

Evaluation of S⁰ as a biosignature in laboratory and field experiments

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Elemental sulfur (S⁰) in the environment is frequently interpreted as having been produced by S-cycling bacteria. Several crystalline phases (α -S₈, β -S₈, and γ -S₈ allotropes) of S⁰ exist in nature. It was recently discovered that micrometric S⁰ spheres encapsulated with carbon can be produced in the absence of any microbial activity through the reaction of dissolved organic compounds with sulfide, a process called organomineralization [1]. Organomineralized S⁰ commonly exists as the metastable allotropes β -S₈, and γ -S₈, which are never present in biomineralized S⁰. STXM analyses of samples collected from the Frasassi cave system (Italy) reveal S⁰ encapsulated within organic matrices outside of microbial cells. S⁰ is present as β -S₈ based on XRD. XRD and TEM however show that intracellular S⁰ inclusions in the S-oxidizing bacterium *Thiothrix* are composed of amorphous or microcrystalline S⁰ (Figure 1).

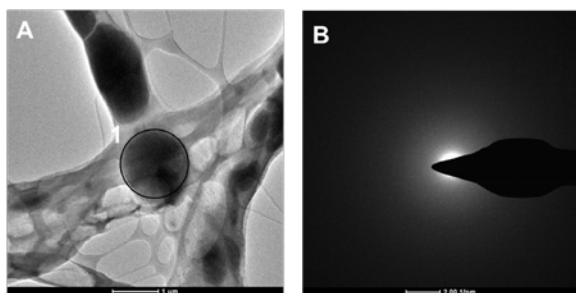


Figure 1: (a) TEM image shows S globules within filaments of *Thiothrix*. Circle depicts where SAED was collected; (b) SAED reveals that the S is amorphous or microcrystalline.

Our results suggest that S⁰ crystal structure and close association with extracellular carbon, may serve as signatures to discriminate organomineralization from biomineralization processes in the environment.

REFERENCES

[1] Cosmidis, J. and A.S. Templeton (2016) Nature Communications, 7.