METAPROTEOMICS REVEAL UNCHARACTERIZED BETAPROTEOBACTERIAL ELECTRON CONDUITS

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Metal-rich ancient ocean analogues provide an opportunity to explore primitive, microbially-driven metal cycling. Respiratory pathways can be investigated in uncultivated microbes using meta-omic techniques. We evaluated the metaproteomic profile of sediment enrichments from Lake Matano, an ancient ocean analogue, cultured anoxically over ~1 year with soluble Mn^{3+} as the sole electron acceptor. DNA and protein for metagenomic and metaproteomic sequencing were recovered from the fourth transfer on day 335. Spectral counts from shotgun proteomics determined on a high accuracy tandem mass spectrometer provided relative quantification of protein expression. Metagenomic binning recovered a near-complete *Dechloromonas* genome (hereafter "*Candidatus* Dechloromonas occultata" [occultata (L. adj.), hidden]). The genetic inventory of "*Ca.* D. occultata" was consistent with a neutrophilic metal-oxidizing lifestyle. *D. occultata* encoded a porin-cytochrome outer membrane complex absent in metal-oxidizing *Dechloromonas agitata*. An uncharacterized operon rich in multiheme c-type cytochromes (cCyt) including an undecaheme cCyt was highly expressed. The cCyt-rich operon is also present in other Betaproteobacteria from metal-rich subsurface ecosystems, including many uncultivated members. Denitrification proteins were also highly expressed in "*Ca.* D. occultata", despite the lack of nitrogen oxides in the media. Our findings support a role for betaproteobacteria in metal and nitrogen cycling in the deep subsurface through potentially uncharacterized mechanisms. *Funded by NASA Exobiology and NASA Astrobiology Institute Alternative Earths.*