TURNING A LIABILITY INTO AN ASSET: Can we use the invasive apple snail *Pomacea maculata* in biomonitoring of metal contamination in freshwater marshes?

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UNIVERSITY of LOUISIANA LAFAYETTE
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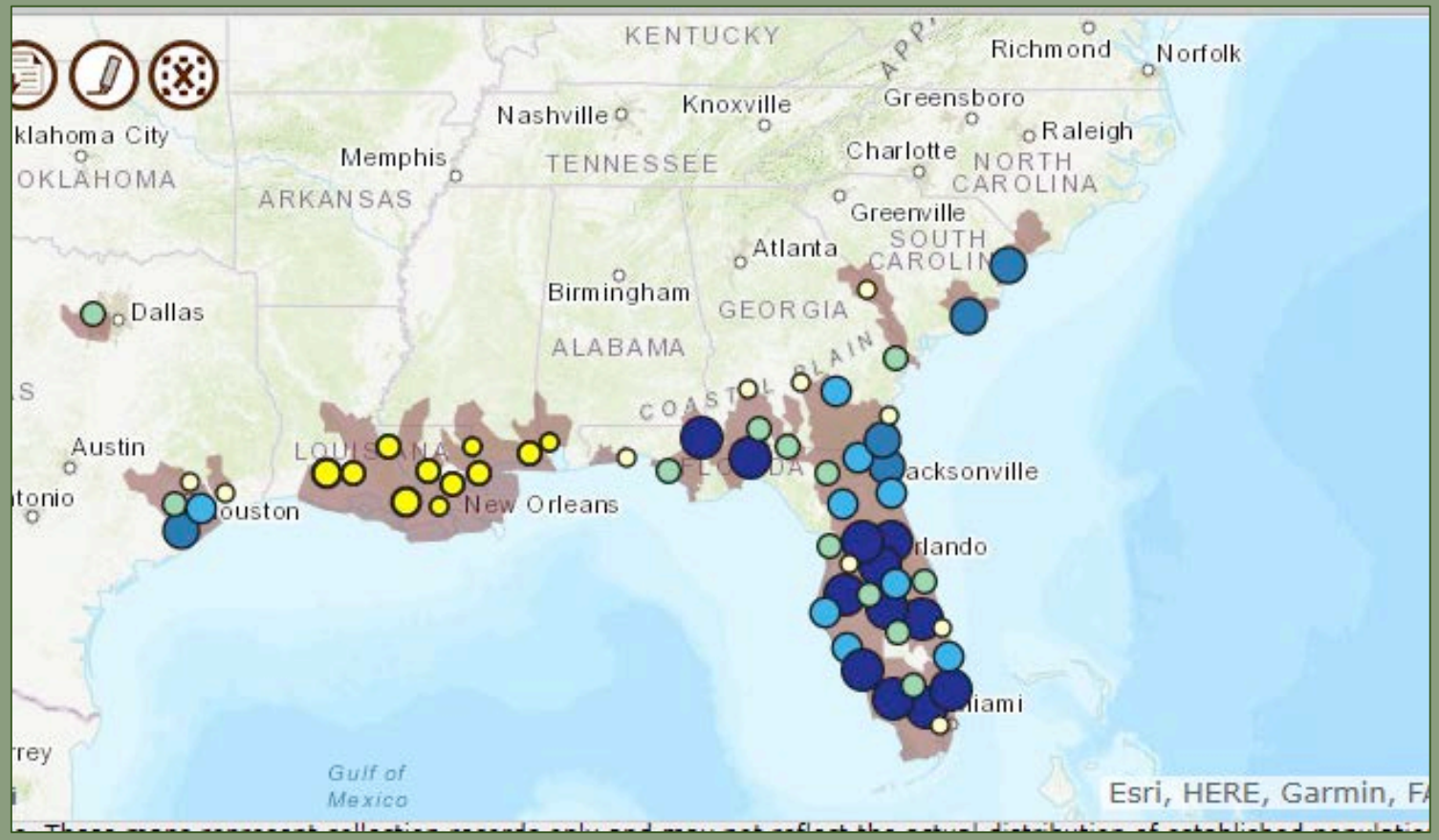
The Bayou State

- Louisiana coastal wetlands being lost at a very rapid rate
- Freshwater diversions from the Mississippi River for marsh restoration
- Metal contamination in marshes from Mississippi River input and local agricultural and industrial activities
- Contamination often most severe in sediment

US Army Corps of Engineers Image (http://commons.wikimedia.org/wiki/File:Atchafalaya_River_delta.jpg)

Pomacea maculata

- In Family Ampullariidae – includes largest freshwater snails
- Native range: Large areas of South America (CABI Invasive Species Compendium)
- **Bioinvader** (like zebra mussel and nutria)
- Limited to fresh and oligohaline waters in warm-temperate to tropical climates
- Combination of a branchial respiration system



Pomacea introduction in the United States

- Alabama, Georgia, Florida, Louisiana, Mississippi, North Carolina, South Carolina and Texas
- Earliest genetically confirmed specimen of *P. maculata in* Tallahassee, Florida
- 2006 in Verret Canal in Gretna, Louisiana

Introduction and its consequences

- Apple snails are known agricultural pests, feeding on rice crops and causing great economic damage
- Known to be a carrier of the rat lungworm parasite (*Angiostrongyliasis* sp.)
- This talk: positive consequences in ecotoxicology?

