

Sediment phosphorus forms in a highly recreationally developed Precambrian lake

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Introduction

Phosphorus (P) is typically a limiting macronutrient in freshwater systems.¹ Excessive P can result in harmful algae blooms, hypoxia, decline in water quality and a loss of biodiversity.² Reducing external P inputs has been an important effort in preventing these declines; however, accumulation of P in the sediments and its release into the water column can undermine these efforts.³ Thus, understanding the P efflux at the sediment-water interface is important for understanding why P management efforts are not as effective as predicted.

Located in Northern Ontario, Manitouwabing Lake covers approximately 1178 hectares, with a volume of 65 970 000 m³, a mean depth of 5.6m, and a max depth of 33m.⁴ The lake is underlain by Precambrian rock and is classified as mesotrophic with total phosphorus (TP) values averaging around 11.5g/L.⁴ Despite the mesotrophic status, regions within Manitouwabing Lake have experienced blue-green algal blooms.

The objective of the study is to determine the concentration of different forms of sediment P in Manitouwabing Lake, and to use this knowledge to better understand the occurrence of algal blooms.

There is no data available on internal P cycling in Manitouwabing Lake, so the research will be important for understanding whether external loading or internal cycling contributes the most to the resident P. This research is particularly important to the Township of McKellar to help them understand whether reducing external P inputs will be an effective effort to prevent future declines in water quality.

Materials and Methods

We collected sediment cores from three sites in Manitouwabing Lake: South Tait (ST), McKellar Bay (MB) and Middle Lake (ML). These locations were selected due to their depth. Site profile data was collected before collecting the cores, including temperature, dissolved oxygen, salinity, pH, total dissolved solids, oxidation reduction potential and conductivity.

In the lab, we determined the concentration of soluble reactive phosphorus (SRP) and iron in the porewater. The cores that were not used for porewater extraction were separated into 1cm sections up until a depth of 5cm and then sectioned at 5cm increments. The sections were used to complete a sequential P extraction following

