Concentrations and speciation of potentially toxic trace elements in waters of an urban estuary; Bayou Bienvenue, New Orleans, Louisiana

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Acknowledgements

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Why Study Heavy Metals in Estuaries?

- Estuaries serve as nurseries for marine organisms
  - Commercially important shell- and fin-fishes
  - Shrimp, oysters, redfish
- Estuaries can act as natural "filters" for heavy metals and other pollutants

Bayou Bienvenue, Louisiana

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Why Study Heavy Metals in Estuaries?

- Current paradigm → estuaries filter heavy metals
- Reality → little is actually known about the biogeochemical cycling and transport of heavy metals in Louisiana's numerous estuaries

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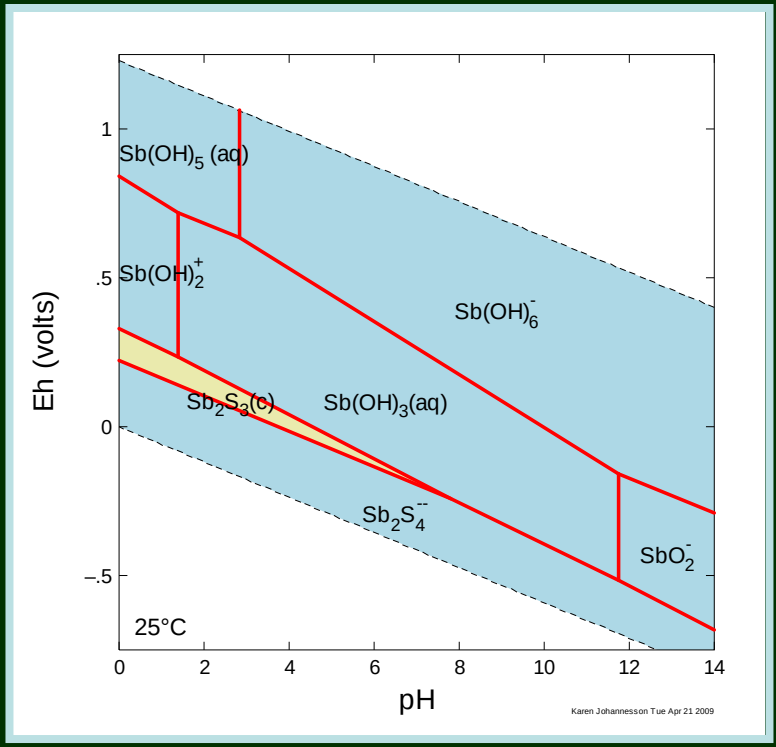
Metal Speciation

- It's not enough to measure the concentrations of heavy metals
  - Tells us little about their bioavailability, toxicity, mobility
- Need to determine speciation



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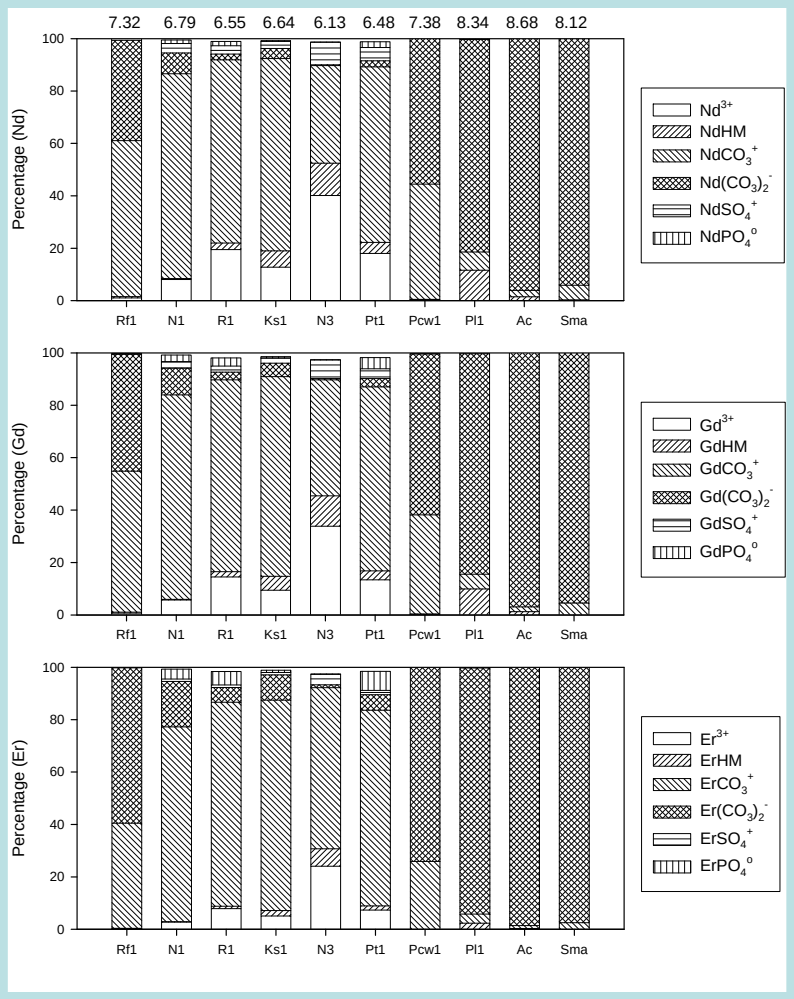
Metal Speciation