Use in biomonitoring?

- Sedentary lifestyle
- Wide range of abiotic tolerances
- High metal accumulation rates

Make *Pomacea* a suitable candidate for use in biomonitoring of freshwater metal contamination

Pomacea in ecotoxicology

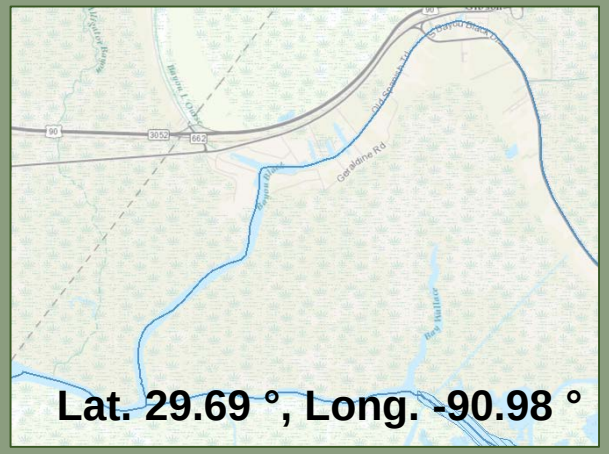
- Alter the biogeochemical cycling and fate of metals?
- Ecotoxicological consequences of metal pollution in freshwater environments
- Biomonitor for environmental contaminants- heavy metals such as copper (Cu), cadmium (Cd) and lead (Pb)

Topics

- **Bioaccumulation- tissue distribution of Cu**
- Snail tissue [Cu] reflecting environmental [Cu]?
- Shell and operculum- assess their potential use

Collection site

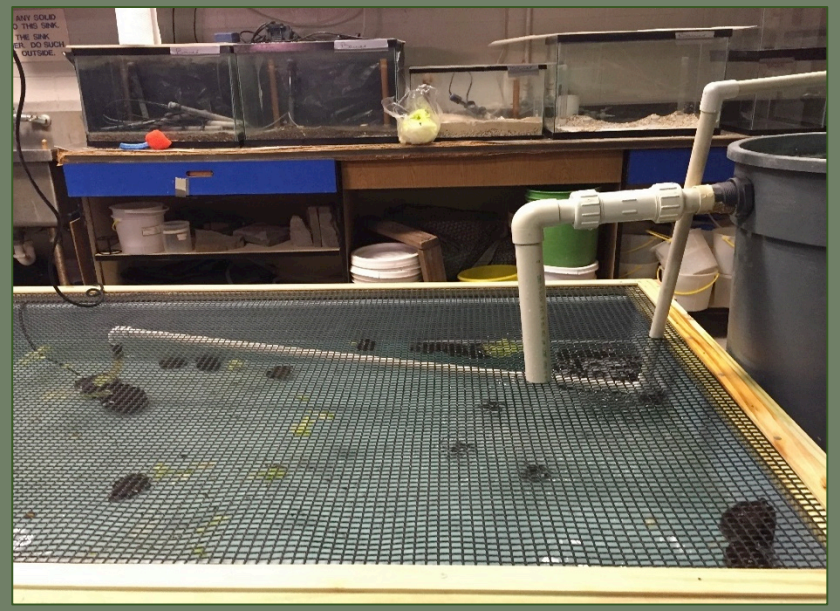
Metal levels in areas along the Gulf Intracoastal Waterway in **Lafourche** and **Terrebonne** Parishes exceed statewide limits

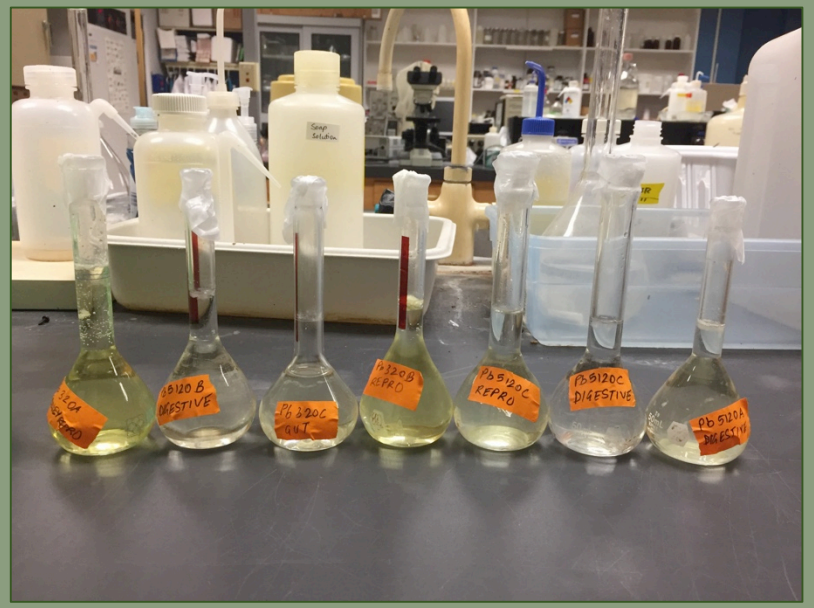


Bayou Black, Gibson, LA

Laboratory component

- Snails were maintained in water at a range of copper (Cu) levels (low, medium, high) for 10 days
- Metal levels were quantified in their gills, lung, kidney, gut, digestive and reproductive glands
- Brief depuration time (generally 24–48 h) in clean water was allowed prior to analysis