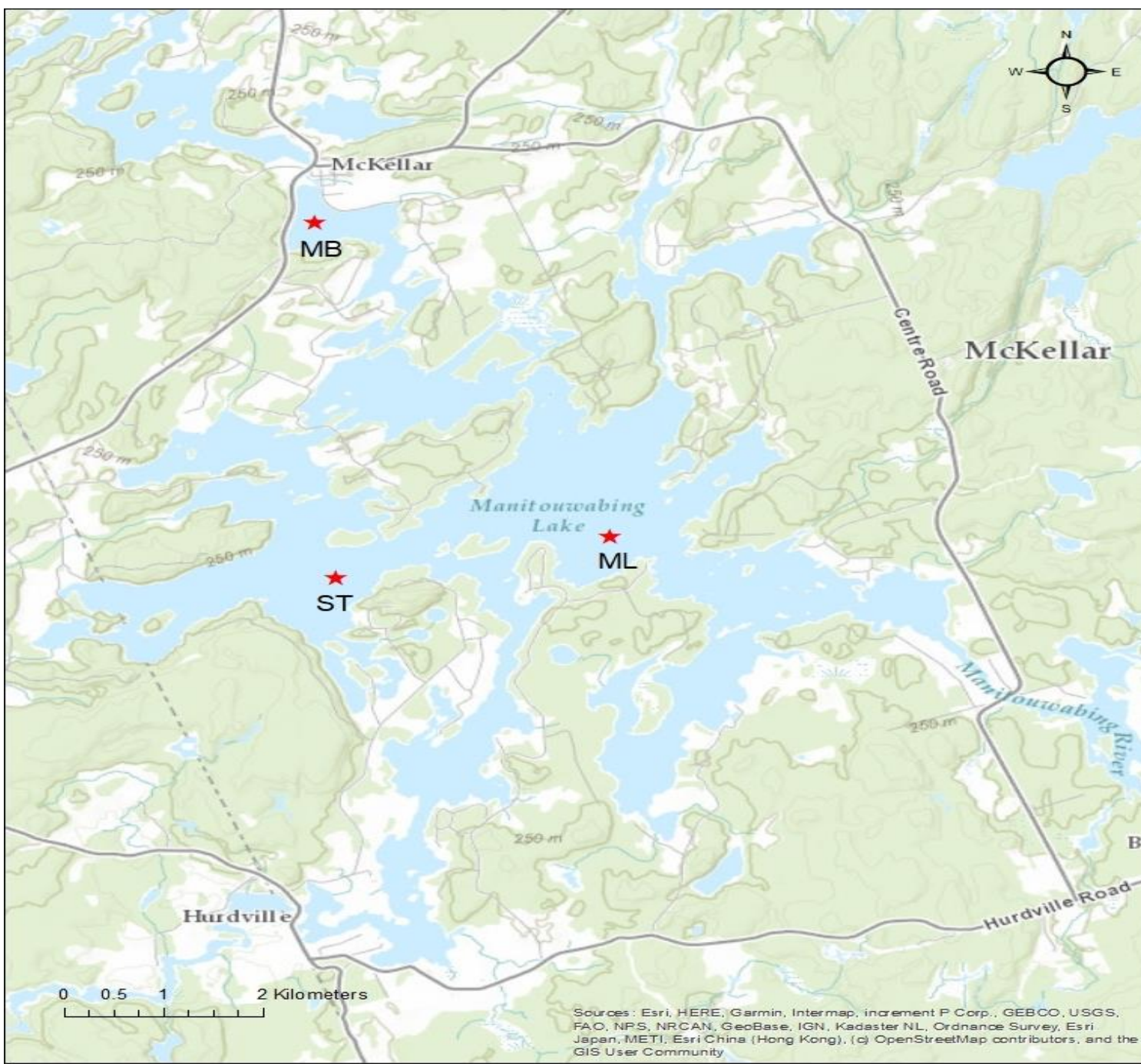


Figure 1. Site locations in Manitouwabing Lake.

Hupfer et al.(2009), which determined the concentrations of labile P, redox-sensitive P bound to Fe and Mn oxyhydroxides, P bound to hydrated oxides of aluminum and clay, organic bound P, calcium-bound P and refractory P.

