Lead sequestration enhanced by protein accumulation on Cyanidiales

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Due to anthropogenic activities, the non-biodegradable lead (Pb) is dispersed throughout the ecosystem, especially in acidic environment, facilitating the transportability of Pb. Cyanidiales are the thermoacidophilic red microalgae that could survive in extremely conditions (25-56℃; pH 0.2-5.0) with concentrated Pb [1,2]. Although the unique Cyanidiales that have special gene function to survive in extreme environments are of interest to geologic scientists [3,4,5], a distinct gap of knowledge about their role in Pb geochemistry is still exist.

Therefore, the worthy issue is to clarify the mechanism for how Cyanidiales tolerate and survive in environments with enriched Pb. We conducted sorption isotherms of Pb on Cyanidiales. Lead speciation using Pb L_{III}-edge x-ray absorption spectroscopy and the type as well as degree of protein aggregation on collected Cyanidiales were performed. Collective results suggested that soluble Pb could be transformed into lead phosphate ($Pb_3(PO_4)_2$) and chloropyromorphite ($Pb_5(PO_4)_3Cl$), the most stable Pb mineral in natural environments. In addition, Cyanidiales could fix Pb using organic functional groups on cell surfaces and sequestrate Pb using the thiol group in proteins, which are key processes to defense the Pb toxicity. Cyanidiales show the potential application in the remediation of Pb and could be considered as the promising and green material for bioremedial treatments in acidic environments.

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