The Impact of Sea Level Rise on Arsenic Speciation in Wetland Flora

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Coastal wetlands sequester large amounts of heavy metals in their sediments and biomass; however, sea level rise and invasive exotic plant species destabilize marsh ecosystems and may cause previously sorbed contaminants, such as arsenic (As), to be released. Marsh plants play a critical role in the fate and transport of As in wetlands through direct absorption into root tissue, sorption of the metal to iron plaques formed around the roots, and incorporation and secretion of As in aboveground biomass. These relationships were tested on *Phragmites australis* and *Spartina alterniflora*, which were raised in a controlled growth chamber and exposed to saline conditions ranging from freshwater to seawater. The experiments were first conducted hydroponically and then in natural marsh soil. Pore water samplers were used to determine the redox state, pH, and As concentration in the soil experiments. Arsenic in the root plaques was analyzed using a modified dithionite citrate bicarbonate (DCB) method and the total As in plant biomass was measured with inductively coupled plasma optical emission spectrometry (ICP-OES). Salts excreted on *Spartina* leaves were collected and analyzed by inductively coupled plasma mass spectrometry (ICP-MS). The distribution/association of As in the roots collected from these experiments was also investigated using synchrotron-based micro-X-ray absorption near edge structure (micro-XANES) and micro-X-ray fluorescence (micro-XRF) spectroscopy, respectively, at the National Synchrotron Light Source, Argonne National Laboratory, and SLAC National Accelerator Laboratory. Roots and outer plaques were analyzed as whole and cryosectioned 30 μm cross-sections to spatially differentiate the oxidation state of the As sorbed on the plaques and absorbed in different regions of the roots. This study provides key insight to more fully understand the impact of sea level rise on the cycling, mobility, and speciation of redox sensitive As and other heavy metals in the rhizosphere of wetlands.