High Resolution Sampling Reveals a Complex Geochemical Environment at Fayetteville Green Lake, N.Y.

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Fayetteville Green Lake (FGL) is a meromictic lake, with an upper oxic mixolimnion extending from the surface to the start of a chemocline at approximately 15 m, a zone extending from ~15 m to ~22 m over which the chemistry of the water transitions from oxygenated (dissolved oxygen >250 μM, predominant DIN as nitrate, conductivity ~1200 μS/cm, and low Fe and Mn, ~20 nM and ~10 nM, respectively) to reduced (sulfide > 0.2 mM, NH_4(T) > 50 μM, conductivity > 1500 μS/cm, and higher Fe and Mn, > 100 nM and > 4000 nM, respectively).

To better elucidate the geochemistry through the entire water column, we deployed an apparatus that allowed for near instantaneous water sampling from the surface through to the bottom (53 m) at 1 m intervals, and at ¼ m intervals from 16 to 24 m, in conjunction with a Sonde equipped with sensors for measuring depth, pH, conductivity, temperature, turbidity, and dissolved oxygen content. We analysed samples collected in November of 2012 and July of 2013 for over 25 different physical and geochemical parameters. From this level of resolution, we can describe the dramatic changes in concentration and redox chemistry that occur across the 7 m zone below the chemocline, and demonstrate a dynamic and shifting geochemical environment which harbours the majority of biomass and productivity for the lake. Using geochemical tracers of different processes and water sources, we check the validity of previous modelling to describe the movement of water and nutrients through the system, and test the viability of using FGL as a proxy for early Earth ocean conditions.