

## Elucidating the role of chemolithotrophic sulphide-oxidizers in the formation of S(0) deposits

P.A. HENRI<sup>1\*</sup>, C.S. CHAN<sup>1</sup>, J.L. MACALADY<sup>2</sup>, S.M. WEBB<sup>3</sup>, A. STEELE<sup>4</sup>

- <sup>1</sup> Dept. of Geological Sciences, University of Delaware  
(\*correspondence: henri@udel.edu)  
<sup>2</sup> Dept. of Geosciences, Pennsylvania State University  
<sup>3</sup> Stanford Synchrotron Radiation Lightsource  
<sup>4</sup> Carnegie Institution of Washington

S(0) is a central intermediate in the S-cycle, commonly produced and dissolved by microbes. While it is very possible that microbial S(0) production could ultimately lead to economic-scale sulphur deposits, we do not know the conditions that would lead to preservation. To understand the fate of biogenic S(0), it is paramount to determine the composition and characteristics specific to biogenic S(0) and how they affect reactivity and bioavailability. Extracellular S(0) deposition by sulphide oxidizing microorganisms is also of great ecological importance since it releases reactive species, available for other S(0) oxidizers, reducers, and disproportionators in the environment. However, the mechanisms of biogenic extracellular S(0) deposition and the properties of the biogenic deposits have still to be fully elucidated. In this study we characterized biogenic S(0) produced by (1) two isolates of sulphide-oxidizing *ε-proteobacteria* and (2) S(0)-rich biofilms formed during an *in situ* colonization experiment in the Frasassi sulphidic cave, using thermogravimetry and spectroscopy (Raman, XANES). Colonization devices were quickly covered by white filamentous biofilms. The colonization was sampled over 17 days. Analyses of 16S rRNA genes showed that streamer filaments were *Sulfurovumales* (S-oxidizing *ε-proteobacteria*), while Raman spectroscopy confirmed the presence of abundant extracellular S(0) associated with the filaments. The Frasassi and cultured biogenic S(0) globules all contained crystalline  $\alpha$ -S<sub>8</sub>. Abiotic S(0) sols had the same average composition but were more reactive in that they were more sensitive to photo-oxidation than biotic globules. Previous work on a phototrophic sulphide oxidizer, suggests that organic material coats S(0)-globules. Surface analyses are ongoing to determine if this could explain the higher stability of chemolithotrophic biogenic S(0). In addition to S(0) globules, rhombic S(0) is also present in the Frasassi biofilms. Rhombic sulphur may form by sulphide-induced transformation of the original material, as evidenced by overgrowths. Sulphide oxidizers that form S(0) globules, can further oxidize them when other electron donors are depleted. We showed that both the isolates and the filamentous bacteria from the Frasassi biofilms were able to consume S(0) globules, none were able to consume the rhombic S(0). This suggests that in environments with a high sulphide flux, biogenic S(0) could quickly age and accumulate despite the presence of S(0)-consuming microbes. Metagenome analyses of cave samples are in progress to elucidate the genetic mechanisms and the role of the extracellular S(0)-producers and ecological interactions in S(0) accumulation.