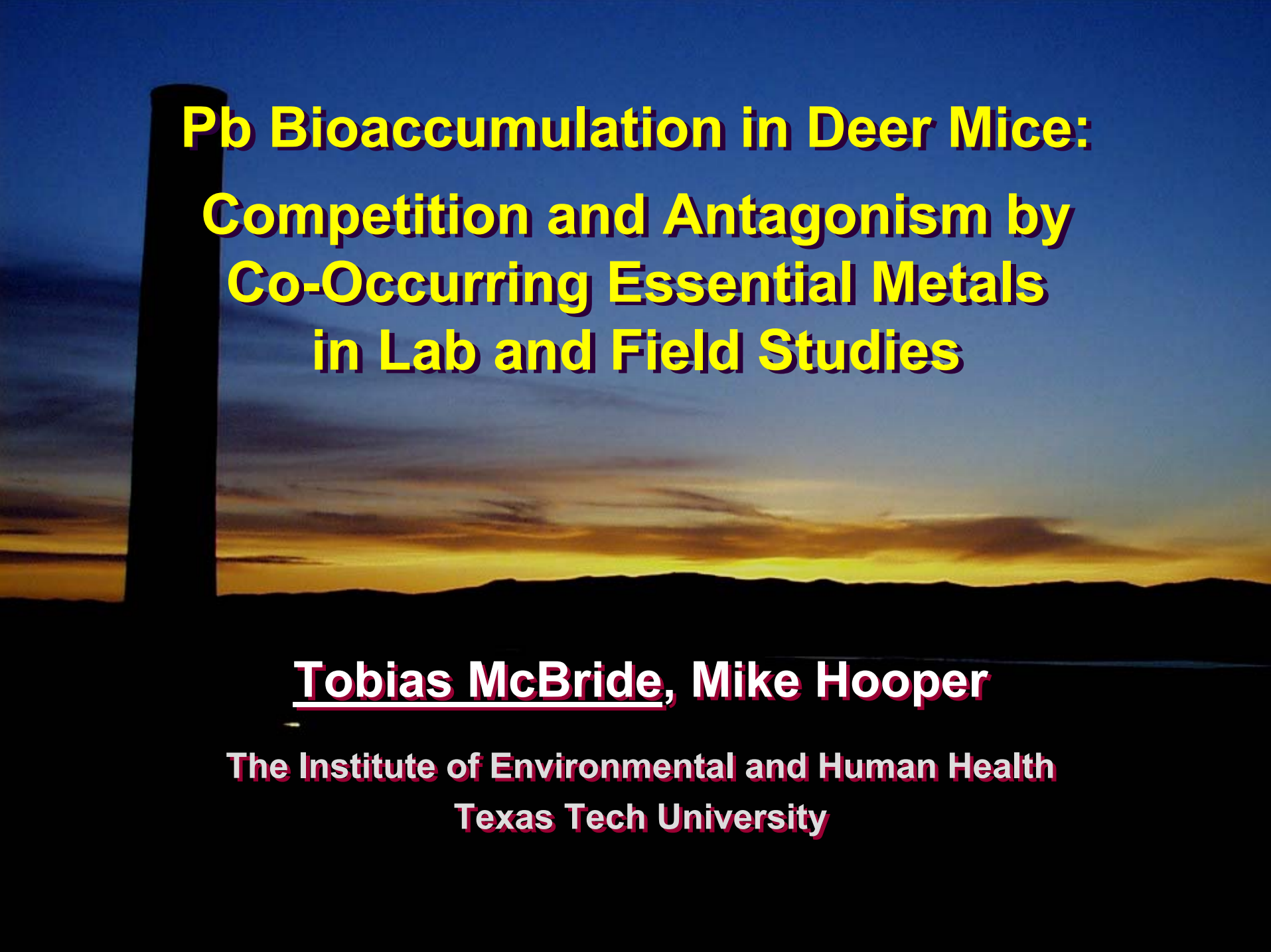

Pb Bioaccumulation in Deer Mice: Competition and Antagonism by Co-Occurring Essential Metals in Lab and Field Studies

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Acknowledgments

- NIEHS – ES 04696 – U. Wash /TTU
- Dr. Dale Hoff, U.S. EPA-Region 8
- Dr. Bill Olsen, USFWS

- Dr. Blakely Adair, U.S. EPA (2001 Wetterhahn Award Winner)
- Dr. Kevin Reynolds, USFWS
- Dr. Craig McFarland, US Army
- Dr. George Cobb, TTU
- Dr. Scott McMurry, TTU

