“From Genes to Ecosystems: Understanding How the Ocean’s Most Abundant Photosynthetic Organisms Use Iron”

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Abstract:

The ocean is a complex web of microbial life. The genes of the ocean’s microbial inhabitants have the potential to reveal a tremendous amount about global-scale processes like the cycling of greenhouse gases. Marine cyanobacteria are central to understanding this cycling because they account for 20-30% of the 104 billion metric tons of carbon dioxide consumed annually by photosynthetic organisms. In many parts of the ocean their growth is limited by a lack of iron, an essential nutrient that is virtually insoluble in seawater. To overcome this, cyanobacteria have evolved a number of strategies to acquire iron. Gene distribution, metagenomics and physiological assays near Costa Rica and the Galapagos islands have revealed that iron limitation is, paradoxically, more severe in coastal areas than in the open ocean, where iron is less abundant. Despite average surface ocean iron concentrations of just 0.07 nM, most marine cyanobacteria lack iron-binding siderophores that are present in many pathogenic bacteria and heterotrophic marine bacteria. In fact, a common class of siderophores can actually inhibit the growth of cyanobacteria independently of iron limitation, effectively acting as antibiotics. This raises interesting questions about the true ecological purpose of siderophores and the nature of iron limitation.