The chemical and biological evolution of a meromictic lake, Washington USA

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There have been serveral step increases in redox-state throughout Earth's history that likely led to significant changes in microbial ecology. We consider these influences of environment on community through a paired study of the chemical and microbiological turnover within an anoxic lake. Lime Blue Lake is a shallow (15 m) stratified lake located in northern Washington. Overall, the sulfur concentrations are moderate (SO_4 = 11 mM; H_2S = 0.8 mM). Although the anoxic photic zone is shallow, the most abundant sulfur phototroph is a genus of green sulfur bacteria (*Pelodictyon*) distributed throughout the anoxic water column. However, the sediments deposited since 1480 AD (tephra in upper 50 cm) reveal a significant change in up-core redox and biodiversity. Reactive iron indicates fluctations between oxic and anoxic conditions until the uppermost sediments when the lake became permanently anoxic (FeHR/FeT > 0.38) and ferruginous (FePy/FeHR << 0.7). These deeper sediments are dominated by iron reducing bacteria. The C isotope composition of TOC also shifts at the top of the core from phytoplankton (-25‰) to bacterial carbon fixation (-34‰). Pyrite S isotope values systematically decrease by 19‰ up-core, suggesting sulfate became more available with time. This is consistent with the genomic data that indicate an increasingly diverse assemblage of anoxygenic photosynthetic sulfur bacteria (Chromatiaceae, Chlorobiaceae, and Rhodospirillaceae). Combined, our record indicates strong co-variation between geochemistry and biology occuring over short time-steps.