

Pyrite and organo-sulfur formation in modern euxinic lakes

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Reduced sulfur (S) undergoes inorganic and organic reactions within water column and sediments during burial. Studies have focused on modern euxinic systems where S isotopes can potentially differentiate the relative pathways that lead to pyrite and organo-S compound (OSC) formation. Mahoney Lake, Canada and Green Lake, New York, contain productive communities of phototrophic purple S bacteria and sulfate-reducers. The different degrees of euxinia between the two lakes ($H_2S \approx 35$ mM in Mahoney and 2 mM in Green Lake) can help elucidate factors that influence S burial. Dissimilatory sulfate reduction is the dominant process of S isotope fractionation in the water column of both lakes resulting in a large isotope offset between sulfate and sulfide ($\Delta^{34}S > 50\%$). Within the Mahoney Lake sediments, the $\delta^{34}S$ of total organic sulfur (TOS) is higher than pyrite $\delta^{34}S$ by 15‰, yet this isotopic difference decreases downcore down to nearly a zero offset. In contrast, TOS has $\delta^{34}S$ values 10‰ higher than those of pyrite in Green Lake surface sediments. We hypothesize that different kinetic rates of pyrite and OSC formation influence the partitioning of reduced S in these two pools and their S isotope compositions. Our geochemical kinetic modeling evaluated the dominating pathway by varying the environmental parameters (C_{org} , H_2S , Fe) of the system. Initial results show that only significant levels of labile organic carbon (e.g. citral) can trigger organic matter sulfurization rates in levels similar to those of pyritization. These kinetic rates potentially lead to the incorporation of an isotopically similar S inorganic source to pyrite and TOS during the same timescale associated with the zero isotope offset. In addition, FT-ICR-MS analysis of organic matter within the water column of Mahoney lake revealed an abundant and diverse array of OSCs. This suggests that rapid sulfurization of organic matter can occur syngenetically. We continue to explore constraints on the isotopic compositions of these two S pools.