

Metal Extraction and Biomining

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Defining Statement

Microbial Transformations of Metals
Microorganisms that Solubilize Metals
Microbial Extraction of Metals from Ores and Biomining
Acidophilic Microorganism–Mineral Interaction
Mechanisms Involved in Metal Solubilization by Acidophiles

Biomining in the Postgenomic Era

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Glossary

biofilm A layer of adhesive exopolymeric substances attached to a surface and secreted by microorganisms forming colonies on it.

bioleaching Refers to the microbial conversion of an insoluble metal (usually a metal sulfide or oxide) into a soluble form (metal sulfate).

biomining The use of microorganisms to recover metals in industrial operations.

bioremediation Use of microorganisms to remove toxic chemicals from the environment.

biosorption Refers to the binding of metal ions by whole biomass (living or dead).

chemolithoautotroph A microorganism that fixes CO₂ and obtains its energy by the oxidation of inorganic compounds.

consortium A group of microorganisms living together and in which each individual benefits from the others.

genome The complete set of genes present in an organism.

genomics Refers to mapping, sequencing, and analyzing genomes.

proteome The total complement of proteins present in a cell at any one time.

proteomics Genome-wide study of the structure, function, and regulation of proteins in the cell.

systems microbiology Considers microorganisms or microbial communities as a whole to create an integrated picture of how a microbial cell or community operates.

Abbreviations

2D- Two-dimensional polyacrylamide gel
PAGE electrophoresis
AMD acid mine drainage
DGGE denaturing gradient gel electrophoresis
ESI-MS electron spray ionization MS
FISH fluorescence *in situ* hybridization

FT-ICR Fourier transform ion cyclotron resonance
MS mass spectrometer
HPLC High performance liquid chromatography
MS mass spectrometry
QS quorum sensing
SDO sulfur dioxygenase
SOR sulfite oxidoreductase
TEM transmission electron microscopy

Defining Statement

Microorganisms interact with heavy metals, transforming them by uptake, bioaccumulation, bioprecipitation, bioreduction, biooxidation and other mechanisms. Some of these activities result in the solubilization or extraction of metals which are successfully used in industrial biomining processes to recover valuable metals or in bioremediation to remove toxic metals from contaminated soils.

Microbial Transformations of Metals

Microorganisms interact with metals by several mechanisms, most of which are shown in [Figure 1](#). All bacteria require several metals that are essential for their functioning and the uptake of most of them is metabolism- or energy-dependent. For this bioaccumulation, they possess specific or general energy-dependent metal transporters to directly incorporate them or through chelation by