Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.16724

Uncovering the hydrogen utilization potential of the microbial dark matter in seafloor habitats

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In seafloor habitats molecular hydrogen (H_2) can play a pivotal role in the metabolisms of a multitude of microorganisms. Microbial hydrogen oxidation fuels primary biomass production but also fosters fermentation by maintaining low hydrogen concentrations in different seafloor habitats, e.g. in deep-sea hydrothermal vent systems and anoxic sediments. The hydrogen-based energy conservation starts with the enzymatic interconversion of H_2 to protons and electrons, catalyzed by hydrogenases. These key enzymes so far have all been described as metalloenzymes requiring a complex maturation apparatus.

Here we will present data from two different approaches to uncover the microbial hydrogen oxidation potential in seafloor habitats. The first approach comprises hydrogen amended short-term sediment incubation experiments where we monitored hydrogen consumption alongside with shifts in the respective bacterial and archaeal communities based on RNA analyses. We observed hydrogen consumption in all of our incubations, yet differences occurred in the specific rates and in the communities apparently responsible for hydrogen utilization. Given the unculturable microbial majority and the need for culture-independent techniques, we recently established a function-based screen to recover hydrogenases from metagenomic fosmid libraries. We will introduce some novel hydrogenases recovered by applying this screen to fosmid libraries of seafloor habitats.