University of Arizona Superfund Research Program
"Risk and Remediation of Metal-Mining Wastes"

Director: Raina Maier
Associate Director: Clark Lantz

https://superfund.arizona.edu/

ADMMR Photo Archive, Arizona Geological Survey

NIH National Institute of Environmental Health Sciences
Superfund Research Program

THE UNIVERSITY OF ARIZONA

Residual mine waste is one of the largest waste streams in the world

https://durangoherald.com/articles/100800

The Gold King Mine spill, 2015

The Samarco iron ore mine dam collapse, 2015

https://en.wikipedia.org/wiki/Bento_Rodrigues_dam_disaster

http://www.northernminer.com/regulatory-issues/tailings-dam-failures-expected-to-increase-experts-say/1003703723/

The Mt. Polley tailings dam break, 2015

The Cananea Mine spill, 2014

http://www.watersecuritynetwork.org/learning-from-the-cananea-mining-spill-in-sonora-mexico/

Dust Emission at the Iron King Mine and Humboldt Smelter Superfund Site

Video: Mackenzie Russell
Atmospheric Science

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(P42ES004940) https://superfund.arizona.edu/

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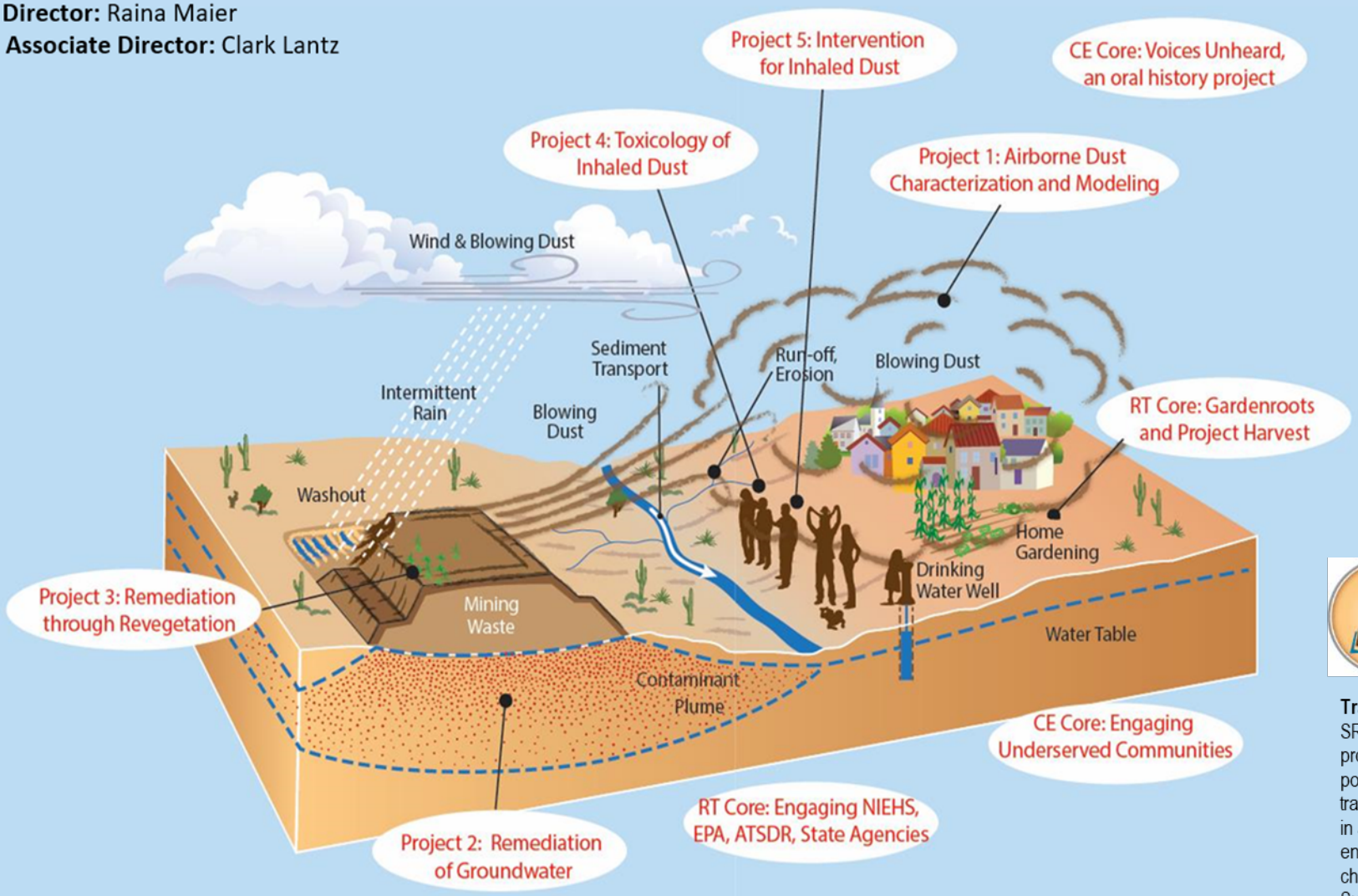


