A novel elemental sulfur biomineralization mechanism

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A variety of sulfide-oxidizing microorganisms have the ability to form and stabilize elemental sulfur (S^0). Microbial S^0 biomineralization usually results in the formation of S^0 globules that can be found inside or outside the cells. Here we describe a very original form of S^0 biomineralization by bacteria from the Flavobacteriaceae family that have been isolated from a cold sulfur-rich environment (Borup Fiord Pass, Canadian High Arctic).

When cultivated in the presence of opposing gradients of sulfide (H_2S) and oxygen, these bacteria produce a complex network of extracellular filamentous structures rigidly connecting to each other at 45° and 90° angles, and on which S^0 eventually precipitates during the oxidation of H_2S. S^0 is also formed at the surface of large (up to 1μm) outer membrane vesicles produced by the cells. We will present data from fluorescence microscopy, electron microscopy, synchrotron-based soft x-ray spectromicroscopy (STXM), and infrared nano-spectrocopy coupled with AFM, that provide insights into the chemical composition, ultrastructure and formation mechanism of these biomineralized structures. We will also discuss their potential as biosignatures in present and ancient sulfur-rich environments, as well as their potential utility in the material sciences field.

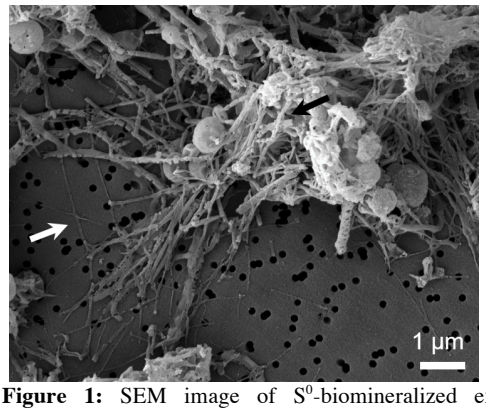

Figure 1: SEM image of S^0-biomineralized extracellular material produced by *Gillisia sp*. from Borup Fiord Pass. The white arrow points to non-mineralized filamentous structures whereas the black arrow points to filamentous structures encrusted with S^0. Large S^0-encrusted outer membrane vesicles are also visible.