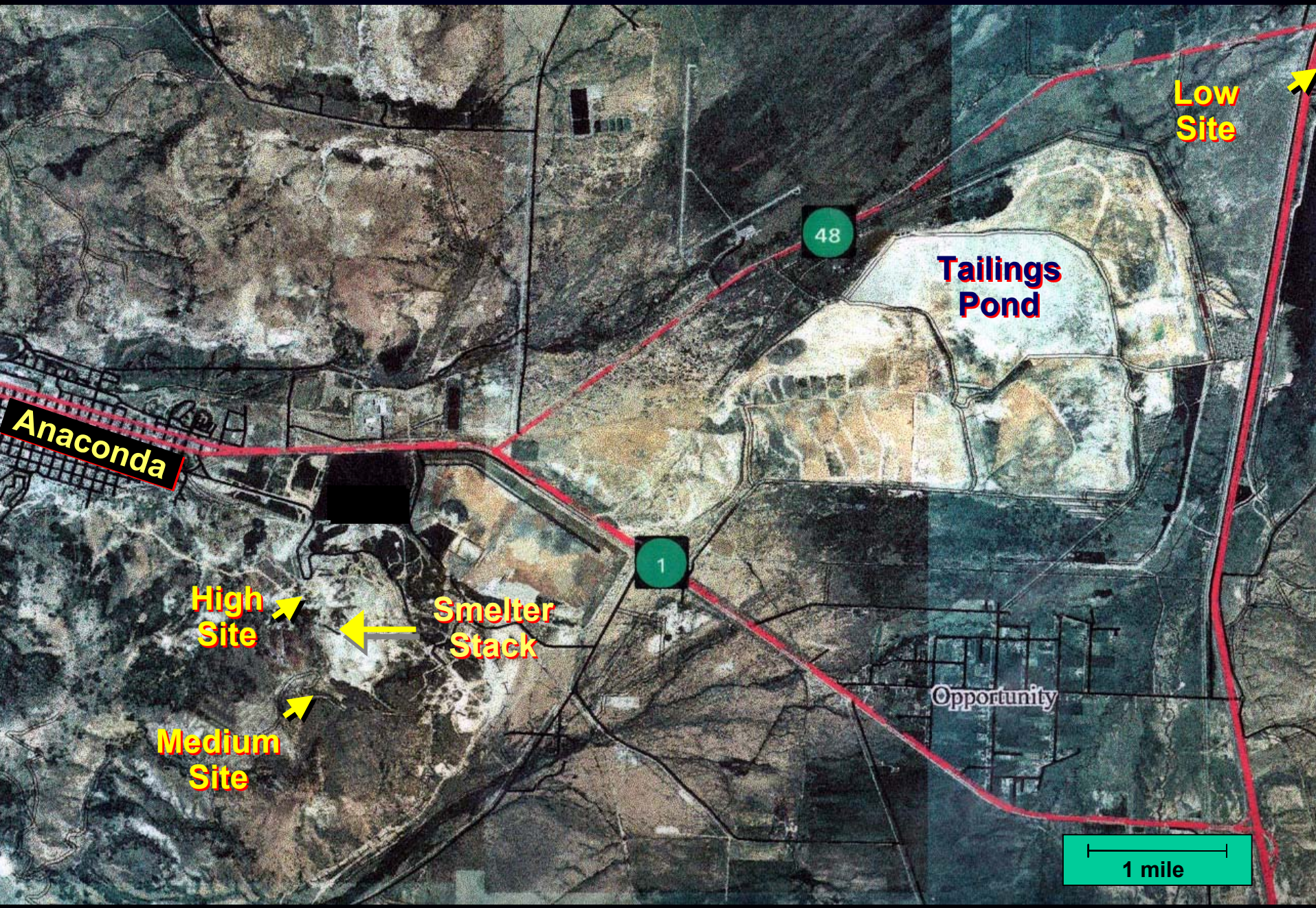
Anaconda Copper Smelter, Montana

CERCLA National Priorities List (NPL) in 1983.

75 tons of metals expelled from stack DAILY.

Contaminants of Concern (COCs): As, Cd, Cu, Pb, Zn

Anaconda Smelter Superfund Site



Wildlife Assessments at the Anaconda Smelter Site

Smelter Soil Metal Concentrations (ug/g)			
	Pb	Cu	Zn
Low	134	309	217
Medium	617	1201	445
High	1480	2976	2435

Site Mean Tissue Pb Concentrations (ug/g)		
	Kidney	Carcass
Low	0.217	0.558
Medium	0.548	1.66
High	1.036	1.99

CERCLA NRDA Regulations

43 CFR
11.62 Injury Determination Phase.

Delta-aminolevulinic acid dehydratase (ALAD) inhibition.

Injury has occurred when the activity level of whole blood ALAD in a sample from the population of a given species at an assessment area is significantly less than mean values for a population at a control area, and ALAD depression of at least 50 percent can be measured.

The ALAD Enzyme

* Cytosolic zinc metalloenzyme, catalyzes the formation of the monopyrrole precursor in heme synthesis.

* Enzyme activity is specifically inhibited due to a Pb displacement of one of four required Zn atoms.

* Well characterized for a number of wildlife species, for use in Pb contamination investigations.

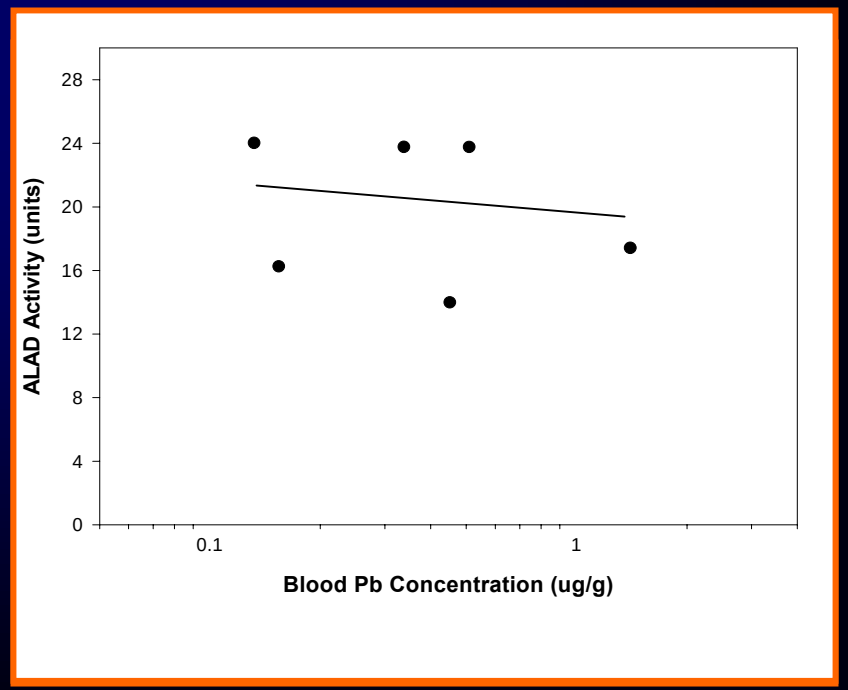
* Enzyme activity shows a distinct linear relationship with increasing blood Pb concentration.

Deer Mouse ALAD Response to Lead

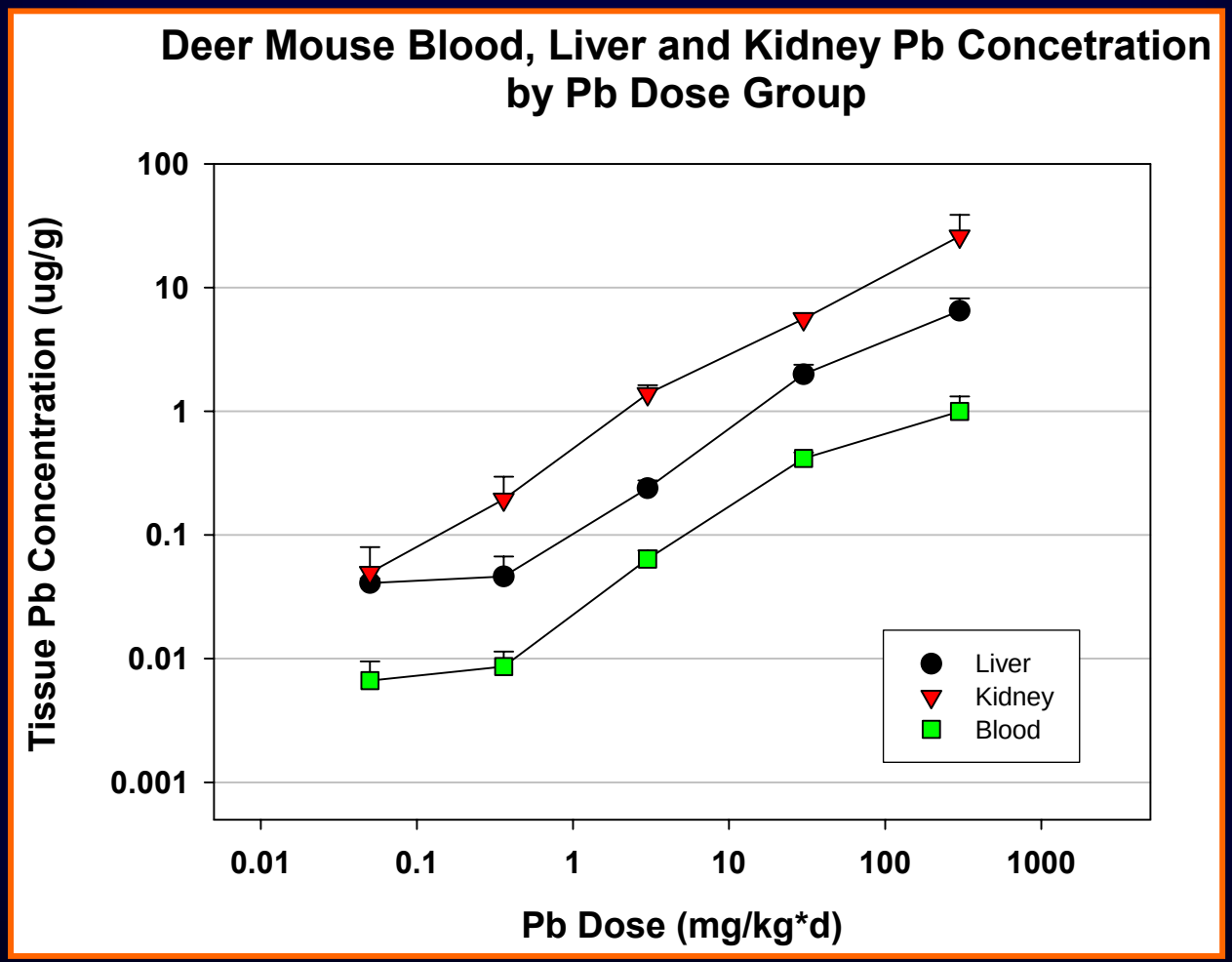
Unexpected lack of biomarker response.

