The University of Arizona Superfund Basic Research Program – Matching Needs with Research Expertise

Photo Credit: Janick Artiola

Presented by:
Monica Ramirez, MPA
Research Translation Coordinator
The University of Arizona, Tucson, Arizona
June 19, 2007

Presentation Outline

- Overview of National Superfund Basic Research Program (SBRP)
- The University of Arizona Superfund Basic Research Program mission (UA SBRP)
  - Mission
  - Biomedical research projects
  - Environmental research projects, technology transfer and field trial sites
- Bridging the gap: the role of the Research Translation Core
- Discussion: how can our program meet your needs?

Superfund Basic Research Program

UCDAVIS SUPERFUND RESEARCH PROGRAM

Berkeley University of California

UCSD

Superfund Basic Research Program
The University of Arizona

fund Basic Research Centers

Dartmouth College	5	11	Michigan State University
Harvard School of Public Health	5	12	University of Cincinnati
Boston University	6	13	Texas A & M University
Columbia University	9	14	University of California-Davis
Mount Sinai School of Medicine	9	15	University of California-Berkeley
New York University School of Medicine	9	16	University of California-San Diego
University of Kentucky	9	17	University of Arizona
Duke University	10	18	University of Washington
University of North Carolina-Chapel Hill	10	19	Oregon Health & Science University
University of Florida			

Superfund Basic Research Program

The University of Arizona

Our Mission is to advance science and to apply the biomedical and environmental research conducted by our program for the improvement of human health and the environment.

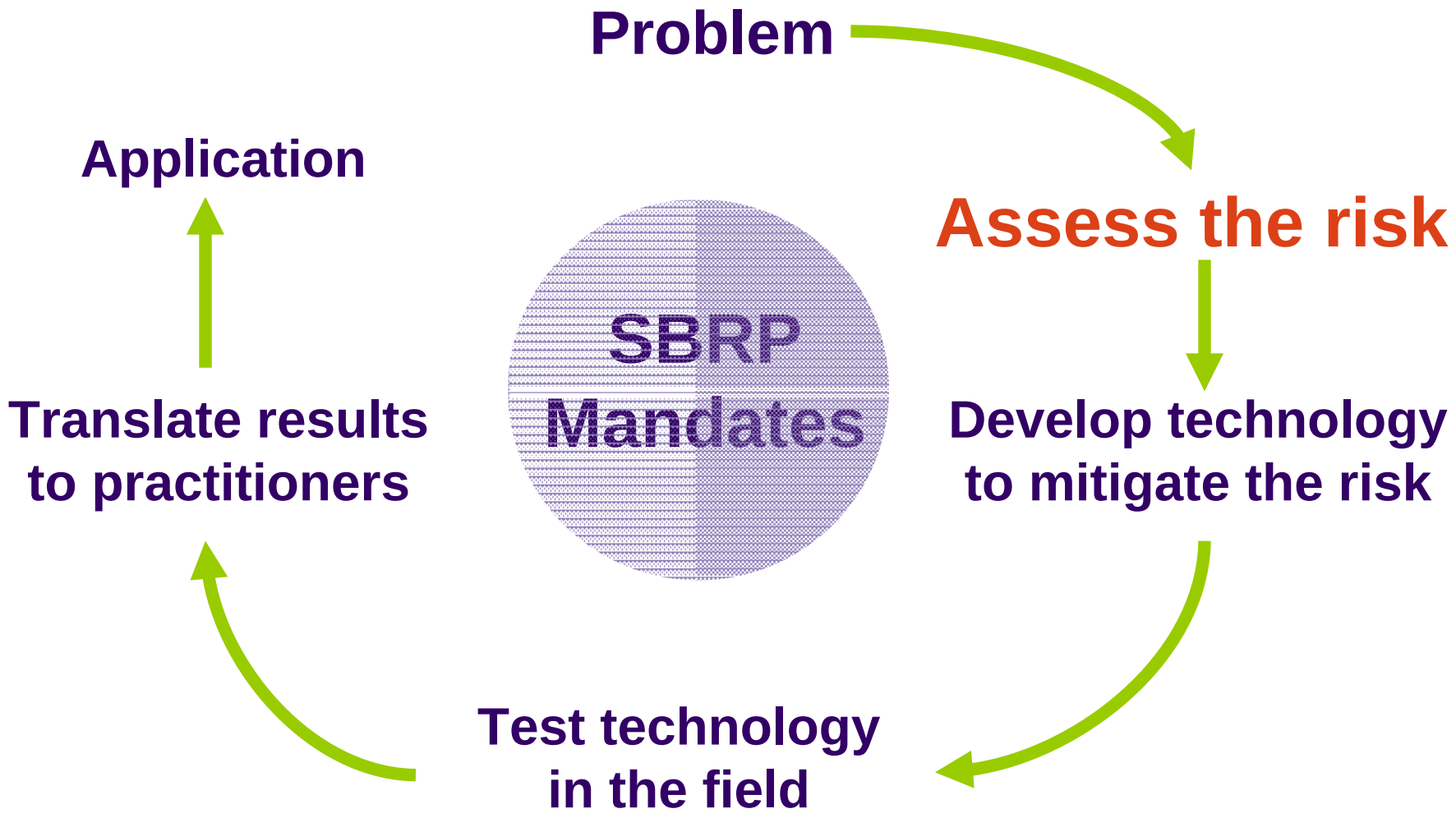
Superfund Basic Research Program
The University of Arizona

UA SBRP

- Committed to interdisciplinary appr
  environmental research and educa
- Investigates hazardous waste and
  issues currently confronting the southwestern U.S.

Objectives of the UA SBRP

- Develop **risk assessment methodologies** for metal and organic contaminants through toxicologic and hydrogeologic studies
- Develop **innovative remediation technologies**
- Emphasize hazardous waste issues in the **arid and semi-arid southwestern** U.S. and Mexican border
- Results not limited to the southwest –provide principles of toxicology and remediation



Imperative to maintain constant communication with stakeholders at all levels to fulfill these goals

UA SBRP Research Projects – Biomedical

Project 1 – *"Molecular Effects of Low Level Arsenic on the Human Bladder"*
A. Jay Gandolfi, Pharmacology and Toxicology

Project 2 – *"Role of Annexin II in Peripheral Vascular Disease"*
Richard Vaillancourt, Pharmacology and Toxicology

Project 3 – *"Susceptibility to Trichloroethylene (TCE) and Chlorinated Acids In Heart Development"*
Ornella Selmin, Veterinary Science and Microbiology

