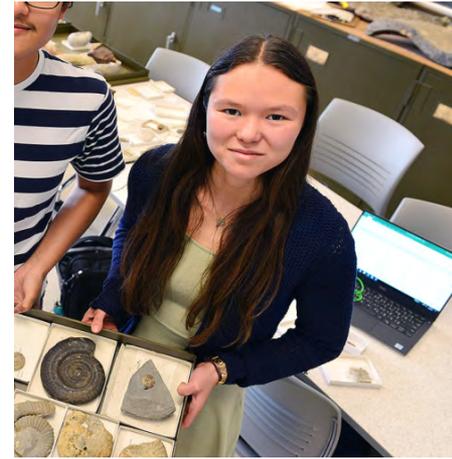
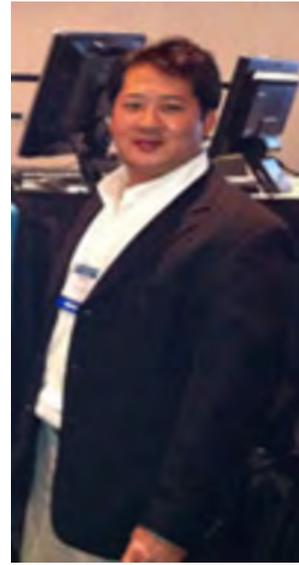
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The Friends of Bolton Lakes!



References

Davison, W., Fones, G., Harper, M., Teasdale, P., Zhang, H., 2000, Dialysis, DET and DGT: in situ Diffusional Techniques for Studying Water, Sediments, and Soil: In Situ Monitoring of Aquatic Systems: Chemical Analysis and Speciation.

Panther, J., Bennett, W., Welsh, D., Teasdale, P., 2014, Simultaneous Measurement of Trace Metal and Oxyanion Concentrations in Water using Diffusive Gradients in Thin Films with a Chelex-Metsorb Mixed Binding Layer: Analytical Chemistry, v. 86, p. 427-434.

Ruttenberg, K. C., 1992, Development of a Sequential Extraction Method for Different Forms of Phosphorus in Marine Sediments: American Society of Limnology and Oceanography, v. 32. no. 7, p. 1460-1482.

Raiswell, R., Canfield, D., Berner, R., 1994, A comparison of iron extraction methods for the determination of degree of pyritisation and the recognition of iron-limited pyrite formation: Chemical Geology, v. 111, p. 101-110.

Pain, A., 1990 , Sediment Phosphorus Reservoirs in Tropical Bays: Implications for Phosphorus Availability and Bioluminescent Dinoflagellate Populations [B.A. thesis]: Middletown, Wesleyan University 106.

Questions?