- **The particular chemical form that an element exists in water**
  - **Free ion, e.g., $[Cu^{2+}]_F$**
  - **Bound to organic ligands**
  - **Complexed to inorganic ligands**
  - **Different redox species, e.g., As^{3+} vs. As^{5+}**

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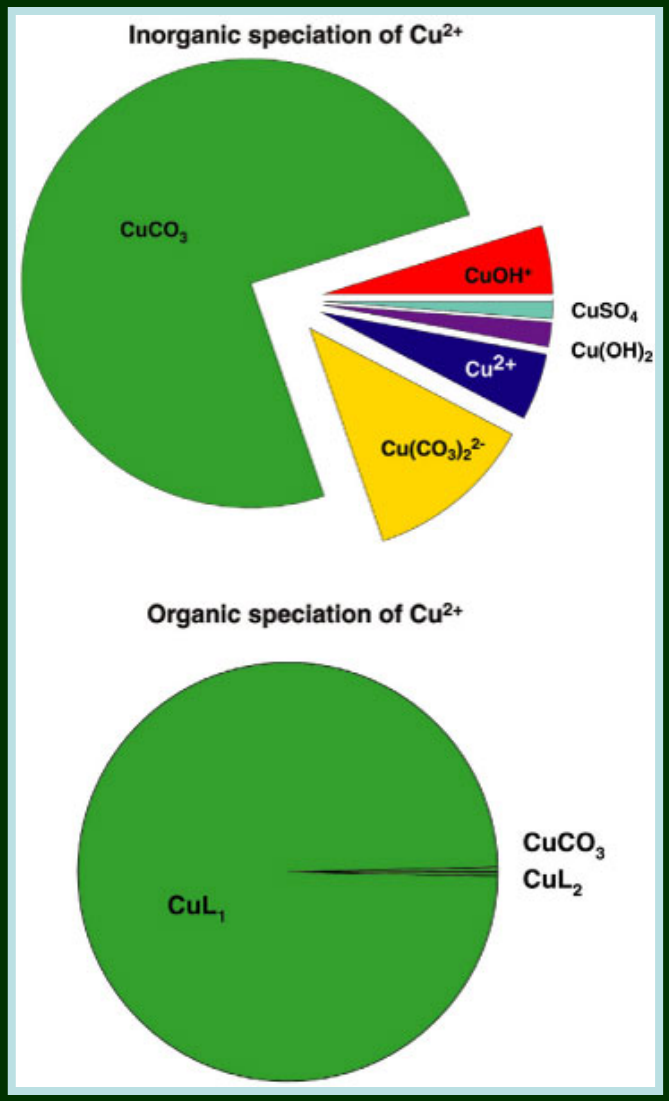
Metal Speciation

- Speciation controls trace element's:
- Bioavailability
  - Free-ion activity model
- Toxicity
  - As^{3+} is 10 – 60 more toxic than As^{5+}
- Effective solubility
- Mobilization and transport in the environment



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Methods/Description

- Collect series of surface waters samples along Bayou Bienvenue
- Ultra clean trace element techniques
- Clean hands – dirty hands