Quantification by atomic absorption spectrophotometry (AAS)

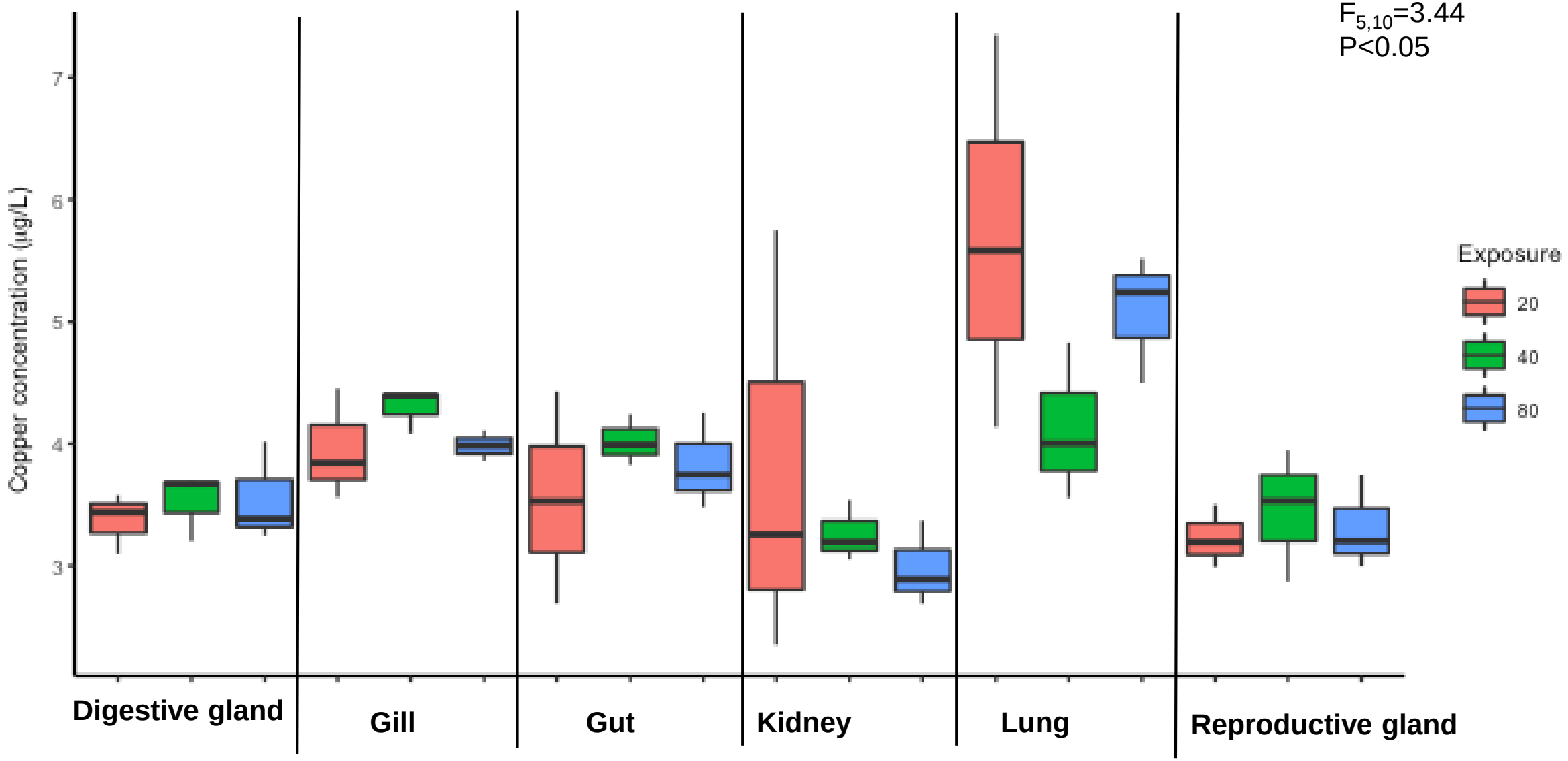
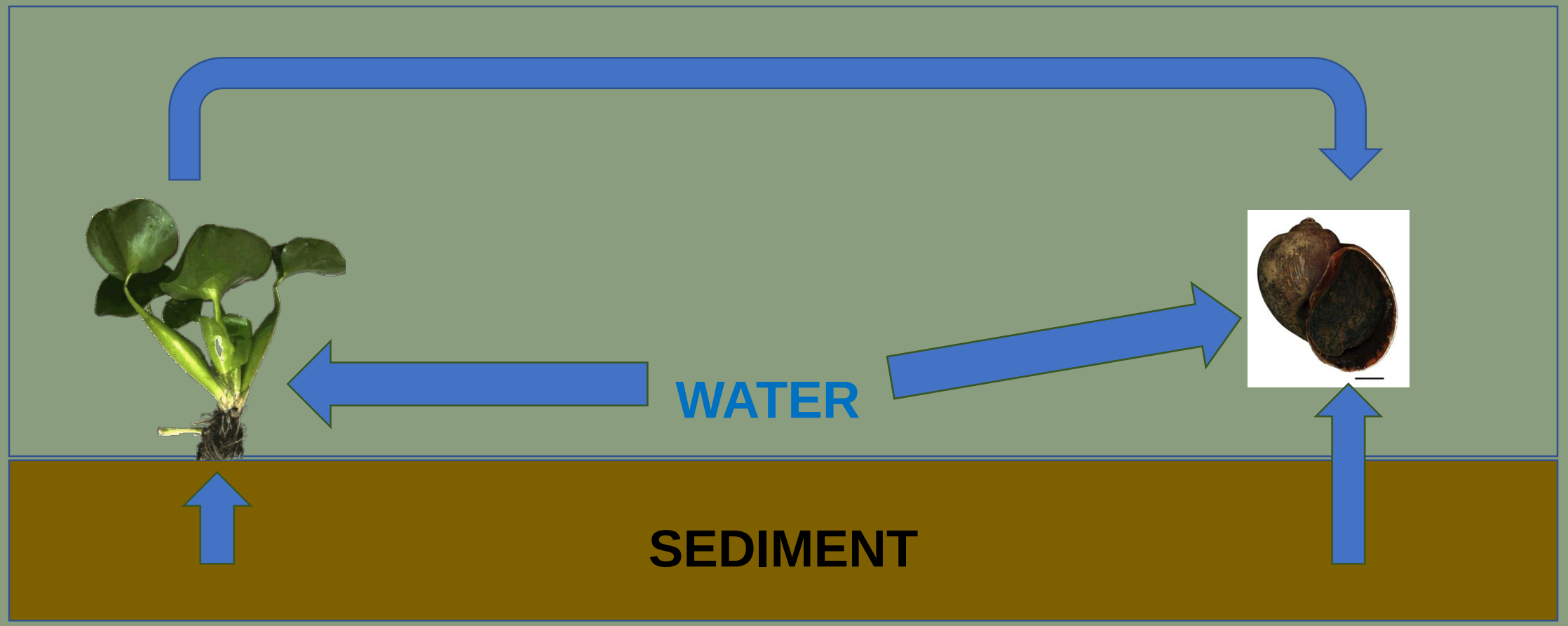


