Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24447

Microbial nitrogen and arsenic cyling in rice paddy soils under alternate wetting and drying

MICHAEL VEGA[1], BENJAMIN QUINT[1], WILLIAM DIGNAM[1], HYUN YOON[1,2] AND MATTHEW REID[1]

[1]Cornell University

[2]University of California, Berkeley

Presenting Author: mav226@cornell.edu

In rice paddy soils subjected to alternate wetting and drying (AWD), microbially mediated redox reactions control nitrous oxide emissions and porewater arsenic speciation, influencing greenhouse gas emissions and arsenic uptake into rice. Whereas denitrification leads to net N loss through release of nitrous oxide or dinitrogen gas, dissimilatory nitrate reduction to ammonia (DNRA) retains nitrogen as ammonium, a more favourable outcome for nitrogen utilization by rice. In the context of arsenic speciation, couplings between denitrification and arsenite oxidation have been identified, decreasing the plant availability of arsenic. However, significantly less attention has been paid to DNRA. Here, we investigate potential couplings between DNRA and arsenite oxidation in rice paddy soils. Rice paddy soil metagenomes indicated that DNRA is encoded across nine bacterial phyla, with more than half of all DNRA bacteria also encoding for arsenite oxidation; thermodynamic calculations further reveal an exergonic reaction that could support microbial growth. Greenhouse-based mesocosm experiments and complementary batch studies test the hypotheses that (i) DNRA can be coupled to arsenite oxidation, and (ii) increasing soil organic carbon increases DNRA activity, and, somewhat counterintuitively, enhances arsenite oxidation. Overall, this work aims to constrain the relevance of different nitrogen respiration pathways coupled to arsenite oxidation in rice paddy soils, with a goal of decreasing nitrous oxide emissions and inorganic arsenic rice uptake under AWD.