No relationship between soil Pb and ALAD in mice

No relationship between blood Pb and ALAD

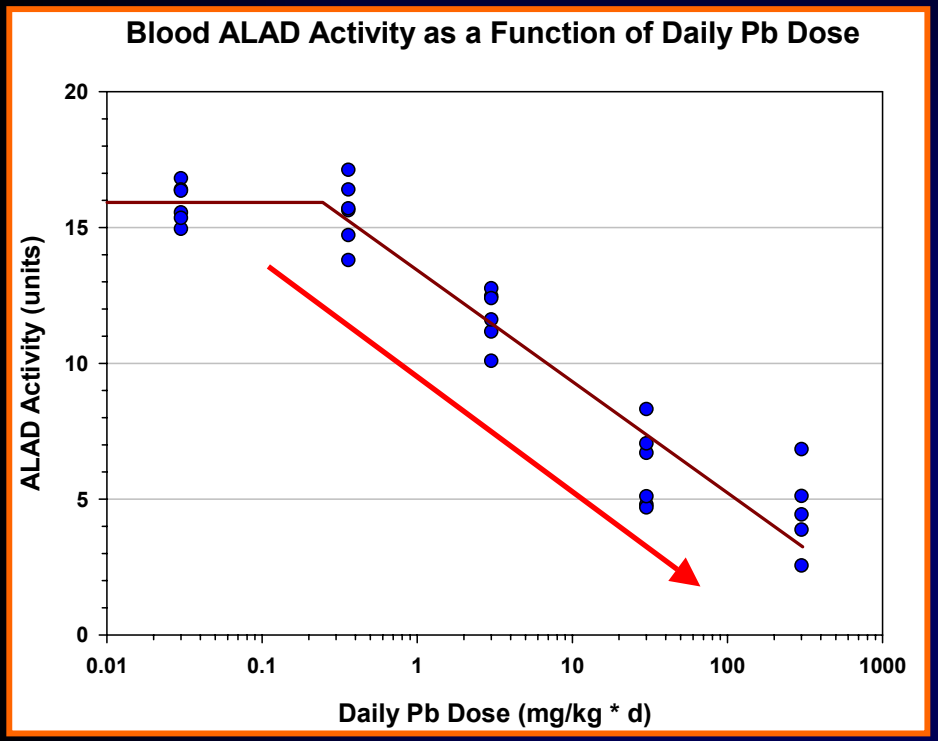


Pb Acetate Dose-Response Study

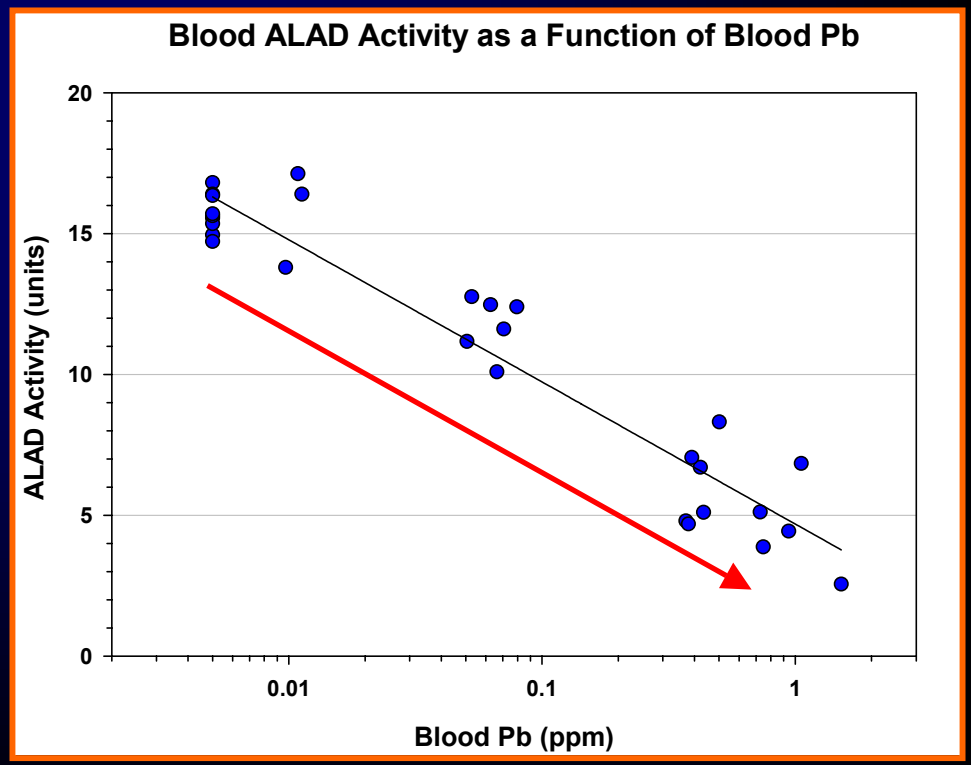


Blood ALAD Inhibition

Dose-Response Study



Unlike field data, deer mouse ALAD behaved as expected.

