ENGLISH ABSTRACT

In anoxic environments, microbial induced corrosion (MIC) can accelerate the oxidation of metallic iron (Fe^0) 1,000 - 10,000 times above abiotic corrosion rates. Oil and gas production systems, nuclear waste reservoirs, chemical weapons, and the metallic infrastructure of many industries can be affected by MIC. The economic and environmental consequences of MIC need to be prevented, thus it is important to identify the corrosive species within the communities, document their efficiency, elucidate the mechanisms, and their interactions inside complex communities during Fe^0 deterioration. Methanogenic archaea are often associated with corroded infrastructure especially under non-sulfidic conditions, but their role in corrosion is poorly explored. In this work, I investigated the role of different microorganisms including possible interactions under non-sulfidic conditions. In **manuscript III** we evaluated the corrosive potential of ten species of methanogens and discovered that methanogens with low H_2-thresholds were more effective Fe^0-corroders than those with high H_2-thresholds. Yet for some strains, corrosion could not be explained by H_2 alone. Next, we evaluated the role of the heterodisulfide supercomplex in enzymatic H_2-evolution, as a potential agent for high corrosiveness in the *Methanobacteriales* and *Methanomicrobiales*. Still, the role of these enzymes in Fe^0 corrosion augmentation requires further confirmatory studies. In **manuscript IV,** a second MIC mechanism was investigated**,** namely the direct electron transfer from metal to microbe involving outer-surface multi-heme *c*-type cytochromes in an autotrophic strain of *Geobacter sulfurreducens.* Additionally, we investigated MIC from a community perspective as relevant to natural environments. Therefore, we took a closer look at MIC by communities enriched on Fe^0 from a diversity of environments where steel infrastructure is buried underground. In **manuscript I** we revealed that non-acetotrophic *Methanosarcina* from Baltic sediment was competing with acetogenic *Clostridium* for electrons from Fe^0. In **manuscript II** we studied an unusual interaction in a community enriched on Fe^0 from an urban lake. Methanogenesis was enhanced at the collapse of acetogenic-*Clostridia*. Further experiments corroborated that methanogens may save energy by scavenging both enzymatic H_2, generated by highly effective proton-reducing [FeFe]-hydrogenases, as well as reactive nitrogen fixed by the dying *Clostridia*. Finally, Fe^0 corrosion by complex communities from coastal marine environments was investigated in **Manuscript V**. Unlike non-sulfidic systems we observed that the methanogenic community on Fe^0 was generally represented by H_2-utilizing groups other than *Methanosarcinales*. Synergistic interactions between bacteria and methanogens were required to promote effective Fe^0 corrosion. My studies have thus revealed a large diversity of organisms, mechanisms, and interactions involved in MIC, and they may contribute to the future development of mitigation strategies.