Arsenic Oxidation by the manganese soils of Graskop

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This study characterizes the physical and chemical properties and the reaction kinetics of the extraordinary manganese soils found in Graskop, South Africa. Despite their importance in cycling redox sensitive compounds in natural systems, much remains unknown about the ability of manganese-oxides to oxidize arsenic under environmental conditions. To study how these manganese-oxides react, soils were collected from Graskop, South Africa. Soils were excavated with a range of manganese concentrations up to 20%. The soil in each horizon was analyzed to determine the chemical and physical properties of the soils, including the cation exchange capacity (CEC), point of zero charge (PZC), and pH. X-ray powder diffraction (XRD) and scanning electron microscopy (SEM) was used to characterize the mineralogy of the crystalline material found in the clay fraction. A series of batch reactions were used to determine the capacity of these soils to oxidize arsenite into arsenate. Reactions were conducted under varied pH and temperature to elucidate how these conditions influenced the oxidation reaction. Samples were analyzed by liquid chromatography-inductively coupled plasma-mass spectrometry (LC-ICP-MS). Solid samples were analyzed at NSLS-II on beamline 4-BM (XFM) to determine the changes in manganese oxidation state after reacting with arsenite under varying conditions. This study provides key insights to more fully understand the role of manganese-oxides in controlling redox sensitive reactions in the environment.