

Wastewater treatment and sustainability

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POTW- Publicly owned treatment works
Treat wastewater from domestic and
industrial sources to meet national and
state standards





These were largely financed via the Clean Water Act of 1972 that was promulgated in response to some high profile events

In addition to high profile- less visible or dramatic insults were also commonplace



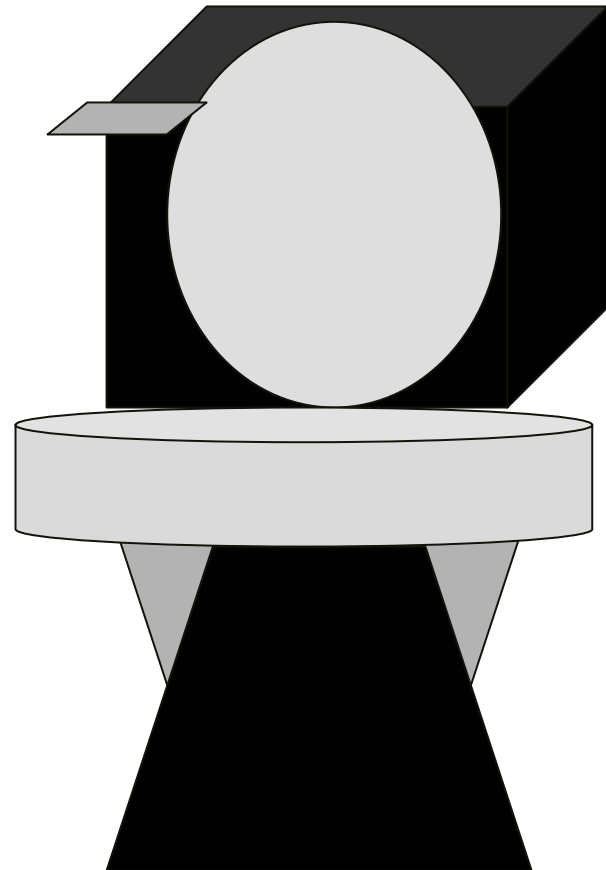
Wastewater treatment



Charles River Swimming Club, Inc.

- Was the greatest advance in public health in the 20th century
- POTWs Should be seen as stewards of the environment
- Look at what POTWs do and what the potential to maximize benefits are
- Products of wastewater treatment

Most visible source, input into plants:



Other sources include:



Products include:

- Biosolids
 - Fertilizer value
 - Carbon value
 - Carbon for soil
 - Carbon as fuel



Products include:

- Reclaimed water
 - Fertilizer value
 - Water recycling
 - conservation
 - resilience



