Mary Griggs Burke Center for Freshwater Innovation
NORTHLAND COLLEGE

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Quantifying the distribution of phosphorus fractions in sediment of Chequamegon Bay, Lake Superior

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Background

Chequamegon Bay (CB) is one of the shallowest, most isolated, and warmest bays in Lake Superior. Recent data collected by researchers at Northland College indicate episodic events contribute significant tributary loads of total phosphorus to CB. The CB region is predicted to warm in response to climate change, potentially leading to an increase in water temperature and the potential for eutrophication driven by internal phosphorus loading from conditions in the hypolimnion.[1] For this reason, it is important to understand the concentration and distribution of phosphorus in sediments of CB. We present results from sediment phosphorus-and sediment particle size distribution in CB.

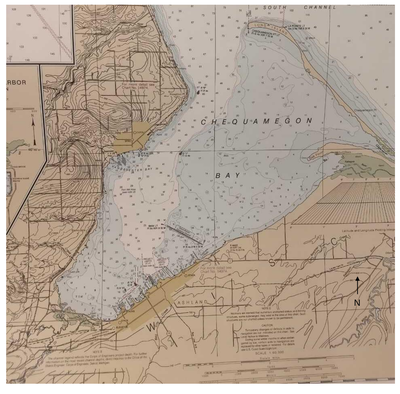

Figure 1. Bathymetry of Chequamegon Bay. Credit: NOAA

Objectives

- Evaluate the relationship between sediment grain size and phosphorus distribution
- Understand potentially available phosphorus concentrations in the sediment of CB.

Methods

We collected a series of spatially-distributed sediment samples from 11 sites in CB using a PONAR dredge. The samples were analyzed for:

- metal-bound and unbound (loosely sorbed) phosphorus through agitation and colorimetric analysis.[2,3,4,5]
- Sediment grain size composition was also analyzed through hydrometer and sieve analysis.

Results

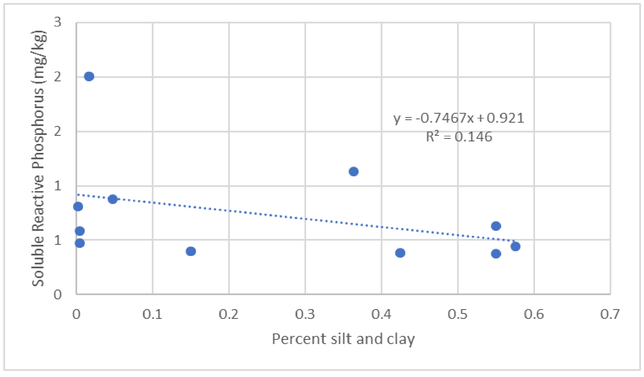

Figure 2. Linear regression of sediment silt and clay percentage relationship to soluble reactive phosphorus. The relationship was not statistically significant.

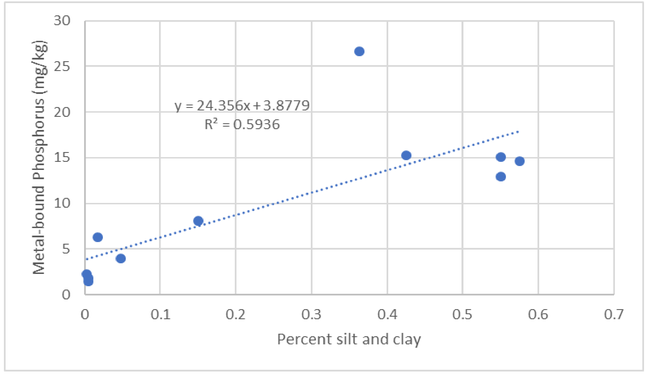

Figure 3. Linear regression of sediment silt and clay percentage relationship to metal-bound phosphorus fraction. The resulting relationship was statistically significant.