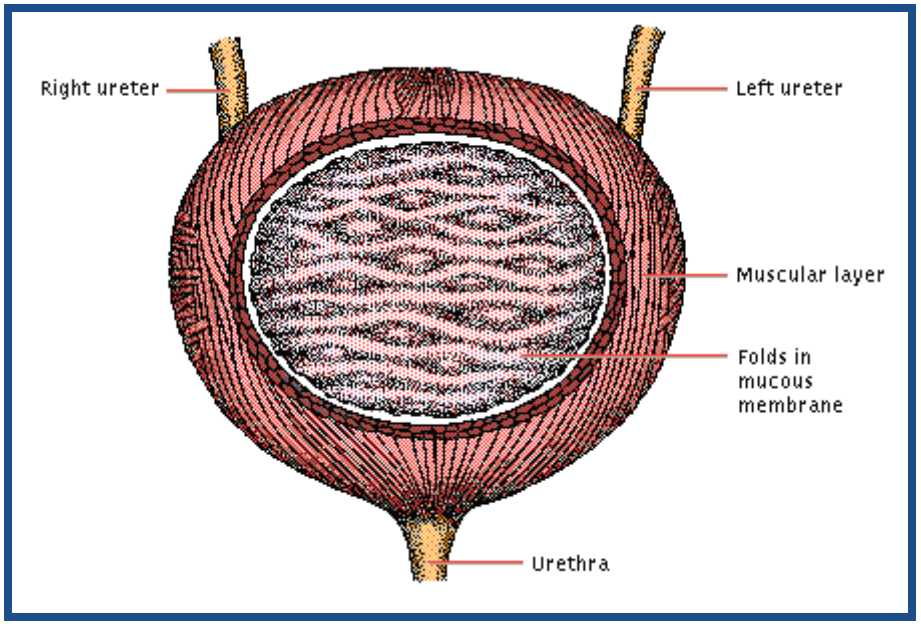
Project 4 – *"Pulmonary Response to Arsenic in Susceptible Populations Alterations Following In Utero and Early Postnatal Exposure"*
Clark Lantz, Cell Biology and Anatomy

Project 5 – *"The Human Genetics of Arsenic Biotransformation"*
Walt Klimecki, Pharmacology and Toxicology

UA SBRP Research Project 1

"Molecular Effects of Low Level Arsenic on the Human Bladder"

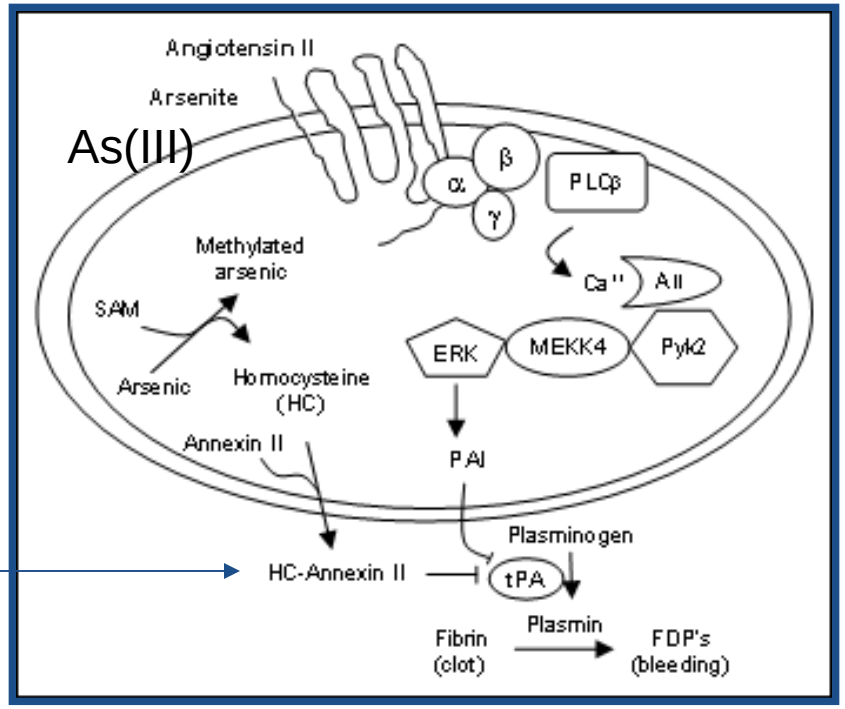
- Clarify the toxic effects of **low-level arsenic** in human bladder model
- Provide potential **biomarkers** for arsenic - induced bladder Injury



UA SBRP Research Project 2

"Role of Annexin II in Peripheral Vascular Disease"

- **Arsenic** effects on cell signaling in vascular tissue
- Link effects to vascular diseases: **hypertension, diabetes**

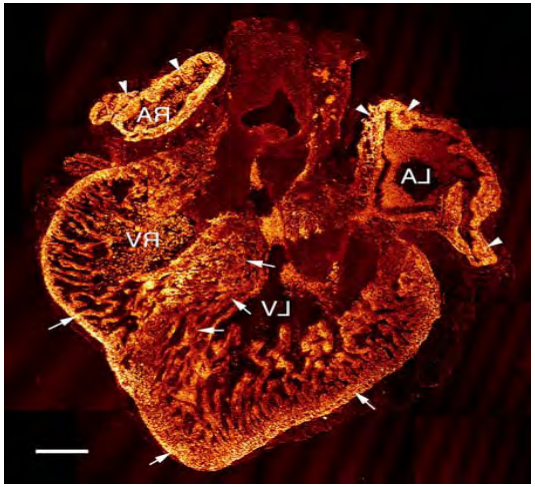


Two proposed mechanisms for regulation of plasmin (affects clot process)

UA SBRP Research Project 3

"Susceptibility to Trichloroethylene (TCE) and Chlorinated Acids in Heart Development"

- The effects of TCE on heart valve development
- Therapeutic effects of dietary folic acid



