



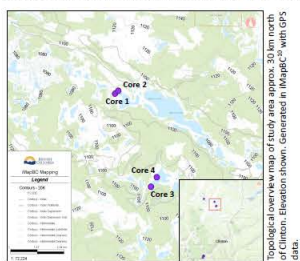
Cariboo Plateau Alkaline Lakes and Mineralogy



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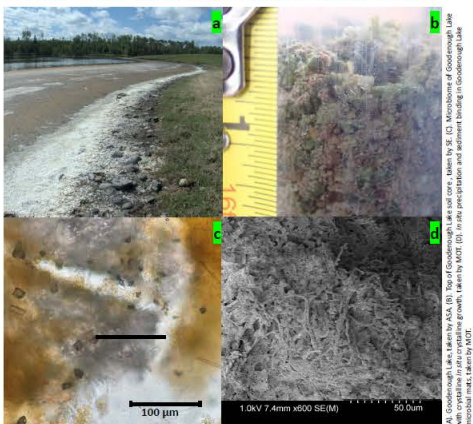
Why study alkaline lakes?

- The Question: What is the role of microbes in controlling carbonate precipitation?
- What are the implications of finding microbe-associated carbonates on other planets (e.g., carbonates in Martian paleolakes)^{2,3}.
- What are the biological mechanisms behind inducing precipitation^{2,4,5,8,9}



Locality

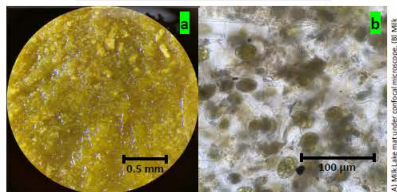
- Evaporative environment and with seasonal rainwater input and variable groundwater input.^{4,6} Lake depth varies throughout year.
- On top of Chilcotin Group (Miocene-Pliocene flow basalt, gabbro, silicic tephra). Glaciation had eroded top of basalt flow and caused depressions for lakes to form in. Resulting basaltic soil may be source of ions.¹¹



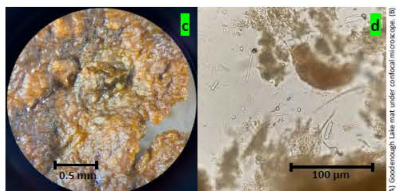
Materials and Methods

- Microbial mat sampling, stored in 90% EtOH
- Surface water sampling, filtered through 0.22 µm pores.
- Pore fluid sampling via 0.15 µm pore rhizons at centimeter interval.
- Light and scanning electron microscopy with energy dispersive X-Ray spectroscopy.
- High pressure fluid ion chromatography.

Microbe Mat Light Microscopy

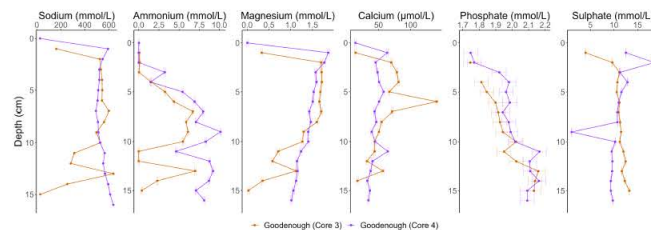
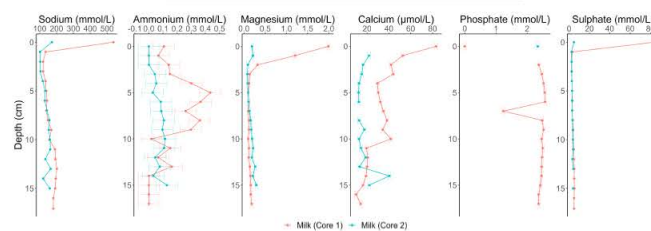


- (B) The cells that make up the Milk Lake surface mat are large (30 µm across) and abundant, and each cell is housed in a segmented sheath, making each strand colonial. These cells appear structurally similar to zygotic forms of the *Spirogyra* genus¹⁴. (A) White sediment is seen under the surface.



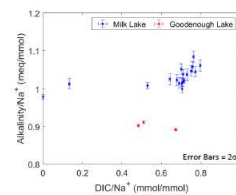
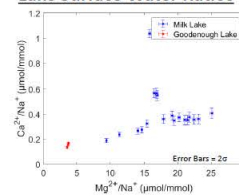
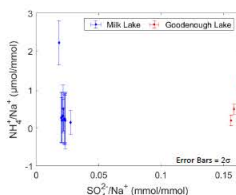
- (C) Goodenough Lake mats are tightly bound together; the cellular morphology of mat individuals is diverse, and carbonate nodules lie underneath, giving the surface a texture best summarized as "fried chicken". (D) Cells are ~3-5 µm across. The dominant morphologies are *Spirulina* and *Oscillatoria*-like¹⁴ and are tightly wound in 75 µm to 300 µm diameter chunks.

Milk Lake and Goodenough Lake Pore Fluid



- In Milk Lake, Mg²⁺, Na⁺, and SO₄²⁻ are all conservative with slight fluctuations; if Mg²⁺ is being consumed via precipitation, Na⁺ and SO₄²⁻ are likely to be consumed during precipitation as well. PO₄³⁻ seems to mirror Na⁺. Still investigating possible mechanism behind this.¹²
- In Goodenough Lake, Na⁺ and Mg²⁺ are conservative. SO₄²⁻ has been decoupled and stays relatively stable after 3cm.
- Typical NH₄⁺ peaks, but depth varies. Both Goodenough cores have similar magnitude; Milk Core 2 does not have a peak. NH₄⁺ concentrations are function of O₂ and organic matter. Coupling to NO₂⁻ and NO₃⁻ would allow for better alkaline lake nitrogen cycling.

Lake Surface Water Ratios



- NH₄⁺ is unchanged between Milk Lake and Goodenough Lake, but SO₄²⁻ is significantly higher in Goodenough. Low [O₂(aq)] and the strong smell of sulphur suggest anoxygenic photosynthesis occurring below O₂ exchange but within photic zone¹⁵.
- Ca²⁺ and Mg²⁺ are both significantly lower in Goodenough; Mg²⁺ shows a much greater decrease. These lakes are conducive environments for non-classical carbonate precipitation and are found to have carbonates with lower-than-average Ca/Mg ratios⁹.
- [DIC] is similar between lakes, but lower alkalinity in Goodenough suggests an outflux during evaporation².

Acknowledgements

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