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Nature of the Problem

Water is important to all environmental systems and is vulnerable to contamination by both anthropogenic and natural sources. One such contaminant is arsenic, found throughout Southern Texas as a byproduct of uranium mining. Concentrations may be sufficient to cause adverse health effects in humans. Potential health effects include skin lesions, hyperpigmentation, hyperkeratosis and several forms of cancer (Mandal et al., 1998).

The cycling of metals through a system involves several complex processes. These processes are both biological and geological. The aqueous concentration of metals may decrease as a result of precipitation as oxides, sorption onto mineral or organic surfaces or bioaccumulation. Because arsenic is mobile throughout a wide range of pH, direct precipitation is unlikely. Arsenic may be taken out of water through co-precipitation with iron or manganese oxyhydroxides. Throughout the literature, early studies on arsenic focused on the co-precipitation of arsenic with iron and manganese oxyhydroxides as the main factor controlling the concentration of dissolved arsenic in water (Masscheylen et al., 1991). Many areas in South Texas contain relatively small concentrations of iron and manganese oxyhydroxides meaning some other mechanism must control the concentrations of dissolved arsenic. Thus it is possible that uptake of arsenic (specifically arsenate due to its chemical similarity to phosphate) by organisms may be another main factor in controlling the phase of arsenic. My initial experiments suggest arsenate is utilized in growth by the cyanobacterium, *Anabaena* sp. Strain PCC 7120, in phosphate limited conditions. The cyanobacteria grew significantly more in samples with a higher mass of arsenate. Loss of arsenate from solution was also greater in inoculated flasks versus uninoculated controls. This implies that biological controls may play a major role in arsenic fate and transport in iron and manganese oxyhydroxide deficient areas.

The toxicity of arsenic is greatly dependent on its speciation. Inorganic arsenic is orders of magnitude more toxic than organic forms of the metal. Cyanobacteria are found in many aqueous environments such as streams, ponds, and wetlands as well as marine environments. It is possible that cyanobacteria may bioaccumulate arsenic from surrounding water. Cyanobacteria may decrease the inorganic concentration of arsenic. Bioaccumulation of inorganic arsenic will directly remove inorganic arsenic from water where it will be converted to organic arsenic which is the less toxic form. The conversion of inorganic arsenic to organic arsenic generally occurs by a process known as methylation whereby a methyl group is binded to the arsenic by the organism (Karojwa et al., 1994). It is possible that cyanobacteria may be active agents of methylation in these aqueous systems.

Cyanobacteria may play a significant role in the cycling of arsenic in surface water systems where these cyanobacteria have a sufficient biomass or where the absence of iron

or manganese oxyhydroxides is not the dominant mechanism controlling arsenic solubility. My research involves two major experiments. Experiment One measures arsenate uptake by *Anabaena* sp 7120, over time. Several arsenate concentrations (ranging from 1 μ M to 1 mM) will be used. Experiment Two measures arsenate uptake over time in the presence of increasing phosphate concentrations.

My research will facilitate a better understanding of the effect cyanobacteria have in regulating the amount of arsenic in a system. It is important to know where arsenic may be accumulating to help determine the risks associated with arsenic in the water. It may eventually help in remediation of water with elevated concentrations of arsenic. An increased biomass of cyanobacteria may also indicate a natural remediation mechanism by which the more toxic inorganic arsenic species are converted to the less toxic organic species.

References

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