Preliminary Results

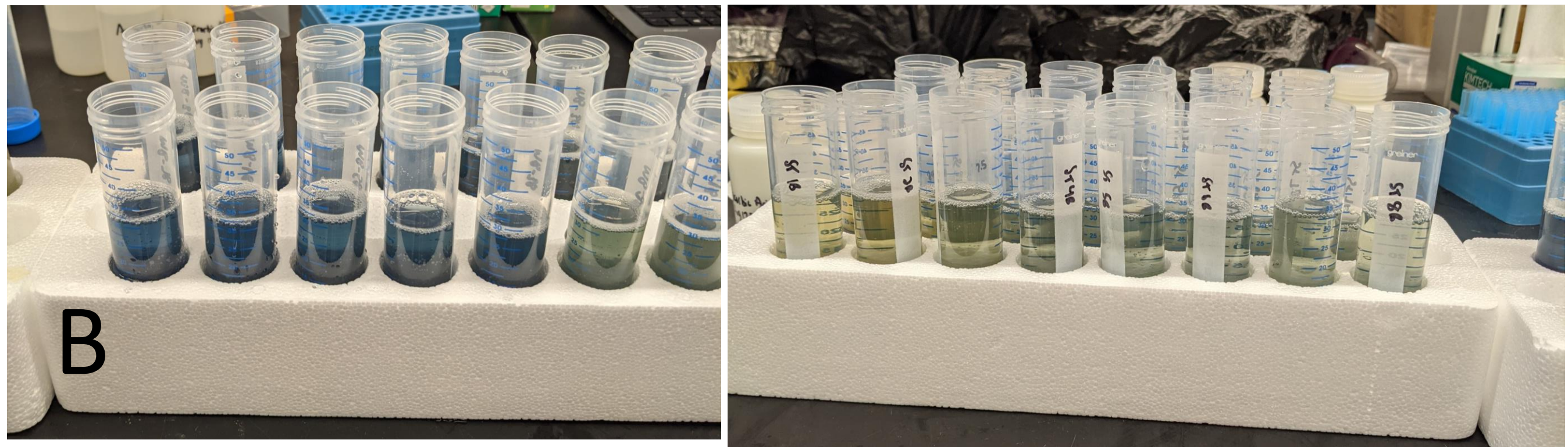
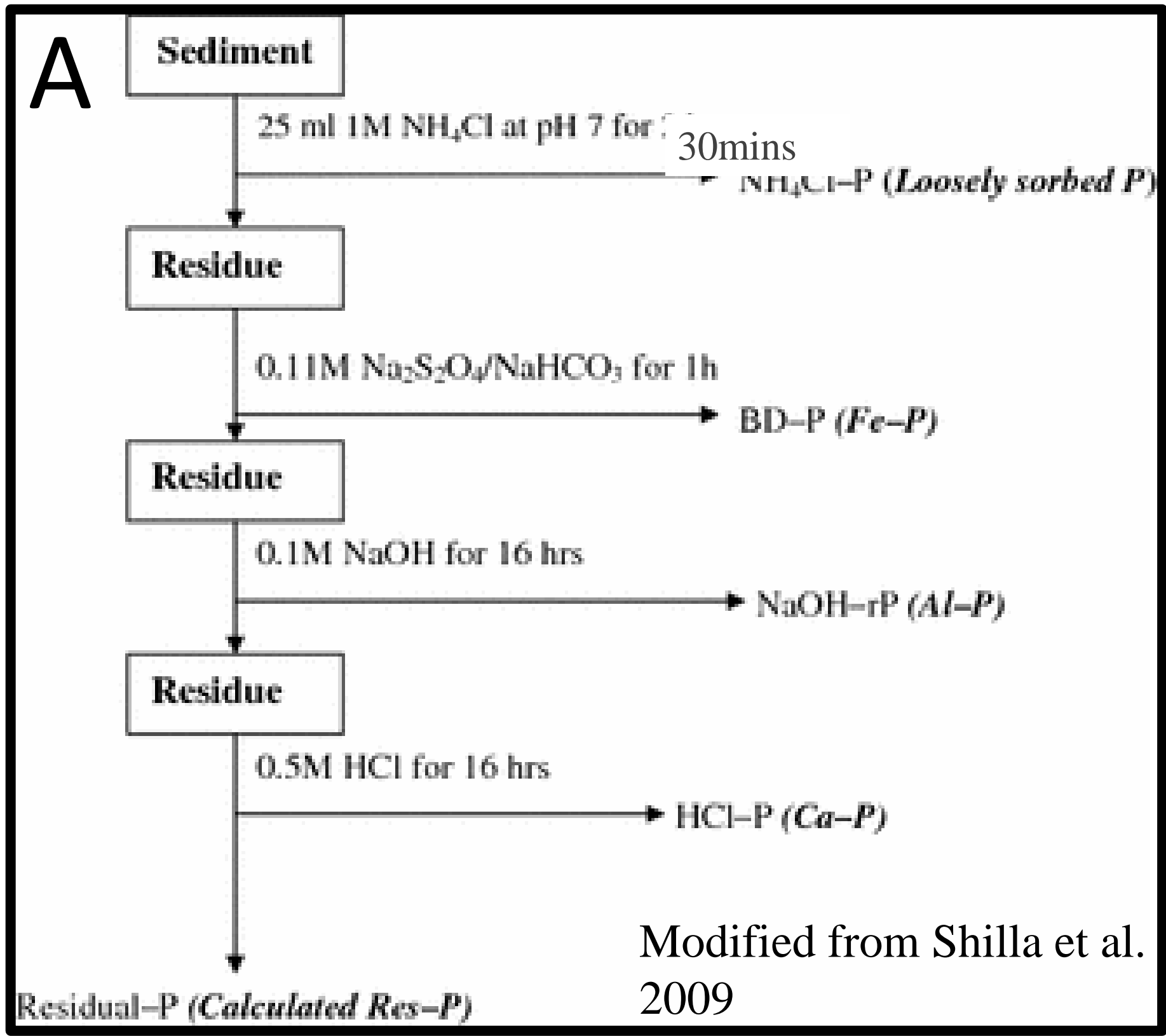


Figure 2. (A) Process for the sequential extraction of various phosphorus forms in the sediment. (B) Photos of the extracted SRP after the chemicals are added for the blue ascorbic acid method.