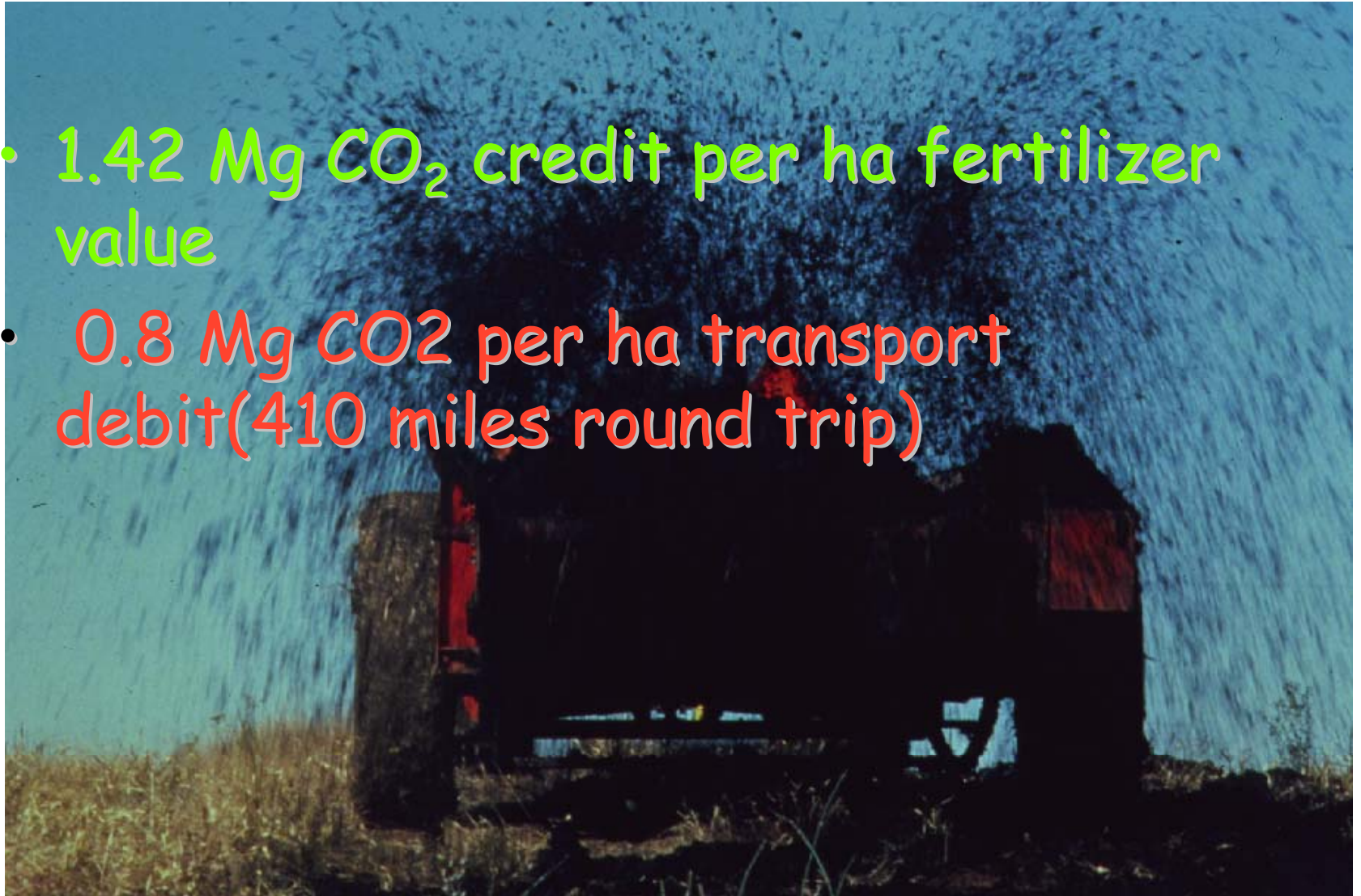
Agricultural Value of Biosolids

- King County, WA uses biosolids to fertilize commercial tree plantations, wheat, hops, and other agronomic crops



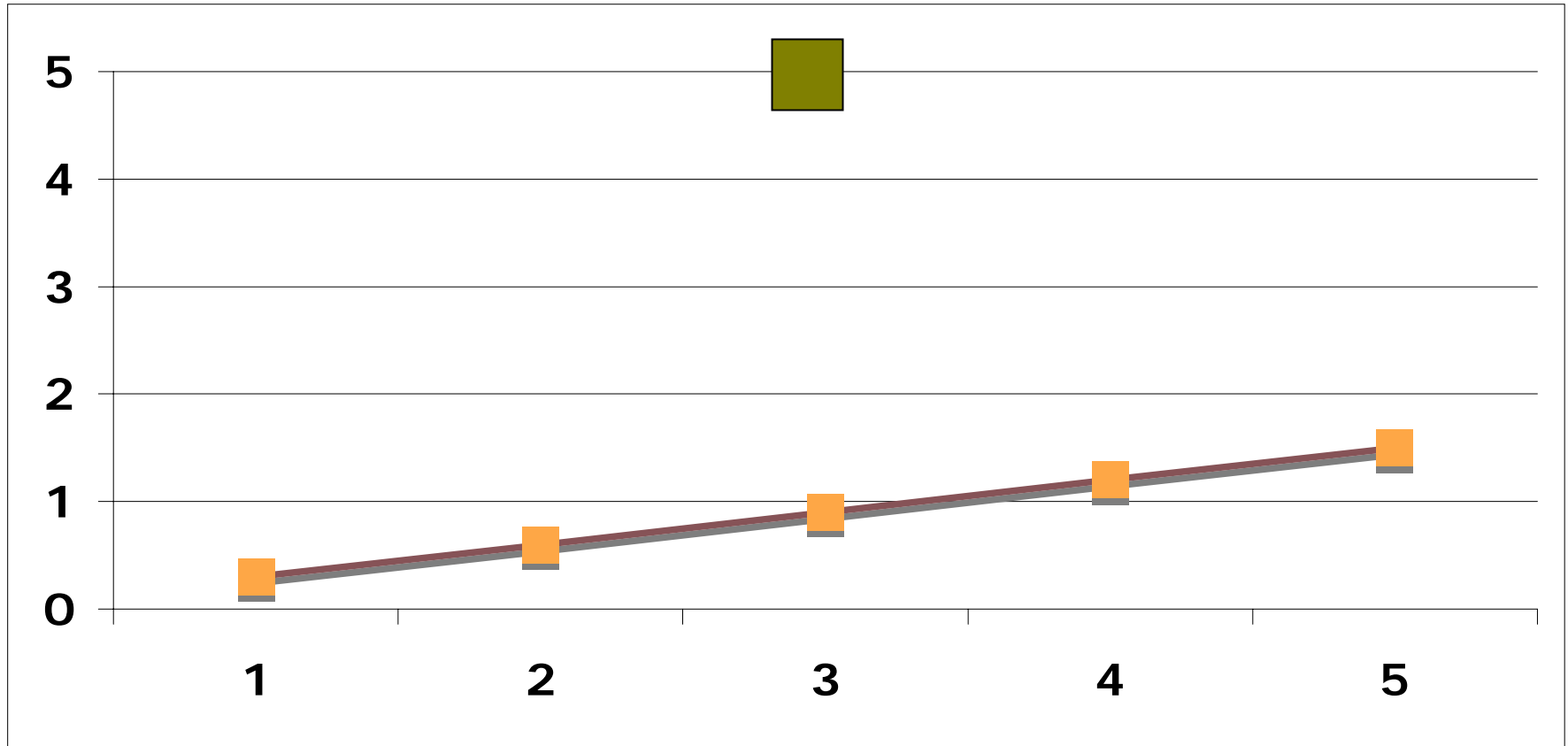
GHG implications of using biosolids for fertilizer

- 1.42 Mg CO₂ credit per ha fertilizer value
- 0.8 Mg CO₂ per ha transport debit(410 miles round trip)



No till + Biosolids

4.1 Mg C increase over no till
(Spargo et al, in review)



What does a 1% increase in soil carbon mean?

- For a soil with 4% carbon
 - 80 Mg C per hectare
 - 220 Mg CO₂ per ha (17 600 gallons of diesel)
- Add 1%
 - 20 Mg C per hectare
 - 74 Mg CO₂ per ha
- The soil also gains productivity...

