**Interaction of Bacteria with Their Environment: Bacterial Surfaces Ensure Metal Ion Sorption and Fine-grained Mineral Development**

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Microorganisms are the most abundant life form on Earth and are capable of growing in almost any imaginable environment, sometimes even under extreme geochemical conditions. Prokaryotes have existed for ~3.6 Ga and have had a profound effect on the Earth as we know it (e.g., the global cycling of important elements including C, N, O, P, S and many metallic ions). As microbes grow, their metabolic products can alter geochemical conditions, and sometimes they can even use ionic couples as energy sources (e.g., dissimilatory iron reducing bacteria use Fe II/III). Archaea and bacteria share the common characteristics of having a relatively simple cellular design, minute size and variation in shape (Beveridge, 1989). These traits ensure an extremely high cellular surface area-to-volume ratio for these small cells so that they are exquisite nucleating agents for secondary mineral development. Indeed, bacteria rely on diffusion for obtaining foodstuffs and therefore require highly interactive surfaces to acquire solutes, including electrolytes. Frequently dilute metal ions are trapped by surface macromolecules lowering the interfacial free energy to the extent that precipitation often ensues (Warren and Ferris, 1998). Over time, dehydration can form bona fide crystalline mineral phases (Fortin *et al*., 1998). At the same time, these same reactive surfaces can attract preformed fine-grained minerals from the local environment and make strong anchoring sites for them. It is not unusual, then, to examine bacteria from natural environments and find them to be studded with an array of minerals, some newly developing and others that have been trapped from the external milieu. Certainly, too, these same surface mineral phases can also act as sinks for a variety of other ions within the local environment.

Because bacteria are so small, detection and characterization techniques for these mineral phases usually involve some sort of microscopy (e.g., transmission electron microscopy, atomic force microscopy, selected area electron diffraction, energy dispersive x-ray spectroscopy, electron energy loss spectroscopy, and electron spectroscopic imaging; Beveridge *et al*., 1996). Clearly, new optical systems now allow synchrotron radiation to be focused into sub-micrometer beams that are capable of discerning some of these bacterial phases. My talk will present an overview of bacterial surfaces and their interaction with the geochemical environment that surrounds them in hopes of encouraging more collaboration between the fields of geomicrobiology and high-energy physics.

**References**

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