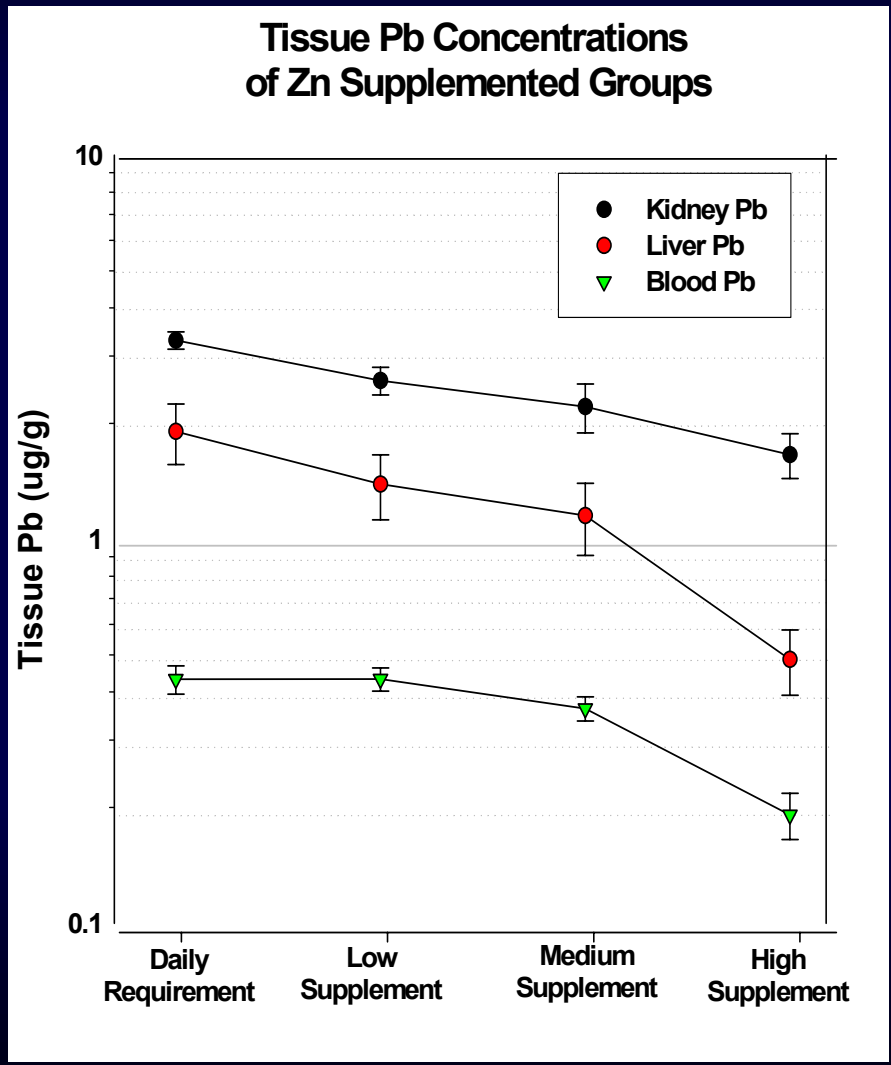


Decreasing activity with:

- increased Pb dose
- increased blood Pb

Pb Accumulation in Tissues

Binary Metal Mixtures



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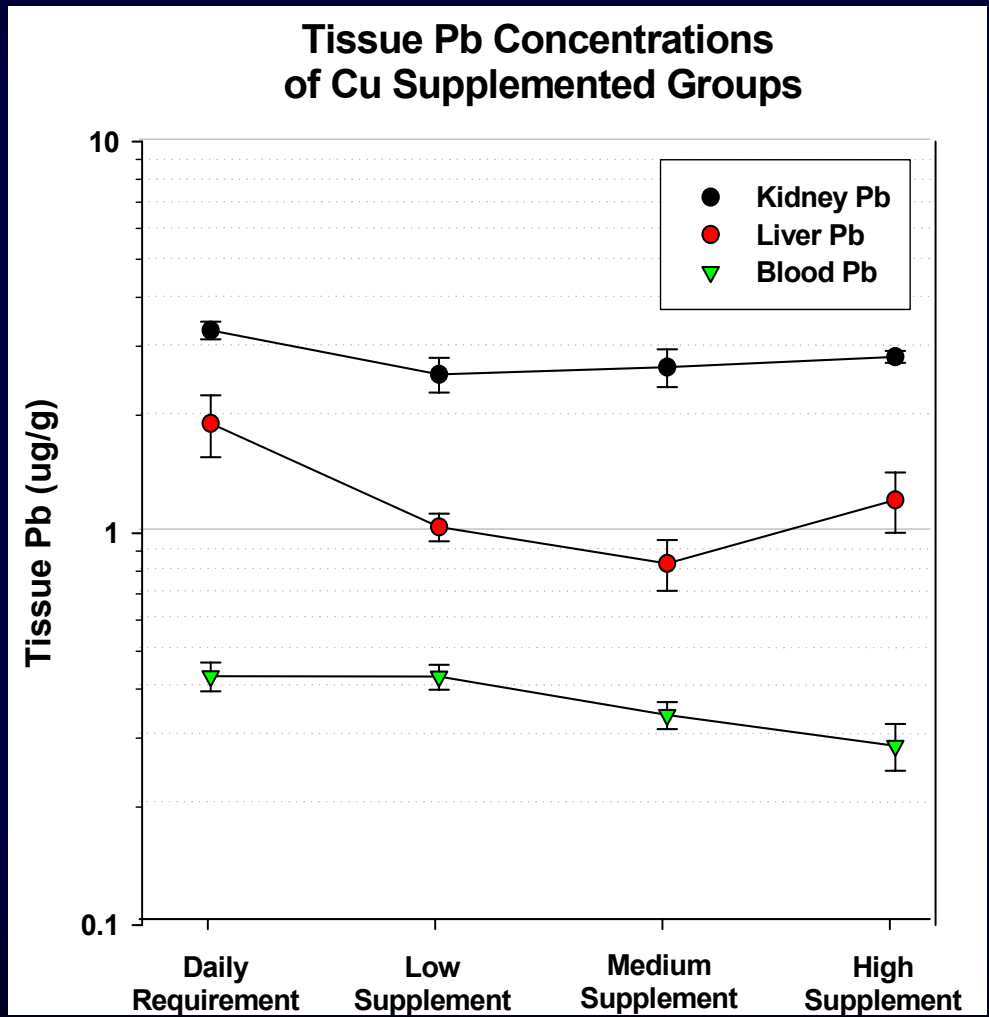
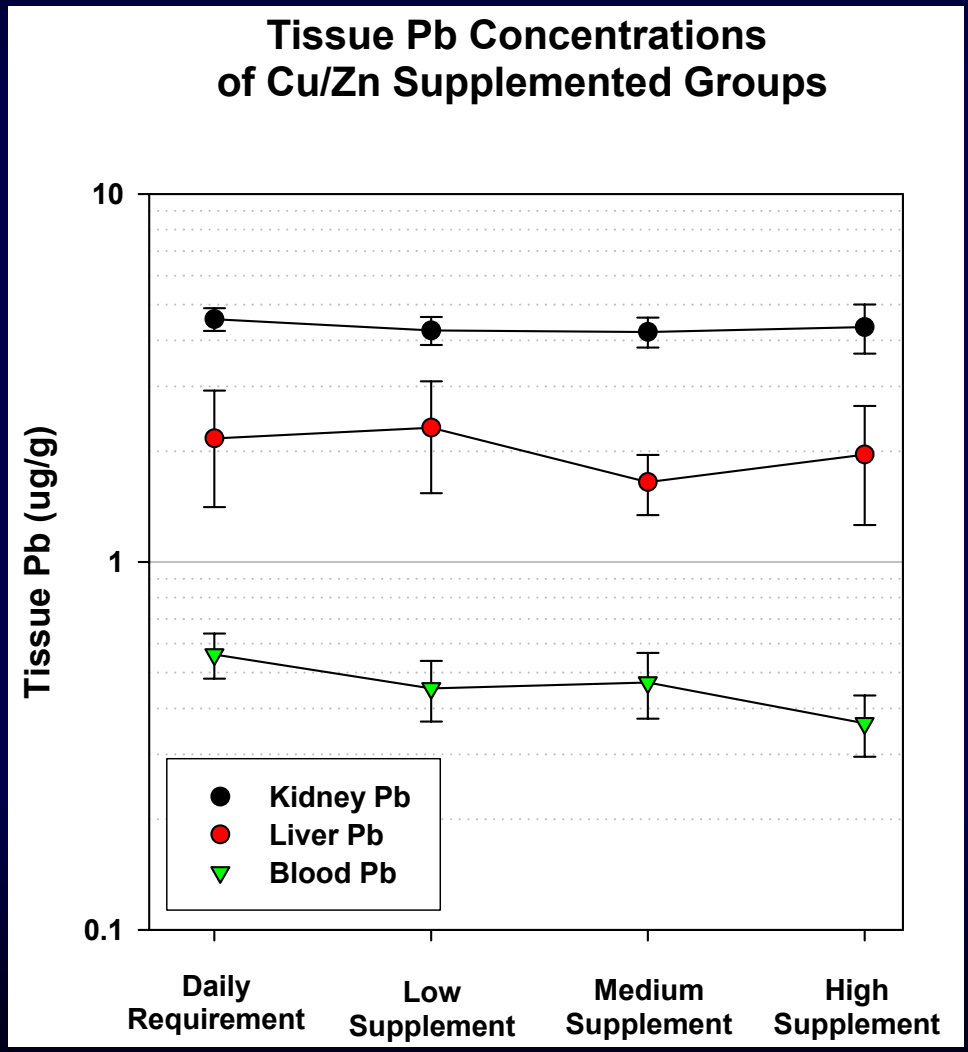


