Microaerophilic iron-oxidizing microbial community coupling with carbon assimilation in paddy soil

CHEN YATING, CHEN LINXING, LI XIAOMIN, LI FANGBAI*, LIU TONGXU

Guangdong Institute of Eco-Environmental and Soil Sciences, Guangzhou 510650*, P. R. China,*
cefbli@soil.gd.cn

Iron is the fourth most abundant element in Earth's crust and has long been recognized as a physiological requirement for many microorganisms in soils and sediments. Microbial Fe redox cycling at circumneutral pH can significantly affect many soil geochemical processes, including degradation of organic matters, mineral weathering, metal mobilization, and greenhouse gas emissions. Microaerophilic, neutrophilic iron-oxidizing bacteria (FeOB) can use Fe(II) as an electron donor for carbon assimilation into biomass under low oxygen conditions, which have profound influences on carbon/iron cycling in iron-rich environments. However, little is known about the composition and ecology of FeOB communities in paddy soil, which is considered to be the most important model system for research into iron cycling and carbon sink. Hence, to investigate the microaerophilic FeOB in paddy soil at circumneutral pH and to explore the potential linkage between iron oxidation and carbon fixation, we described the enrichment of FeOB communities from the paddy soil sampled in PRD, and studied the carbon fixation and biomineralization by FeOB. Additionally, we utilized both 16S rRNA pyrosequencing and metagenomic analyses to characterize potential FeOB communities associated with the iron oxidation process coupling with carbon assimilation. The mineralogical analyses indicated the presence of an amorphous and poorly crystalline phase as a result of microbial oxidation of Fe(II). Pyrosequencing and metagenomic analyses of microbial communities indicated that the genes encoding key enzymes for microbial carbon fixation (Calvin-Benson-Basshamn cycle) were largely from *Acidovorax*, *Azospirillum*, *Dechloromonas*, *Flavobacterium*, *Leptothrix*, and many uncultured microorganisms. This study first reveals the distribution of microaerophilic Fe(II)-oxidizing bacteria in paddy soil and will help with understanding carbon assimilation coupling to the iron oxidation process in this habitat.

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