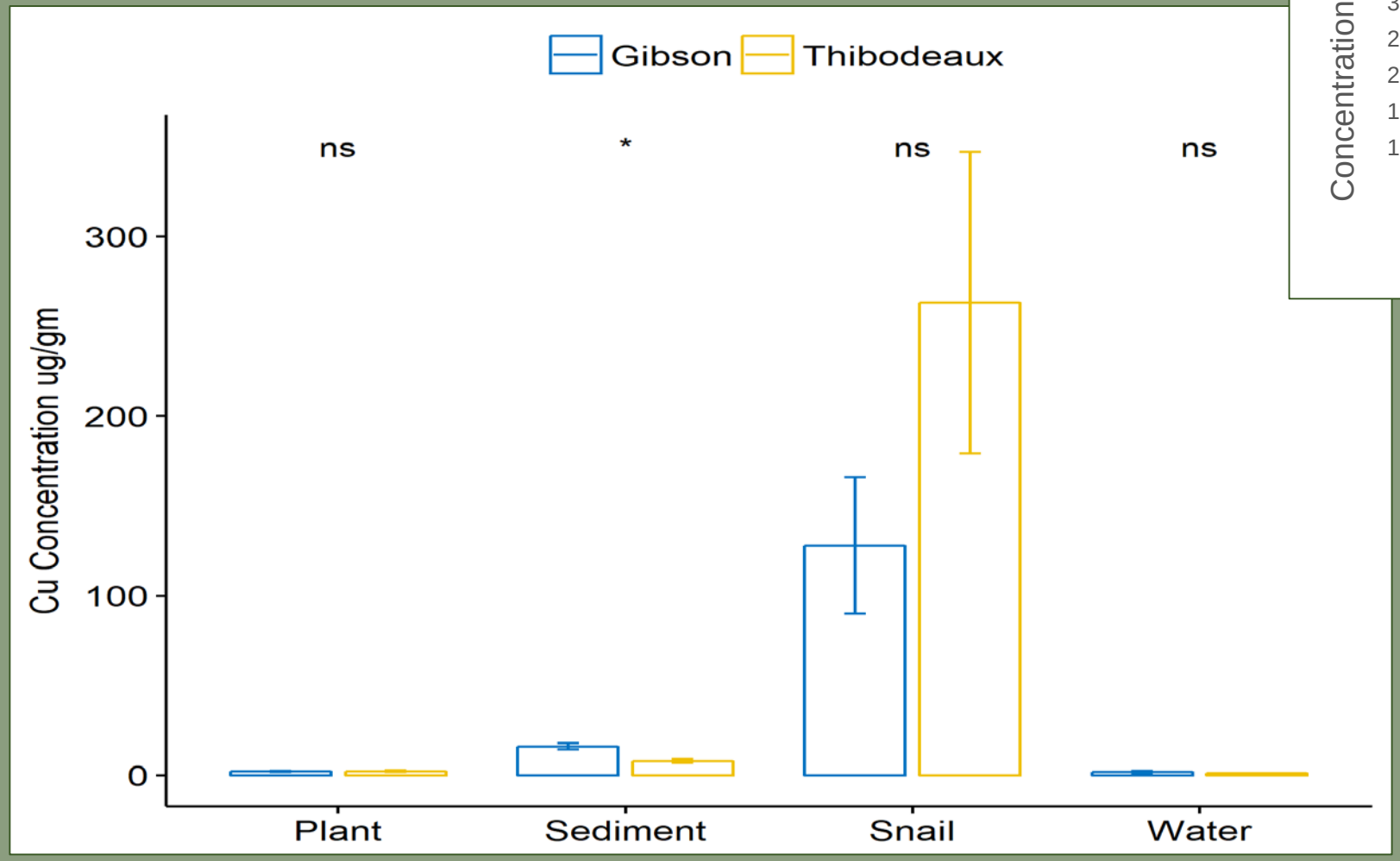
Fig- Differential Cu concentrations in tissues

