Transport, bioaccessibility and risk assessment of fine-grained arsenic-bearing mine tailings

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The fate, transport, and bioavailability of toxic elements in mine wastes are often considerably enhanced in the finest-grained particle size fractions [1]. For example, the natural enrichment of arsenic in gold deposits has led to an environmental legacy of arsenic contamination in abandoned mine tailings (processed ore) throughout the western US, with fine-grained arsenic-bearing particles transported by both windborne and fluvial processes from tailings piles to surrounding background regions.

The environmental risk posed by fine-grained mine tailings particles is enhanced by a combination of 1) increased mobility through physical and chemical weathering processes; 2) enriched concentrations of potentially hazardous trace metal(loid)s with decreasing particle size, and 3) increased exposure pathways of fine-grained particles, particularly those that can be ingested (≤250 μm), respired (≤10 μm), and delivered deep into the lung cavity (≤2.5 μm).

We have conducted extensive field, lab, synchrotron, and *in vitro* extractions simulating ingestion and respiration pathways of fine-grained mine tailings to understand the distribution, transport, and potential toxicity of arsenic in mining environments throughout the state of California. Selected findings from recent studies include:

- Intense and episodic precipitation or wind events mobilize mine wastes downstream, downslope, and downwind, causing an exponential decline in As enrichment as distance from the source increases;
- Initial solid arsenic concentration in a given mine waste material or size fraction is the strongest indicator in predicting the bioaccessibility of arsenic;
- Rainfall volume increases fluxes of arsenic-bearing sediments but decreases arsenic bioaccessibility, likely through dissolution of more soluble As phases;
- Arsenic exposure through inhalation of respirable particles represents the highest probability of exceeding health risk thresholds established for long-term chronic exposure.

[1] Csavina *et al* (2012) *Science of The Total Environment* **433**, 58-73