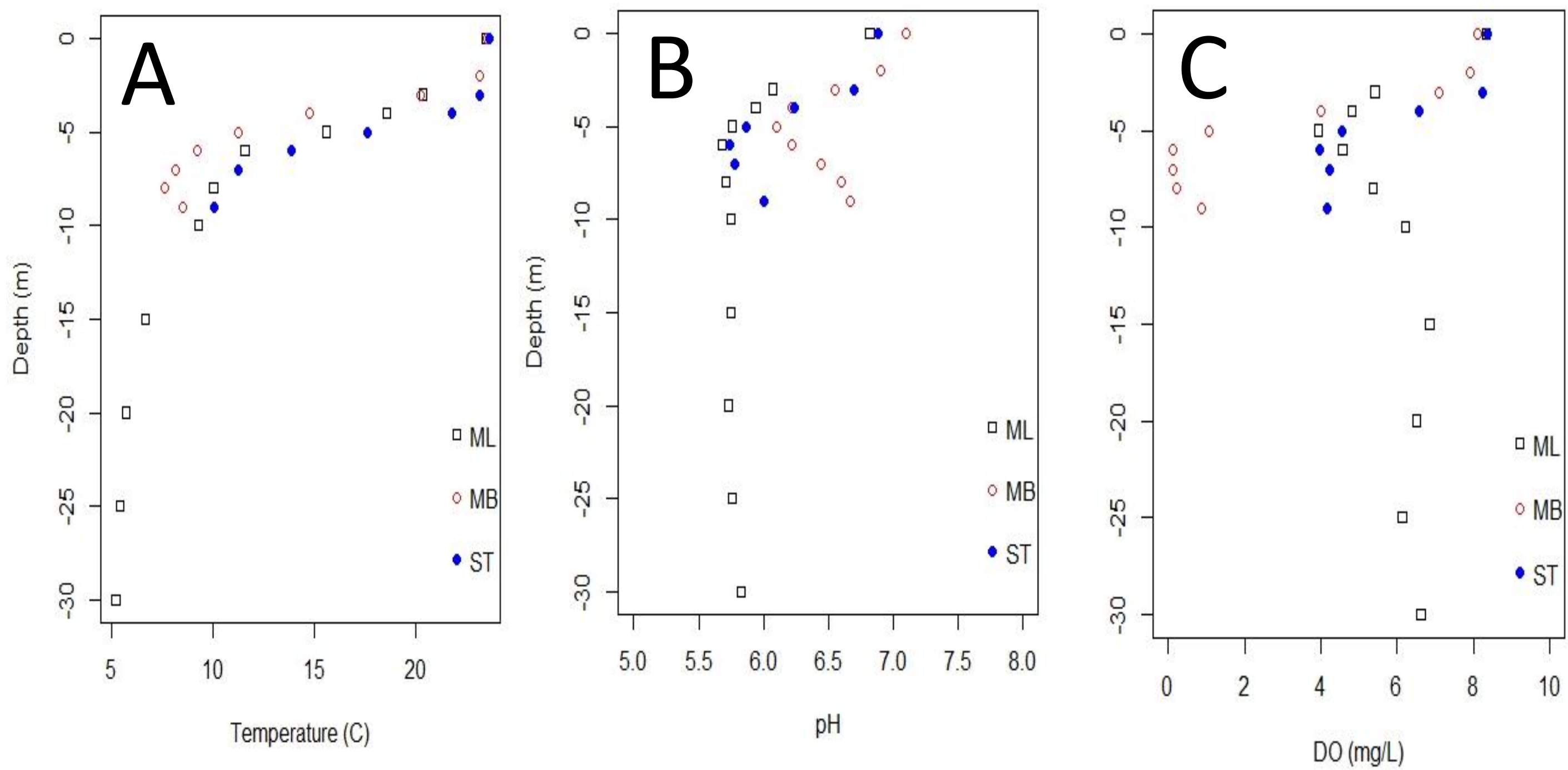


Figure 3. July water depth profiles of (a) temperature, (b) dissolved oxygen (DO) and (c) pH at the three sites in Manitouwabing Lake.

