The Microbial Transformation of Arsenic and Selenium Today and in the Past

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Over the past two decades, robust biogeochemical cycles have been elucidated for the metalloids arsenic and selenium that result from microbial reduction, oxidation, methylation and demethylation processes.[1] As(V) is a potent electron acceptor used by a phylo-genetically diverse assortment of Bacteria and Archaea and As(III) has been shown to serve as an electron donor in photolithoautotrophy and chemolitho-autotrophy. Distinct enzymes are involved in arsenic resistance (Ars), methylation (ArsM), and energy generation (Arr, Aio, Arx).[2] Light dependent As(III) oxidation could provide a source As(V) even in the absence of appreciable molecular oxygen (e.g., in the Archean).[3] The requirement for selenium stems primarily from its incorporation into selenocysteine and its function in selenoenzymes.[1] Selenium oxyanions can serve as an electron acceptor in anaerobic respiration, forming distinct nanoparticles of elemental selenium with unique isotopic composition. Like arsenic, selenium transformations involve specific and probably ancient enzymes (e.g., Ser, respiratory selenate reductase), however much less is known about selenite reductase and methylases. Microbial mediated sedimentary deposits with arsenic and selenium containing minerals provide evidence of these activities in the past.[4] This presentation will review the microbial metabolism of arsenic and selenium and consider implications for both the evolution of life on Earth, as well as other planetary systems.

[1] Stolz, *et al*. (2006) *Annu. Rev. Microbiol*. **60**, 107-130. [2] Stolz, Basu, & Oremland (2010) *Microbe* **5**, 53-59. Oremland *et al*., *Geomicrobiol. J*. **26**, 1-15. [4] Sforna *et al*. (2014) *Nature Geosci*.**7**, 811-815.