

Controls on Metal Partitioning in Contaminated Sediments

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#2

Kinetic Rate Analysis

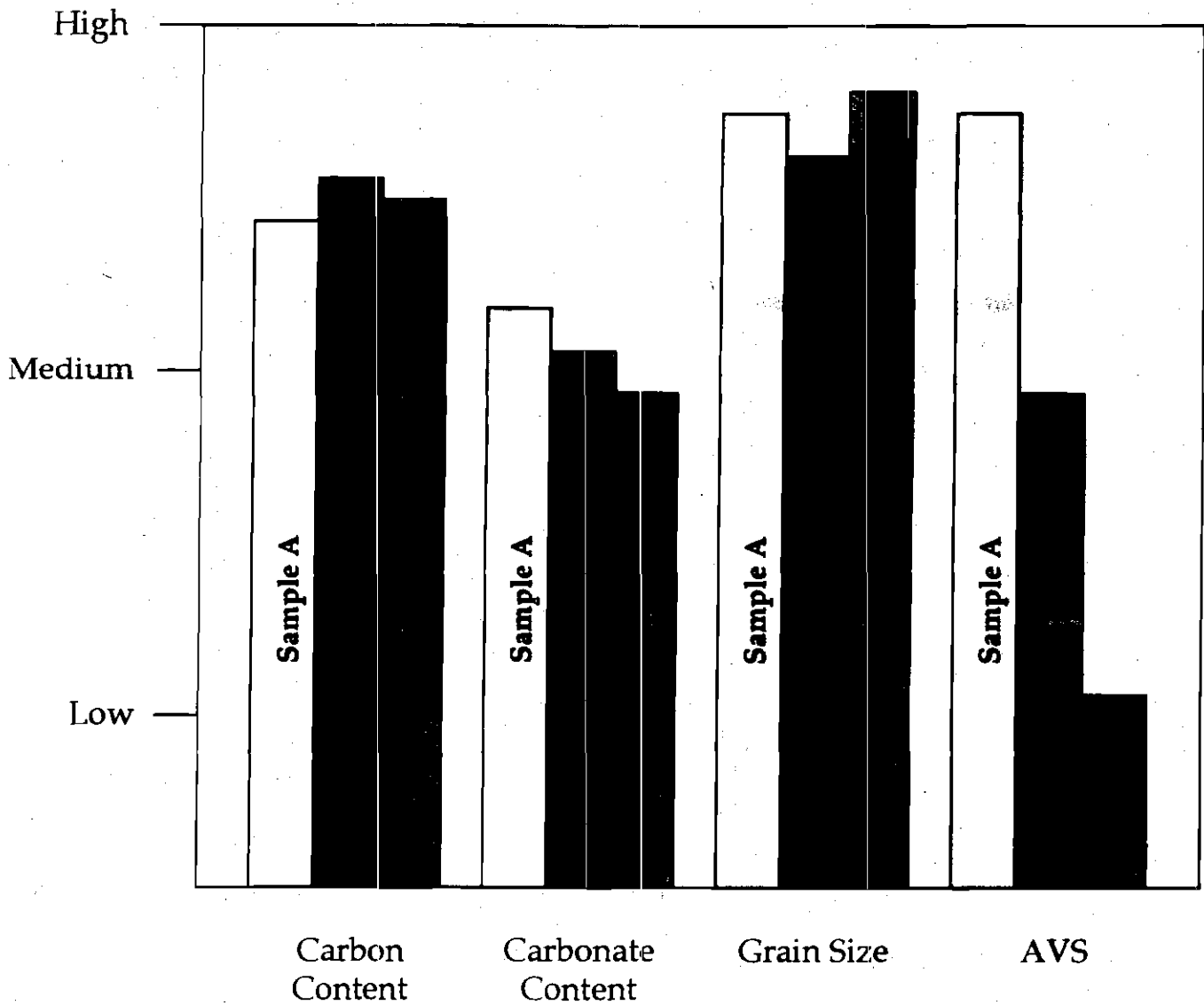
$$\frac{dc}{dt} = -k [Cd][1-\theta]$$

k = *Kinetic Rate Constant*

$[Cd]$ = *Cadmium Concentration in Solution*

θ = *Fraction of Cd Bound/Binding Capacity,*
 X_t/X_{ult}

Example of Selection Process



Objectives in Progress

- Kinetic Study of the Reoxidation of Contaminated Sediments
- Batch Test Analysis for the Replication of the Timed Titration Test and the Study of Other Metals (Cu, Pb, Ni, Zn, Hg)