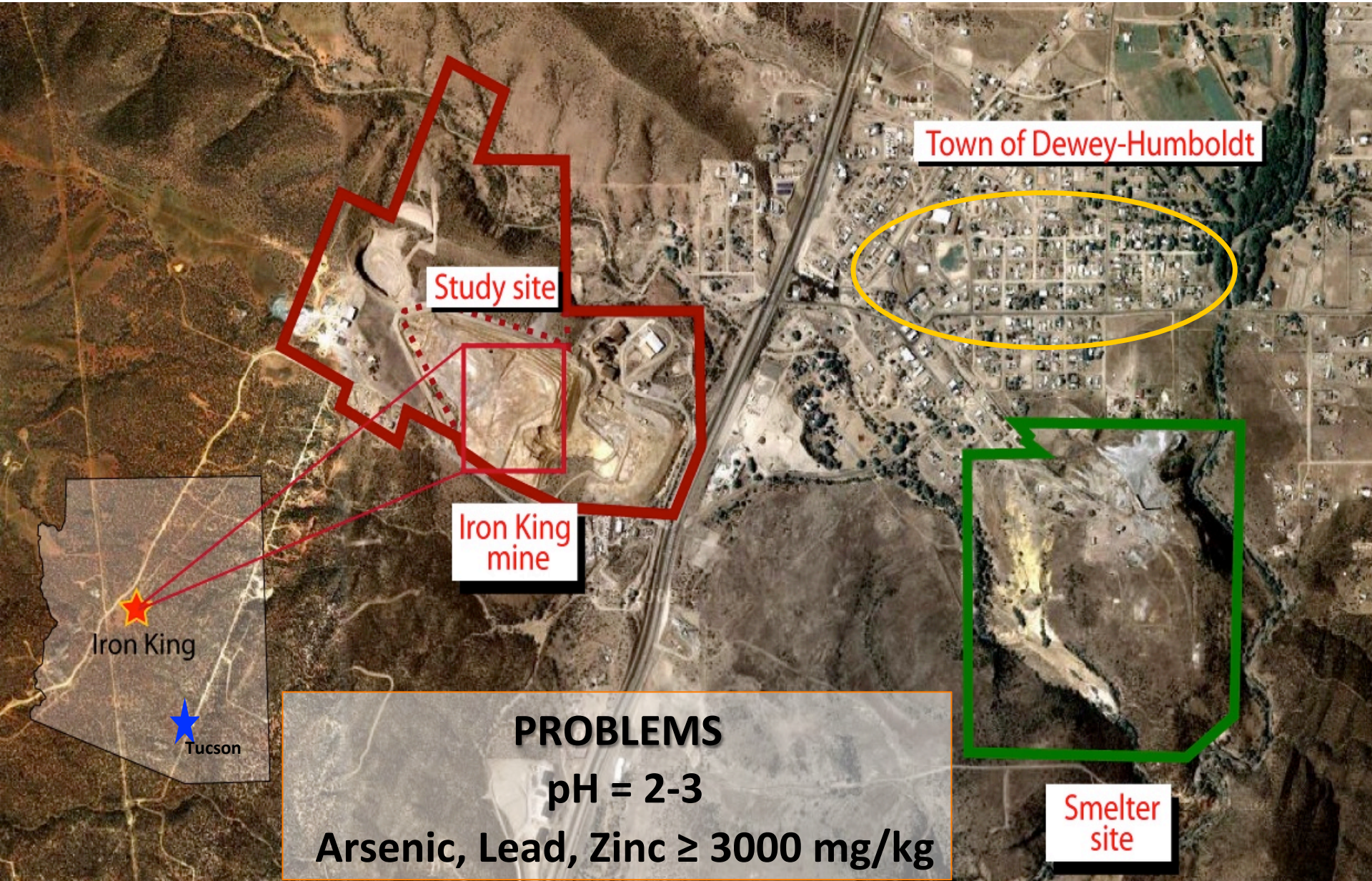
Training Core: the UA SRP Training Core provides students and post-docs with transdisciplinary training in addressing environmental health challenges related to Superfund sites.