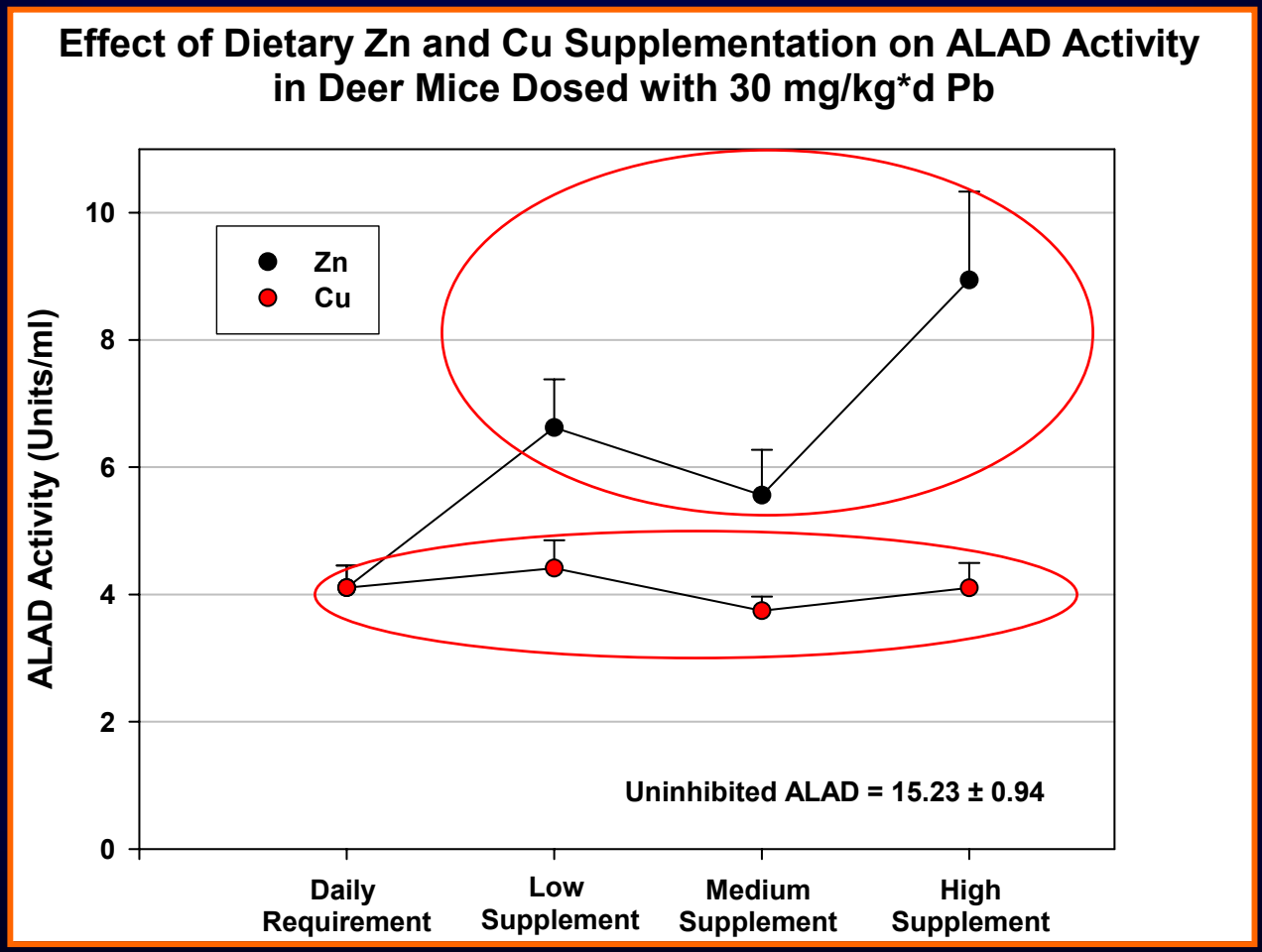
Pb Accumulation in Tissues

Tertiary Metal Mixtures



Modification of Blood ALAD Inhibition

Binary Metal Mixtures



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