Controls of Metal Partitioning in Contaminated Sediments

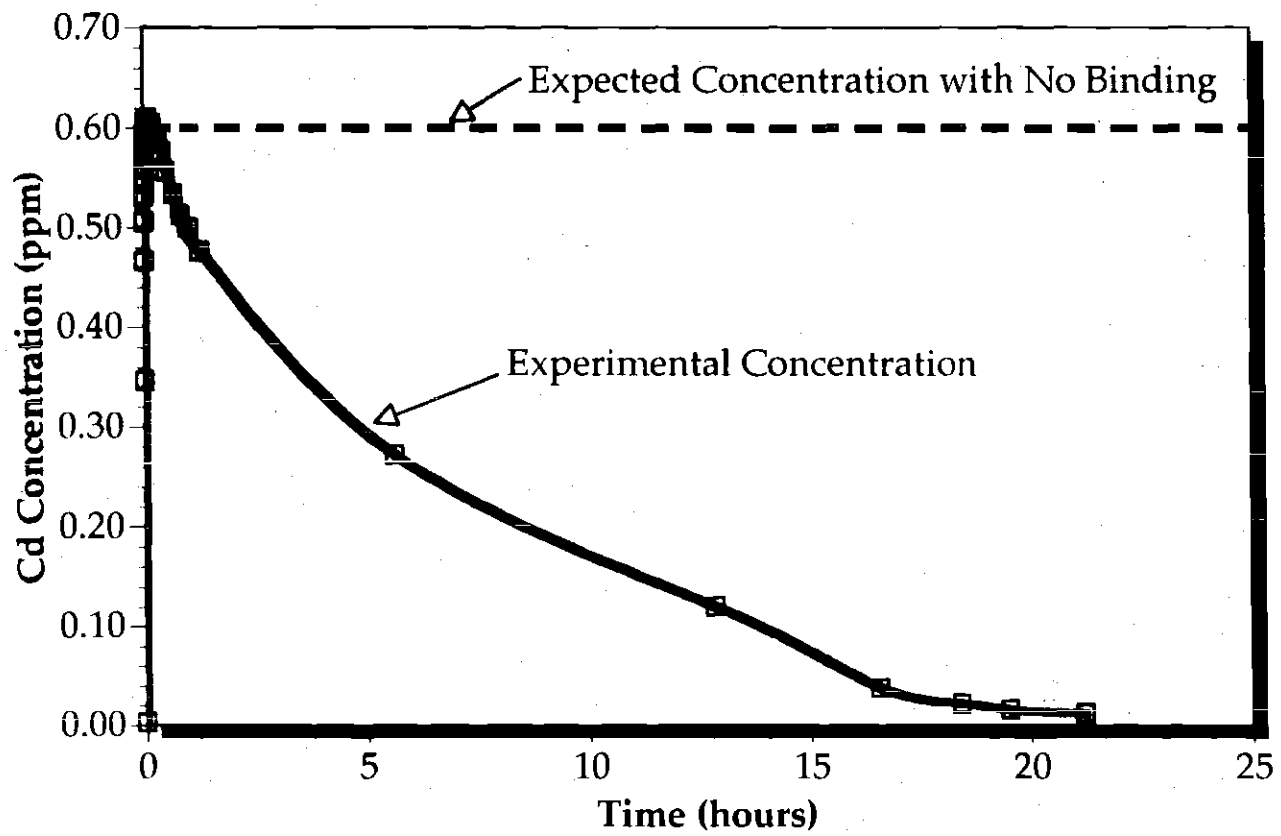
Principal Investigators

Dr. F. Michael Saunders	Georgia Institute of Technology
Dr. Herbert L. Windom	Skidaway Institute of Oceanography
Dr. Richard A. Jahnke	Skidaway Institute of Oceanography
Dr. Joel Kostka	Skidaway Institute of Oceanography

Participating Students

Brian Gray (MS)	Georgia Institute of Technology
Jennifer McMahon (MS)	Georgia Institute of Technology
Jeffrey King (PhD)	Georgia Institute of Technology