National Institute of Environmental Health Sciences
Superfund Research Program

THE UNIVERSITY OF ARIZONA

May 16, 2017

Iron King Mine and Humboldt Smelter Superfund Site



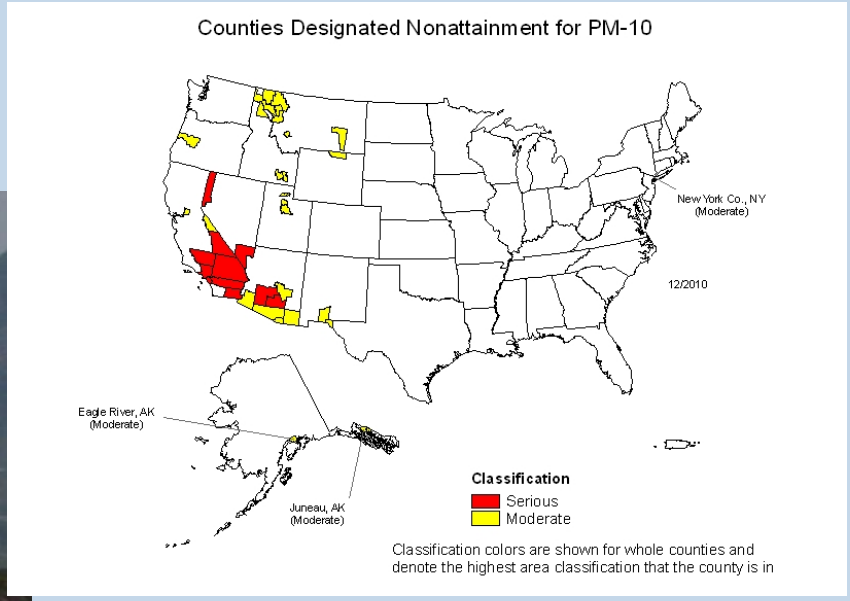
Project 1 - Dust Emission and Weather Forecasting

Dr. Eduardo Saez, Dr. Eric Betterton, Dr. Armin Sorooshian

- Arid climate in US Southwest makes dust an important exposure route
- Assessing aerosol movement and deposition in conjunction with source apportionment
- Combining aerosol modeling with weather forecasting to predict dust movement

Hygroscopic properties may enhance respiratory deposition for mining dusts!