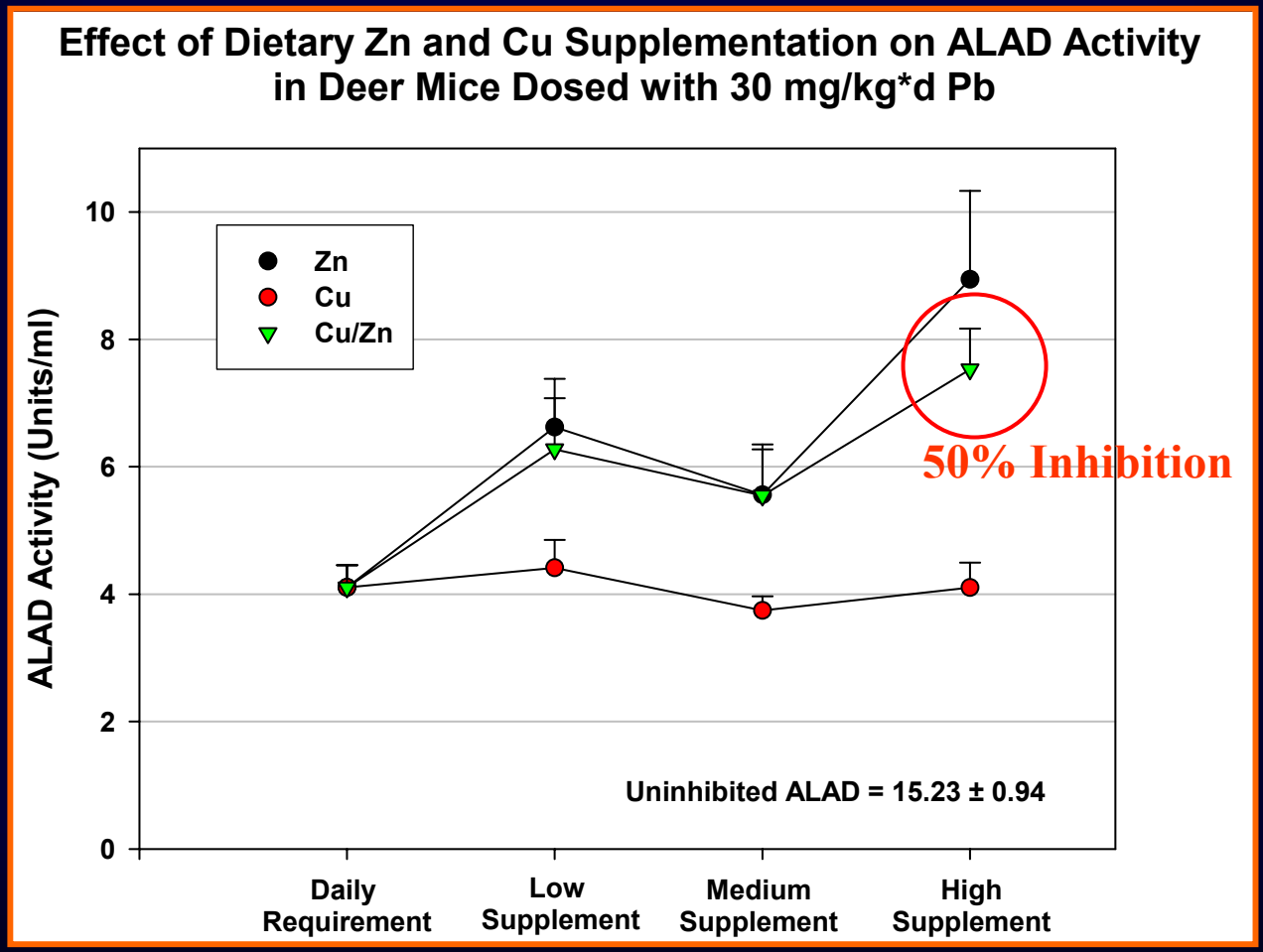

Pb Accumulation in Tissues

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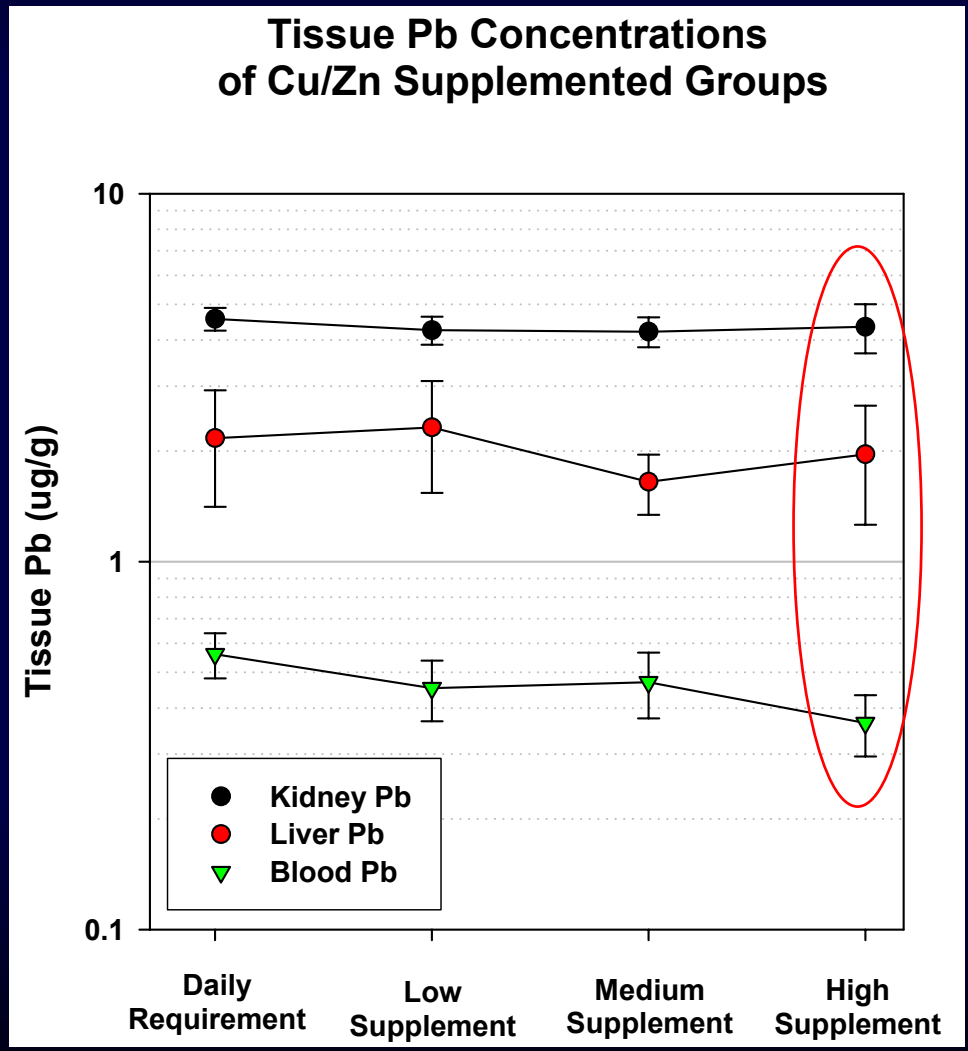