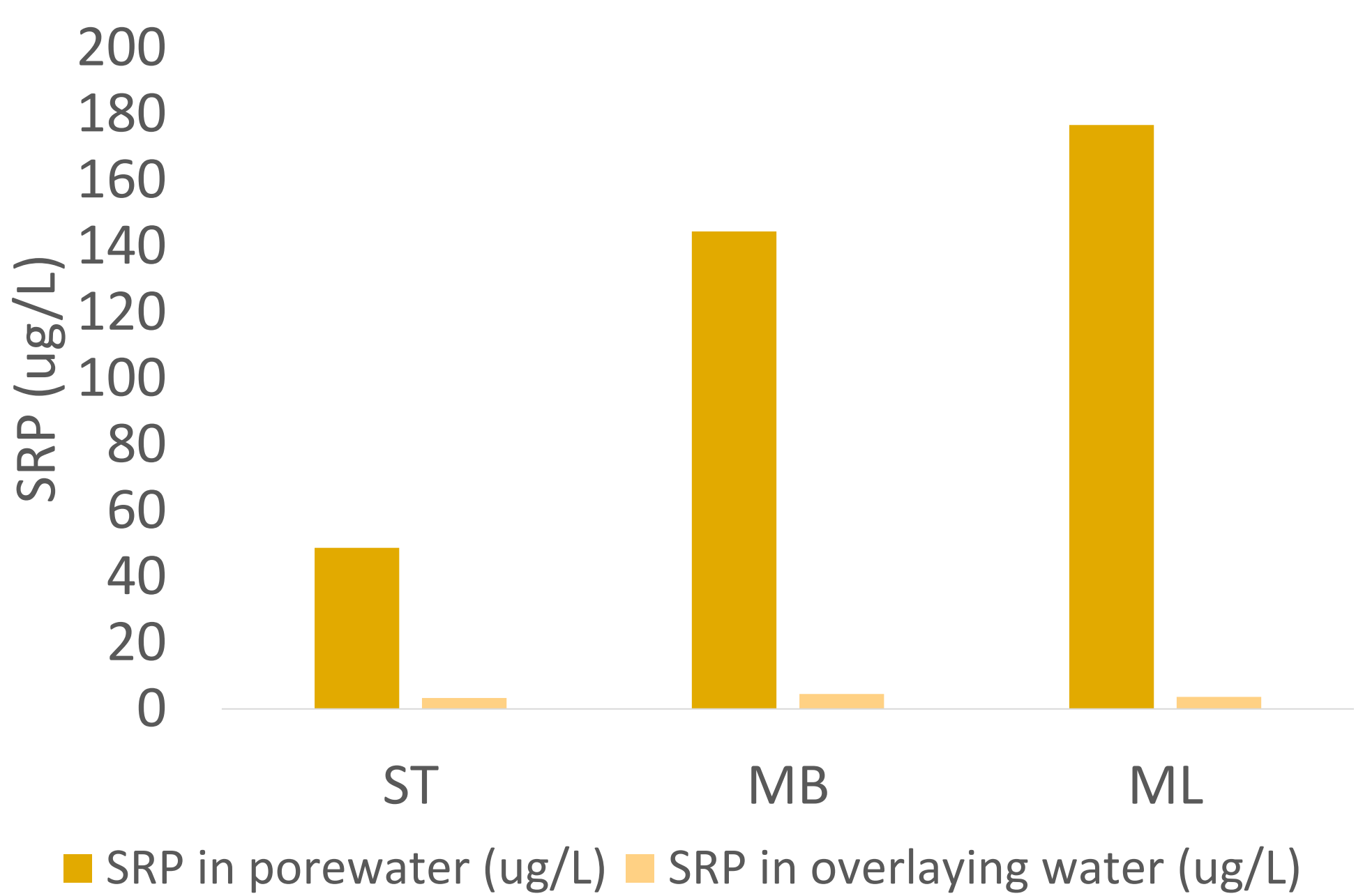
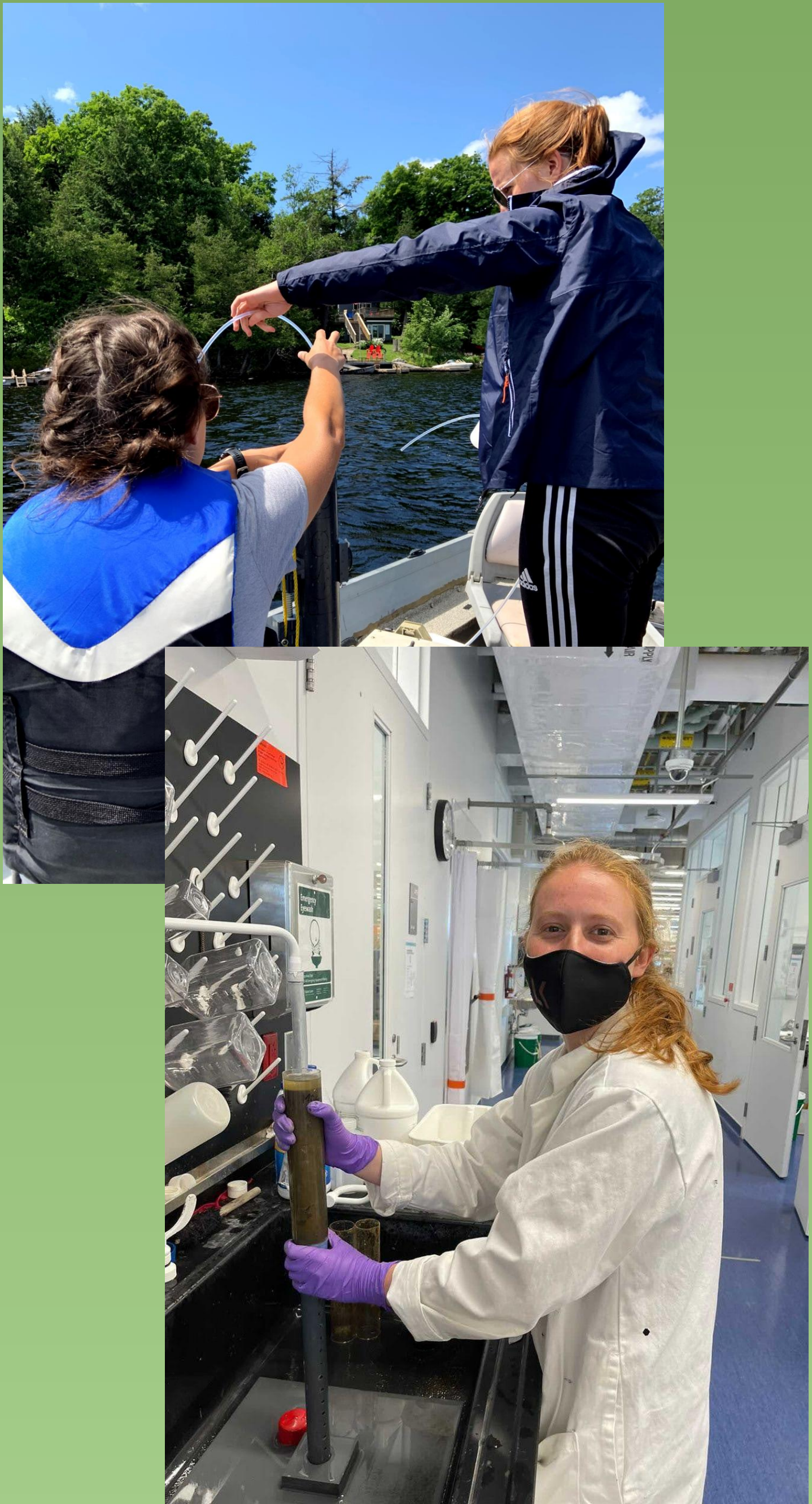


Figure 4. Soluble reactive phosphorus (SRP) concentrations in the sediment porewater and the overlaying water at the three sites in Manitouwabing Lake.

Next Steps

- Finish freeze-drying the sediment samples from July
- Complete P extraction process for July samples
- Use data to determine the diffusive flux of SRP
- Determine whether internal P loading is impacting external P models
- Use the data to determine whether internal P loading may be related to the algal bloom outbreaks



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