

# Investigation of novel putative iron and sulfur oxidizing genes involved in extracellular electron transfer from the genomes of cathode-oxidizing microbe

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The prevalence and diversity of mineral oxidation processes in sediments has remained poorly understood, in part due to the difficulties associated with culturing lithotrophic microbes. We recently demonstrated that using an electrode poised at a given redox potential as a surrogate for a mineral surface, is a feasible approach to enrich and facilitate isolation of microbes capable of mineral oxidation. To this end we isolated microbes from electrode incubations constructed in marine sediment microcosms. The enriched biomass from these incubations was further cultivated under sediment free conditions utilizing solid substrate electron donors such as elemental sulfur, iron, and amorphous  $\text{Fe}_x\text{S}_x$ . Electrode oxidizing microbes isolated from these enrichments belong to the genera *Halomonas*, *Idiomarina*, *Marinobacter* and *Pseudomonas* of the *Gammaproteobacteria* and the *Thalassospira* and *Thioclava* genera of the *Alphaproteobacteria*. Though many of these organisms are commonly detected in marine sediments, they are not generally associated with mineral oxidative metabolisms. Electrochemical analysis of the isolates has demonstrated that, though these organisms have similar physiologies, they employ different biochemical mechanisms demonstrated by the variability in dominant electron transfer modes and the range of midpoint potentials observed for dominant redox active cellular components. This data is supported by our preliminary genomic analysis which suggests a variety of potential pathways for extracellular electron transport including cytochrome containing genes with homology to other iron and sulfur oxidizing microbes. The insight gained from these genomic studies included gene targets for directed mutagenesis studies in genetically tractable strains. Given the abundance of reduced minerals in sediments and the Earth's subsurface this approach holds vast potential for increasing our understanding of the biogeochemical importance and abundance of mineral oxidation reactions.