Tellurium speciation and distribution as a function of depth in semi-arid mine tailings

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An increasing demand for high-tech devices containing tellurium (Te) will result in more end-of-life products that may have associated human and environmental health consequences. Though it is commonly enriched in many Au/Ag ore deposits, most isn't recovered, so significant amounts of Te are deposited into mine tailings weathering in surficial environments that act as a model system for improper future waste disposal and may represent a health risk to surrounding ecosystems and communities [1]. Tellurium is considered to be toxic to humans, Te^{IV} more than Te^{VI} [2]. The historic Delamar deposit (Lincoln County, NV) was mined for Au from 1891 to 1938 and is in a semi-arid region. Our goal is to examine the geochemical weathering of Te in order to assess Te bioaccessibility and mobility.

To that end, two circum-neutral (pH 7.3-8.3) tailings piles with strikingly different physicochemical characteristics were sampled as a function of depth. Surficial tailings contain elevated concentrations of Te (up to 267 mg kg^{-1}) and other metals (e.g., Pb, Bi, Cu, and As). These are vulnerable to dispersion by wind or surface water erosion [3]. Tellurium speciation was examined with X-ray absorption spectroscopy (XAS), and bulk fits unexpectedly suggest the predominance of Te^{VI}, the less toxic form of Te [4]. Spatial relationships were explored with X-ray fluorescence (XRF). Tellurium exhibits a strong spatial collocation with S and sometimes with Au, but Te is not correlated with Fe even though Te has an affinity for iron (oxy)hydroxides [5]. Tellurium is also enriched in smaller (<90μm) particles, with 49% by weight below the wind transportable threshold of 40 μm. However, the tailings containing more small particles are also more cemented, which may be reducing the extent of surface erosion. These preliminary results lend insight into the potential health impacts of Te at Delamar.

[1] Moreno *et al* (2007) *Water, Air, Soil Pollut* **179** (1-4), 93-105 [2] Taylor (1996) *Biol Trace Elem Res* **55** (3), 231-239 [3] Meza-Figueroa *et al* (2009) *Chemosphere* **77** (1), 140-147 [4] Grundler *et al* (2013) *Geochim Cosmochim Acta* **120**, 298-325 [5] Harada & Takahashi (2008) *Geochim Cosmochim Acta* **72**, 1281-1294