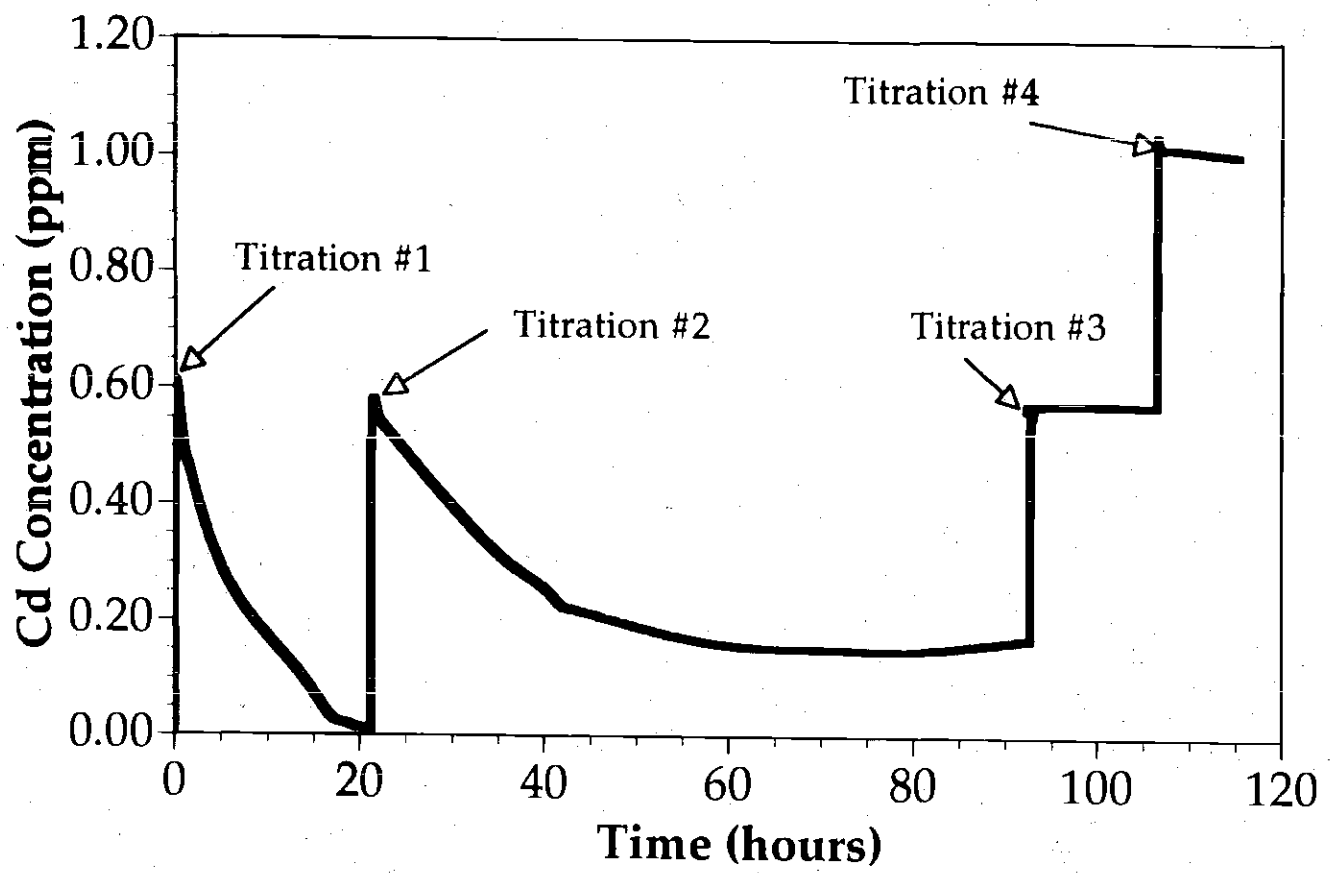
Titration #1 Sample #34



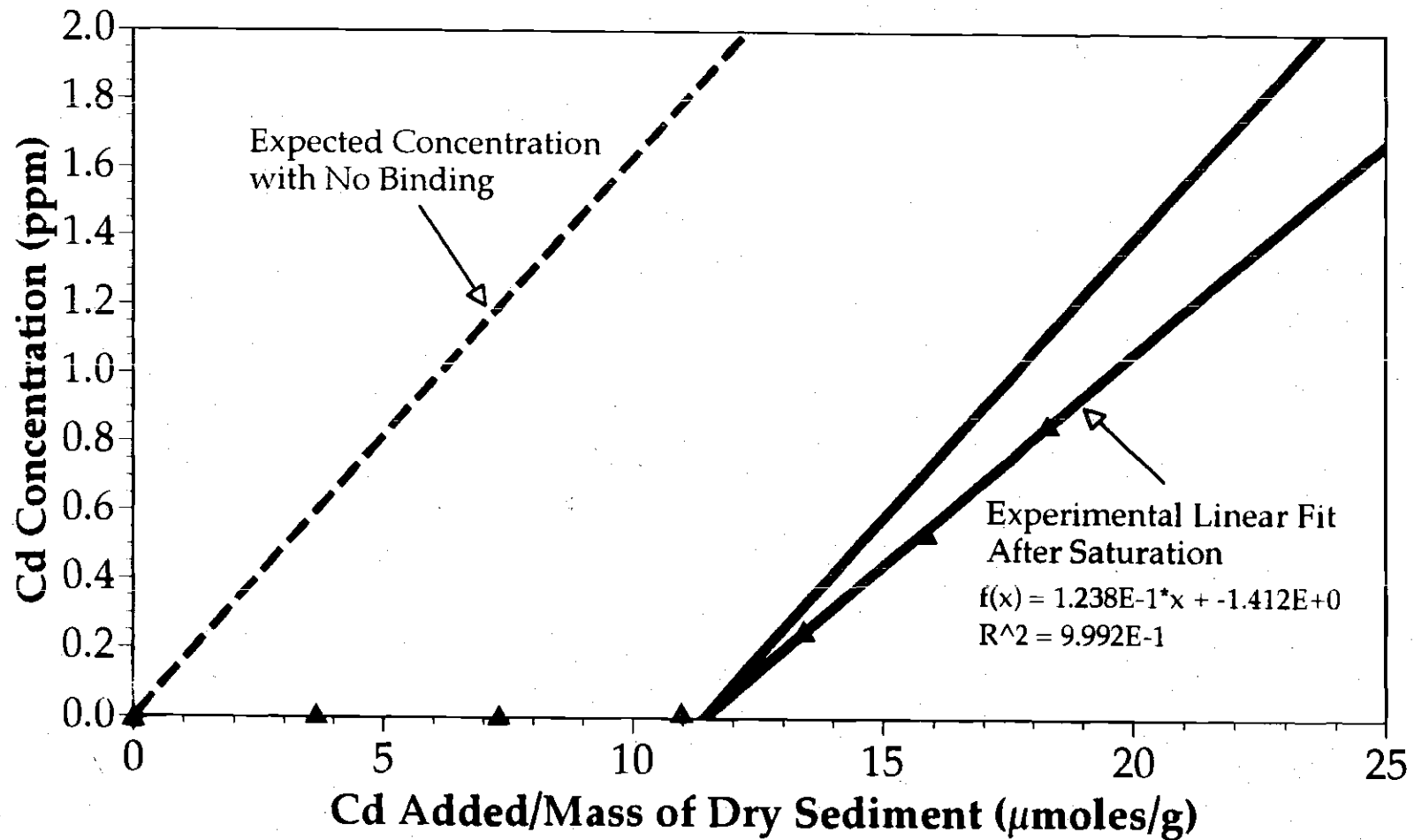
Reactor Environment

- Volume: 250ml
- Wet Sediment Sample Size: 1.4 - 2.0 g
- pH Range: Typically 8.3 - 7.4
- Cadmium Spikes: 0.10 - 0.15 ml
Additions of 1000 ppm
- Temperature: Room Temp $\approx 25^{\circ}$ C
- Typical Test Time ≈ 1 week

