Expanding Our Understanding of Photoautotrophic Iron Oxidation on Earth

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Iron is critical for all living organisms as both a nutrient, and as an electron donor or acceptor for microbial metabolism. Fe(III) can serve as a terminal electron acceptor for iron-reducing bacteria and Fe(II) can serve as an electron donor for iron-oxidizing bacteria. Phototrophic Fe(II)-oxidation (photoferrotrophy) is a special form of iron oxidation through which some bacteria can use the energy of light and electrons from Fe(II) to fix carbon dioxide to biomass. The mechanisms underlying photoferrotrophy are relatively unexplored. This is largely because we only have one model organism to study this process, a freshwater purple nonsulfur bacterium (PNSB) named *Rhodopseudomonas palustris* TIE-1. Given the abundance of iron on Earth, the significance of photoferrotrophy may extend beyond our current understanding. For example, we don't fully appreciate the role of photoferrotrophy in marine environments. Using a collection of natural isolates of marine PNSB, we investigated the prevalence of photoferrotrophy in marine ecosystems. We used an unbiased approach to isolate PNSB from a brackish estuary near Woods Hole, MA. We sequenced the genomes of all these isolates, and using comparative genomics, we determined these isolates consist of *Rhodovulum sulfidophilum*, *Rhodobacter sphaeroides*, and *Marichromatium spp*. Of the 22 organisms isolated, 18 were capable of Fe(II)-oxidation, including each of our *Rhodobacter* and *Rhodovulum* isolates. The Fe(II) rates demonstrated by these isolates was faster than any other known photoferrotroph. We are currently generating a knockout for genes to play a role in photoferrotrophy. Overall, our data suggests photoferrotrophy may be prevalent in PNSB and points to a novel photoferrotrophy mechanism in *Rhodobacter* and *Rhodovulum* isolates.