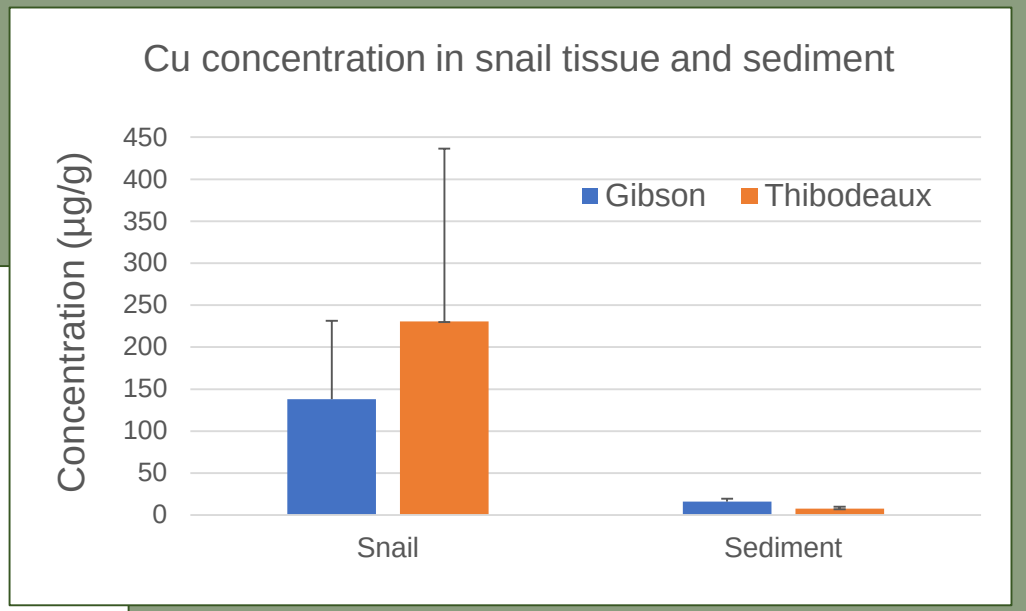
Topics

- Bioaccumulation- tissue distribution of Cu
- **Snail tissue [Cu] reflecting environmental [Cu]?**
- Shell and operculum- assess their potential use

