Microbial dissolution of Se-jarosite by *Shewanella putrefaciens* CN32

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Introduction

Jarosites form in acidic, low temperature, sulfate-rich environments. Jarosite minerals scavenge trace elements, and are involved in trace metal cycling. Selenium (Se) is a trace element in human and microbial metabolism, but is chronically and actuely toxic in higher doses [1]. In jarosites, Se can completely substitute for the sulfate group ($MFe_3(SO_4)_x(SeO_4)_{2-x}(OH)_6$) [2]. Prior studies have focused on microbial interactions with the two aqueous Se oxyanions, selenate (SeO_4^{2-})and selenite (SeO_3^{2-}) but therie has been limited investigations pertaining to bacterial-mineral chemical pathways [3,4,5]. In this study, the circumneutral dissolution of jarosites with a range of Se-substitution for tetrahedral coordianted sulfate in the presence of *Shewanella putrefaciens* CN32 was examined under anaerobic conditions.

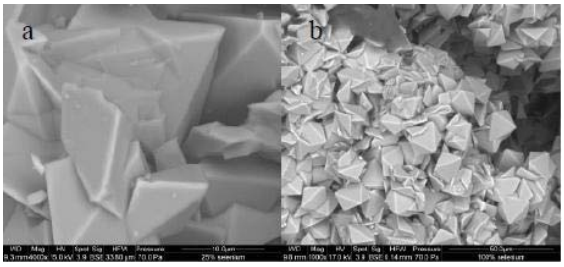

Figure 1: BSE-SEM images of Se-jarosites a) 25% Se substitution b) 100% Se substitution for sulfate

Results and Conclusion

Microbial biomass, ATP, SEM, [Se] and solution chemistry were considered during the experiment to evaluate the influence *Shewanella putrefaciens* CN32 on Se-jarosite dissolution. The reduction and fate of Se will be discussed to provide a better understanding of the interaction of bacteria and Se-minerals in reducing environments.

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Yucatán hydroclimate during the Maya 'megadroughts': Speleothem records of multiple hazards and a test of the hurricane masking effect

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Severe and persistent megadroughts in the Yucatan peninsula have been associated with the so-called 'collapse' of the Maya high civilization in the Terminal Classic Period (TCP) around 900-1000 C.E. [1] An annual stable isotope record from the Chaac speleothem showed that TCP 'megadrought' was rather a series of 8 severe droughts lasting 3-18 years in the interval betweel 800 and 950 C.E., punctuated by brief moist periods characterized by low $\delta^{18}O$ values[2]. We present a nearby annually-dated multiproxy stalagmite record (CH-1), and compare it to the Chaac stable isotope record as a replication test for a coherent regional climate signal.

The CH-1 stalagmite also contains a conservative record of severe tropical cyclone flooding events, as mud layers embedded within the calcite laminae from cave flooding events [3]. In the 20th century historical period, all flooding events in this low-lying cave are associated with years of local hurricane rain events and associated temporarily high levels of the regional water table. Mud layers in CH-1 thus indicate some years with hurricane rainfall. In the 20th century historical period, the threshold for CH-1 mud layer emplacement varies with pre-existing hydrologic conditions; i.e. mud layers are less likely to be emplaced, even by severe storms, when the pre-existing water table was low due to persistent drought. Likewise, mud layers in CH-1 are more likely when the water table is elevated due to wet conditions and/or repeated hurricane events. Historical hurricanes and droughts are associated with other hazards such as wildfire. We combine stable isotope, stratigraphic, and trace element records from CH-1 to track multiple hazards.

In comparing the two local stalagmite records, we note a curious relation during the TCP between tropical cyclone activity (CH-1 mud layers) and breaks in the megadrought sequence (Chaac $\delta^{18}O$ values). Infiltrating hurricane rainwater, which has an anomalously low stable isotopic composition [6], can depress the $\delta^{18}O$ value of speleothem calcite for months to years after the storm event [5]. If this masking effect from hurricane rainfall has altered the speleothem isotopic record during the TCP, then we would expect that years with high hurricane rainfall would be correlated with years with low calcite $\delta^{18}O$ values. Furthermore, we would expect that during peristent drought, years with low hurricane activity would correlate to times with high speleothem $\delta^{18}O$ values. We present a test of the hurricane masking effect in Yucatan speleothems during the Terminal Classic 'megadroughts', and discuss the implications for tropical speleothem paleoclimatology, and for understanding complex patterns of human-climate interactions during this event.

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