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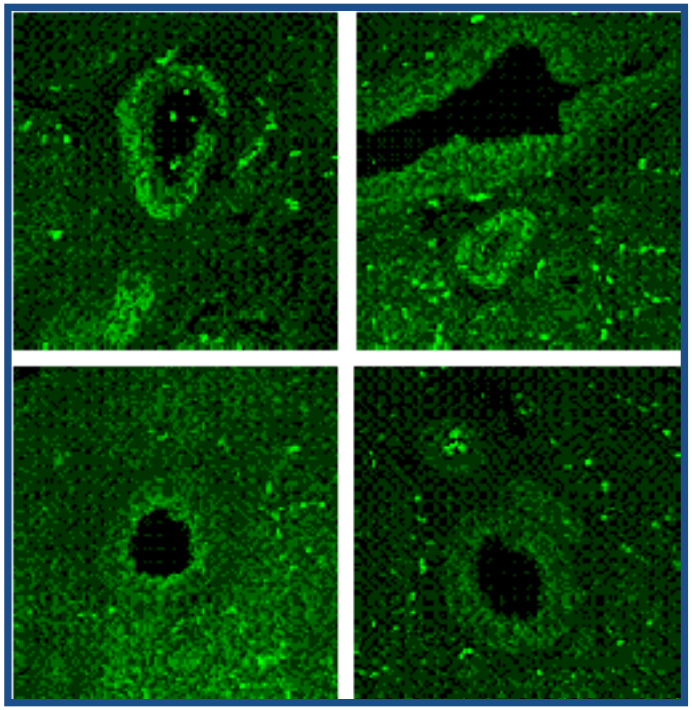
UA SBRP Research Project 4

"Pulmonary Response to Arsenic in Susceptible Populations: Alterations Following In Utero and Early Postnatal Exposure"

- **Arsenic** effect on **lung development**
- Large incidence of lung problems (e.g. asthma) in **children**
  - Higher incidence in various ethnic and economic groups
  - Drinking water and inhalation exposure

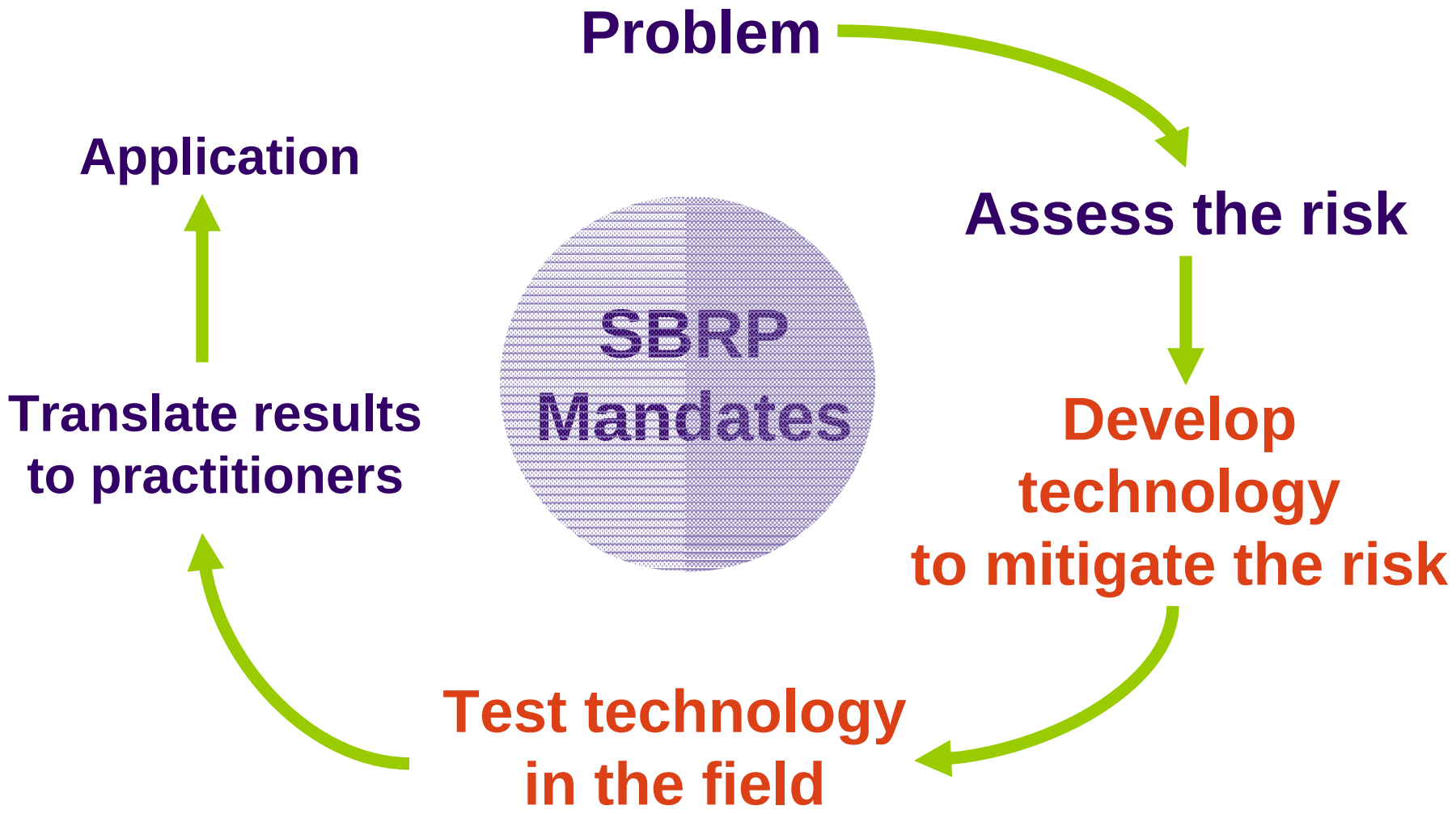


Changes in structural lung proteins in offspring of arsenic exposed mothers

UA SBRP Research Project 5

"The Human Genetics of Arsenic Biotransformation"

- Correlate **genetic differences** in arsenic biotransformation with **susceptibility** to arsenic-induced toxicities
- Expand populations to determine toxic effects of gene differences



Imperative to maintain constant communication with stakeholders at all levels to fulfill these goals

UA SBRP Research Projects – Environmental

Project 6 – *"New Technologies for the Remediation of Halogenated Organics"*
Eric Betterton, Atmospheric Sciences and Environmental and Chemical Engineering

Project 7 – "Mass-Transfer Dynamics of Chlorinated-Solvent Immiscible Liquids in Porous Media"
Mark Brusseau, Soil, Water and Environmental Science and Hydrology and Water Resources

Project 8 – "Arsenic in Water: Removal Technologies and Residuals Disposal"
Wendell Ela, Environmental and Chemical Engineering

Project 10 – "Phytostablization of Mine Tailings in the Southwestern United States: Plant-Soil-Microbe Interactions and Metal Speciation Dynamics"
Raina Maier, Soil, Water and Environmental Science

UA SBRP Research Project 6

"New Technologies for the Remediation of Halogenated Organics"

- Catalytic Destruction of Perchloroethylene (PCE) and Trichloroethene (TCE) from Soil Vapor Extracted Gases

