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Towards quantification of phosphorus pools and fluxes in water and sediments of an extremely phosphate-rich soda lake

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Extremely high phosphate concentrations (up to 37 mM) are found in Last Chance Lake, a carbonate-rich alkaline ("soda") lake on the Cariboo Plateau, British Columbia, Canada (Figure 1). Such high natural phosphate concentrations might contribute to a solution to the "phosphorus problem of the origin of life" [1]. It describes the discrepancy between the typically very low phosphate concentrations found in the environment (10^{-6} M) and the high phosphate demands (1 M) of prebiotic phosphorylation [2], a process necessary to form crucial biomolecules like nucleic acids.

We have recently gained a deeper understanding of the general mechanisms behind the unusually high phosphate accumulations in Last Chance Lake, which are caused by low calcium concentrations limiting calcium phosphate mineral (apatite) formation combined with limited biological N_2 fixation [ref 3; Haas et al., in prep.]. However, detailed research on phosphorus cycling in high-phosphate soda lakes is still surprisingly scarce. Here, we present results from sequential phosphorus extraction [4] from sediments of Last Chance Lake and neighboring, somewhat less phosphate-rich, Goodenough Lake, as well as phosphate and total dissolved phosphorus concentrations from water column and sediment porewater. The goal of this analysis is to identify and quantify phosphorus pools and fluxes in the possibly most phosphorus-rich lake in the world. This may provide new insights into phosphorus biogeochemistry at high phosphate concentrations and into the amount of phosphorus available for prebiotic phosphorylation on early Earth.

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[2] Powner, Gerland & Sutherland (2009), *Nature* 459, 239–242.
[3] Toner & Catling (2020), *PNAS* 117 (2), 883-888.
[4] Ruttenberg (1992), *Limnol Oceanogr* 37 (7), 1460–1482.