Arsenic and Antimony Contamination, Bioaccumulation, and Effects on Growth and Survivorship in Aquatic Systems

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Tailing piles from past mining activity can release high concentrations (mg/L) of heavy metals into streams and wetlands. Although a number of studies have examined arsenic (As) levels around mining sites, the toxicity and behavior of As in freshwater organisms and in food webs is still poorly understood. Antimony (Sb), a toxic element of emerging global concern, has received even less attention. Here we report concentrations and redox speciation of As and Sb in water and aquatic organisms collected at the Stibnite Mine near Yellow Pine, Idaho. Preliminary results suggest that water from Meadow Creek and the surrounding seeps and springs had As concentrations ranging from 1.4 ppb (upstream reference point) to 26,214 ppb (seep adjacent to tailing pile). Antimony water levels ranged from 0.3 ppb to 1,152 ppb at the same sites. Within the stream, contaminant concentrations increased in a downstream direction and were highest in riparian plants, followed by periphyton-grazing tailed frog tadpoles, and then macroinvertebrates. In wetlands, As concentrations reached 89,794 mg/L in algal mats and 3,009 mg/L in boreal toad tadpoles, the highest values reported for an amphibian. However, we observed minimal effects on boreal toad tadpole growth rate and survivorship and a decrease in As and Sb tissue concentration as the animals approached metamorphosis. Contaminants were not concentrated solely in gut contents or in tail tissue. Surprisingly, inorganic As(III) was more prevalent than less toxic forms including As(V), MMA, DMA, and As-betaine in frog tadpoles found in Meadow Creek. Aquatic organisms in this preliminary study show elevated As and Sb levels at sites with elevated surface water concentrations, but further work is needed to determine how contaminants are transferred among trophic levels and how these organisms are able to persist in these toxic environments.

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