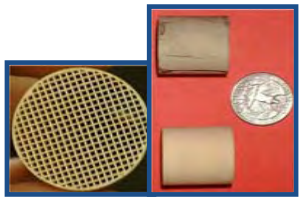
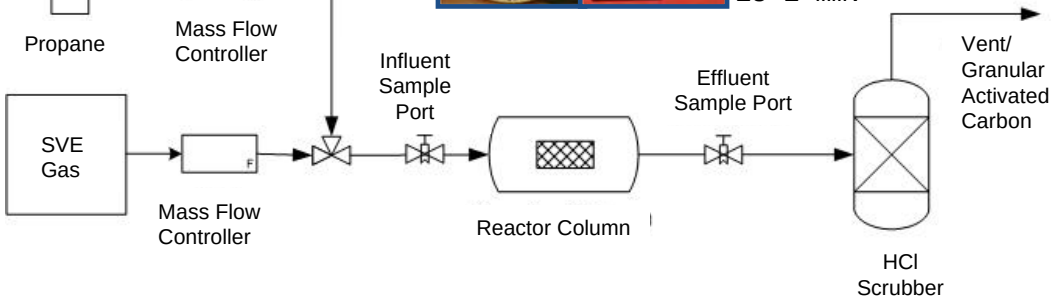
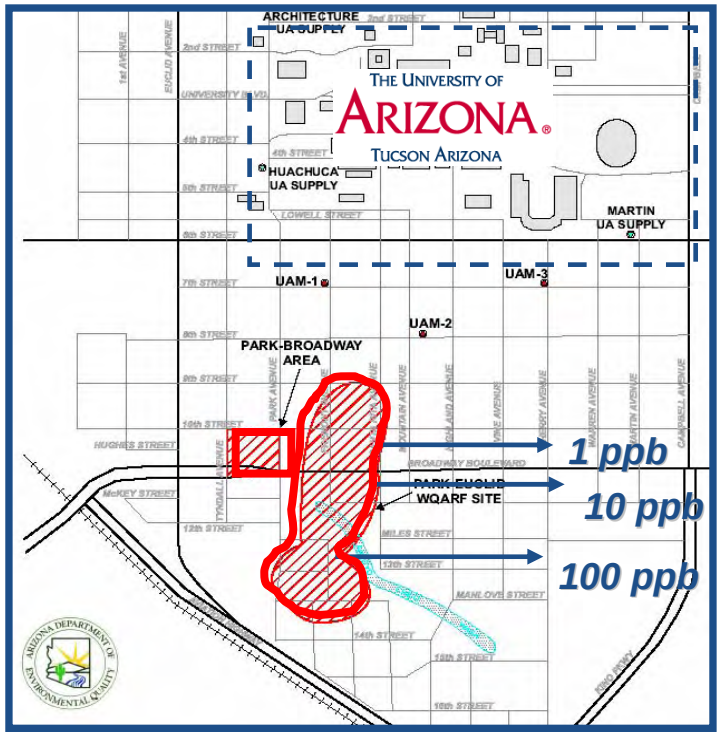
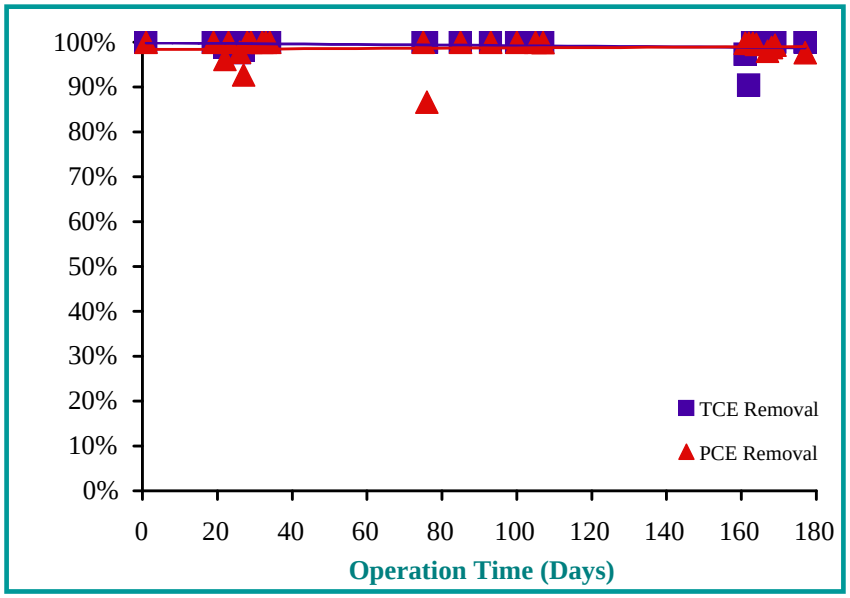


Image 1. Top view of catalytic converter honeycomb monolith. Each square channel is 1 mm.





Site Vicinity Map of Park-Euclid WQARF site, Tucson, AZ.



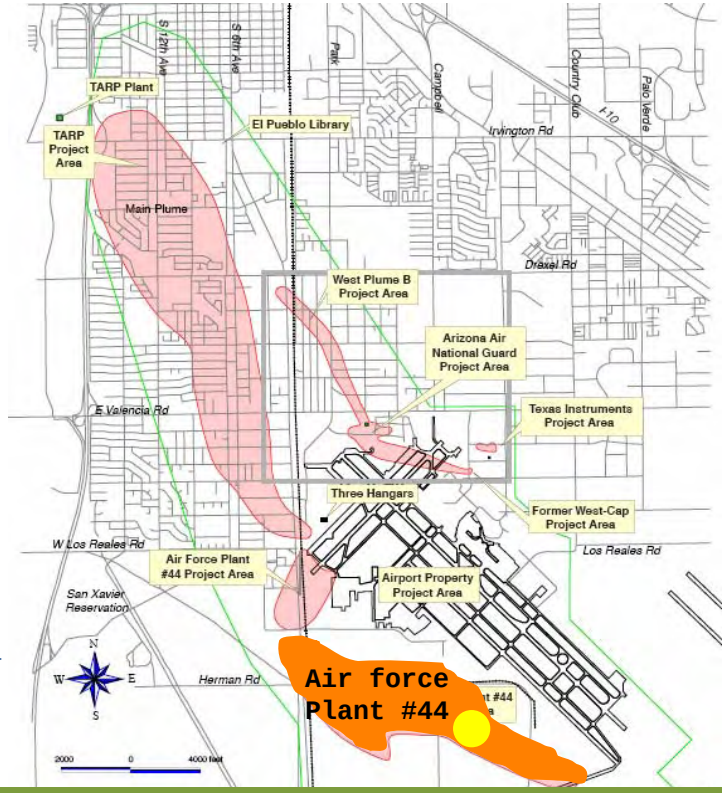
Catalytic Destruction technology has removed 90-100% PCE and TCE from SVE gases over the 180 days of operation.