King County is working to further optimize this



Biosolids to fertilizer bioenergy crops

- Initial field trial in Sunnyside, WA

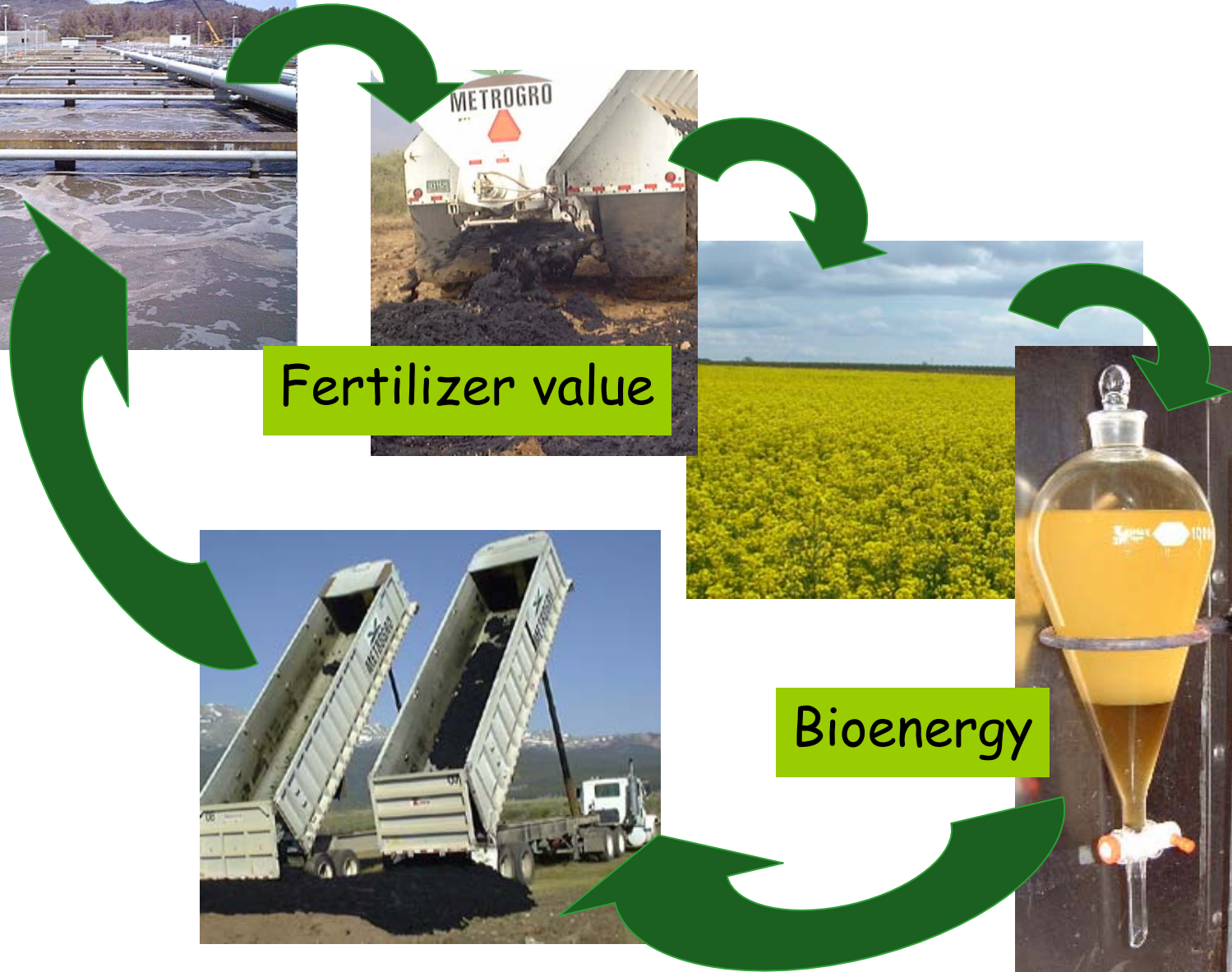


Closed loop operation



Fertilizer value

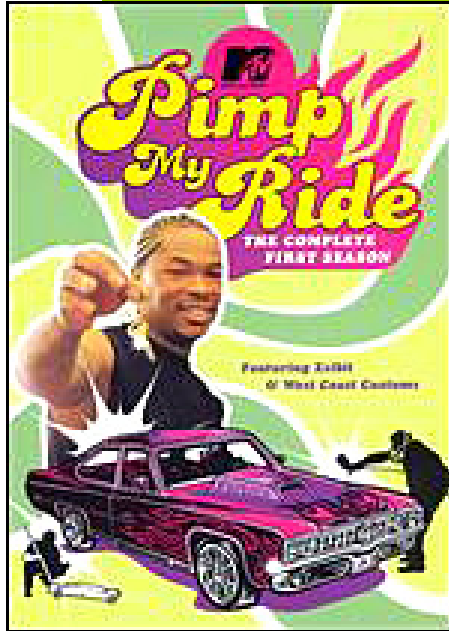
Bioenergy



Gone full scale



Biosolids: In King County you can flush with pride!



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



Restoration sites- accumulation even more pronounced Leadville, CO



Historic mine tailings washed down and accumulated in deposits up to and exceeding 2'

Deposits are toxic to riparian vegetation

Contaminated soils, barren of vegetation, are highly susceptible to continued erosion by the river



