Cryptic cycling of iron-organic matter complexes by phototrophic Fe(II)-oxidizing bacteria

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Microbial and abiotic iron (Fe) redox cycling, including reduction of Fe(III) and oxidation of Fe(II), occurs in aquatic and terrestrial environments and can strongly influence both the behavior of environmental contaminants and many other biogeochemical cycles [1]. However, this Fe cycle can also be 'cryptic' due to the rapid oxidation of Fe(II) and reduction of Fe(III), so that their concentrations remain extremely low and stable despite a rapid turnover. It has previously been shown that Fe can be cycled rapidly either purely microbially or purely abiotically in a way that no measurable changes in Fe(II) and Fe(III) concentrations were observed [2, 3].

By combining geochemical modeling, cell growth experiments and non-growth cell suspension experiments with representative phototrophic Fe(II)-oxidizing bacteria (*Rhodobacter ferrooxidans* SW2), we have demonstrated a new type of light-driven cryptic Fe cycle that is relevant for the photic zone of environmental habitats [4]. This new type of cryptic Fe cycle involves both microbial and chemical processes: abiotic photochemical reduction of Fe(III)-organic matter complexes and microbial anoxygenic phototrophic Fe(II) oxidation.

This new type of cryptic cycle of Fe has important implications for biogeochemical cycling of iron and carbon. This cryptic cycle of Fe not only supports the growth and carbon fixation of Fe(II)-oxidizing bacteria in habitats with low Fe(II) concentration, but also continuously promotes the release of labile carbon for a heterotrophic bacterial community. Overall, the result of our study suggests that Fe cycling in organic-rich photic habitats could be more prominent and have a larger influence on carbon cycling than previously thought based on the measured low concentrations of Fe.

[1] Borch et al. (2010) *Environ. Sci. Technol.* 44, 15-23.
[2] Barbeau *et al.* (2001) *Nature* 413: 409.
[3] Berg *et al.* (2016) *Environ. Microbiol.* 18: 5288-5302.
[4] Peng *et al.* (2019) *Appl. Environ. Microbiol.* In press.