

Competitive silicic acid - dimethylarsenic acid (DMA) uptake by Fe hydroxide plaques

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Processes affecting the mobility of the organoarsenical DMA agent in the rhizosphere in presence of a strong sorbent like the Fe plaques on rice roots were elucidated by a surface complexation adsorption modeling approach. Experimental batch equilibrium data show that DMA is strongly adsorbed in the acidic pH range only, and show a steep adsorption edge in the circumneutral pH region between the DMA acidity constant and the point-of-zero-charge value for the adsorbent. Published spectroscopic and molecular modeling information suggest DMA to form bidentate-binuclear surface complexes with Fe hydroxides similar to the inorganic As oxyanions. Based on this information, a 1-pK CD-MUSIC model was fitted to the experimental adsorption vs. pH data with a single inner-sphere complex. The same was done for the silicate-goethite system. Both individual DMA and Si CD-MUSIC models were then merged to predict the binary DMA/Si behavior. Silicate was thus predicted to strongly compete for DMA which may mobilize up to 50% of the organoarsenical at a pH 6. This model prediction could well be verified subsequently by experimental batch equilibrium data (Fig. 1). This behavior may add to the increase of the DMA proportion in rice grains observed upon rice husk or silica amendment.

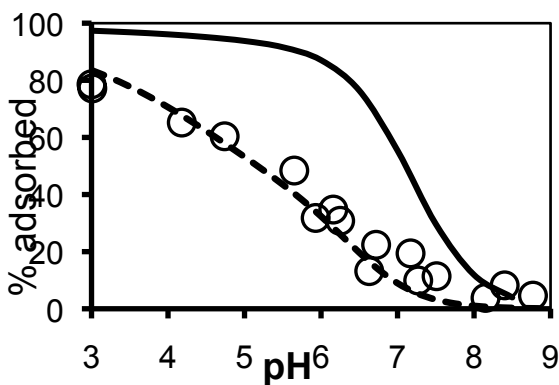


Figure 1: CD-MUSIC results for 50 μM DMA adsorption in 10 mM NaNO_3 with 2 g/L goethite suspension, without Si (solid line) and with 0.5 mM silicate added (dashed line).