Title:
Microbial versus geochemical drivers of pyrite formation: the case study of two alpine freshwater lakes

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Abstract (300 words maximum): :
Sulfur is a key component of both the geo- and biospheres. Microbial sulfate/sulfur reduction drives an active redox cycle in surface environments, resulting in the formation of hydrogen sulfide and pyrite (FeS2) through subsequent chemical reactions. By sequestering reducing power, pyrite plays a crucial role in regulating the oxidation state of the atmosphere and is ubiquitously used as a tracer of past environmental conditions. Even though it has become clear that microbes might have other roles in pyrite formation than supplying the necessary sulfide, it has proven to be challenging to link these processes to environmental parameters. Here, we couple microbial ecology and aqueous geochemistry to investigate the main drivers of pyrite formation in the sediments of two adjacent alpine freshwater lakes, Stellisee and Grünsee, sharing the same catchment basin and previously shown to contain pyrite. Redox and sulfide microsensor measurements showed that Stellisee sediments were consistently more reducing with the presence of free sulfide recorded at one site. Preliminary analyses show that sulfur-cycling microbes are present in both lakes at high relative 16S rRNA gene abundances (from 3.5 to 16% per some samples). The most abundant sulfate-reducers were the Sva0081 sediment group, Desulfatirhabdium and Desulfobacca, while the most prominent sulfur-oxidizers were Sulfuriferula and Thiobacillus. A comparison of microbial communities at the general and sulfur-specific levels found no significant differences between lakes, although differences were observed across sampling sites within Stellisee. In other words, even though the two lakes and their sediments are geochemically distinct, microbial communities, that could be possibly involved in pyrite formation, are surprisingly similar. Future investigations will focus on correlating microbial diversity to a more detailed suite of geochemical parameters, as well as the morphological characterization of pyrite to disentangle key players and/or patterns in its formation in these disparate sediment basins.