Who is driving the system? Microbial sulfur metabolism and autotrophic carbon-fixation at vents

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At deep-sea hydrothermal vents, microorganisms mediate the transfer of energy from the geothermal source to the higher trophic levels. In particular the microbial oxidation of reduced sulfur compounds through chemolithotrophic processes has been identified to be at the nexus of the biogeochemical carbon and sulfur cycles at these systems. Traditionally, gammaproteobacteria have been considered as important sulfur-oxidizers. However, in recent years metabolically versatile epsilonproteobacteria have been identified as a major component of microbial communities at deep-sea vents. We have previously identified a novel sulfur-oxidizing epsilonproteobacterium, which produces sulfur in filamentous form that is similar to material observed after volcanic eruptions. In the meantime, many autotrophic epsilonproteobacteria have been isolated and characterized from deep-sea vents, providing further evidence that these organisms play an important role in sulfur-, nitrogen-, and carbon cycling in these environments. These kinds of bacteria may form an important component of a subseafloor biosphere, a currently poorly defined, yet potentially critical component of deep-sea vents. Epsilonproteobacteria also emerge as the primary colonizers of newly exposed surfaces after disturbances, such as volcanic eruptions.

Many autotrophic bacteria and archaea occurring at deep-sea hydrothermal vents use pathways other than the Calvin-Benson-Bassham cycle for autotrophic carbon fixation. In particular the reductive tricarboxylic acid cycle, which is used by all autotrophic epsilonproteobacteria and *Aquificae* as well as some archaea, emerges as an important pathway, questioning the paradigm of the Calvin cycle being at the base of the food web of these ecosystems. Recent studies also suggest that oxidation of H_2 might be more important at deep-sea vents than previously thought. Along these lines, organisms have been identified that have the ability to obtain energy from the oxidation of H_2 as well as reduced sulfur compounds, representing a very useful strategy for persisting in these highly dynamic environments.

This presentation will provide an overview of our current understanding of chemoautotrophic processes at deep-sea hydrothermal vents and outline future research directions. In particular, it will be important to (1) measure relevant geochemical parameters on the scale of the microbes, (2) quantify autotrophic organisms, (3) assess whether these organisms are active in their environment, and (4) implement studies that couple the identity of microorganisms more directly with their function and metabolic rates. These integrated geochemical and biological studies will be greatly facilitated by having the genomes of representative chemolithoautrophic bacteria and archaea available.

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