Experimental silicification of sulfur-oxidizing bacteria and carbon-sulfur biomorphs

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The development of biogenicity criteria allowing the discrimination of true and false microbial fossils is crucial for future astrobiological research, as well as for the interpretation of microbial signatures in the rock record. In recent years, biomorphic filamentous and spherical structures composed of organic carbon and elemental sulfur (S^0) have been formed in experimental contexts under abiogenic conditons [1], potentially challenging the validity of "microfossils" of sulfur-cycling bacteria discovered in the geologic record. Many putative Precambrian fossils are found preserved in cherts and other siliceous formations; consequently, experimental silicification provides a lens into the formation mechanisms and preservation of fossilized bacteria in such contexts.

We silicified at room temperature (1) environmental samples of filamentous sulfur-oxidizing bacteria (dominated by *Thiothrix*) and (2) biomorphic carbon-sulfur filaments. Samples were collected at different time intervals over a six-month period. Before silicification, the two kinds of experimental samples (abiotic and microbial) presented morphological and compositional similarities, both being composed of S^0 associated with micrometric organic filamentous structures. We characterized changes in morphology, carbon and sulfur distribution and chemical speciation, and silica encrustation over time, using a range of techniques including scanning electron microscopy, transmission electron microscopy, X-ray spectromicroscopy, Raman spectromicroscopy, and fourier-transformed infrared spectroscopy. Our results help establish a baseline for the interpretation of the abiogenic versus biological origin of putative silicified sulfur-oxidizers in the ancient rock record.

[1] Cosmidis & Templeton (2016), *Nature Communications* **7**, 12812.