Redox transformations of iron and other transition metals by acidophilic bacteria

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The solubility of many (cationic) transition metals is greatly enhanced in acidic liquors, and consequently acidophilic microorganisms (bacteria, archaea and eukarya) are frequently exposed to concentrations of soluble metals which are far greater than those typically encountered by neutrophilic life forms. The ability to grow in the presence of elevated concentrations of soluble metals is a trait common to most species of acidophilic bacteria and archaea. Many transition metals, such as iron, copper and manganese, can occur in different oxidation states. Redox reactions involving these metals can both provide electrons (i.e. act as energy currency) and act as sinks of electrons generated by microbial oxidation of both organic and inorganic electron donors. Many acidophiles are now known to catalyse the oxido-reduction of iron, with at least two genera (*Leptospirillum* and "*Ferrovum*") seemingly being restricted to using ferrous iron as sole electron donor. More recently, it has been shown that all iron-oxidising acidophilic bacteria can also oxidise copper (I) and that all iron-reducing bacteria can also reduce copper (II), but that these redox transformations of copper are mediated indirectly (by ferrous and ferric iron) rather than directly by the bacteria. The same appears to be the case with manganese. The ability of acidophilic bacteria to catalyse redox transformations of transition metals other than iron has significant environmental and industrial implications.