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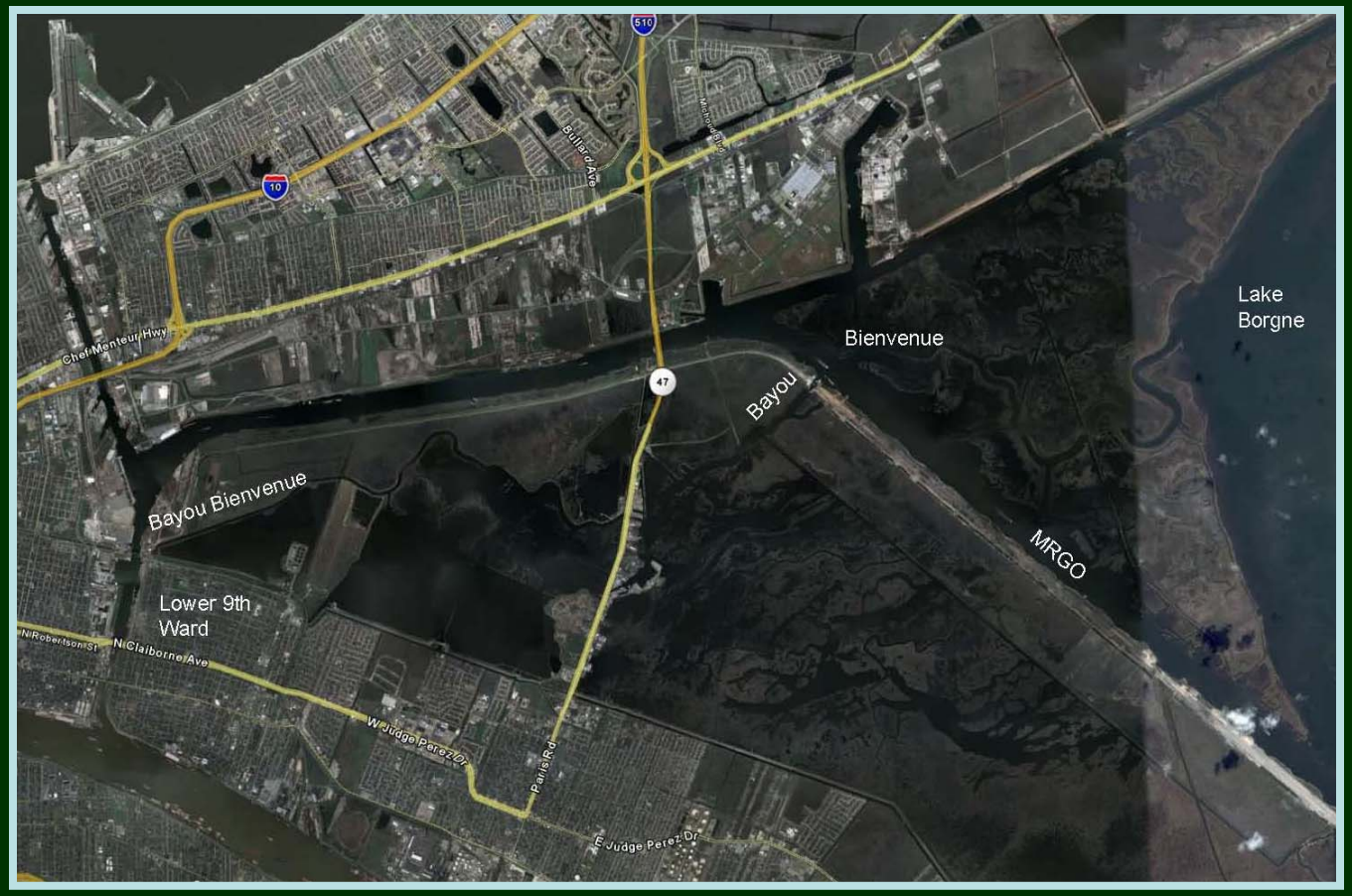
Bayou Bienvenue



