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Chemie der Verwitterung und Bodenbildung

Autoren
S. Brandt[1], M. Händel[2], K. Totsche[1]
[1]Friedrich-Schiller-Universität Jena, Institut für Geowissenschaften, Lehrstuhl für Hydrogeologie, Jena; [2]Mellingen

Titel
Reductive transformation of birnessite by low-molecular organic acids

Abstract
Mn(IV)-oxides are highly redox-active minerals, which are often reductively dissolved during biogeochemical processes, resulting in the release of Mn^{2+} and associated compounds into the aqueous phase. Mn^{2+} is known to reductively transform birnessite (MnO_2) into metastable feitknechtite ([beta]-MnOOH) and manganite ([gamma]-MnOOH). Natural solutions, e.g. in soils, contain highly reactive low molecular weight organic acids like lactate. We investigated the impact of lactate on the transformation of birnessite under laboratory conditions during a period of 500 d. We found that birnessite was reductively transformed into feitknechtite, which subsequently transformed into the more stable manganite, without any release of Mn^{2+}. Lactate served as the electron donor and was oxidized into pyruvate and acetate. Metals previously adsorbed to the birnessite's surface were released during the transformation. The coupled reductive transformation of short ranged ordered minerals like birnessite with the abiotic oxidation of lactate might be an important process controlling the abundance of low molecular weight organic acids in natural systems besides their microbial consumption uptake. Our results further indicate, that the reduction of Mn(IV)-oxides does not exclusively result in their dissolution but instead in the formation of more stable Mn(III)-oxides.