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Biogenic inorganic crystalline phase formation as a result of biogeochemical interactions in between the chemolithotrophic archaeon Metallosphaera sedula and meteorite: implications for potential microbial biosignatures

Tetyana Milojevic, Amir Blazevic, and Kaan Georg Kutlucinar
University of Vienna, Department of Biophysical Chemistry, Vienna, Austria (tetyana.milojevic@univie.ac.at)

Chemolithotrophy has been indicated as the most primordial form of microbial metabolism on the early Earth and proposed as a possible metabolic form for other iron-mineral-rich planets like Mars. Rock-eating extremophiles represent an exciting field of research for the study of microbe-mineral interactions in order to find the unique biosignatures of life in the extreme conditions. Metallosphaera sedula is the chemolithotrophic archaeon, which thrives at 73°C and pH 2, using energy derived from metal oxidation at the edge of living limits. When given an access to extraterrestrial material (a stony meteorite H5 ordinary chondrite NWA1172), M. sedula releases soluble metal ions into the solution from NWA1172 due to its metal oxidizing metabolic activity.
Here we report the formation of inorganic crystalline phase as a result of biogeochemical interactions in between M. sedula and extraterrestrial material. Inorganic ions released from meteorite as a result of M. sedula mediated leaching were trapped into crystalline material by solvent evaporation technique. Scanning Electron Microscopy observations and EDX analysis revealed that this crystalline phase is mainly composed of Ni, S, Mg and O elements. Biogenicity of this inorganic crystalline material was evaluated by comparing to abiotic conditions. Biological nature of Ni-, S-, Mg- and O -containing crystalline phase was established, since it was not mimicked in abiotic experimental conditions, allowing clearly to exclude abiogenic origin. Further investigations of exact mineralogical nature of biogenic of Ni-, S-, Mg- and O -crystalline material and its implication as a biosignature for detection of life are going to be investigated.