Cu pathways







Cu concentrations in snail and sediment at Gibson and Thibodeaux

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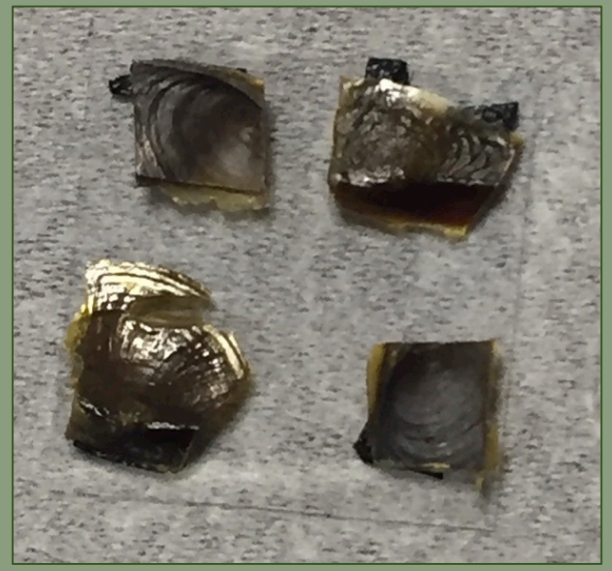
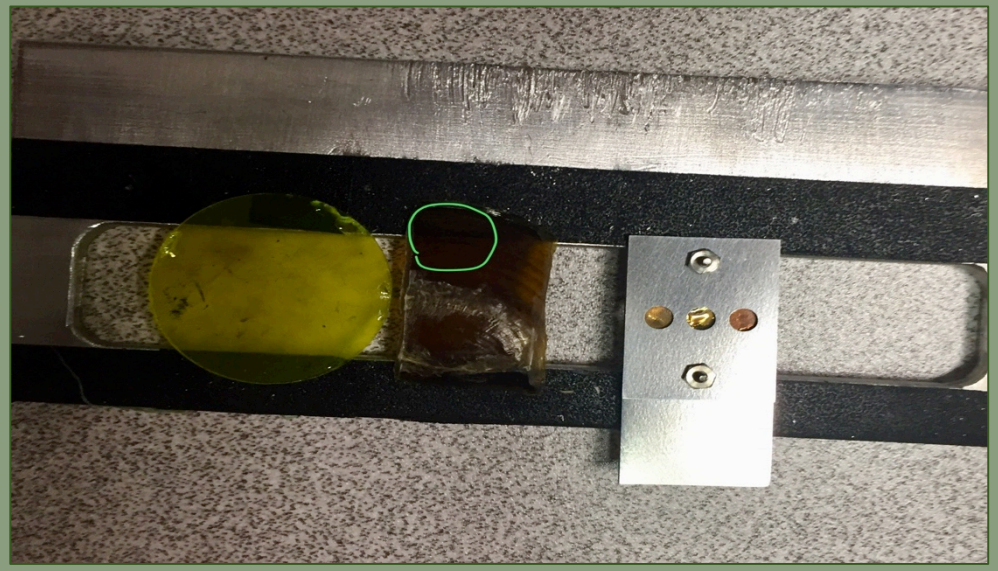
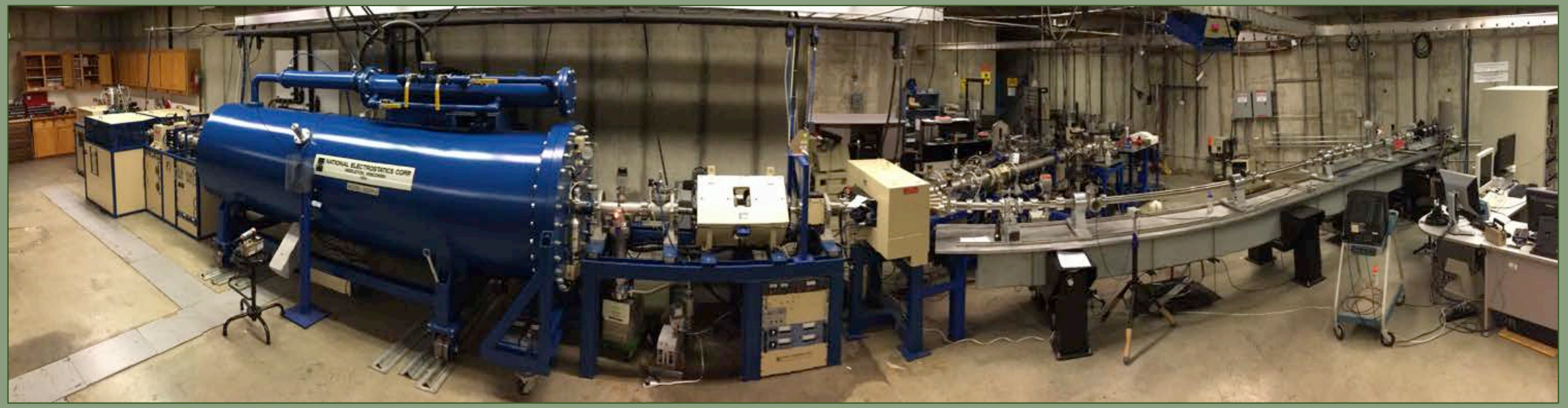
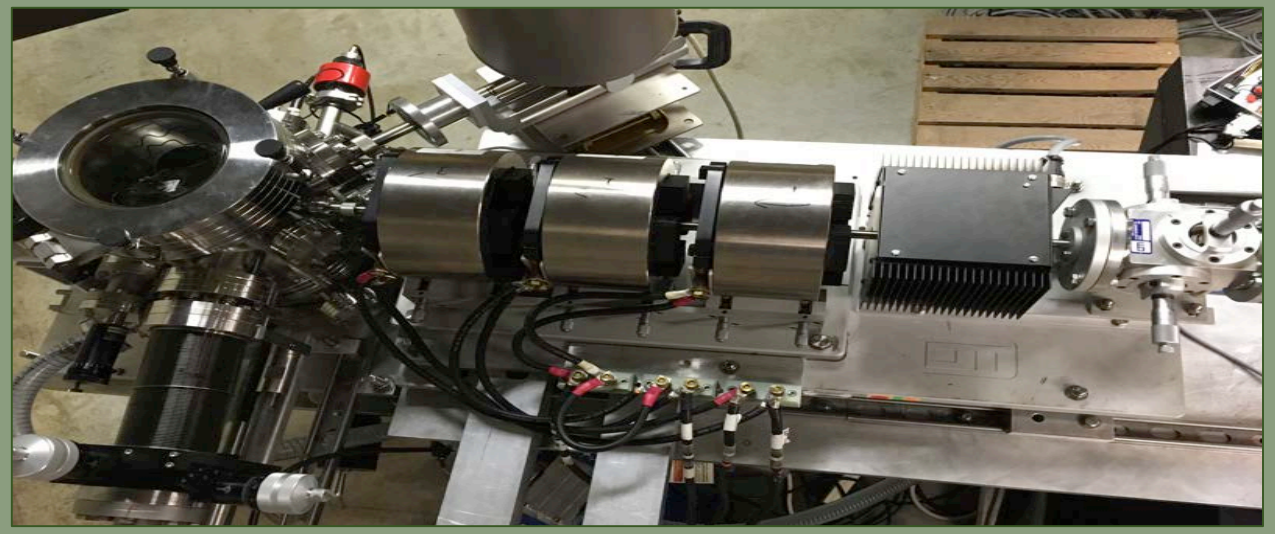