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Bayou Bienvenue

Dr. Alex Kolker from LUMCON will assist us with boat time

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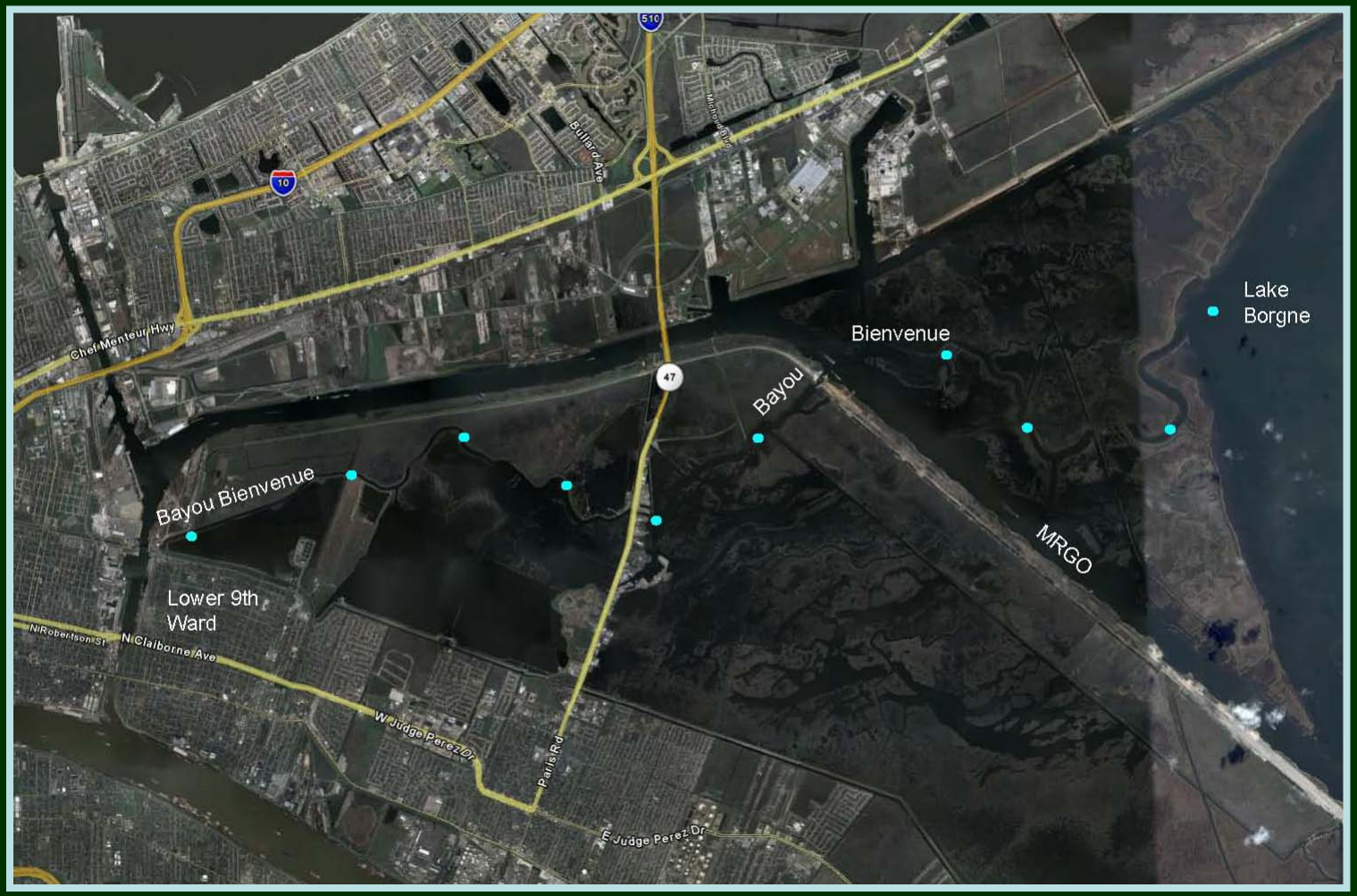
Bayou Bienvenue