Actual layout of the catalytic redox converter system at the Park-Euclid State Superfund site

UA SBRP Research Project 7

"Mass-Transfer Dynamics of Chlorinated-Solvent Immiscible Liquids in Porous Media"

- **Innovative Site Characterization Analysis**
  - Contaminant distributions (location and amounts)
  - Aquifer permeability (hydraulic conductivity)
  - Aquifer heterogeneity (example: distribution and size of clay zones in the contaminated aquifer)
  - Contaminant mass transfer and transformation processes
  - Evaluation of the impact of source zone management on site remediation



Location of Tucson International Airport Area Superfund Site. Yellow dot indicates the source zone that was

Tucson International Airport Area Superfund Site Advanced Site – Characterization project

Tool	Purpose
Depth-specific sampling	Characterize vertical contaminant distribution
Partitioning tracer tests	Detect and quantify immiscible liquid saturation
Contaminant elution and rebound	Characterize contaminant removal behavior
Mass flux reduction/mass removal	Characterize mass flux reduction/mass removal relationship
Contaminant Transport modeling	Characterize TCE transport
	Evaluate impact of source-zone management

Concentration (µg/L)

QuickTime™ and a
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are needed to see this picture.

Time (Y)

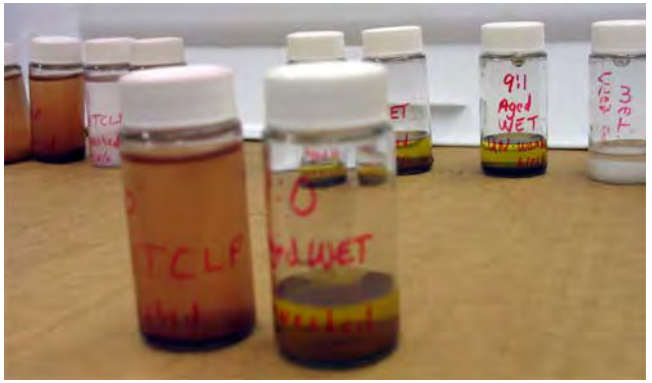
UA SBRP Research Project 8

"Arsenic in Water: Removal Technologies and Residual Disposal"

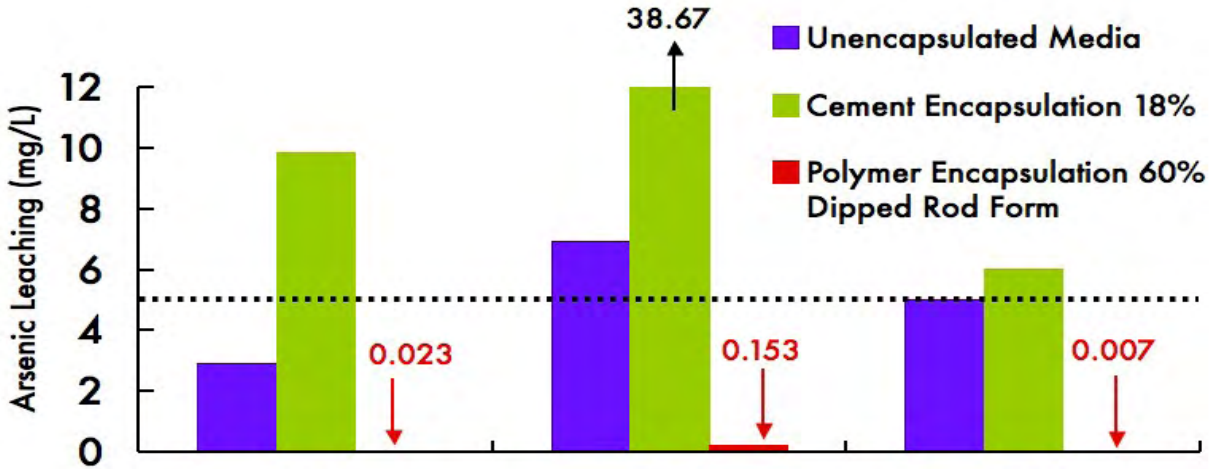
- Evaluating a variety of absorbents that remove (reduce) arsenic from water
- Proper storage of arsenic residuals

Blackbox Mass Balance Model

Landfill Input =
2.24 g_{As}/capital*year
560 kg_{waste}/capital*year
0.15 - 11 $L_{leachate}/kg_{waste}$



Standard and modified US-EPA 18 hour TCLP and California 48 hour WET leaching tests.



GFH Media

granular ferric hydroxide

E33 Media

iron oxide hydroxide

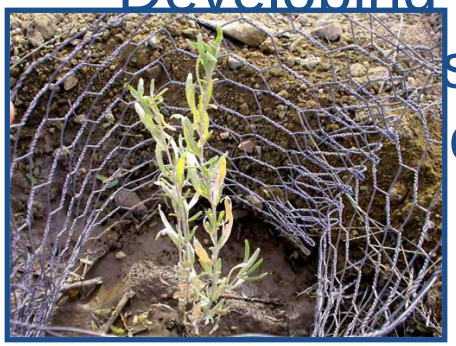
AAFS Media

activated alumina sorbents

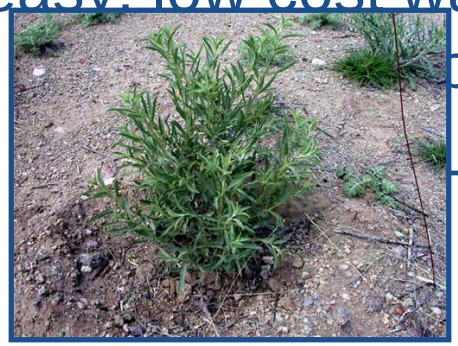
UA SBRP Research Project 10

"Phytostabilization of Mine Tailings in the Southwestern United States: Plant-Soil-Microbe Interactions and Metal Speciation Dynamics"

- Stabilizing mine tailings with drought-tolerant native plant species
- Developing easy, low cost ways to revegetate mine tailings st preparation, fertilizer and e



