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Biotransformation of extraterrestrial and terrestrial metal-bearing materials

The ability of chemolithotrophic microorganisms to catalyze redox transformations of metals is an exquisite tool for energy transduction between a mineral body and a living entity. Evolutionally diversified metal-solubilizing microorganisms with their fascinating metabolic routes have developed an exquisite set of capabilities for manipulating minerals, dissolving them to access useful metals. In the meantime, mankind has begun to learn how to harness their activities in biotechnological processes. Biomining is an increasingly applied biotechnological procedure for processing of ores in the mining industry (biohydrometallurgy), which relies on metal solubilization mediated by microorganisms. Iron and sulfur-oxidizing acidophiles have widespread use in the processing of metals ores. We have been investigating the microbial-mineral interface of bioleaching extremophile *Metallosphaera sedula*, which is a metal-oxidizing archaeon that lives in hot acid conditions and exhibits unusual heavy-metal resistance. Exploring the viability and metal extraction capacity of *Metallosphaera sedula* living on and interacting with extraterrestrial and terrestrial minerals, we have shown that this microbe actively colonizes meteorite NWA 1172, synthetic Martian regolith materials and hard, rare metal oxide ores. Ultrastructural analysis of the hard metal-biomineralized cell wall of *Metallosphaera sedula* is a focus of our current investigations to reveal redox destiny and coordination chemistry of the incorporated metals. The results of our work have direct implications for extraterrestrial (e.g., asteroid) biomining and development of *in situ* resource utilization programs, as well as for biomining of rare hard metal ores on Earth.

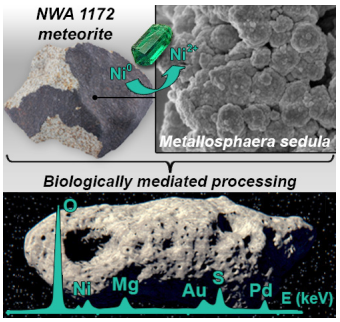

Figure-1: *Biologically mediated processing of extraterrestrial materials: metal respiring extreme thermoacidophile Metallosphaera sedula colonizes the stony meteorite NWA 1172 and utilizes metals trapped in it as the energy source. In course of tight intimate biogeochemical interactions Metallosphaera sedula leaves behind free soluble metals.*

Recent Publications

1. Kolbl D, Pignitter M, Somoza V, Schimak M O, Strback O, Blazevic A and Milojevic T (2017) Exploring fingerprints of the extreme thermoacidophile *Metallosphaera sedula* grown on synthetic Martian regolith materials as the sole energy sources. *Front Microbiol*; 8: 1918.
2. Milojevic T (2015) Earth microbe prefers living on meteorites. *C. Reed. Science*. DOI: 10.1126/science.aab2499.

Biography

Tetyana Milojevic has her expertise in metal-microbial-mineral interactions. Since 2014, she is the Deputy Head of the Department of Biophysical Chemistry at the Faculty of Chemistry, University of Vienna and a Leader of Biochemistry/Space Microbiology group investigating biotransformation of terrestrial and extraterrestrial minerals and microbial survivability in outer space environment. She is leading an excellence Elise-Richter FWF research project to decipher metal-oxidizing machinery of the extreme thermoacidophile *Metallosphaera sedula*.

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