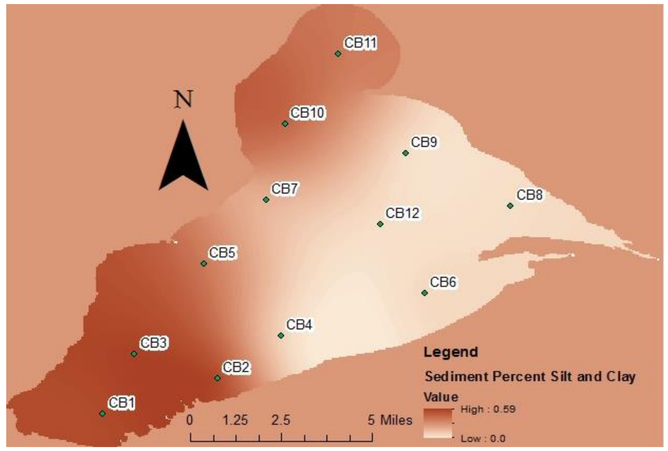

Figure 4. Spatial distribution map of sediment characteristics across the bay mapped according to percent silt and clay in sample.

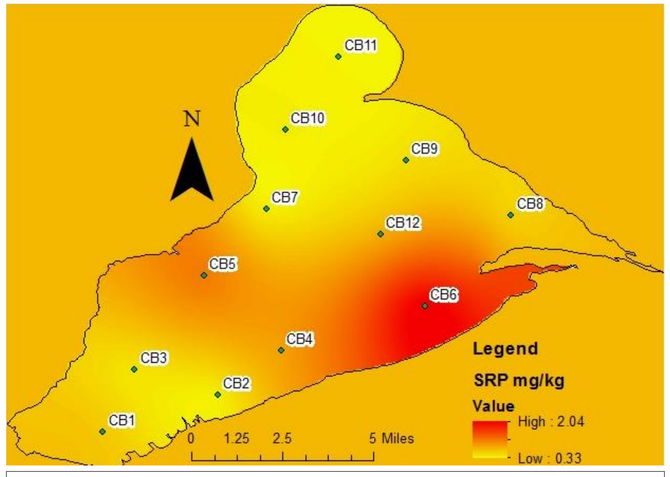

Figure 5. Spatial distribution of soluble reactive phosphorus concentrations (mg/kg) in sediment across Chequamegon Bay.

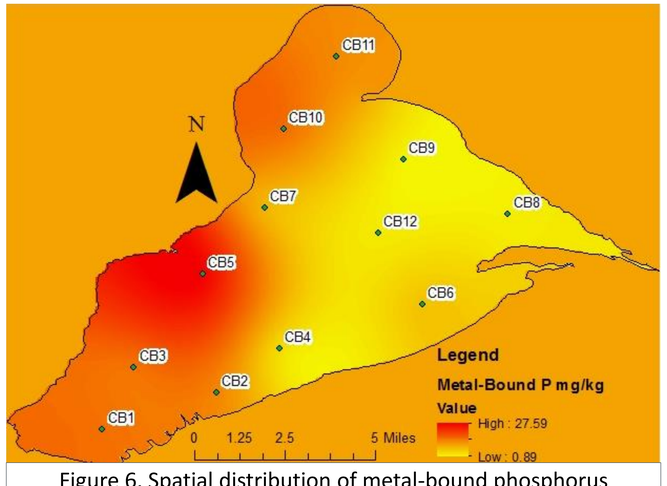

Figure 6. Spatial distribution of metal-bound phosphorus concentrations (mg/kg) in sediment across Chequamegon Bay.

- Both fractions of phosphorus were present at all sampling locations
- The concentration patterns of the two fractions were distinct.
- Distribution for metal-bound phosphorus is driven by percent silt and clay present in the sediment.
- SRP distribution was not significantly (statistically) influenced by the sediment composition.

Discussion

- SRP is available but metal-bound phosphorus would only become available for use if thermal and oxygen cycles and stratification patterns shifted
- These conditions could occur as a result of regional warming which has been occurring over the last 4 decades.
- Lake superior is warming faster than the atmosphere over the adjacent land.(6)
- These regional warming trends are the conditions that may lead to conditions for internal loading of phosphorus.
- As climate change progresses, more attention should be paid to sediment phosphorus and the management of internal loading.

References

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