Geobiotechnological metal dissolution and precipitation

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The dissolution of metal sulfides at low pH is catalyzed by acidophilic iron- and sulfur-oxidizing bacteria and archaea. The geobiotechnological application of this process is termed biomining for processing of ores in the mining industry (biohydrometallurgy). Nowadays the production of copper from low-grade ores is the most important industrial application and a significant part of world copper production already originates from heap or dump/stockpile bioleaching. Conceptual differences exist between the industrial processes of bioleaching and biooxidation. Bioleaching is a conversion of an insoluble valuable metal into a soluble form by means of microorganisms. In biooxidation, on the other hand, gold is predominantly unlocked from refractory ores in large-scale stirred-tank biooxidation arrangements for further processing steps. In addition to copper and gold production, biomining is also used to produce cobalt, nickel, zinc, and uranium.

Up to now, biomining is merely used as a procedure in processing of sulfide ores and uranium ore. With regard to the bioleaching processes of metals that are used especially in the electronic industry, as well as of mine and industrial waste (e.g. mine tailings, ash etc.), promising laboratory methods and even pilot processes already exist. Anaerobic bioleaching (Ferredox process) enables the processing of laterites and possibly other oxide ores like manganese nodules or even silicate ores.

A biotic selective precipitation of metals as minerals from mine-impacted waters (such as acid mine drainage) can be performed for iron minerals such as schwertmannite by acidophilic iron-oxidizing bacteria as well as for different metal sulfides by hydrogen sulfide generating acidophilic sulfate-reducing bacteria.

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