Transplanted *Atriplex lentiformis*



Establishment - 9 months later

80% of transplants survived

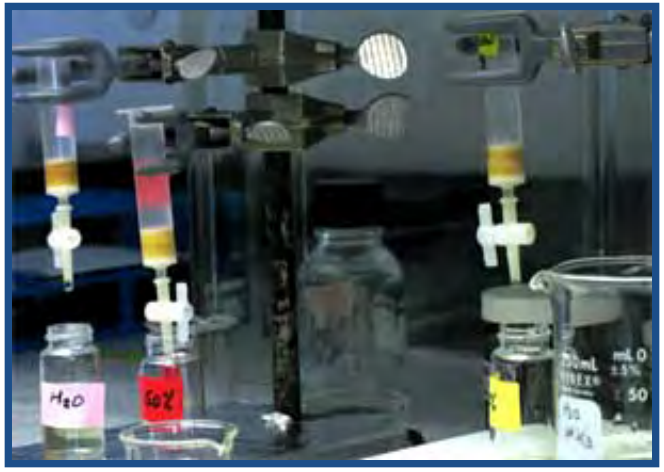
Biomass increased significantly

No difference between compost/no compost treatments in neutral tailings

Bacterial community monitored to indicate plant and soil health

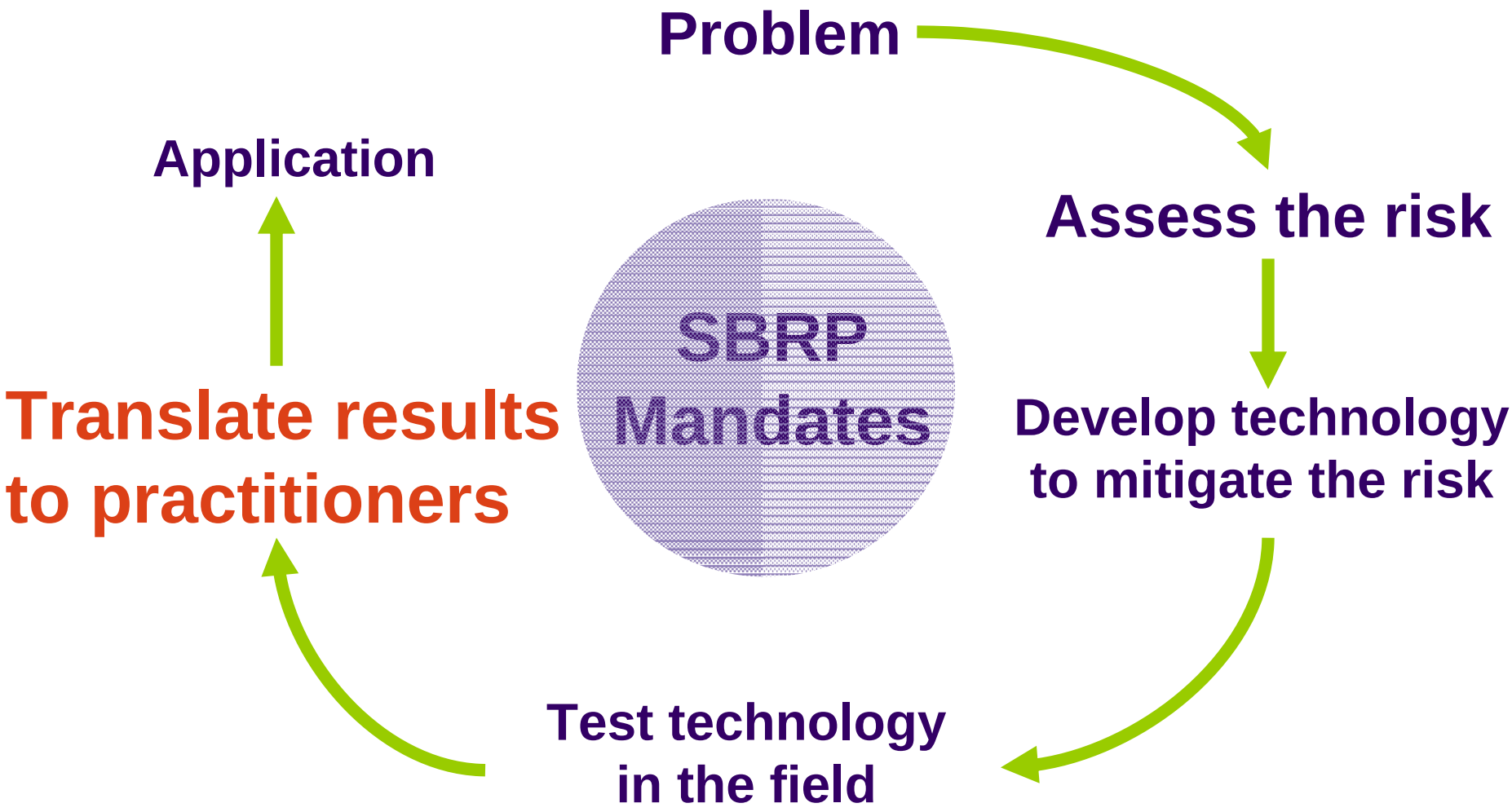
UA SBRP Support Cores

- Administrative
- **Research Translation**
- Hazard Identification
- Outreach
- Training



