

## **Relationships between particle size, arsenic concentration, surface area, and bioaccessibility of mine tailings from the Empire Mine, CA**

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An estimated 47,000 abandoned mine sites exist statewide as a result of the historic mining of gold and silver in California. Since the halt of mining operations, communities have developed near abandoned mine wastes at certain locations. This is of concern because waste material left over from the processing and extraction of precious metals often contains associated toxic metal(loid)s including arsenic (As), which can be mobilized into surrounding communities and incidentally ingested by humans. The purpose of this study is to characterize trends in initial As concentration, surface area, and bioaccessibility as a function of particle size from contaminated sites within the Empire Mine region.

Empire Mine is an abandoned gold mine located in Grass Valley, California among the Sierra Nevada Mountains. This region contains mine waste piles with As concentrations approaching 10,000 ppm. Samples from the Empire Waste Dump, Prescott dump, Sabastopol, Prescott Shaft area, Power Line Central, Betsy Mine, Sand Dam, Mine Waste, and Native Mineralized regions were collected and separated via mechanical sieving into eleven distinct size fractions ranging from  $\geq 2830 \mu\text{m}$  to  $\leq 20 \mu\text{m}$ . Nitrogen absorption surface area analysis and initial elemental concentrations (including arsenic) were measured for each size fraction. *In vitro* simulated gastric fluid extraction tests were then performed to determine the bioaccessibility of As for each discrete particle size fraction as well as the  $\leq 250 \mu\text{m}$  size regime (corresponding to the directly ingestible size fraction).

Initial characterization of the size fractions largely displays an inverse correlation between average particle size and initial As concentration as well as an inverse correlation between average particle size and surface area. This could be due to the preferential weathering of matrix phases leaving a higher concentration of As behind and/or As dissolution and subsequent reabsorption onto fine-grained iron hydroxides.

The extraction tests exhibit an inverse correlation between particle size and mass of As released. When normalizing for either initial concentration or surface area, the former appears to be a larger contributor to the observed correlation; however, accounting for both factors provides the strongest explanation for the trend observed.