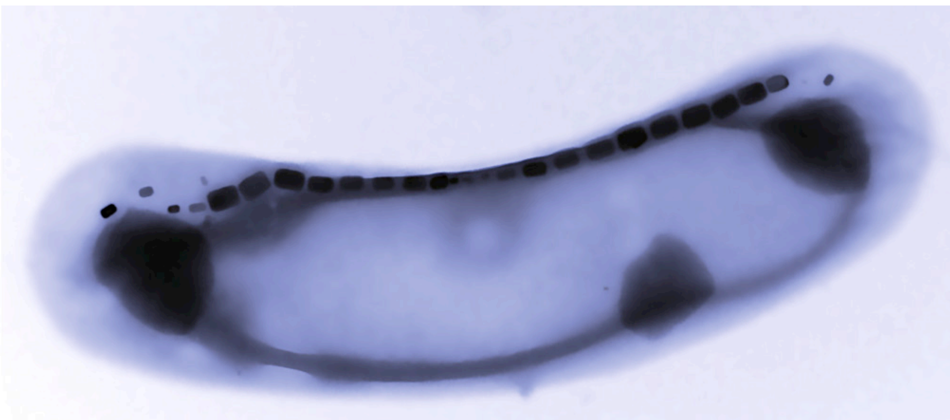
SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

Biomineralization of Nanosized Magnets for Nanotechnology

Impact Statement



SITUATION

Microorganisms are the oldest living inhabitants of planet Earth, spanning some 3.5 billion years, and their importance in shaping the Earth's soils, oceans, and atmosphere has long been accepted. The biosynthesis of magnetite (Fe_3O_4) by magnetotactic bacteria is an interesting example that has generated a great deal of interest because it is a nanoscale- mineral with magnetic properties that can have applications in miniaturized electronics, nanotechnology, and biomedical sciences. Furthermore, the biogeochemical cycling of iron by microorganisms (e.g., the accumulation and conversion of iron into Fe_3O_4 by magnetotactic bacteria) is of particular importance because iron is a ubiquitous and very reactive constituent of surface and subsurface environments and, as a result, impacts regional and global scale climatic and ecological phenomena. Despite the discovery of magnetotactic bacteria over 30 years ago, the mechanism for Fe_3O_4 biomineralization remains unknown.

RESPONSE

OSU scientists obtained funding from the U.S. National Science Foundation to study the biochemical mechanism by which magnetotactic bacteria synthesize magnetite. The scientists have identified several proteins that are involved in the biomineralization process and are developing novel forms of microscopy to study the function(s) of these proteins on a very small scale (i.e., nanometer scale).

IMPACT

Understanding the molecular mechanism by which bacteria direct the synthesis of magnetite nanoparticles represents an important paradigm for bioinspired materials synthesis that will provide enormous insight into the strategies of controlled crystal synthesis used by other organisms, including multi-cellular organisms such as humans. Because the mineralization process in microorganisms is inherently controlled by nanoscale structures (e.g., proteins), this knowledge will become the basis for bio-controlled approaches to synthesize tailor-made inorganic nanostructures for applications across a diverse span of nanotechnologies. Furthermore, the novel imaging techniques developed as a result of this project have emerged as powerful tools for single-molecule microscopy that can be used for studies in other biological systems.

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