Pb Bioaccumulation from Soil Ingestion

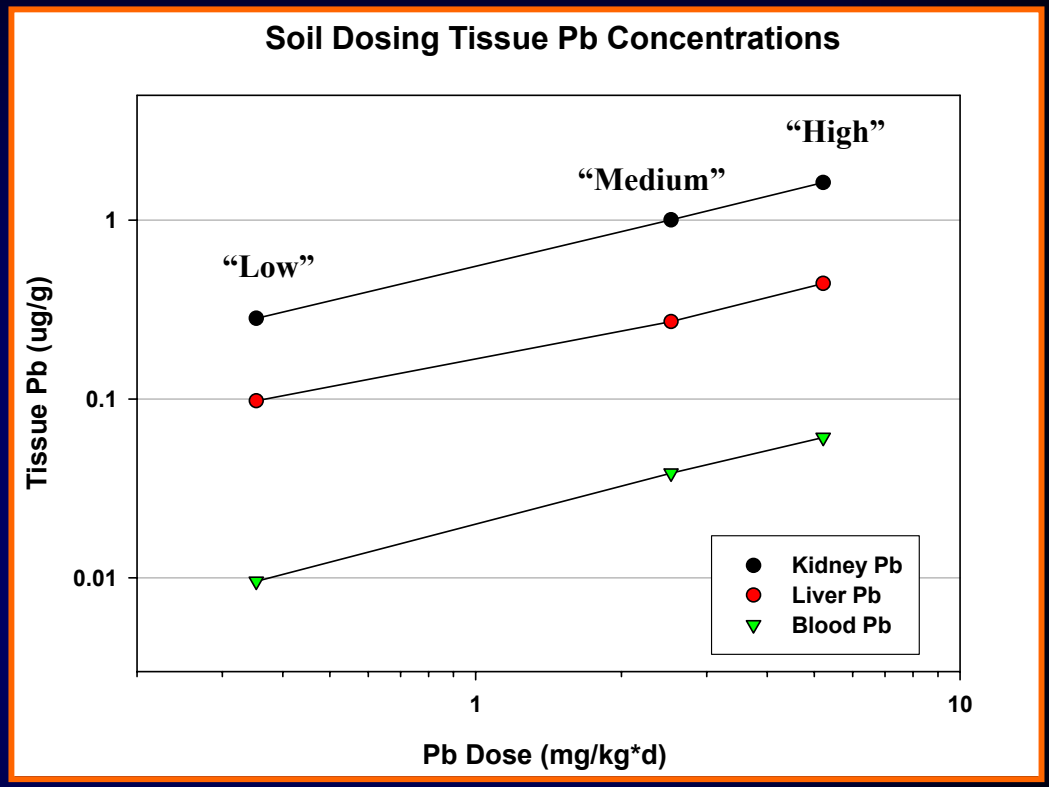
Soils collected from the three sites,
and 0.25 mm fraction soil mixed into a powdered feed.

3% using EPA estimate for incidental ingestion by rodents
by fraction stuck to food items and during preening.

(mg/kg*d)	Pb	Cu	Zn
Low	0.4	3.3	5.5
Med	2.5	10.5	7.4
High	5.2	16.3	15.9

Pb Bioaccumulation from Soil Ingestion

Progressive dose-dependent increase in Pb.



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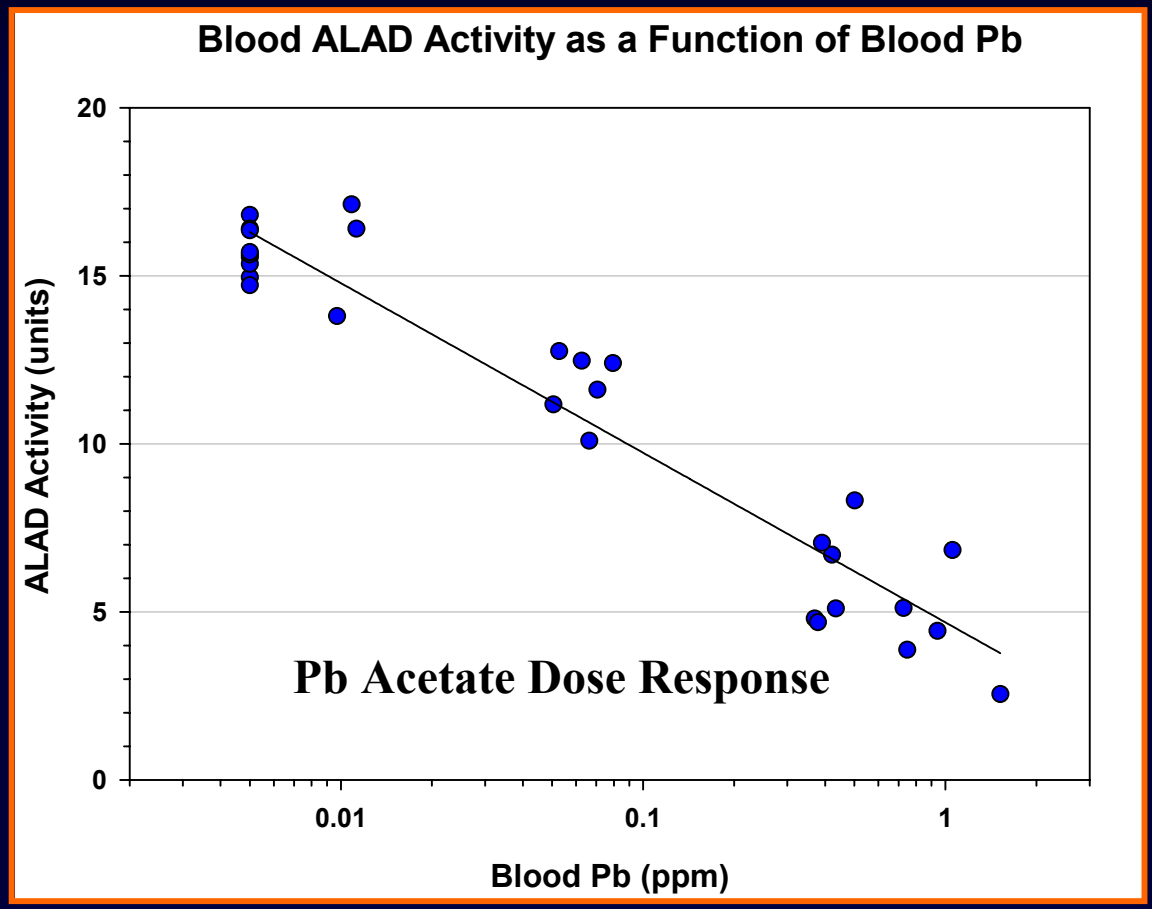
ALAD Response to Blood Pb

