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Microbes and arsenic biogeochemistry: A dynamic interplay

SARAH ZECCHIN AND LUCIA CAVALCA

University of Milano

Microorganisms play a key role in arsenic biogeochemistry, driving its speciation and bioavailability. This is critical in ecosystems related to human drinking water and food supply, such as groundwater and rice paddies.

As a redox-active element, arsenic is influenced by redox potential and pH. Its interactions with sulfur- and iron-based compounds suggest a close link between arsenic biogeochemistry and sulfur- and iron-cycling microbial populations. This complex interplay has been explored in micro-oxic/reducing groundwaters, where iron-reducing microorganisms were associated with the presence of arsenite, leading to the selection of arsenite-oxidizing microbial populations[1].

In rice paddies, water management significantly shape rhizosphere microbial communities and key iron- and sulfur-cycling microbial populations inhabiting root rhizoplane that in turn impact arsenic mobility and plant uptake[2]. Specifically, continuous flooding promotes arsenite-releasing microorganisms such as arsenate- and Fe(III)-reducing, and sulfur-oxidizing bacteria. Conversely, aerobic rice cultivation favors arsenite- and Fe(II)-oxidizing microorganisms, correlating to lower arsenic translocation to rice grains[3,4].

Collaboration with Britta Planer-Friedrich has significantly advanced our understanding of arsenic biogeochemistry in rice rhizosphere, unraveling interrelationship of soil and pore-water microbial communities and considering the role of soil organic matter in the formation of thioarsenates[5]. Investigating the interplay of carbon, sulfur, iron and arsenic revealed that, in low-carbon soils, the concomitant activity of rhizospheric dissimilatory arsenate-, Fe(III)-, and sulfate-reducing bacteria determines higher thioarsenates concentrations in pore water compared to high-carbon soils. However, the presence of ferrous Fe(II)-oxidizing bacteria in pore-water decreases overall arsenic mobility through sorption onto iron minerals, ultimately leading to lower rice grains contamination[6].

Britta Planer-Friedrich's pioneering contributions to arsenic biogeochemistry are deeply appreciated and will continue to inspire our research on the role of microorganisms in arsenic dynamics.

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