Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19947

Microbial manganese cycling in seasonal hypoxic zones of the Northern Gulf of Mexico

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The Northern Gulf of Mexico (NGoM) region is subjected to seasonal hypoxia beginning in late spring, reaching a maximum during late summer and subsiding during the fall. Excess nutrients from anthropogenic sources are introduced into the Gulf of Mexico via the Mississippi-Atchafalaya River basin, increasing algal production and exacerbating hypoxia. In addition to nutrient fluxes, the mixing of freshwater and saltwater over the river-ocean transition creates a dynamic system with distinct geochemical gradients. Here we explore the role of manganese (Mn) in the seasonal hypoxic zone. Mn is a redox-active element whose cycling is microbially mediated, but the organisms responsible for manganese oxidation and the mechanism(s) of oxidation in the environment remain unresolved. In this project, water column samples taken at different depths and sites in the NGoM from two cruises on the R/V Pelican, one during early spring and one during late summer, were utilized to isolate Mn oxidizing cultures. Enrichment cultures were screened for Mn-oxidizing activity, by monitoring microbial growth and Mn speciation via the LBB colorimetric technique in cultures spiked with 100 µM dissolved Mn(II). The 61 tested cultures came from 10 sample sites with 41% of the cultures producing measurable Mn oxides (>1.0 µM). Mn oxide concentrations produced ranged from 1.0 to 63.0 µM. Cultures from one of the hypoxic sites had relatively shorter lag phases and faster growth rates than at other sites, with cultures from surface samples growing the fastest. Using isolated Mn-oxidizing microorganisms, we will be able to constrain the geochemical conditions that Mn oxidation occurs under (including oxygen and iron concentrations, nutrient concentrations, and salinity) and identify biogenic Mn-binding ligands.