GEOMICROBIOLOGY OF A COLD SULFIDE SPRING: USE OF ESEM TO REVEAL PATTERNS OF ELEMENTAL SULFUR DEPOSITION

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We have used environmental scanning electron microscopy (ESEM), together with transmission electron microscopy (TEM) and light microscopy to investigate a unique microbial community from a cold sulfide (3.8 mM) spring near Ancaster, Ontario, Canada. At its source, the anoxic spring waters host a wide variety of green sulfur bacteria and purple sulfur bacteria in accumulations of pink to brown-green mats with interspersed white patches. As the water flows downstream along the bottom of a small ravine, the channel bottom is whitened by extensive accumulations of colourless sulfur oxidising bacteria (both unicellular and filamentous). Using ESEM, mat features unobservable by other EM techniques were noted. We were able to see the extensive extracellular polymeric matrix (EPS) which forms the "glue" within which most of the mat cells were embedded. When equipped with an energy-dispersive xray spectrometer (EDS), ESEM also allows detection of elements, particularly sulfur, which tend to be lost or masked by the processes used to prepare samples for conventional SEM and for TEM thin sections. In our mats, elemental sulfur was present in many different forms at an estimated composition of 95-98% S. In regions where green sulfur bacteria were common (i.e., at the spring source), large masses of spherical sulfur grains were seen. In some cases, the sulfur took on specific forms, leading to the speculation that there may be underlying direction to its formation provided by a particular type of microorganism. In addition, the large spherical, intracellular sulfur grains present in filamentous colourless sulfur oxidising bacteria could be seen and analysed by ESEM-EDS. In this presentation, we wish to introduce this fascinating and complex microbial community and indicate the types of analyses that can be done using different forms of microscopy.