Blue dots show sampling sites on Bayou Bienvenue

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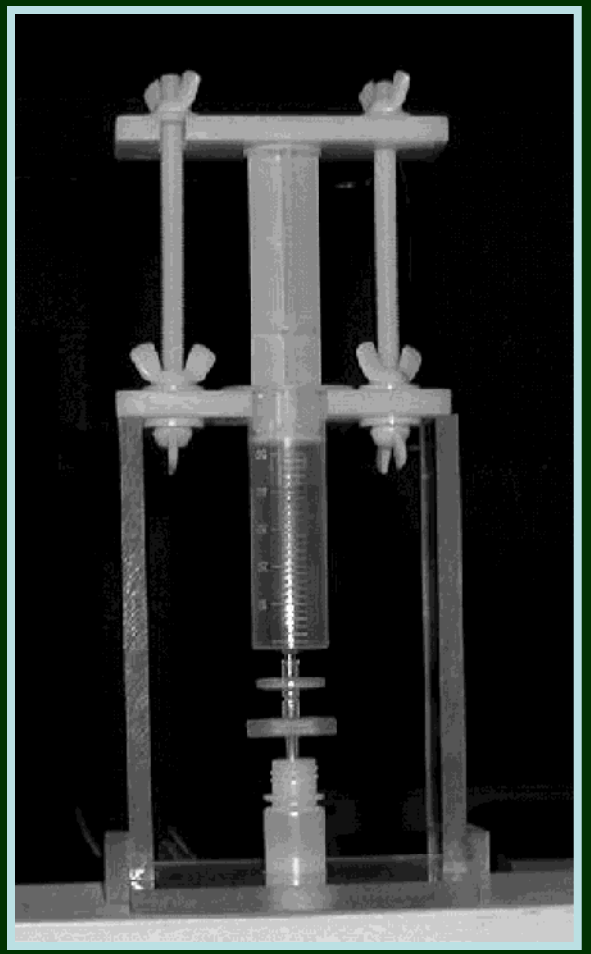
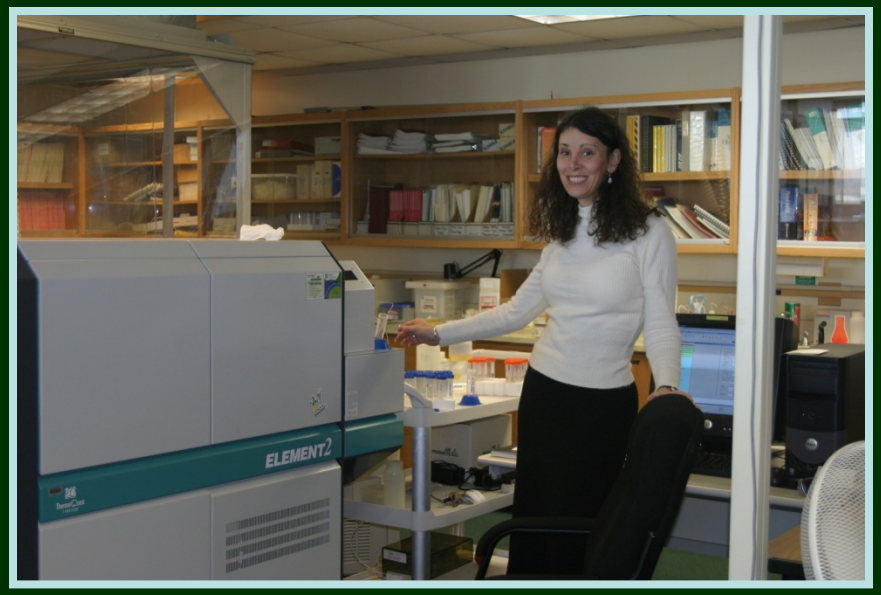
Speciation Analysis

- Filtration
- Unfiltered samples
- Filtered through 0.45 um
  - colloidal
- Filtered through 0.02 um
  - “truly dissolved”



Trace Element Analysis



Magnetic Sector ICP-MS at Tulane University

- Inductively Coupled Plasma Mass Spectrometry
- As, Se, Sb, Cr, Pb, Ni, Zn, Tl, Mo, W, V, U
- Fe, Mn
- Measure in each filtration aliquot

Organic carbon will be determined in each aliquot too.

