PRELIMINARY STUDIES ON BIOPRECIPITATION PROCESSES MEDIATED BY SULFATE REDUCING BACTERIA (SRB) AND METAL IMMOBILIZATION IN MINE IMPACTED ENVIRONMENTS.

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Mining activity often leaves a critical legacy represented by huge volumes of mine wastes and residues, usually made up of highly reactive materials, which lead to the mobilization and dispersion of harmful elements in soils and waters. Although these extreme environments are adverse to the development of living organisms, it has been observed that some microorganisms are able to adapt, playing a role in metal mobility, and becoming part of the resilience of the system itself.
The Iglesiente and Arburese (SW Sardinia, Italy) mine districts, now abandoned, have been exploited for centuries by mining activities aimed at Pb-Zn extraction from sulfides and non-sulfides (calamine) deposits. Here, biogeochemical barriers naturally occur as an adaptation of the ecosystem to environmental stresses. Studies, from macroscale to microscale, showed that sulfate-reducing bacteria (SRB) may influence metal mobility by mediating the precipitation of secondary authigenic metal sulfides under reducing conditions. Specifically, framboids of Zn sulfides and Fe sulfides have been observed in the sections of stream sediments core characterized by the presence of abundant organic matter, especially residues of vegetal tissues (e.g. roots and stems of Juncus acutus and Phragmites australis).
Laboratory-scale experiments were performed to better understand the bioprecipitation processes. For this purpose, anaerobic batch tests were carried out using high polluted mining waters (Zn and sulfate concentrations up to 102 and 103 mg/l, respectively) inoculated with native selected sulfate-reducing bacteria from stream sediments collected in the investigated areas. Dramatic decrease (up to 100%) in Zn and sulfate was observed in solutions. Moreover, scanning electron microscopy - energy dispersive spectroscopy (SEM-EDS) analysis, performed on solids recovered at the end of the experiments, showed the presence of precipitates characterized by a tubular morphology and made up by S and Zn. SRB inocula were studied by next-generation sequencing (NGS) approach, with the aim to compare the microbial diversity of the different SRB communities and to search for indigenous novel metal-tolerant sulfidogenic microorganisms.
These findings represent a valuable step forward to plan effective bioremediation strategies for reducing metal mobility and dispersion. Also, bioprecipitation mediated by SRB can have great potentialities for metal recovery and our results can help to develop biomining techniques.

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