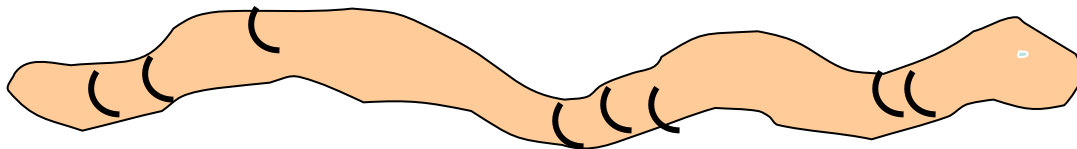
Ecological Assessment

Mark Sprenger, US EPA ERT

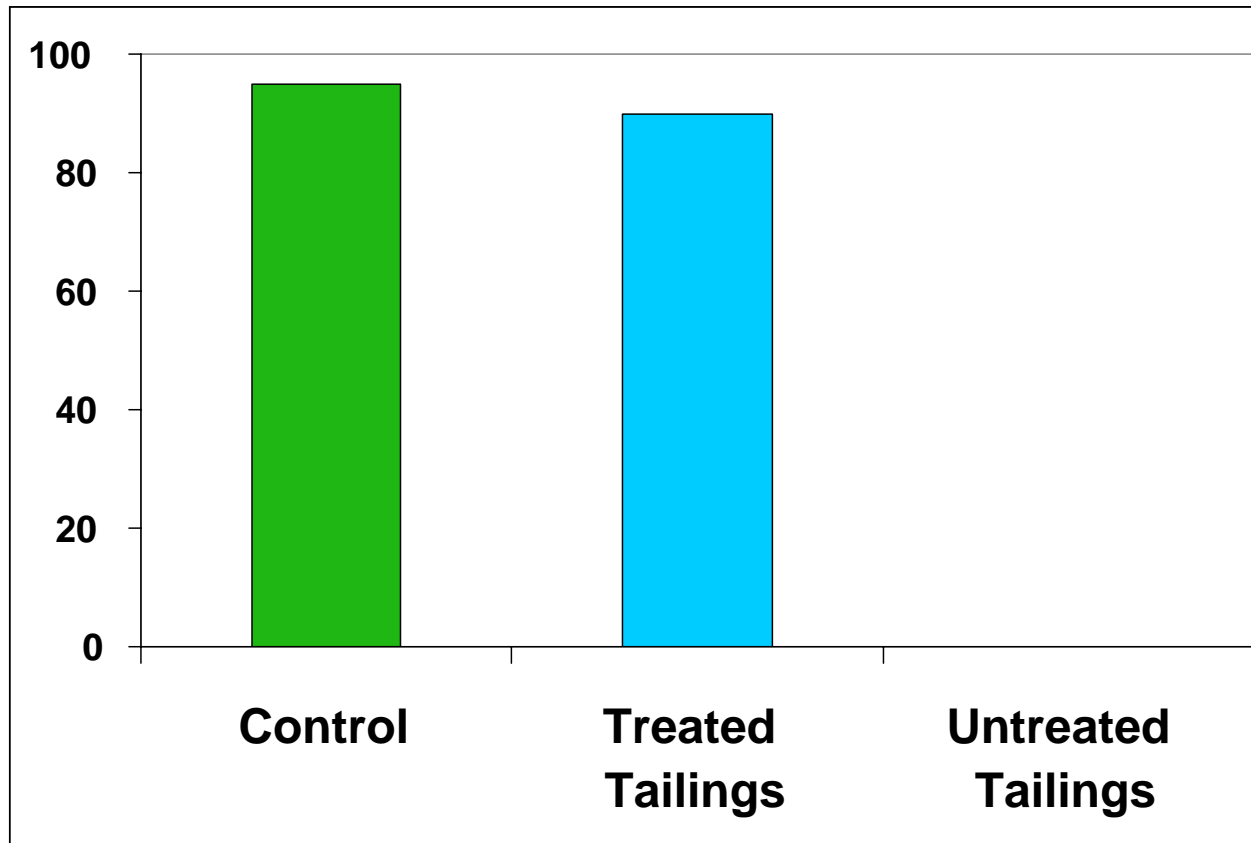
- Leadville, CO
- Similar results from Jasper County
- Similar results from Palmerton, PA

Earthworm Survival

	Tailings	Biosolids amended tailings	Upstream control
Survival	0%	89± 3	96
Biomass	----- -	12 mg	6.8



Re-entrainment Study Fathead Minnow % Survival



Soil Carbon-Leadville, CO

- Soil carbon pre
 - 213 Mg CO₂ per ha



- Soil carbon post
 - 799 Mg CO₂ per ha
 - 224 dry tons biosolids per ha 7 years prior



And you restore function

- No microbial activity
- No nutrient cycling
- No plant growth
- No animals
- Functional soils
- OM accumulation
- Nutrient cycling
- Habitat



In an urban setting

- City of Tacoma makes a range of Class A soil products
- Provide an alternative to synthetic fertilizers
- Add carbon to soils
- Restore degraded urban soils



Soils at the treatment plant



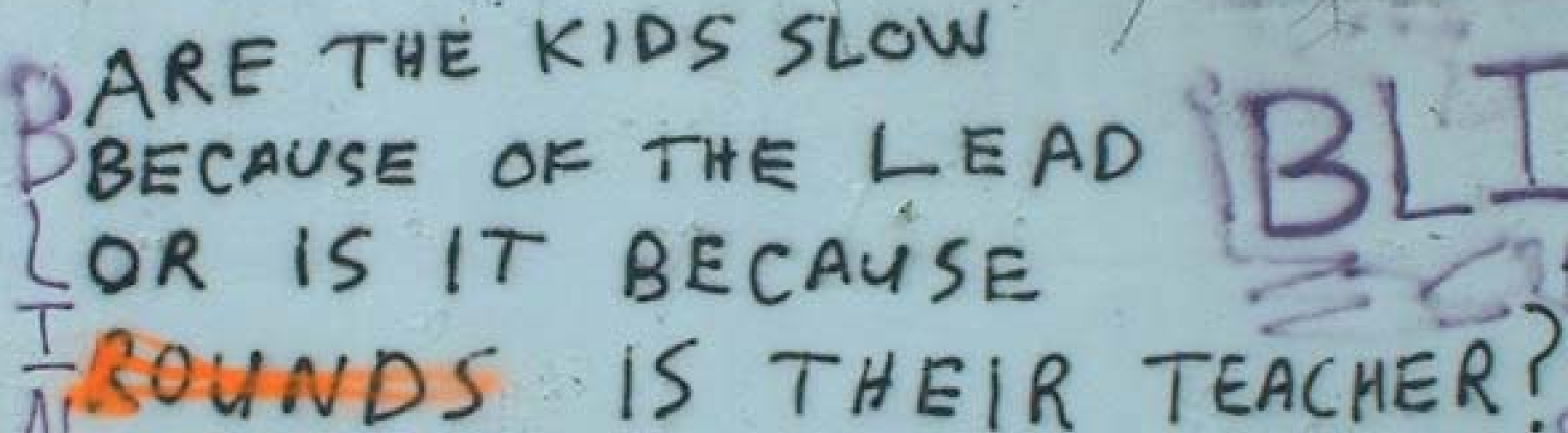
Community food systems:
Tagro soil products are being
integrated into community
gardens, school gardens