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Partition Coefficients

- $K_d^{\text{POC-DOC}} = \{[M_{\text{POC}}]/[\text{POC}]\}/[M_{\text{DOC}}]/[\text{DOC}]$
- $K_d^{\text{COC-DOC}} = \{[M_{\text{COC}}]/[\text{COC}]\}/[M_{\text{DOC}}]/[\text{DOC}]$
- **[POC], [COC], & [DOC] are the concentration of particulate, colloidal, and dissolved organic carbon, respectively.**
- **[M_{POC}], [M_{COC}], & [M_{DOC}] are the concentration of individual trace elements associated with different size fractions of OC.**
- **M_{POC} > 0.45 um**
- **0.45 um ≥ M_{COC} ≥ 0.02 um**
- **M_{DOC} < 0.02 um**

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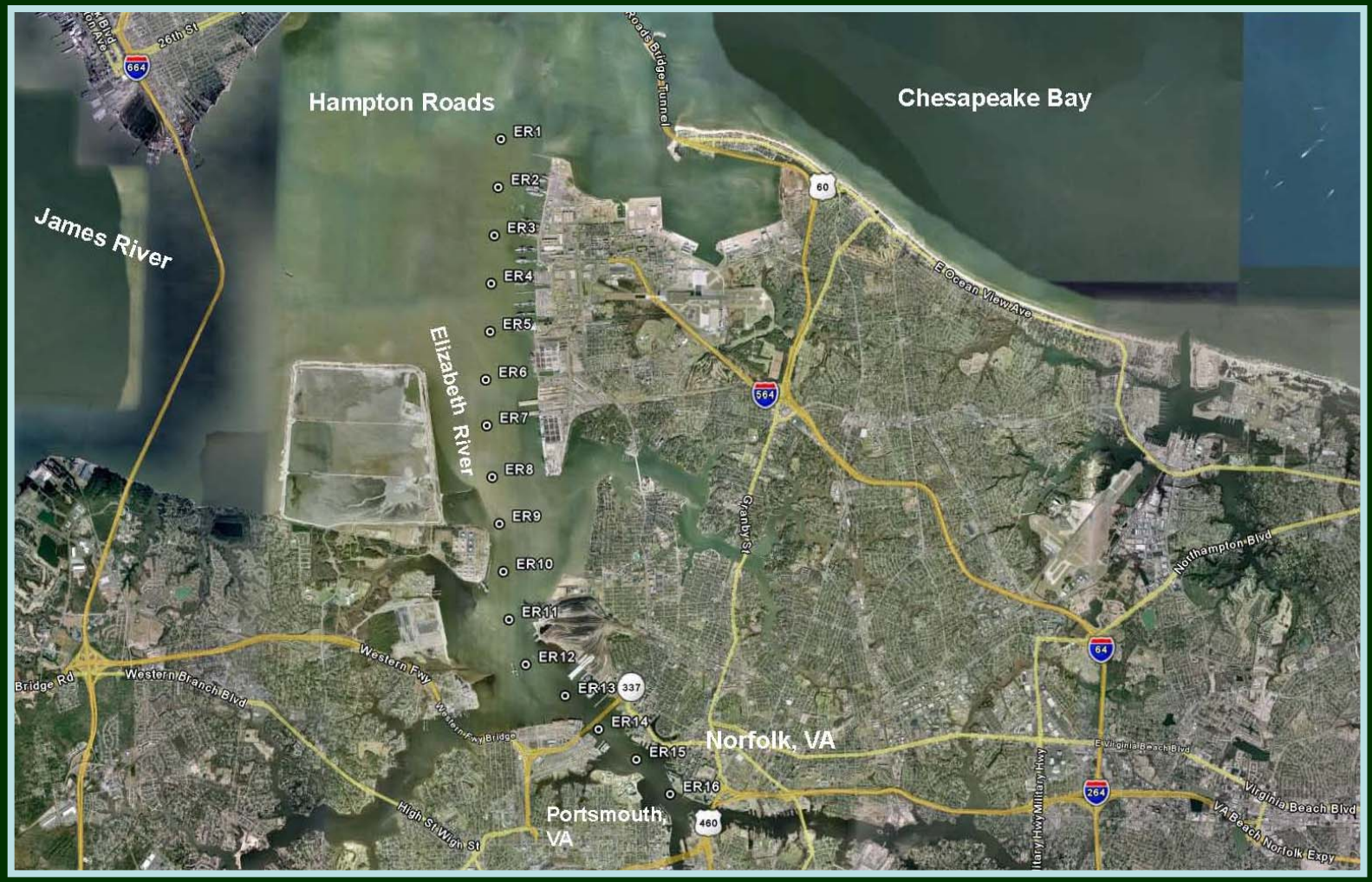
Lanthanide Series