Anaconda Soil Ingestion Study



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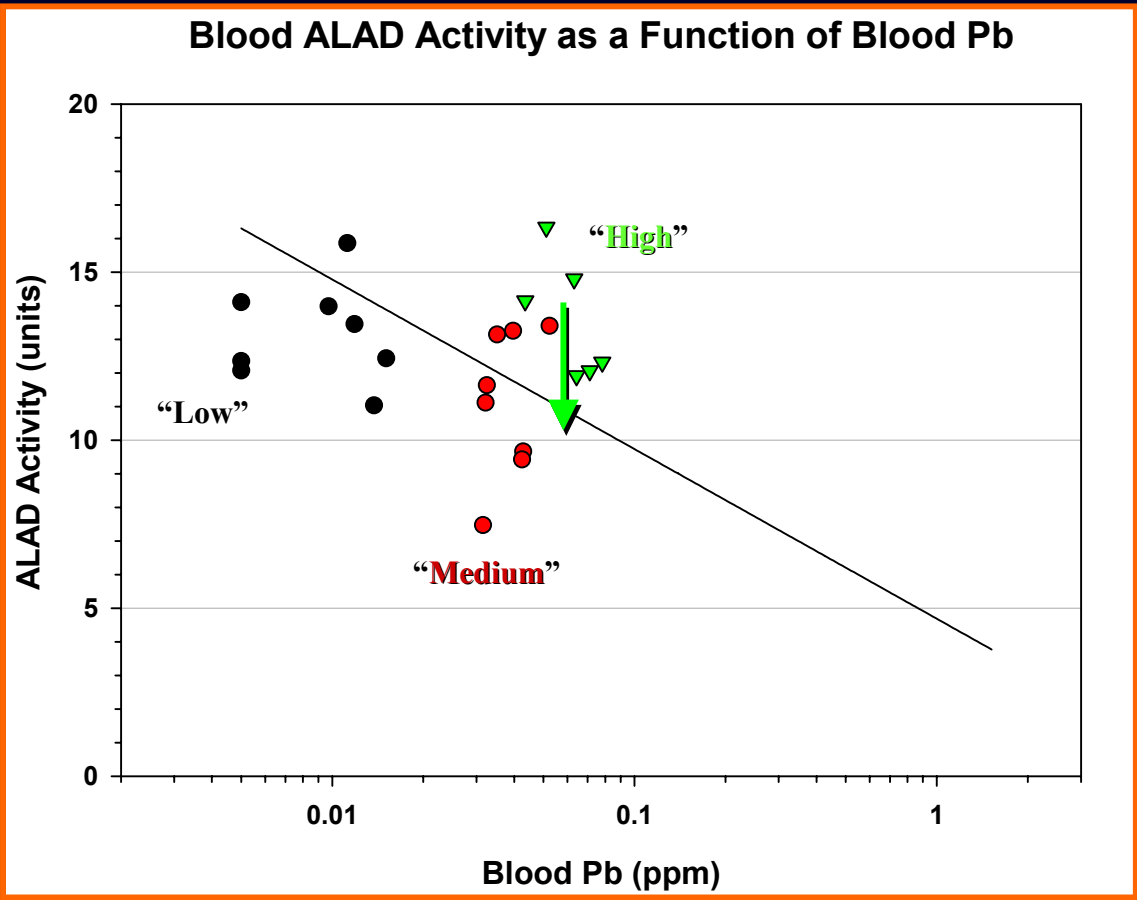

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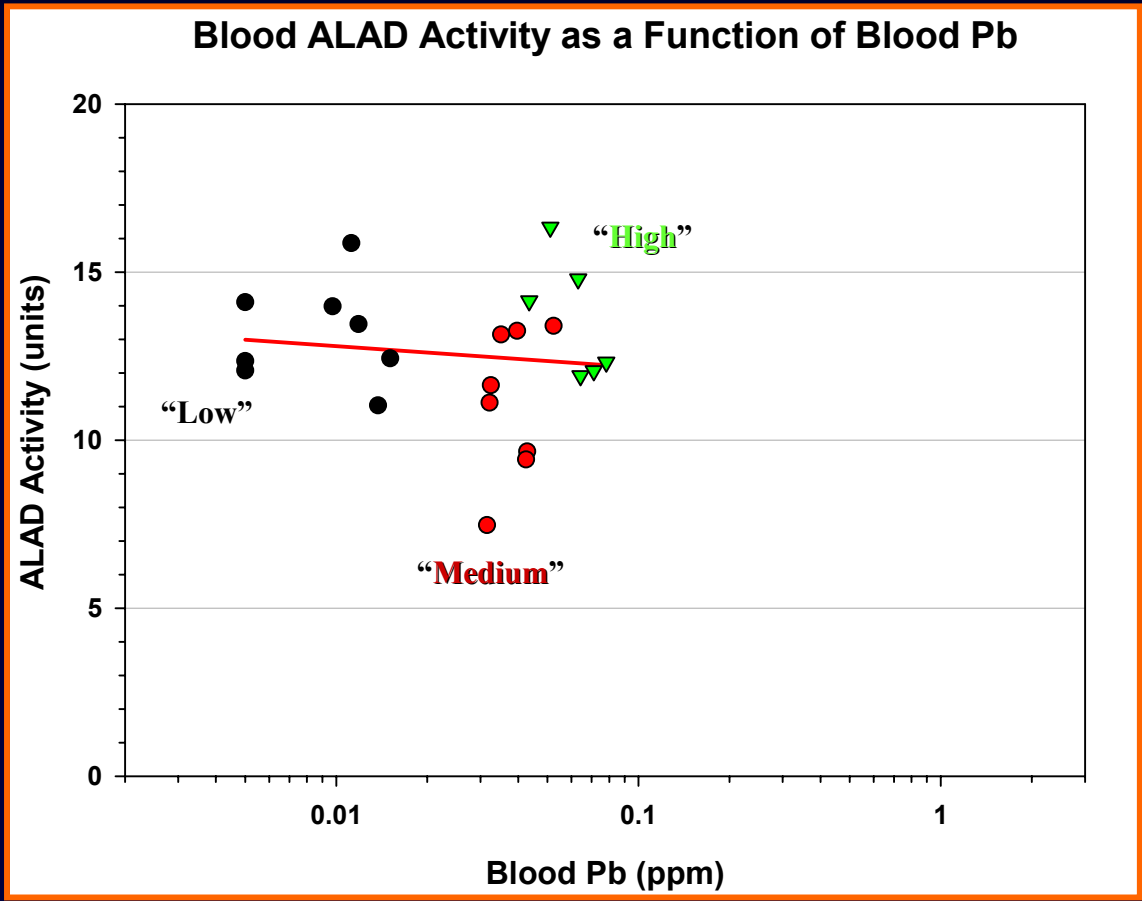

(mg/kg*d)	Pb	Cu	Zn
Low	0.4	3.3	5.5
Med	2.5	10.5	7.4
High	5.2	16.3	15.9

Conclusions

1. Increased oral exposure to Zn reduces Pb uptake and accumulation, and decreases Pb-induced ALAD inhibition.

2. Oral exposure to Cu/Zn mixtures may result in only subtle reductions in tissue Pb accumulation, but may still notably reduce Pb-induced ALAD inhibition.

3. Most importantly – although ALAD inhibition does demonstrate Pb effects in field populations,

- Zn and Cu co-exposure should be evaluated in environmental exposures of Pb, as a ***lack*** of ALAD inhibition does not preclude the potential of other Pb-induced health effects.