Processes and mechanisms of Se transformations mediated by fungi

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Selenium (Se) is both a nutrient and contaminant with a very small window of sufficiency that can have detrimental ecological impacts owing to its toxicity at high concentrations. Of particular interest for mitigating negative ecological effects of Se, is the ability of fungi to reduce aqueous Se(IV or VI) to nanoparticulate Se(0) and organic Se(-II) under oxic conditions, though the mechanisms controlling these transformations and the long-term stability or reactivity of these reduced forms is currently unknown. Here, we present results of various culture-based experiments exploring mycogenically mediated Se transformation processes, including Se biomineralization, and investigations into the underlying mechanisms controlling fungal Se transformations.

Using a multi-analytical approach, mechanisms of Se(IV) removal were explored using known Se-transforming fungi. In the presence of 0.5 mM Se(IV), two particular fungal strains, *Alternaria alternata* and *Paraconiothryium sporulosum*, continuously removed aqueous Se between 5-32 days. Removal progressed via early Se(IV) adsorption on fungal biomass (< 5 days) followed by formation of Se(0) biominerals and organic Se(-II) (5-20 days). Se volatilization primarily occurred later in the removal process (14-32 days). Mycogenic Se(0) nanoparticles were initially intracellular, however by 32 days were found primarily in extracellular space. Additional potentiometric titrations measured fungal sulfhydryl sites of two other Se(IV)-reducing fungal strains, *Acremonium strictum* and *Plectosphaerella cucumerina*. Sulfhydryl sites are known to play a major role in Se(IV) adsorption and redox transformations by bacteria. Sulfhydryl site concentrations accounted for 35-54% of the total sites, suggesting that sulfhydryls are a primary route of initial Se(IV) accumulation by the fungi. Clarifying the underlying mechanisms of biological Se transformation is essential for understanding the role these processes play in natural systems and predicting the fate of Se in the environment.