Sequesteration and mineralization of metals in bacterial organelles

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Microbial sequesteration and mineralization of metals is a major driver of biogeochemical processes whose full impact has yet to be understood. One particularly fascinating example of microbe-metal interactions is the uptake and transformation of metals within specialized subcellular compartments in bacteria.

We study magnetotactic bacteria (MTB), organisms that use their magnetosome organelles to transform soluble iron into subcellular magnetic minerals (magnetite or greigite) that are used as an internal compass to navigate along geomagnetic fields. MTB are surprisingly ubiquitous in aquatic environments, are thought to represent the most ancient biomineralizaiton process, and are incredibly diverse in their genealogy and biomineralization behaviors. Over the last few years we have identified many of the genes required for biomineralization in two model organisms, *Magnetospirillum magneticum* AMB-1 and *Desulfovibrio magneticus* RS-1. Through this work we have discovered evolutionarily conserved pathways, as well as novel innvoations, that define the magnetite biomineralization processes of diverse MTB.

In the process of studying magnetite formation in RS-1, we discovered an independent organelle, called the ferrosome, which also sequesters iron within the cell. Surprisingly, the ferrosome appears to be widespread amongst many diverse bacterial species, raising the possibility that its activity can have an impact on the distribution of iron in various environments.

These two systems, the magnetosome and the ferrosome, highlight the diversity of microbial-metal interactions and the variety of genetic and biochemcial mechanisms that create organelles and minerals.