Sediment manganese oxide content as an indicator of groundwater arsenic pollution potential

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Arsenic is a contaminant of global concern often found in well water at concentrations above human health standards. Arsenic contamination of well water can be derived from geogenic (internal to the aquifer) or allogenic (external) sources, and few metrics exist for predicting the potential for future contamination of aquifers by these sources at local scales. The primary objectives of this study were to quantify how sediment Mn oxides influence 1) the rates and extent of geogenic As release from aquifer solids to groundwater and 2) the binding and transport of allogenic As withing aquifers. A suite of sediments, with naturally varying ratios of Mn to Fe oxides from a low-As-groundwater aquifer in Cambodia, were utilized in laboratory batch and column experiments.

Anaerobic incubation of the sediments with labile dissolved organic carbon (DOC) increased the release of *geogenic* As, Mn, and Fe over parallel incubations without carbon addition or with sodium azide. Aqueous As speciation and sediment X-ray absorption spectroscopy analyses demonstrated that As, Mn, and Fe were reductively mobilized within the DOC treatments. Across the suite of experiments, Mn release occurred before As and Fe release, and sediments with higher initial Mn concentrations had slower initial As and Fe release to groundwater. However, throughout the year-long experiments, after a certain threshold of Mn was released, As was rapidly mobilized from sediments.

Within batch-sorption and column-flow experiments, retention of *allogenic* As was predicted by the Mn-oxide content of the sediment. Langmuir isotherm As adsorption maxima (R^2>0.9, N=9) and As breakthrough in columns (R^2>0.9, N=4) were linearly correlated with the extractable Mn oxides in sediments. These correlations were stronger than those for any other thested aquifer solid-phase metrics, including Fe-oxide content.

Collectively, these results suggest that Mn-oxide content of aquifer sediments, which my be quantified by simple extractions, may serve as useful tools for evaluating the groundwater As pollution potential at the scale of wells.