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Identification of dissimilatory iron-reducing bacteria in anoxic rice soil microcosms by stable isotope probing of RNA

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Microbial ferric iron oxide reduction is an important biogeochemical process in anaerobic soils and sediments. Dissimilatory ferric iron-reducing microorganisms gain energy from coupling oxidation of organic compounds or hydrogen to the reduction of ferric iron(hydr)oxides, which are basically insoluble at circumneutral pH. The reduction rate appears to be higher for amorphous iron (III) oxides such as ferrihydrite compared to more crystalline iron oxides (e.g., goethite).

In rice field soil, ferric iron minerals are rapidly reduced upon soil flooding and at oxic-anoxic interfaces, where iron redox-cycling occurs. However, the microbial populations involved are largely unknown. In this study, we used stable isotope probing (SIP) of rRNA to identify the microbial populations, actively involved in the reduction of ferric iron minerals (e.g., ferrihydrite, lepidocrocite, goethite, and hematite) typically found in rice paddies. After the reduction of endogenous ferric iron, iron (III) oxide minerals (40 μmol g dry soil^{-1}) were added and iron-reducing microorganisms were probed with ^{13}C-labeled acetate (0.5 mM) as electron donor. Iron reduction and acetate turnover were followed over time, to enssure sufficient but short label application. Upon nucleic acid extraction, "heavy", ^{13}C-enriched RNA and "light", unlabelled RNA were separated by density gradient centrifugation and the community structure was characterized by T-RFLP analysis as well as cloning and sequencing of 16S rRNA. Here, we present a comparison of the microbial populations involved in iron reduction in the presence of different iron oxides.