Youn et al., 2016. Environ. Sci. Technol., 50:11706

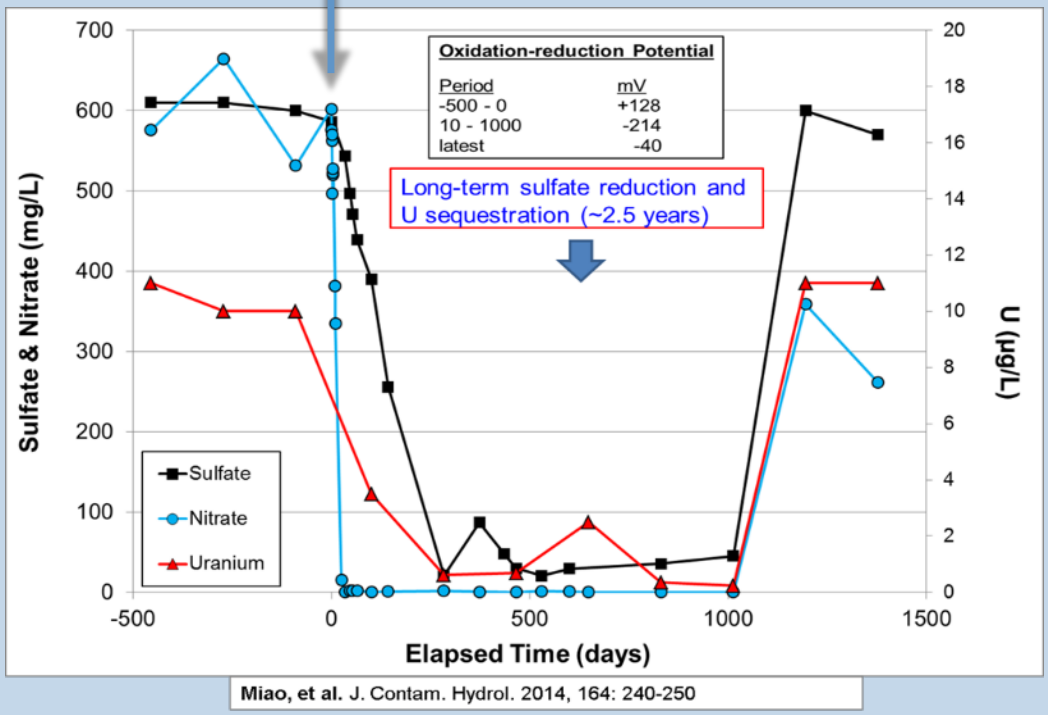


Counties designated as nonattainment for PM10

Project 2 - Bioremediation of Uranium Plumes

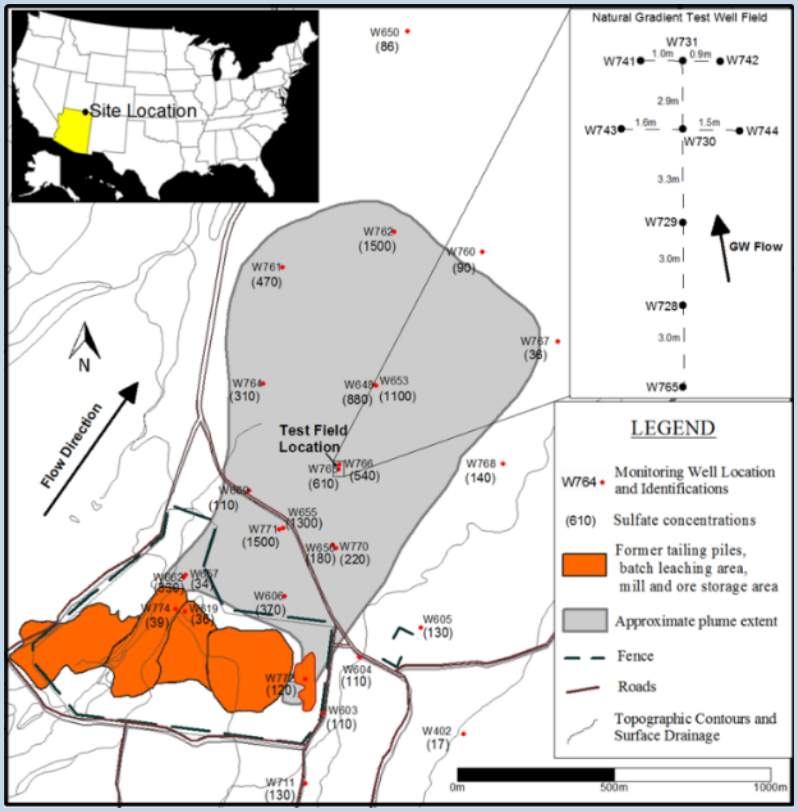
Dr. Mark Brusseau, Dr. Jim Field

1% ethanol injection



Miao, et al. J. Contam. Hydrol. 2014, 164: 240-250

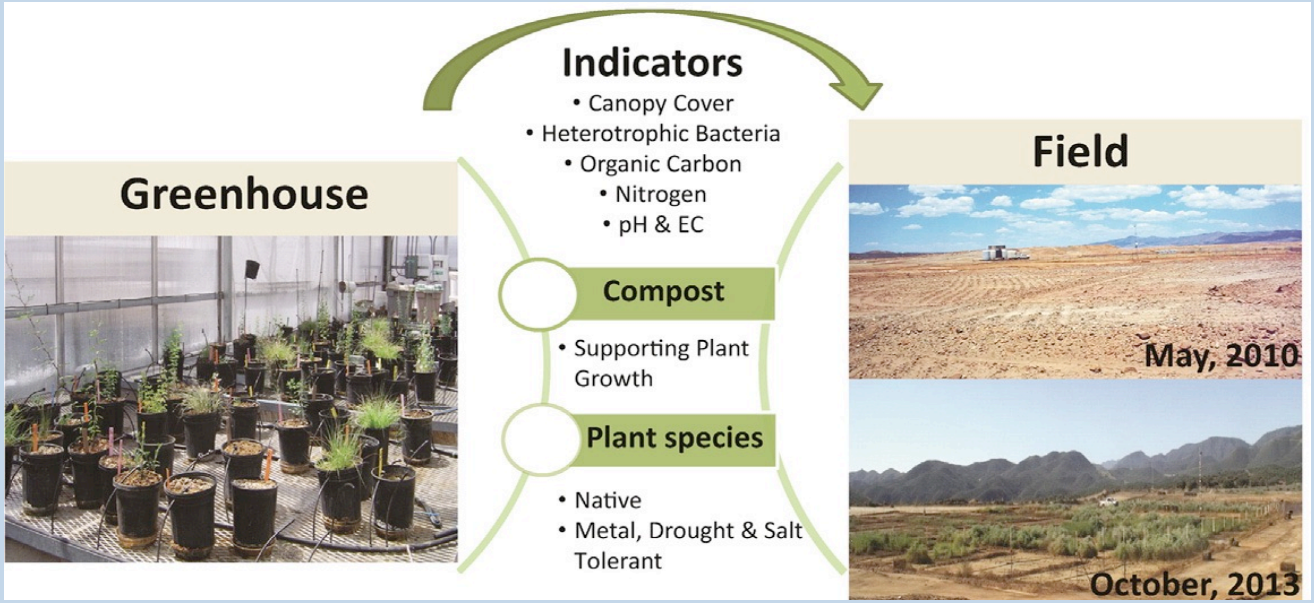
Monument Valley UMTRA Site



One ethanol injection sequestered nitrate and uranium for 2.5 years!

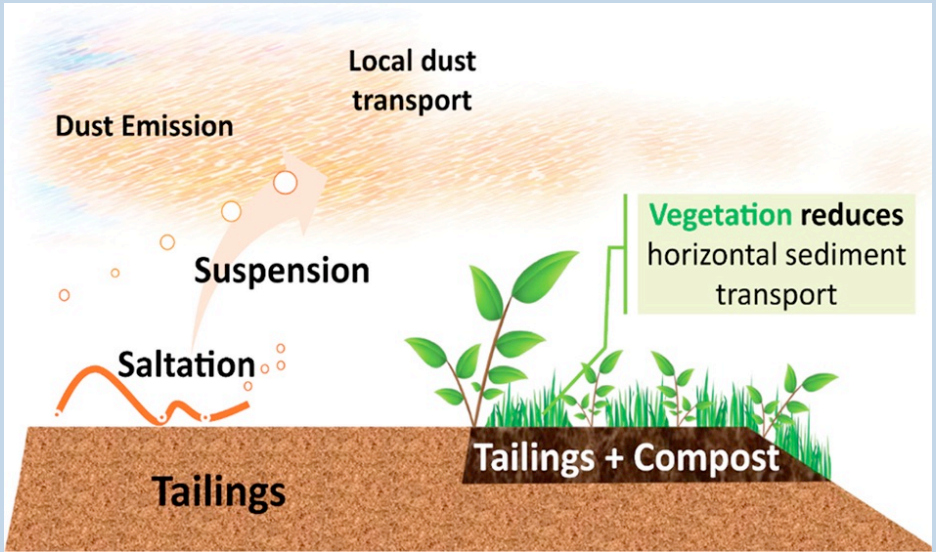
Project 3 - Phytoremediation of Mine Tailings

Dr. Raina Maier, Dr. Julie Neilson, Dr. Jon Chorover, Dr. Mark Barton



Scaling from greenhouse to field works!

Gil-Loaiza et al., 2016, Sci. Total Environ.



Vegetation reduces dust off-site dust transport!

Gil-Loaiza et al., 2018, Environ. Sci. Technol.

Warring Microbes

Iron King Mine tailings field study 2010 to 2017

Time zero

1 year

3 years

After compost amendment

- Adds C, N, and other nutrients
- Adds plant growth promoting microbes

But……. difficult to establish sustained plant growth

Project 4 - Toxicology of Inhaled Dust

Dr. Clark Lantz, Dr. Scott Boitano, Dr. Donna Zhang

Animals were exposed through inhalation to real world dusts collected from the Iron King mine tailings at various developmental times.

Exposures altered a number of Epithelial to Mesenchymal Transition (EMT) markers.

