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Footprints in the Landscape: Sustainability through Plant and Soil Sciences

Environmental Influences On Mn-Oxide Catalyzed Arsenic Oxidation.

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Convention Center, Exhibit Hall BC, Second Floor

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Previous studies have demonstrated rapid oxidation of arsenite [As(III)], catalyzed by manganese oxides minerals, producing the less toxic and less mobile arsenate [As(V)] species. In natural environments, additional minerals, ions, and biological factors can influence this reaction. In this current study, the effect of adding goethite, phosphate, and bacteria on the reaction rates of this oxidation pathway are examined. Rapid-scan attenuated total reflectance (ATR) Fourier transform infrared (FTIR) spectroscopy has been used to collect *in situ* kinetic data for oxidation of As(III) to As(V). Using a rapid-scan technique, IR spectra are collected between 2.5 and 12 seconds (24 scans, 8cm⁻¹ resolution). Through observation and analysis of IR bands corresponding to As(V), rapid chemically-controlled As(III) oxidation is observed via hydrous manganese oxide (HMO). Also, the data reveal oxidation of As(III) is followed by rapid binding of As(V) to HMO, at least in part, through surface bound Mn(II). The binding of As(V), and Mn(II), leads to surface passivation of the mineral phase and prevents further oxidation from occurring. For reaction of As(III) with HMO, analysis of first-order rate kinetics for revealed 95% transformation of As(III) to As(V) in < 3 min ($t_{1/2}$ < 1 min). This initial reaction rate is much faster than what was observed for As-oxidizing bacteria, which show a much slower initial oxidation rate. Additionally, the presence of selected soil components, such as other minerals (i.e., goethite), competing ions (i.e., phosphate), and bacteria (i.e., *Pseudomonas fluorescens*, *Alcaligenes faecalis*), during oxidation via Mn-oxides reduce the extent and rate of As(III) oxidation. This research reminds us of the importance in considering soil heterogeneity for complex reactions in soil, such as As(III) oxidation via Mn-oxides.

See more of: [Chemical and Biological Controls On Arsenic Bioavailability: II](#)