Interactions of C, Fe and P biogeochemical cycling in methanogenic environment

LI ZHUANG[1]*, JIA TANG[2], ZIYANG TANG[3]

[1]School of Environment, Jinan University, Guangzhou 510632, China. zhuangli@jnu.edu.cn
[2] Guangdong Institute of Eco-environmental & Technology, Guangzhou 510650, China. tangjia@soil.gd.cn
[3] Guangdong Institute of Eco-environmental & Technology, Guangzhou 510650, China. 1184780014@qq.com

Recent studies found that conductive iron oxides can facilitate microbial methanogenesis in anoxic ecosystems[1-4], while poorly crystalline iron oxides always exert inhibitory effect on methanogenesis[5-6]. This implies that type of iron oxides might be important to regulating methane production. In natural environments, the formation of secondary iron minerals is controlled by complex environmental factors, in which phosphate is often considered as primary factor[7]. Thus, methanogenesis in the presence of different iron minerals that regulated by phosphate indicate an interaction of C, Fe and P biogeochemical cycling in methanogenic ecosystem.

In this study, we investigated the response of methanogenic activity to different biomineralization pathways of ferrihydrite controlled by phosphate concentration in both paddy soil enrichment and defined co-culture of *Geobacter-Methanosarcina*. Experimental results showed that vivanite and magnetite were the secondary mineralization products from ferrihydrite bioreduction with and without phosphate, respectively. Utilizing acetate, ethanol and propionate as substrate, methanogenic activities in the presence of magnetite formation were always higher than those in the presence of vivanitite formation. The facilitated methanogenesis is likely associated with magnetite-mediated direct interspecies electron transfer between syntrophic bacteria and methanogens. This study might cast a new light on the biogeochemical cycling of C, P and Fe in anoxic soils and sediments.

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