Urban problem: Elevated Lead in Children

Blood Pb > 10 $\mu\text{g}/\text{dL}$

- Impaired learning and motor skills
- Leading to the question -



ARE THE KIDS SLOW
BECAUSE OF THE LEAD
OR IS IT BECAUSE
T BOUNDS IS THEIR TEACHER?

BLI

Baltimore, MD- soil Pb in home gardens > 400 mg kg
Added high iron biosolids compost
Farfel et al, 2005



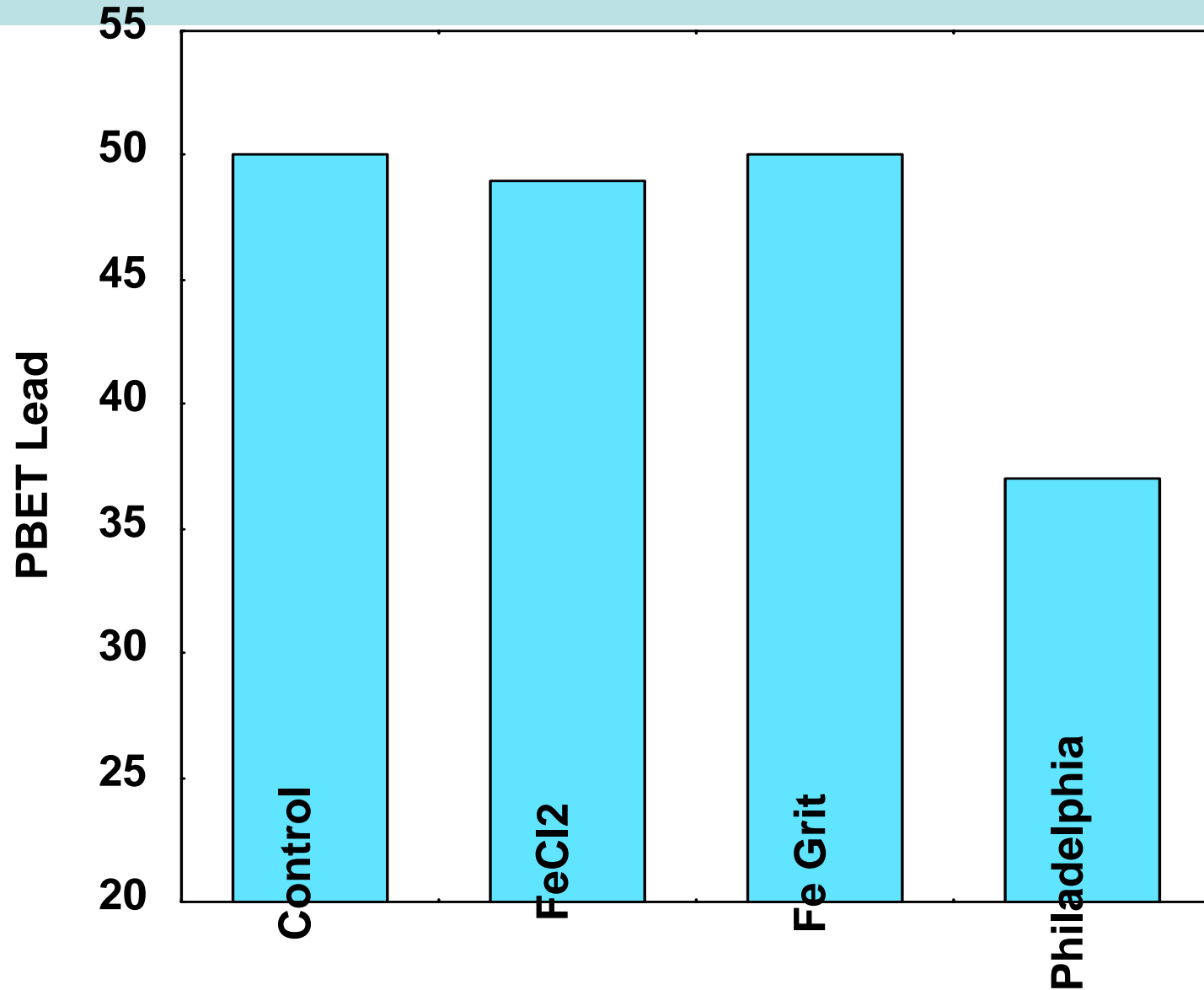


Changes in Lead Availability

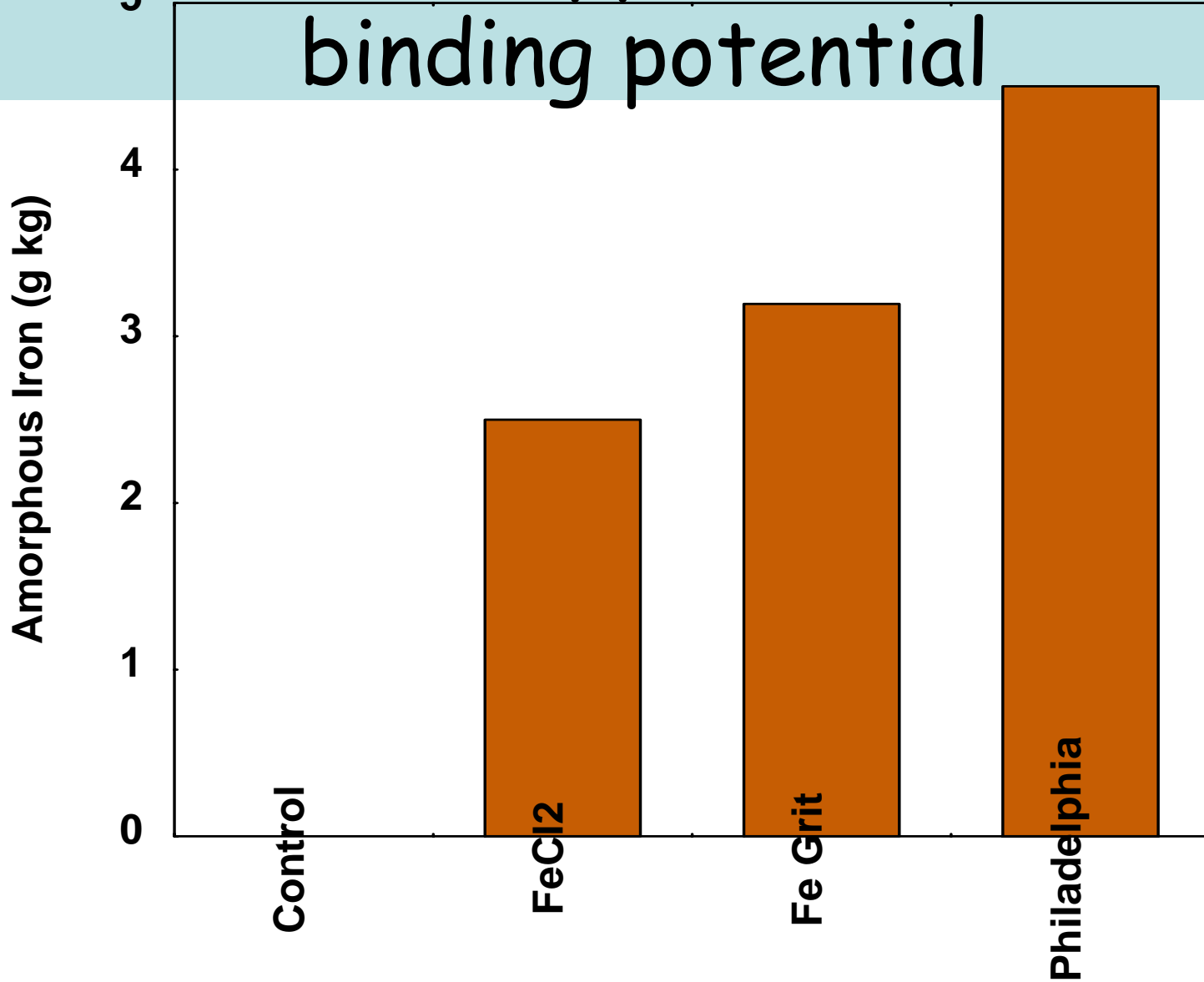
- Pre Compost
- 1622 mg kg

- Post Compost
- 595 mg kg

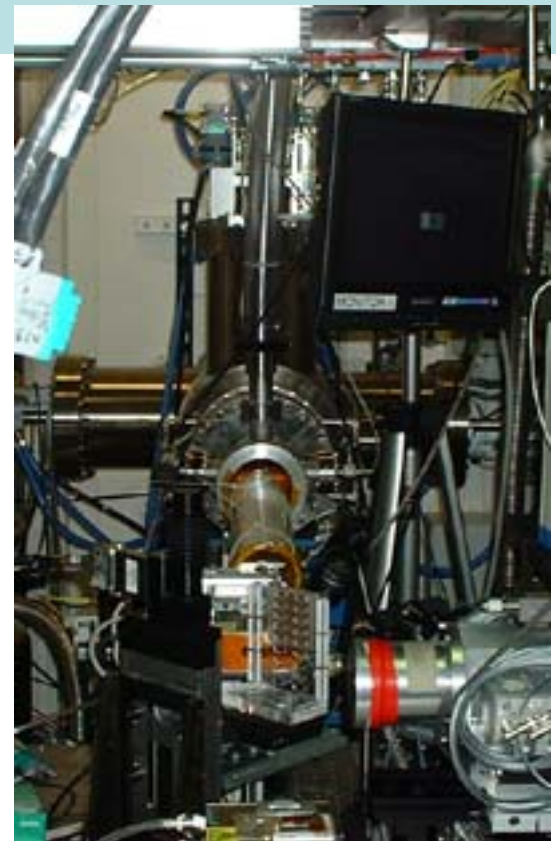
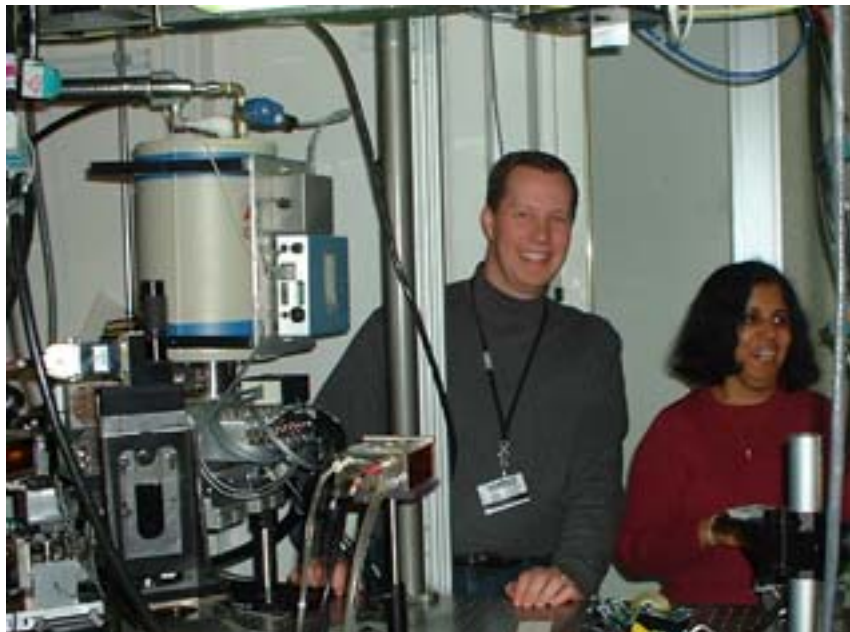
Laboratory Incubation- Pb



