Biochar Mitigated Zerovalent Iron-Induced Methane Emissions in an Arsenic-Contaminated Paddy Soil: The Mechanism

Chengyu Ding, Wan Yang, ***Shengsen Wang***
Yangzhou University, Yangzhou, Jiangsu, China

Biochar (BC) and zerovalent iron (ZVI) can synergistically enhance immobilization of arsenic (As), but their synergistic effects on mediating methane emission in As-contaminated soils remain largely unknown. Here, the responses of soil organic carbon, methane emissions, and microbial community to combined use of ZVI and BC in an As-contaminated paddy soil were investigated in an incubation experiment. The results indicated that ZVI reduced As bioavailability by 65%, which was further enhanced by BC, however BC alone increased As availability by 36%. Regarding methanogenesis and oxidation, As discouraged methane emissions in soil partially due to decreased diversity and richness of bacterial and archaeal communities. Besides, ZVI remarkably stimulated methane emissions by decreasing soil redox potential, promoting organic substrate degradation, and enhancing hydrogenotrophic methanogen Methanobacterium. The ZVI-induced methane emission was alleviated by BC application. Firstly, BC inhibited methanogenesis because of promoted iron oxidation and decreased hydrogenotrophic methanogens abundance. Secondly, BC facilitated methane oxidation by enriching methane oxidizing bacterium Methylomonas and metabolic function. That is, BC can enhance As immobilization and mitigate ZVI-dominated methane emission. These findings highlighted the impact of BC and ZVI on carbon-iron-As nexus and its potential for simultaneous As mobilization and carbon sequestration in paddy soils.