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

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)
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
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

Partners

- USGS
- Ohio State University
- University of Missouri
- Chapman University
Arсенічний РБА-студії

USGS

- Балк X-Рей Флуоресценція (XRF) та Балк X-Рей Дифракція (XRD)
- Диференціальна XRD
- Електронна Мікроаналіз (EMPA)
- Сканування Електронна Мікроскопія (SEM)
- Спектроскопія на синчроонічних енергіях
Arsenic RBA Study

Ohio State University

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

University of Missouri

- In vivo bioavailability testing using juvenile swine
Arsenic RBA Study

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

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

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

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

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

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

![Graph showing the relationship between total As and % Bioaccessibility with different groups indicated.]
Arsenic RBA Study

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
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