Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Bioavailability: "The amount of chemical that is actually absorbed into the body"

Issues

- Arsenic is typically the controlling COC for cleanup of former gold mining sites
- Arsenic is often only partially bioavailable: 5% to 90%
- Correlation between in vivo (animal studies) and in vitro (lab methods – simulated gastro digestion) has not been sufficient for health risk decisions
- In vivo methods are expensive and time consuming
- Apparent relationship between various forms of iron oxide and arsenic

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Grant Background

- DTSC applied for EPA Brownsfield Training, Research & Technical Assistance Grant 5/08
- Grant awarded 3/09 in the amount of $750,000
- Research will focus on the threat to human health due to arsenic at mine scarred lands (MSL)

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Objective of the research

Provide better tools to assess health risks at MSL that allow use of bioavailability in risk assessment and risk management decisions by:

- Developing cost effective methods to determine arsenic bioavailability:
  - Improve correlation between in vitro and in vivo methods through improvement of the in vitro simulated gastro-intestinal assay
  - Determine how arsenic is bound in soil at MSL
  - Relate how the arsenic is bound to in vivo bioavailability

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Objective cont.

- Identifying wet chemical, spectroscopic, and physical measurements to use in characterizing MSL
- Developing a database of mine wastes and corresponding in vitro and mineralogy data
- Establishing a methodology for implementation at sites other than EMSHP
- Developing a guidance document for use of bioavailability at MSL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Partners

- USGS
- Ohio State University
- University of Missouri
- Chapman University

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

USGS

- Bulk X-Ray Flourescence (XRF) and Bulk X-Ray Diffraction (XRD)
- Differential XRD
- Electron Microprobe Analysis (EMPA)
- Scanning Electron Microscopy (SEM)
- Spectroscopy at Synchrotron energies

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Ohio State University

- Bulk sample processing and distribution to all investigators
- Sequential extraction studies
- In vitro bioaccessibility testing using the OSU-IVG method

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

University of Missouri

- In vivo bioavailability testing using juvenile swine

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Chapman University

- Particle size analysis
- Extraction studies
- In vitro bioaccessibility testing using Ruby method as modified by Drexler and Brattin
- Extraction in simulated lung fluid (time and funds permitting)

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Current tasks

1. Sample and Analysis Plan with Field Work
2. Develop Database for Predicting Bioavailability
3. Bulk Chemistry, Special Chemistries, and Physical Measurements
4. In Vitro Bioaccessibility Testing
5. In Vivo Bioavailability Testing
6. Spectroscopy at Synchrotron Energies
7. Public Outreach

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Information can be found on DTSC's website

http://www.dtsc.ca.gov/InformationResources/Arsenic_Relative_Study.cfm

- **Quality Assurance Project Plan (QAPP) approved by EPA is posted along with CEQA documents related to sampling at the Empire Mine SHP**
- **As information is developed it will be posted to the website**

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Public Workshops

- Planned for 2010 and 2013
- Purpose is to present results to date and final results of the research
- Researchers other than the partners in the grant may also participate as presenters

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

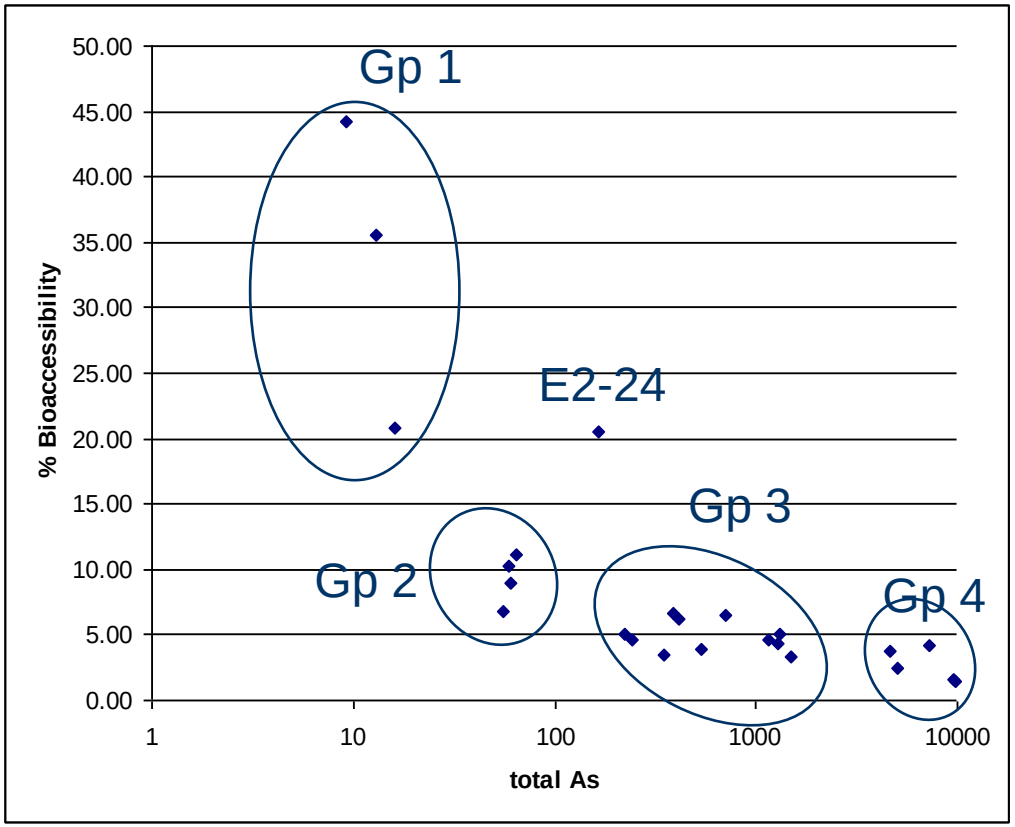
Recon Events

- Empire Mine SHP, Grass Valley, CA
- 3 Recon sampling trips over 6 months using XRF to determine As and Fe concentrations
- Recon samples analyzed for in vitro bioaccessibility by OSU using a limited version of their process
- XRD analysis
- Chose final sampling locations based on all the data and tried to represent each of the 4 groups on the following slide

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Visual Analysis of BL 11-3 Normalized, bckg-subtracted XRD data



Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

First Sampling Event

- Sampling done 9/21-9/23
- Total of 25 individual samples in 46 five gallon containers collected
- Sample processing at OSU prior to distribution to investigators

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Arsenic RBA Study

DEPARTMENT OF TOXIC SUBSTANCES CONTROL

Questions