Bioavailability Measures for Arsenic in California Gold Mine Tailings

S.D. WHITACRE[1]*, N.T. BASTA[1], S.W. CASTEEL[2], A.L. FOSTER[3], P. MYERS[4] AND V.L. MITCHELL[4]

[1]The Ohio State Univ., Columbus, OH, USA (whitacre.39@osu.edu, basta.4@osu.edu)
[2]University of Missouri, Columbia, MO, USA (casteels@missouri.edu)
[3]USGS, Menlo Park, CA, USA (afoster@usgs.gov)
[4]DTSC, Sacramento, CA, USA (Perry.Myers@dtsc.ca.gov, Valerie.Mitchell@dtsc.ca.gov)

Thousands of abandoned gold mining sites with elevated levels of soil arsenic are present throughout the state of California. The primary risk pathway of concern is incidental soil ingestion. Assessment of risk by the use of total soil arsenic (As) is insufficient and can be misleading due to the wide range of soil properties that control the bioavailability of As. The aim of the current study is to measure the potentially bioavailable fraction of As in gold mine tailings from California. Twenty-five samples were collected with total As ranging from 15.3 to 12,095 mg/kg As. The OSU in vitro method (OSU-IVG) and Relative Bioavailability Leaching Procedure (RBALP) with glycine were used to measure the bioaccessibility of As in the samples. Gastric extractable (GE) As in the OSU-IVG ranged from <2% to 9.3% with a mean of 4.2% and GE in the the RBALP ranged from <2% to 14.4% with a mean of 3.6%. In vitro extractable As was compared with swine relative bioavailability (RBA) for twelve of the twenty-five samples, which ranged from 4.0% to 24% with a mean of 16%. The results demonstrated that both in vitro methods greatly underestimate RBA for these soils. As a result, additional extractions were evaluated to conservatively estimate RBA for gold mine soils. The extractions included a modified OSU-IVG and sequential extraction procedure (SEP) which fractionated As into 5 pools: F1, non-specifically sorbed; F2, specifically sorbed; F3, amorphous and poorly crystalline oxides of Fe and Al; F4, well-crystallized oxides of Fe and Al; and F5, residual.