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The structure of the manganese oxide on the sheath of the bacterium *Leptothrix discophora*: An XAFS study

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Abstract

In natural waters, manganese oxides (MnO_x) are important in mediating the bioavailability of trace metals such as Ni, Cu, Zn, Cd, and Pb, as these metals readily adsorb to the MnO_x surface. Manganese from a variety of anthropogenic sources usually enters the aquatic environment in dissolved form as Mn^{2+}. It is subsequently oxidized under oxic and neutral (pH = 6–7) conditions. Often this oxidation is catalyzed by bacteria, such as *Leptothrix discophora*, as part of their natural metabolic process.

Mn *K*-edge X-ray Absorption Fine Structure Spectroscopy (XAFS) was used to investigate the local structure of manganese oxide on the sheath produced by the bacterium *Leptothrix discophora* SP-6. The features observed in the near edge region of the Mn *K*-edge spectrum indicate the presence of three oxidation states of manganese: Mn^{2+}, Mn^{3+}, and Mn^{4+}. Fitting the experimental XAFS data identifies the bacterial MnO_x as being composed of single-layer microcrystals with layers similar to those occurring in Na-birnessite. Some MnO_6 octahedra might lie outside the layer plane, sharing corners with those in the layer plane. X-ray diffraction results for the same samples are consistent with the single-layer structure.