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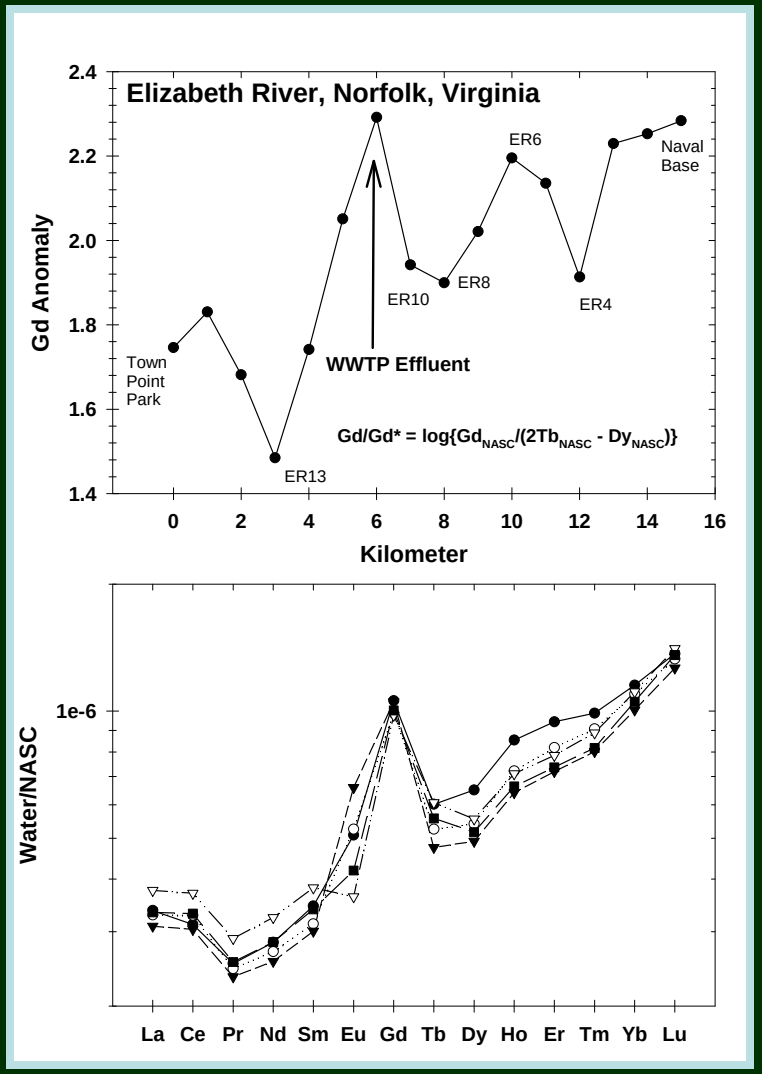
Anthropogenic Gd anomalies

- Gd is used in medical magnetic resonance imaging
- Gd has high magnetic moment
- Administered as:
- Gadodiamide
- gadopentetic acid
- Gd-diethylenetriaminepenta-acetate, i.e., Gd(DPTA)