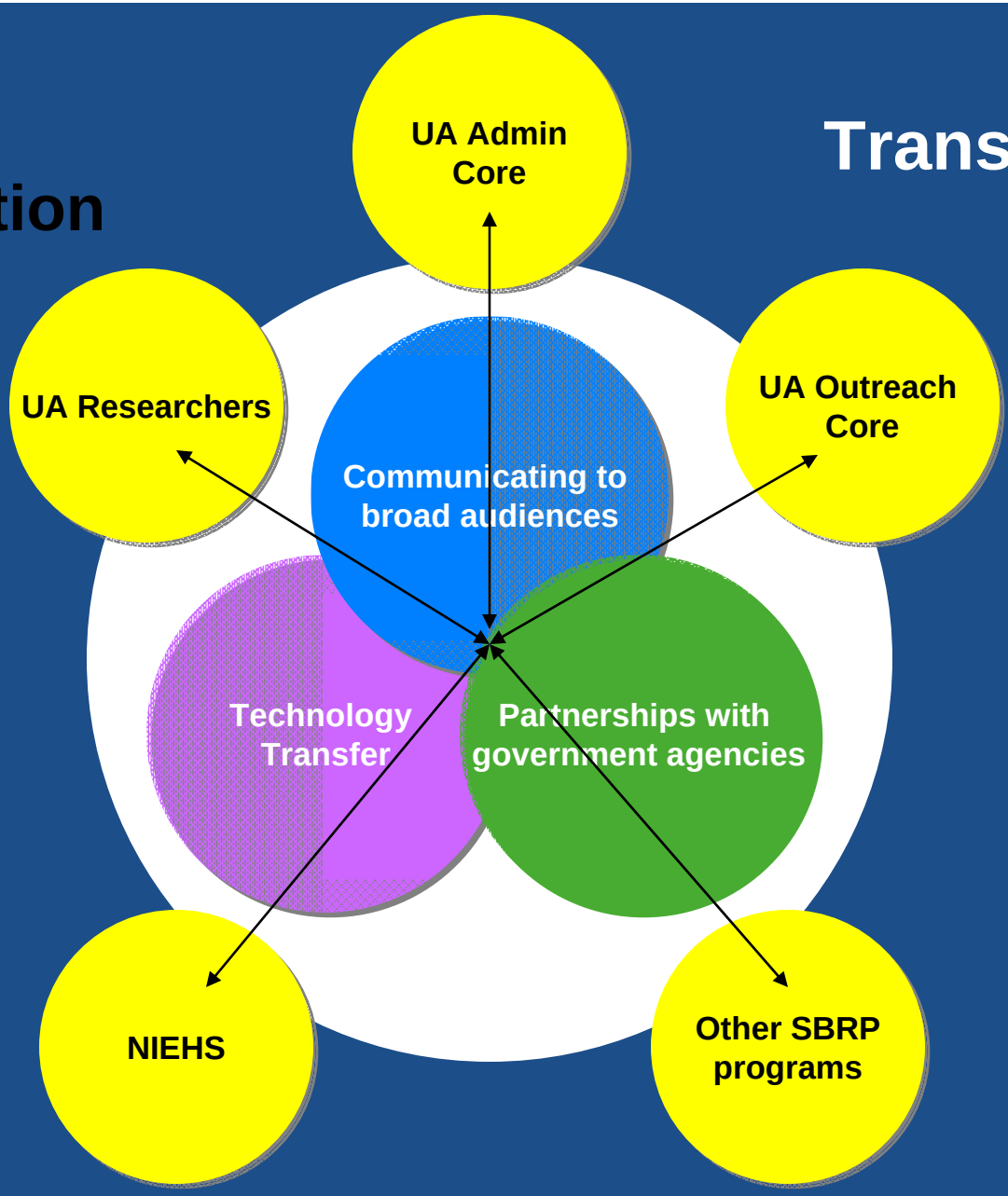
U.S. - Mexico Binational Center

for Environmental Sciences and Toxicology


Problem
Assess the risk
Develop technology to mitigate the risk
Test technology in the field
Translate results to practitioners
Application
SBRP Mandates

Ongoing Internal communication to meet Research Translation goals

Research Translation Core Objectives



Modified NIEHS schematic

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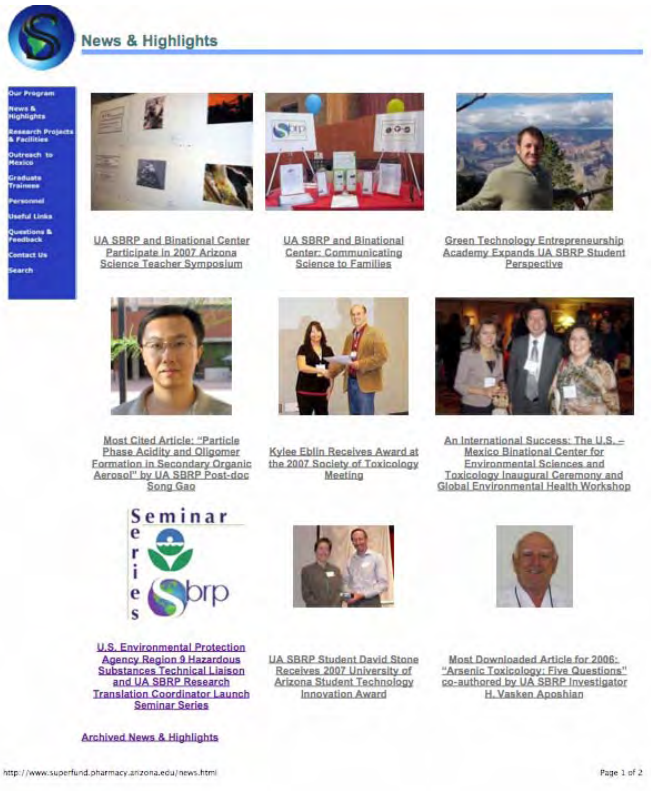
The University of Arizona

Information Transfer




SciTransfer
Issue 001, August 2006

A publication from The University of Arizona
Superfund Basic Research Program

Chlorinated Solvent Contaminants in Arizona Aquifers

By Janick F. Artiola, PhD and Mónica D. Ramírez, MPA

Part I: Sources, Properties, Health Effects and Fate.

Introduction

Groundwater contamination by hazardous organic (carbon-based) was identified in the US as a serious problem beginning in the organic chlorinated liquid solvents in particular can cor sub-surface drinking water resources because they are co concentrations, see next section. The US Environmental Pro identified and listed 9 Superfund sites with groundwater contar also 35 Water Quality Assurance Revolving Fund (WQARF)* lis of these sites contain toxic chlorinated solvents like trichloroe page. Superfund sites with TCE and perchloroethylene (PCE include: electronic manufacturing plants, military facilities, dr most cases groundwater pollution resulted from storage or dis between the 1940s and 1970s. Often TCE and PCE are fou chemicals like dichloroethenes (DCE) and vinyl chloride (VC) degradation of these two chemicals.

( ) = Technical Terms

*WQARF governs the remediation of groundwater contaminated sites in A


¿Como afecta el TCE nuestra salud?

Los científicos han encontrado que la exposición al TCE afecta la salud humana. Principalmente el TCE entra al cuerpo humano por medio del agua de beber. También puede entrar al cuerpo al ser inhalado o absorbido a través de la piel. Los efectos del TCE en la salud dependen en la cantidad y la duración de la exposición. La exposición repetida y prolongada al TCE puede tener efectos de larga duración y posiblemente permanentes.

Las concentraciones muy altas de TCE pueden ocasionar desmayos, paros respiratorios, o muerte. También se ha demostrado que puede causar daños a las funciones del corazón, sistema nervioso, hígado y riñones.

Las concentraciones a niveles bajos, pueden causar reacciones alérgicas como erupciones cutáneas (salpullido), falta de coordinación y dificultad en concentrarse. Además puede causar mareo, dolor de cabeza y otro tipo de irritaciones. Por ultimo, el TCE a concentraciones bajas y de larga duración, también puede causar cáncer en los intestinos, hígado y riñones. Estudios sugieren que la manera en que el cuerpo reacciona al TCE también puede depender en la historia y genética familiar.