Form of Fe appears to effect binding potential



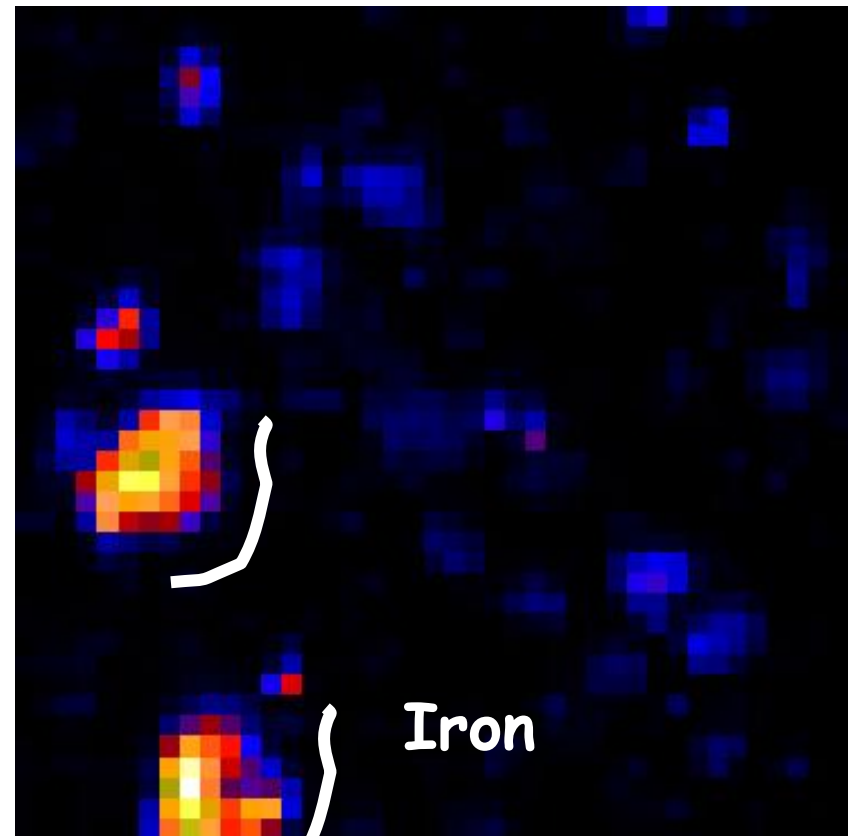
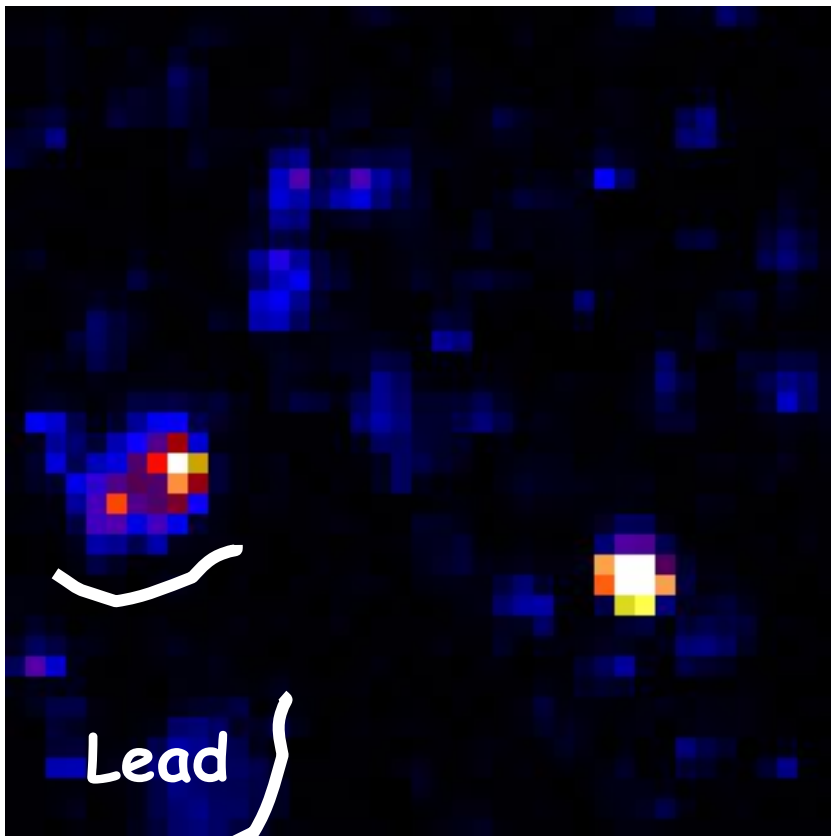
Use XAS to characterize differences in Pb As bonds to relate to changes in availability



