Changes in microbial communities during anaerobic nitrate reduction and Fe(II) oxidation at circumneutral pH in paddy soil

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Paddy soils in South China are with high Fe contents and highly modified by anthropogenic activities with high inputs and accumulation of organic C and N. However, few studies have investigated microbial communities changes during NO_3^- reduction and Fe(II) oxidation in paddy soils. In this study, kinetics of NO_3^- reduction and Fe(II) oxidation in paddy soil were investigated under anoxic conditions at circumneutral pH using three different treatments (i.e., Lactate+Fe(II), Lactate+NO_3^- and Lactate+NO_3^-+Fe(II)). NO_3^- could be rapidly reduced to NO_2^- within two days in treatments of Lactate+NO_3^- and Lactate+NO_3^-+Fe(II), and the presence of Fe(II) facilitated NO_2^- reduction. Whereas no obvious Fe(II) oxidation was observed in Lactate+Fe(II) treatment, Fe(II) oxidation took place only when NO_3^- was added. Illumina high-throughput sequencing results showed that the phyla of *Proteobacteria* and *Firmicutes* had a dominant presence in all three treatments. *Acidaminobacter*, *Proteiniclasticum*, *Alkaliphilus* and *Natronincola* were found to be the dominant genera during NO_3^- reduction without Fe(II), and all were seldom reported to be associated with NO_3^- reduction. *Azospira*, *Zoogloea* and *Dechloromonas* dominated during NO_3^- reduction in the presence of Fe(II), and all are betaproteobacterial NO_3^--reducing bacteria that do not produce ammonium as end products. Whereas *Azospira*, *Zoogloea* and *Dechloromonas* have been identified from NO_3^--reducing Fe(II) oxidation culture previously, the NO_2^- produced by these bacteria can also oxidize Fe(II) abiotically, resulting in facilitated NO_2^- disappearance in the Lactate+NO_3^-+Fe(II) treatment. These findings increase our understanding of the NO_3^- reduction processes in the absence and presence of Fe(II) in anoxic paddy soil at circumneutral pH and extend our knowledge of the microbial communities involved in these processes.

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