Investigating the Geochemistry of Selenium in the Residual from Biologically Treated Mine-Impacted Waters

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Selenium has the potential to be extremely toxic in high concentrations and is of particular concern due to its propensity to bioaccumulate within food chains. Industrial activities, such as mining, have resulted in elevated levels of selenium in the wasetwater and ultimately in nearby surface water bodies. Bacterially-mediated redox based methods are used to treat the wastewater. The by-product of this treatment is a solid state residual which contains selenium at concentrations that can be greater than 4000 mg/kg. This research aims to understand how selenium occurs within the residual, and under what conditions it may remobilize. The speciation of selenium within the residual is of particular importance, as redox state impacts the toxicity and mobility. The mobility controls on selenium in the residual were determined through a series of aqueous batch experiments that simulated a variety of redox and pH conditions using O_2, Fe^{3+} and NO_3^- as oxidants. While selenium was mobilized under all simulated conditions, the highest concentrations were detected under mildly oxidizing conditions. Absorption effects were also observed, as the concentration of selenium in aqueous phase increased initially, followed by a steady decrease. The selenium speciation of the residual will be characterized in both pre- and post-experiment samples using X-ray Absorption Near Edge Structure (XANES) techniques. While the mildly oxidizing conditions created the most detectable aqueous selenium, they showed the least amount of speciation change in the solid phase. The remaining conditions (highly oxidizing and low pH), however, resulted in significant oxidation of metal selenide species to either SeS_2 or Se^0 (red). The goal of this research is to assess the risk posed by the residual and ultimately develop proper disposal methods that will minimize the risk to the local ecosystem and human health.