Particle-Associated Biogeochemical Processes in Fayetteville Green Lake, a high sulfur, permanently anoxic lake
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Key water column biogeochemical features

The autotrophic side of the sulfur cycle
In modern low O₂ environments, and thus probably the early world ocean during periods of anoxia, distinct communities of dark and photoautotrophic sulfur oxidizing and disproportionate autotrophs are abundant. Unlike phytoplankton inoxic environments, the maximum abundance of these primary producers is in deeper and nearly anoxic water where grazing is minimal and in close proximity to ballast minerals, so they have a higher likelihood of sinking to the sediment-water interface (Fig 2-3). Their spatial distribution and biogeochemical function is organized by the tolerance of their carbon fixation enzymes to oxygen, and thus vertical gradients in ambient dissolved oxygen concentration. Dark sulfur oxidizers' carbon fixation pathways fractionate carbon to differing extents while also fractionating sulfur by dark sulfur oxidation/disproportionation (Fig 6) [5,6]. Thus, the C-and S-cycles are intimately intertwined by autotrophic processes. This side of the sulfur cycle is often ignored when interpreting stable isotope data

References

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Figures
1. Location of Fayetteville Green Lake in New York State. Image source: maps.google.com (B) Topographic Map indicating the location of water sample state (yellow star) and sediment trap mooring station (purple star). Image modified from[1]
2. Unlike like biological pump in oxic systems, the main primary producers in Fayetteville Green Lake are cyanobacteria, anoxygenic photoautotrophic purple and green sulfur bacteria, and chemautotrophs, all of who live within one meter of the lower redoxcline boundary [3]. The biological material terms aggregates. The cyanobacteria cause precipitation of CaCO₃ which can make the aggregates more dense and enhance their settling velocity.
3. All data are from field experiments conducted during July 2017 other than zero-valent sulfur data [2] and O₂ data (courtesy of M. McCormick, Hamilton U.). IC asomioric carbon assimilation. BHP-Bacterial Heterotrophic Production. D.O.-dissolved oxygen. Dashed lines indicate upper and lower redoxcline boundaries. The peak in biomass corresponds to the maxima of autotrophic carbon fixation rate and elemental sulfur concentration in the lower redoxcline. Dashed lines are upper and lower redoxcline boundaries
4. In-situ incubation experiments: who (sulfur oxidizer) and how do they make a living: ¹⁴C-HCO₃ stimulation(Fig 4) experiments, Stable Isotope Probing-Raman-Fluorescence in situ hybridization
5. Raman shift spectrum of PSB aggregates collected sediment traps deployed at 40m depth match those of S8 elemental sulfur, showing 50 is being exported to the deep lake in biogenic aggregates. Reference spectrum from [4]