¿Quiere saber más?

Arizona Department of Environmental Quality
http://www.azdeq.gov/

Agency for Toxic Substances and Disease Registry
http://www.atsdr.cdc.gov/

US EPA Consumer Fact Sheet on Trichloroethylene
http://www.epa.gov/OGWDW/contaminants/dw_contamfs/trichlor.html

National Institute of Environmental Health, Superfund Basic Research Program
http://www-apps.niehs.nih.gov/sbrp/

Presentado por:

La misión del Centro Binacional es resolver los retos de salud humana y ambiental a lo largo de la frontera entre los Estados Unidos y México:

Proporcionar y apoyar el entrenamiento, la investigación y el desarrollo de políticas publicas dentro de las ciencias ambientales y la toxicología.

Facilitar el dialogo binacional entre los investigadores y los grupos de interés en relación a la evaluación de riesgo y los problemas de remediación.

Para más información, favor de contactar a:
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1703 East Mabel Street
Tucson, Arizona 85721-0207
Telephone: 520.429.1428, Fax: 520.626.2466
dmoreno@pharmacy.arizona.edu
http://www.superfund.pharmacy.arizona.edu/outreach.html

May 2006

¿Que es el TCE?

El tricloroetileno (TCE) es un solvente líquido usado para disolver sustancias aceitosas o grasosas.

El TCE ha sido introducido al medio ambiente por que la gente lo usa para limpiar la grasa de los metales, especialmente para limpiar partes de aviones. También las tintorerías usaban un solvente relativamente similar conocido como PCE para remover la mugre de la ropa sucia. El TCE puede formarse a través de la conversión del PCE cuando se introduce al medio ambiente.

Antes, no se savia que el TCE podía afectar negativamente a los humanos y al medio ambiente. Por esta falta de conocimiento, no se dispuso del TCE de forma adecuada. Además también se puede fugar al medio ambiente si no es almacenado adecuadamente. Ahora, se dispone del TCE quemándolo en incineradores de alta temperatura especialmente diseñados.

Bilingual materials for stakeholders at all levels

To download our materials, please visit
www.superfund.pharmacy.arizona.edu/cores/research_translation_products.html

Information Transfer

- Supporting and facilitating the exchange of ideas

Collaborative effort between the US-EPA, ATSDR, NIEHS SBRP and academia to evaluate the issues surrounding arsenic removal from drinking water, and the relationship between arsenic mobilization and landfills and waste sites.

Technology Transfer

THE UNIVERSITY OF ARIZONA
OFFICE OF TECHNOLOGY TRANSFER

seeking Partner to license

Effective On-site Destruction of Halogenated Organic Vapors

Background: The University of Arizona is actively seeking potential licensees to commercialize research that effectively destroys halogenated organic vapors by means of a catalytic converter. The research represents an extremely efficient, cost effective method for remediation of soils contaminated with halogenated organics such as those found at most superfund sites. Conventional methods of treatment involve transferring the contaminants to activated charcoal pellets, which then become hazardous waste needing to be shipped to a landfill or incinerator destroyed often at great additional expense.

The catalytic process developed at The University of Arizona provides for a way of effectively destroying the pollutants onsite, thereby preventing the transfer of waste and creating an additional disposal problem.

Applications:
- *Industrial and laboratory settings in which contaminants are currently removed with activated charcoal.*
- *Toxic waste clean up at sites contaminated with halogenated organic materials such as PCE and TCE.*
- *Onsite landfill operations*

Advantages:
- *Cost-effective method of eliminating pollutants means lower cleanup budgets.*
- *Halogenated organics are destroyed onsite thereby saving transportation and later destruction costs.*
- *The catalytic process uses abundant and inexpensive materials.*

The Technology: Researchers at The University of Arizona have developed a cost effective method for onsite destruction of halogenated organic materials such as perchloroethylene (PCE) and tricholoroethylene (TCE). The method involves mixing contaminant vapors in air with a reducing gas inside a catalytic converter, producing carbon dioxide, hydrochloric acid, and water vapor. This process is self contained and destroys the toxic material onsite, mitigating the need for transport, storage, and incineration of contaminants.

Lead Inventors: Prof. Eric Betterton

Stage of Development: Pilot scale systems have been built and field tested.

Status: Provisional Patent Application

Refer to Case # UA05-056
Contact Robin Richards
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Invention disclosure “Process for the Destruction of Halogenated Organic Vapors Using a Catalytic Converter under Redox Conditions”

Arizona Bureau of Land Management
Public Lands USA: Use, Share, Appreciate

BLM Grants UA SBRP $25,000 to phytostabilize a 1.5 acre mine tailings site in the San Pedro River National Conservation Area in southern Arizona.

Building partnerships with government agencies and various stakeholders at all levels

QuickTime™ and a
(Uncompressed) decompressor
re needed to see this picture.

Region 9

- Hazardous Substances Technical Liaison
- Remedial Project Managers
- Community Involvement Coordinators (CIC) at Superfund sites
  - TIAA
  - Phoenix-Goodyear
  - Klondyke State Superfund Site

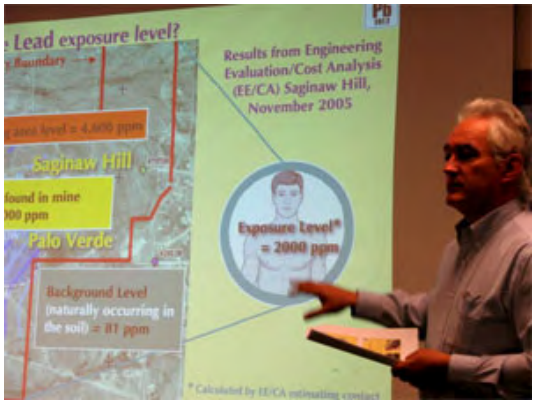
ADEQ Arizona Department of Environmental Quality

Ongoing communication and participation in seminar series

Hazardous Core Liaison at ADHS laboratory

Arizona Department of Health Services

Community Meetings



"Health Information about Arsenic and Lead" and interpreted the Engineering Evaluation/Cost Analysis to community members neighboring an abandoned mining site

Outreach Events

R9 CIC Jose Garcia and Congressman Raul Grijalva at the Sunnyside Neighborhood Fair - one of the communities exposed to TCE from the TIAA site

Discussion: How can our program may better meet your needs?

- Who else should we be in contact with?
- Does our research match your research priorities?
- How can we work together more?
- Are our current communication strategies working?
- Has our presentations been of value to you?