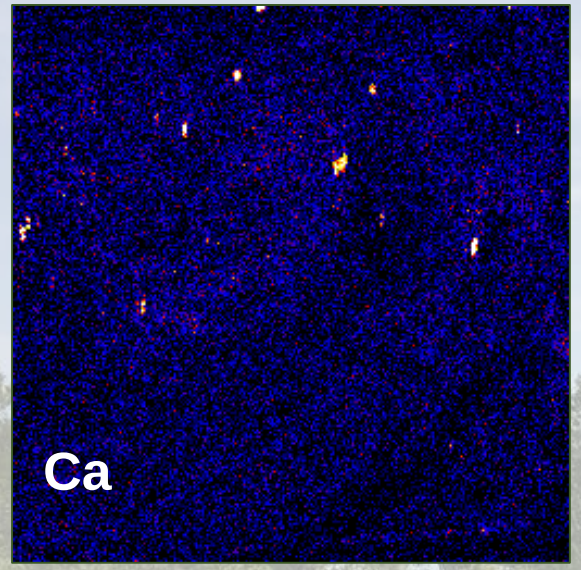


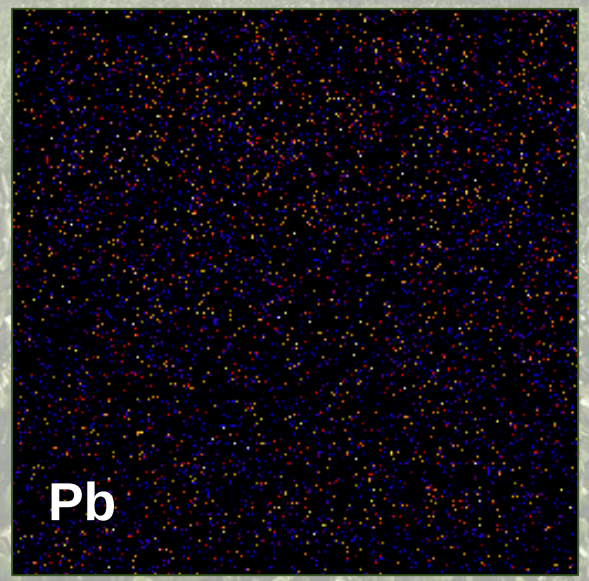
Accelerator at the Louisiana Accelerator Center