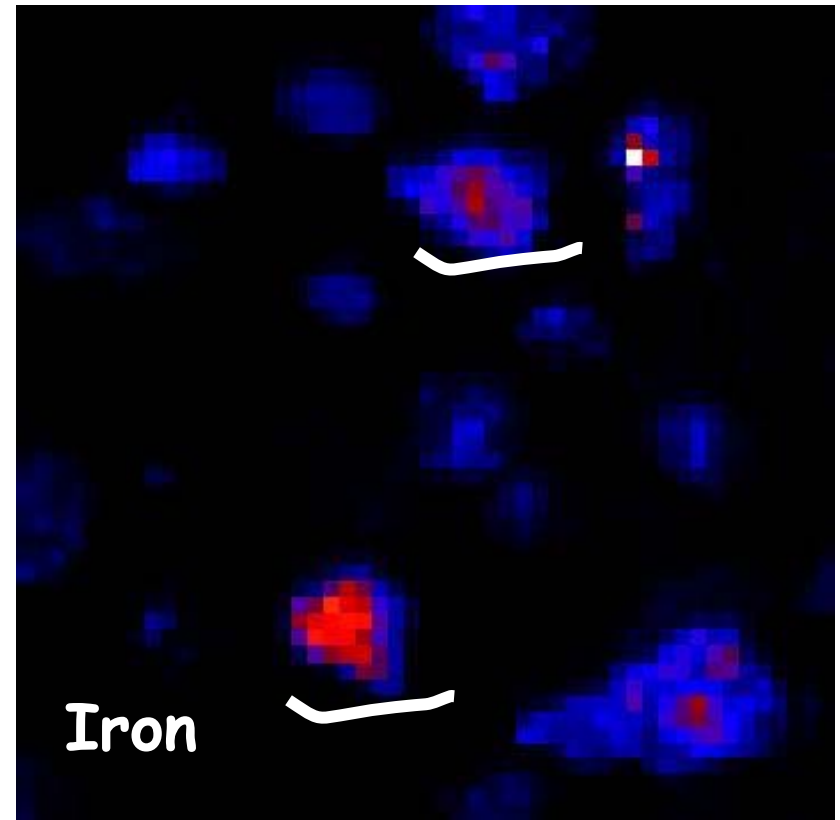
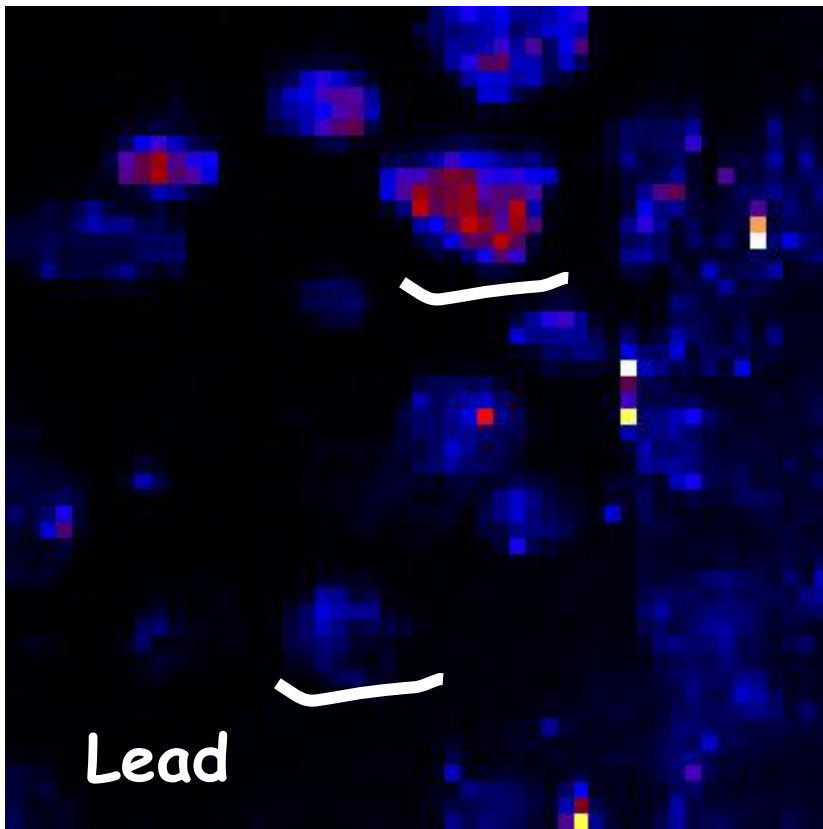
μ XRF to map Pb, As and Fe
(step size < 10 μm)

Run XFAS to characterize bonds

Control soil
1000 mg kg Pb, 100 mg kg As



Effective compost- Fe added in treatment plant



Pb speciation- control

- No association with Fe
 - Hydrocerrusite 60%
 - Pyromorphite 40%

 - Anglesite 14%
 - Galena 17%
 - Pb hillite (Pbsulfate, carbonate) 48%

Pb speciation- Compost

- Clear association with Fe
 - Sorbed Pb 59%
 - Plumboferrite 30%
 - Cerrusite 20%

- Sorbed Pb 100%

Range of end uses are impressive
Plus I can now swim in Lake
Washington