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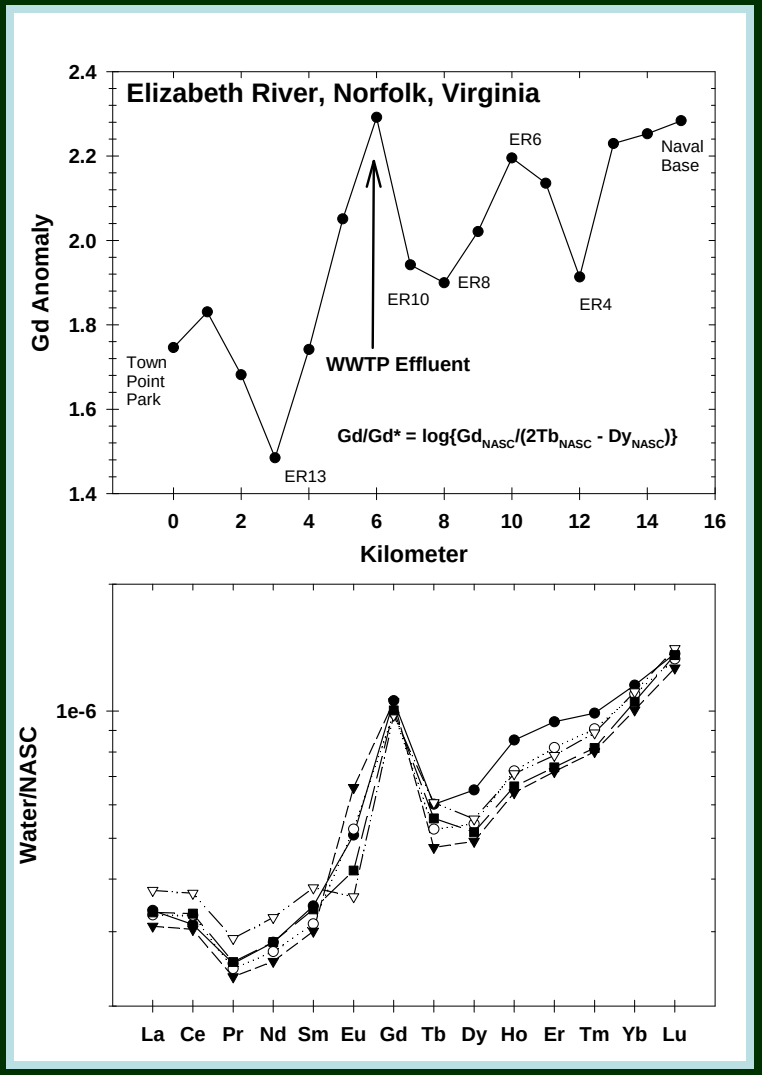
Anthropogenic Gd anomalies

- We will measure the lanthanide series elements in aliquots of our Bayou Bienvenue samples
- Direct measure of anthropogenic influences on these waters



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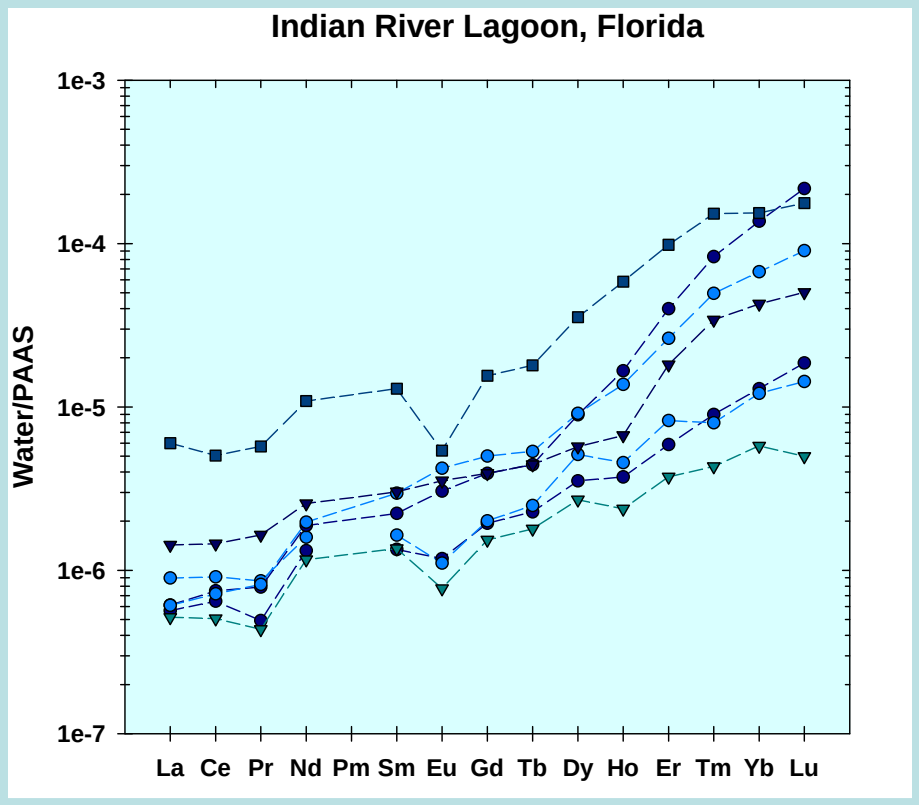
Anthropogenic Gd anomalies



- Non-impacted estuaries do not have substantial Gd anomalies
- Indian River Lagoon in Florida

Johannesson et al. (in prep)

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