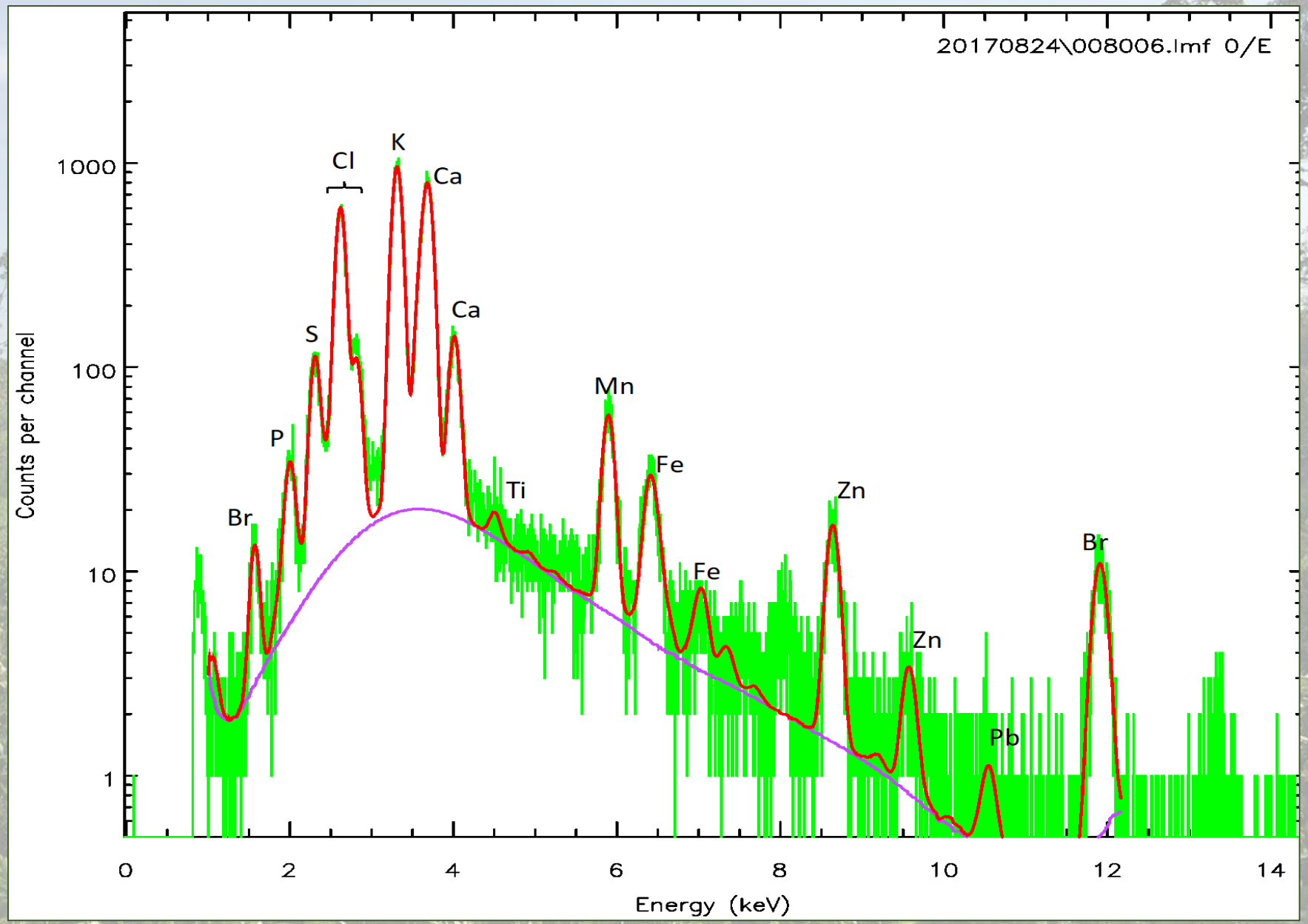


MeV ion microscope for MicroPIXE

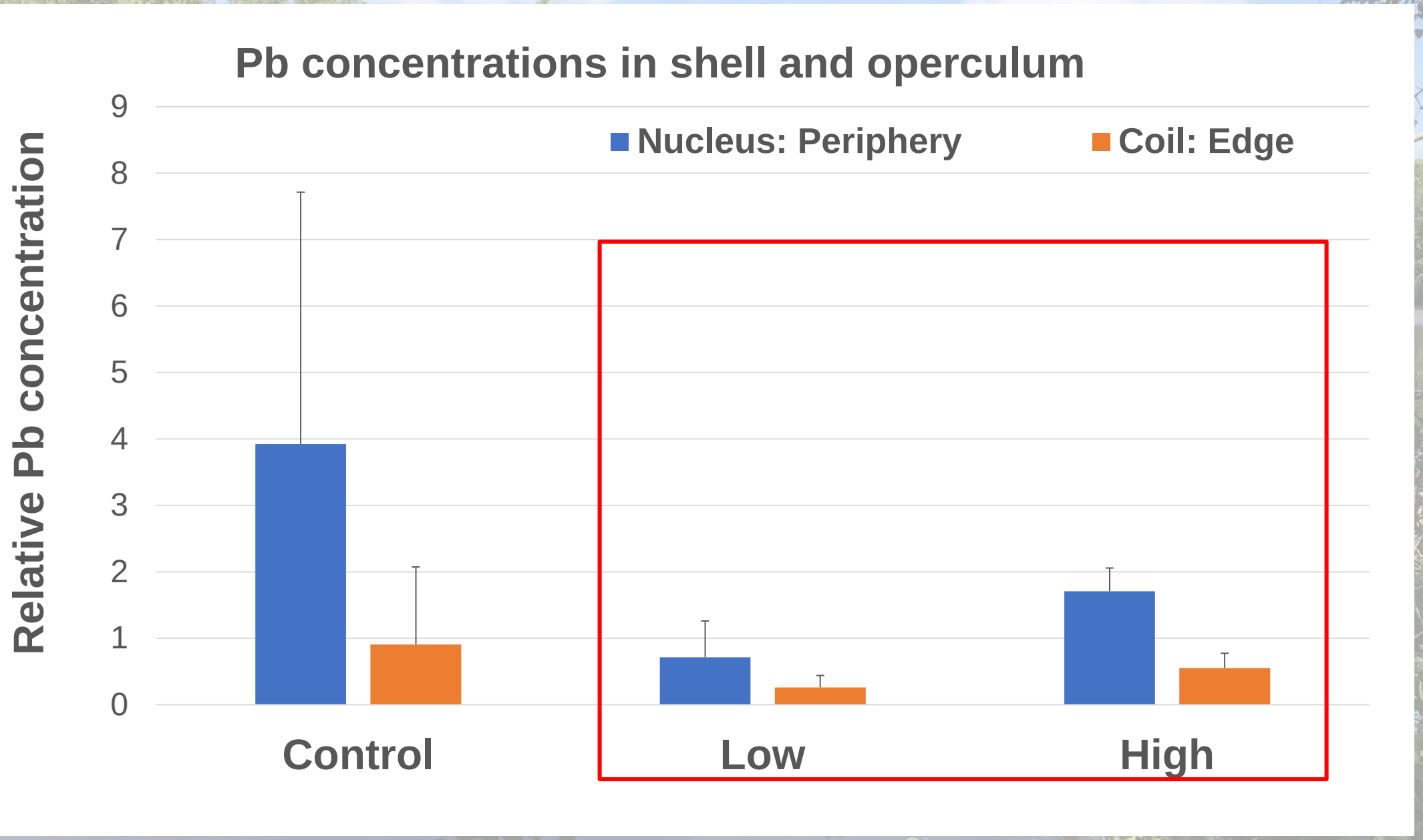
Micro Particle Induced X-Ray Emission (PIXE) will provide information on patterns of accumulation of lead?







PIXE spectra- Operculum nucleus, High concentration


Pb concentrations in shell and operculum
Relative Pb concentration
9
8
7
6
5
4
3
2
1
0
Nucleus: Periphery
Coil: Edge
Control
Low
High

Conclusions

- Cu accumulation in *Pomacea* differs among tissues; highest in digestive gland
- *Pomacea* tissue levels seem to best reflect Cu environmental levels in sediment
- Hard tissues (corneous operculum and shell) of *Pomacea* may be used with micro-PIXE for studying Pb pollution in tropical and sub-tropical wetland environments

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