Microbial biomass change shifts the role of iron oxides in organic C mineralization in anoxic paddy soil

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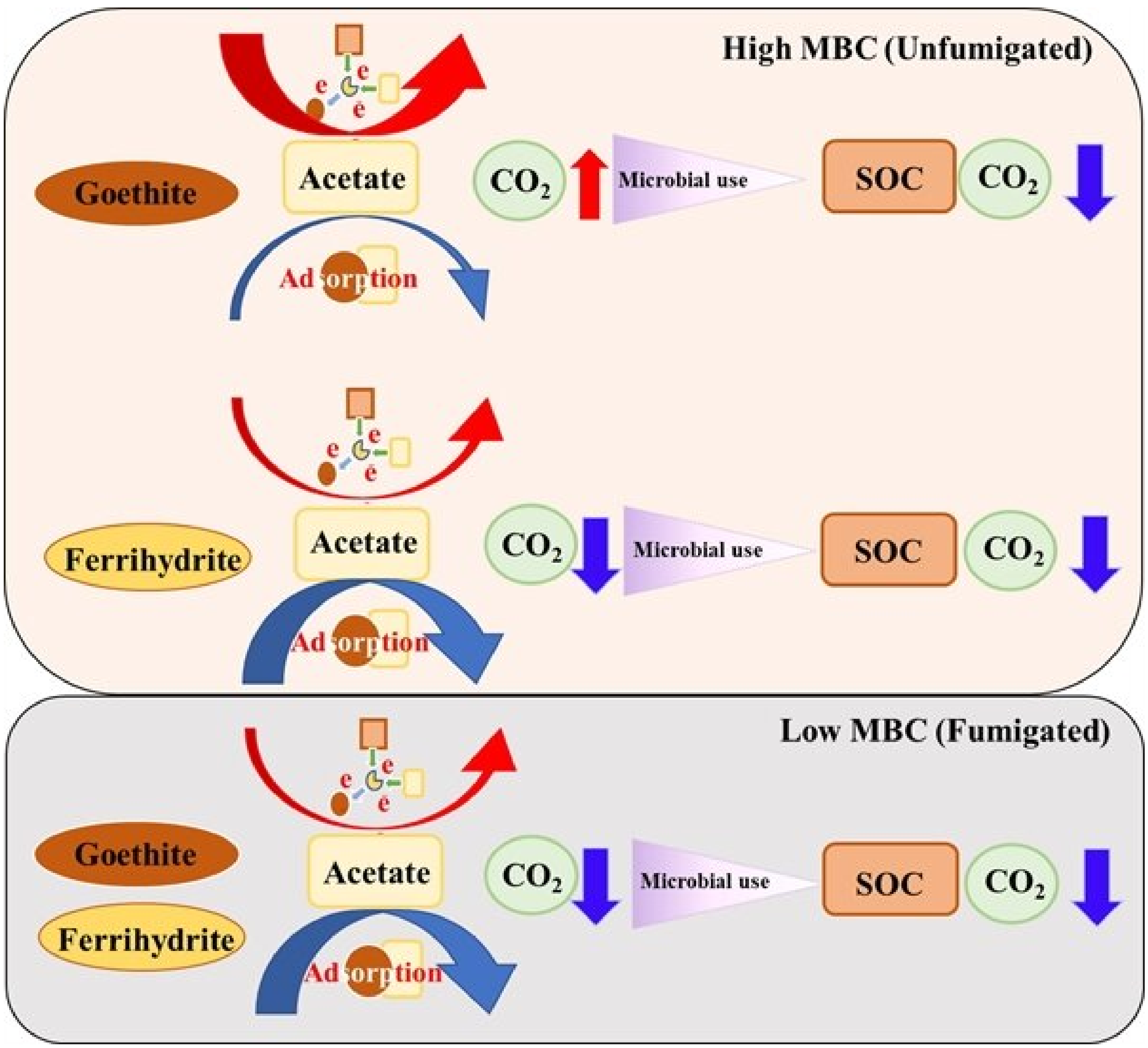

Conceptual model of the effect of iron oxides on CO2 emissions in anaerobic paddy soil with different levels of MBC. Credit: LI Yuhong

In paddy fields, water management creates long-term anaerobic conditions in which soil organic carbon (SOC) mineralisation is largely coupled with redox processes. Iron oxides are one of the main minerals in paddy soils, and over 80% of soil anaerobic respiration depends on iron reduction.

In addition, under anaerobic conditions, microbial communities that are functional for redox processes are mostly responsible for respiration and decomposition. However, how changes on microbial biomass and communities may affect SOC mineralization and the role of iron oxides in this process remain unclear.

A research group led by Prof. Wu Jinshui from the Institute of Subtropical Agriculture (ISA) of the Chinese Academy of Sciences conducted an experiment by adding acetate (^{13}C-labeled) and iron oxides (i.e., ferrihydrite and goethite) to unfumigated and fumigated soils under anaerobic conditions to reveal the effects of iron oxides and microbial biomass on organic C mineralisation in anoxic paddy soils.

Iron oxides can provide electron acceptors promoting organic matter mineralization, and adsorb some organic matter compounds limiting their mineralization.

The researchers found that in the unfumigated soil with high microbial biomass, ferrihydrite and goethite, two typical soil iron oxides differing in their crystallinity, had diverse effects on acetate mineralisation.

Goethite mainly acted as electron acceptors and increased acetate mineralisation, whereas ferrihydrite contributed to both iron reduction and acetate adsorption, resulting in the little negative effect on acetate mineralisation.

However, SOC and acetate mineralisation was sensitive to change of microbial biomass. When the microbial biomass was low (i.e. after fumigation), iron oxide addition decreased CO_2 emissions, both from acetate and SOC, because the dominant role of iron oxides was to adsorb and limit acetate accessibility to microorganisms.

These results highlight the importance of microbial biomass in shifting the role of iron oxides in the organic C mineralisation in soils under anaerobic conditions.

The study was published in *Biology and Fertility of Soils*.

More information: Yuhong Li et al. Contrasting response of organic carbon mineralisation to iron oxide addition under conditions of low and high microbial biomass in anoxic paddy soil, *Biology and Fertility of Soils* (2020). DOI: 10.1007/s00374-020-01510-8

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