Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.34650

Controls on iron sulfide formation and preservation in euxinic lakes of New Hampshire, USA

SARAH P. SLOTZNICK[1], JOSEPHINE G BENSON[1], BRYCE STOLTZ[2], ROGER R FU[3], COURTNEY L WAGNER[2] AND WILLIAM D LEAVITT[1,4]

[1]Dartmouth College
[2]Kent State University
[3]Harvard University
[4]University of Utah

Sedimentary iron sulfides, including pyrite (FeS_2) and greigite (Fe_3S_4), are heavily utilized in chemical, mineralogical, and isotopic proxies for Earth's surface redox state over millions and billions of years. However, the mineralization pathway(s) for these phases are poorly understood. Although it is known that microbial sulfate reduction provides sulfide for these reactions, several recent studies of laboratory culturing experiments and modern environments highlight further microbial roles in the mineral formation process [1]. In a novel approach, we combine environmental magnetism with geochemical and microscopic analyses to characterize water columns and sediments in geochemically stratified lakes. These case studies provide expanded insight into processes that typically occur over millimeters to centimeters in sediments, but span meters in water columns in these lakes. We studied two anoxic and sulfidic stratified lakes 115-kilometers apart in New Hampshire, USA to examine the effects of small variations in the properties of both lakes on mineral formation and preservation. Magnetic characteristics of particulates filtered from the water column reveal mineral formation in anoxic bottom waters and suggest dissolution occurs there as well as in shallow oxygenated waters. Magnetic analyses of water-column particulates and lake-bottom sediments along with elemental analyses and transmission electron microscopy support the presence of greigite in both lakes, although the role of biology in greigite formation is unclear. Magnetite-forming magnetotactic bacteria are positively identified in one lake. Inter-site comparison highlights that pH of the overlying water column, trophic status, and detrital inputs are influencing magnetic mineral formation and preservation. By understanding the controls on iron-sulfide mineral formation in freshwater, low-iron lakes, our results pave the way for future work illuminating microbial influences on mineralization and the signals preserved in geologic records.

[1] Mansor, Duverger, Pasquier, Gorlas, Guyot, Berg, Marin-Carbonne, Cosmidis, & Picard (2025) *Geo-Bio Interfaces*, 2, p. e6. doi:10.1180/gbi.2024.9