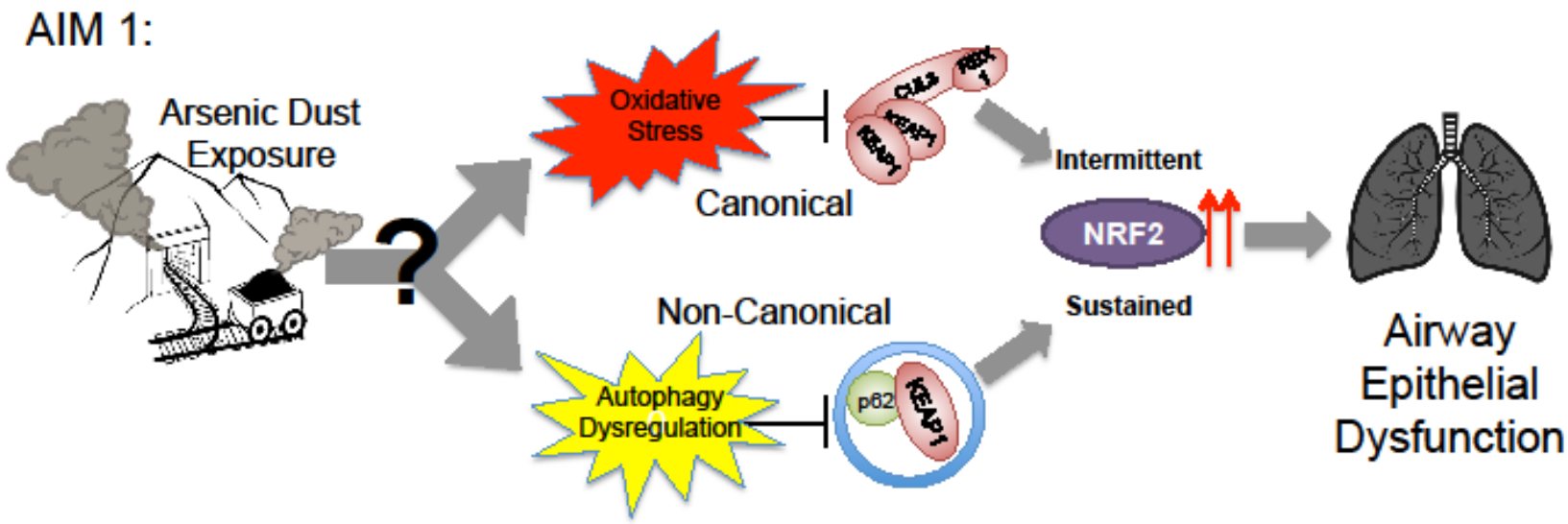
Continuous *in utero* and postnatal exposures produced the most significant effects.

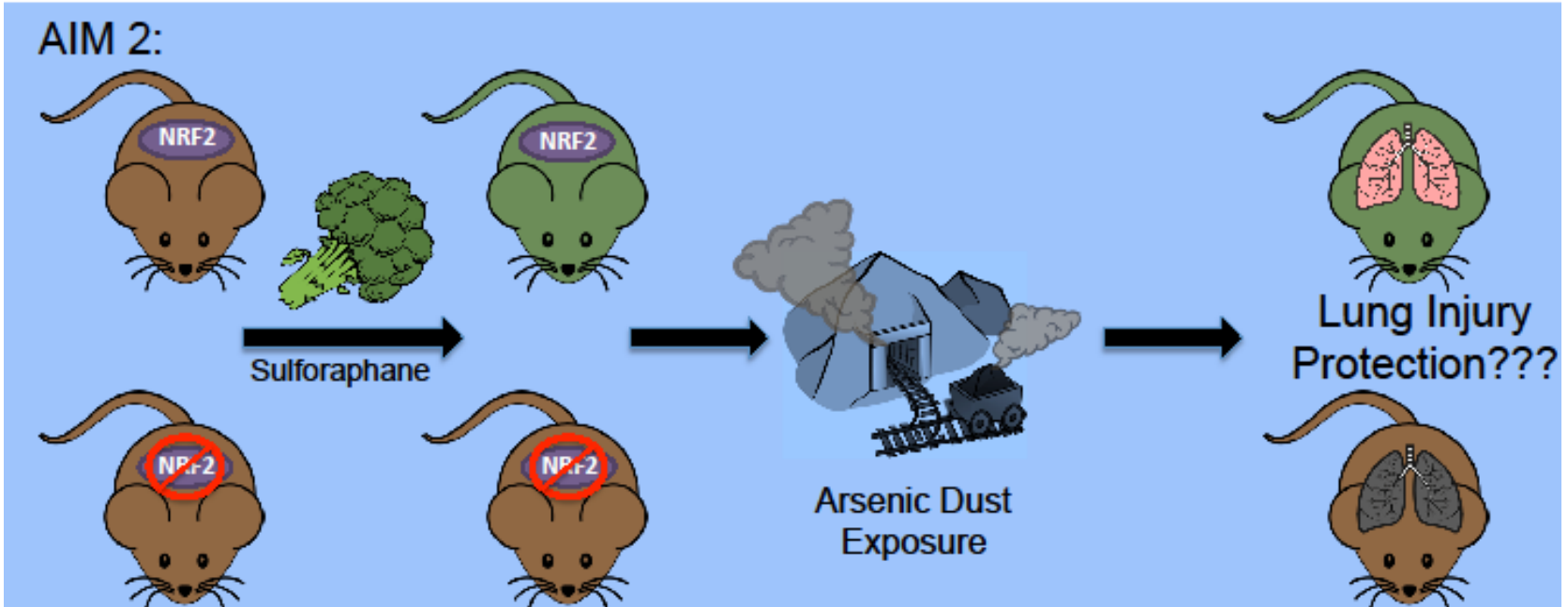
In utero exposures may prime the lung for responding to subsequent postnatal exposures

