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Metal cofactor microbial usage across convergent margins

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Biogeochemical cycles are primarily driven by redox reactions, often mediated by microbes. Due to their wide metabolic plasticity, microbes drive the cycling of elements and nutrients, impacting element availability through time and ultimately maintaining Earth's habitability. Microbially driven redox reactions are catalyzed by enzymes, called oxidoreductases, that frequently contain a metal cofactor. The incorporation of a transition metal into enzyme structures suggests a link between metal environmental availability and the geographical distribution of microbial enzymes crucial to biogeochemistry. Convergent margins, where the subduction of one plate beneath another releases deep volatilized elements though arc volcanoes and secondary geothermal manifestations, represent an ideal setting for studying how metal environmental availability influences microbial cofactor utilization and functional diversity. Here we present a comprehensive analysis of more than one hundred deeply-sourced seeps from diverse geothermal systems sampled around the globe. Coupling transition metal concentrations in both fluids and sediments with metagenomic data, we aim to understand the interactions between the fluids and the rocks they are seeping through, how subduction parameters can influence the delivery of metals to the surface, and how all these variables ultimately influence metal cofactor usage and distribution.