Microbial antimony transformation associated with antimony mine tailing

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Antimony (Sb) is a naturally occurring toxic element and is considered to be a priority pollutant of interest by the USEPA. Although the concentrations of Sb in soils are generally low, elevated levels of Sb have been released via anthropogenic activities due to its increasing industrial use. Antimony is commonly associated with arsenic (As) in the environment and both elements have similar chemistry and toxicity. Increasing numbers of studies have focused on microbial As transformations, while microbial roles in the geochemical cycling of Sb are still not well understood. In this study, soils from an old stibnite mine tailing area in Ehime prefecture, Japan, were characterized geochemically and examined for the presence of Sb-transforming microbial populations. Total concentrations of Sb and As were higher in the surface soil (0-3 cm: 2280 and 1240 mg kg^{-1}, respectively) and decreased with depth (9-12 cm: 330 and 130 mg^{-1} kg). After conducting aerobic enrichment culturing with Sb^{III} (100 μM) in the presence of yeast extract as a carbon source, pure cultures of *Pseudomonas*- and *Stenotrophomonas*-related isolates with Sb^{III} oxidation activities were obtained. Furthermore, anaerobic enrichment cultures capable of reducing Sb^{V} (2 mM) in the presence of lactate were also obtained. Phylogenetic analysis of the Sb^{V}-reducing enrichment cultures showed the predominant presence of α- and β-Proteobacteria and Firmicutes-related populations. As previously reported with a dissimilatory antimonate reducing bacterium [1], the precipitation of antimonite (Sb^{III}) as antimony trioxide was confirmed in these enrichment cultures by X-ray absorption near-edge structure (XANES) and transmission electron microscopy (TEM). These results demonstrate that indigenous microorganisms associated with stibnite mine soils are capable of Sb redox transformations and potentially contribute to the geochemical cyling of Sb *in situ*.

[1] Abin & Hollibaugh (2014), *Environ Sci Technol* 48, 681-688.