EMT Parameter	*In utero* exposures only	Postnatal exposures only	*In utero* and postnatal exposures
Airway hyper-reactivity			✓
TGFβ			✓
SMA	✓	✓	✓
Collagen	✓		
IL-6	✓		
SNAIL1			✓
MMP9			✓
Epithelial barrier			✓
NOX4			✓
Eosinophil cytokines			✓

Project 5 – Intervention for Dust Inhalation

Dr. Donna Zhang, Dr. Clark Lantz, Dr. Scott Boitano

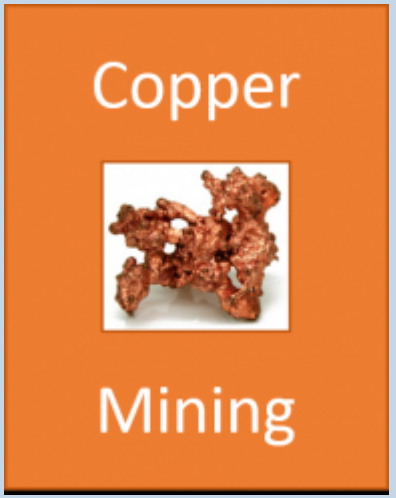




Education and Reaching Out to Stakeholders

Dr. Karletta Chief

Muffin Mining at Earth Day with Tribal students



Mining Modules: Mining and Environmental Education for Tribal Community Colleges

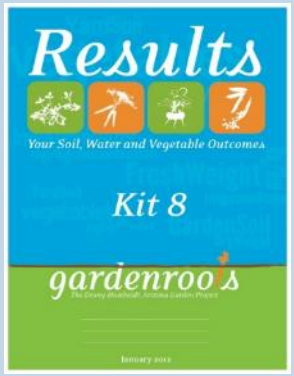
Understanding the Gold King Mine spill

Testifying at Congressional hearing on Gold King Mine spill

Gardenroots: A Citizen Science Program to Empower Communities Neighboring Contamination

Dr. Monica Ramirez

gardenroots
The Dewey-Humboldt, Arizona Garden Project



https://www.superfund.arizona.edu/projects/community-engaged-research/gardenroots/home

Now an Arizona-wide program called Project Harvest

Engaging community members through citizen science about the health of their **harvested rainwater, soil, and plants.**

https://projectharvest.arizona.edu/

Project Harvest

An Outgrowth of this Work:

Center for Environmentally Sustainable Mining

Mission Statement

To develop educational and research initiatives that address environmental issues related to mining activities in arid and semi-arid environments.

- Developed as a research translation vehicle to support Arizona communities, industry, and policy-makers
- Environmental and engagement pillar for mining research at UA
- Supports the Superfund Research Program and various other projects

CESM Industry-Academic Cooperative for Reclamation

Dr. Julie Neilson and Dr. Raina Maier

Reclamation of Mine Tailings

Partnership

Grupo Mexico + KGHM Intl. + Rio Tinto + UA

- Together addressing a critical component of active mining operations
- Shared information
- Shared expertise
- Goal is to both protect environment and reduce operating costs

Questions

https://superfund.arizona.edu/