Total Titration Timescale Sample #34



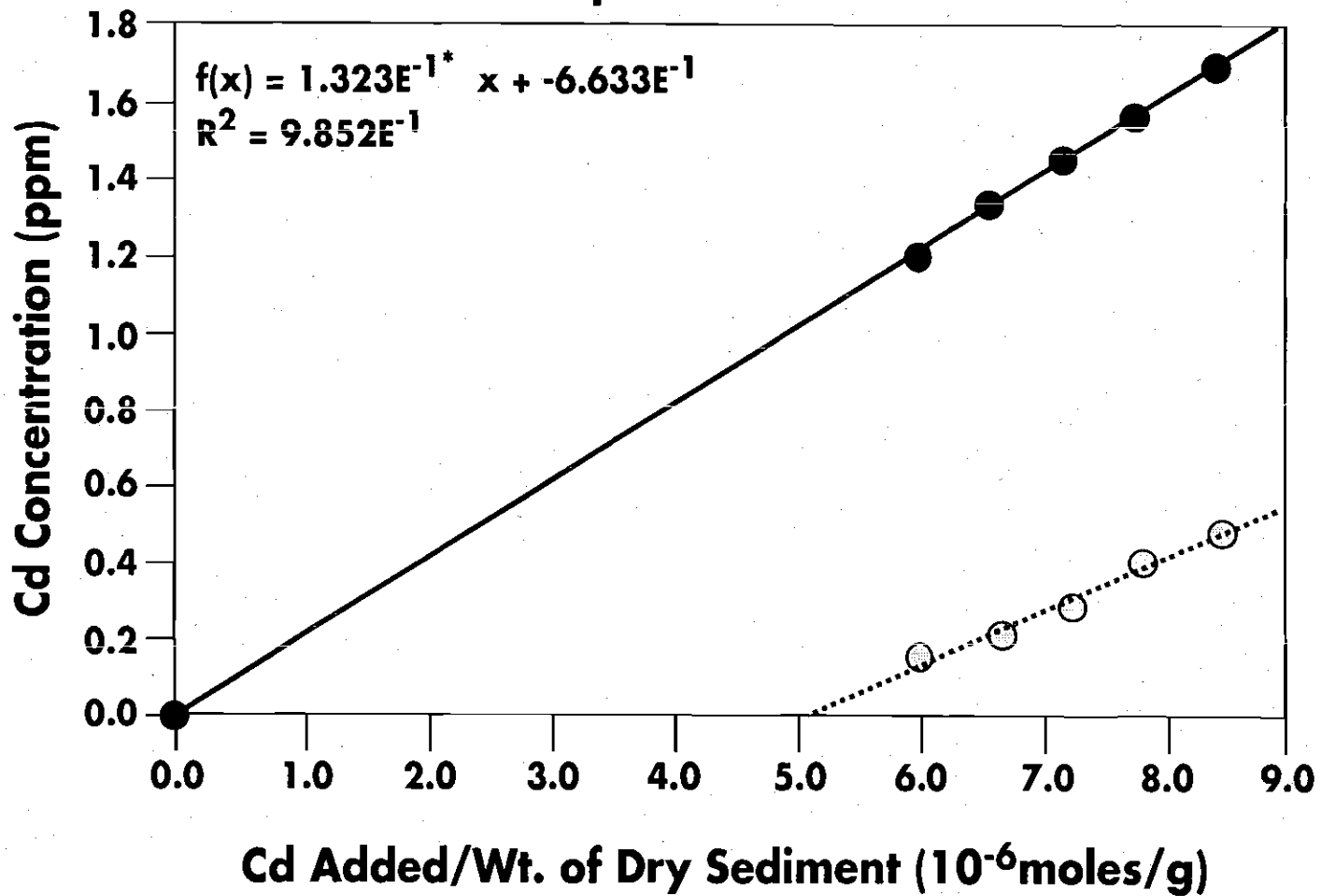
Cd Concentration vs. Total Cd Added/Dry Mass of Sediment Sample #8



Sample Characteristics

Sample (#)	Organic Carbon (%)	Carbonate (%)	Grain Size (phi)	AVS ($\mu\text{mol/g}$)
8	6.04	13.15	4.72	30.3
9	5.56	13.68	3.66	13.3
18	5.95	14.72	4.86	To be tested
22	3.24	28.56	8.54	0.05
27	3.88	15.13	9.37	0.19
34	2.95	14.98	8.92	3
35	4.18	7.2	7.07	0.55
38	3.32	14.56	8.09	11
40	3.22	23.76	8.59	5.0

**Cd Concentration vs. Total
Cd Added / Dry Weight of Sediment
sample ID#40 - DER**



Research Objectives

Determine the relationship between AVS and pore water trace metal concentrations using sediments that are typical of southeastern U.S. estuaries. This will include the study of carbonate-rich sediments which have not been studied previously.

Determine the influence of external factors on the overall pore water concentration-AVS relationship. Factors that will be examined include temperature, overlaying water oxygen concentration, periodic pore water oxidation and periodic sediment mixing.

Identify the characteristics of sedimentary phases other than AVS that are capable of binding pollutant metals and confounding SEM:AVS interpretation.

Evaluate the response of pore water-AVS relationship to various isolation approaches.

Objectives Of First Year Effort

To determine how carbonate content, organic carbon, grain size, and AVS control the sediment binding capacity of cadmium, using a variety of sediments from the southeastern U.S.

To determine a rate of reaction for binding of each of the tested sediments.

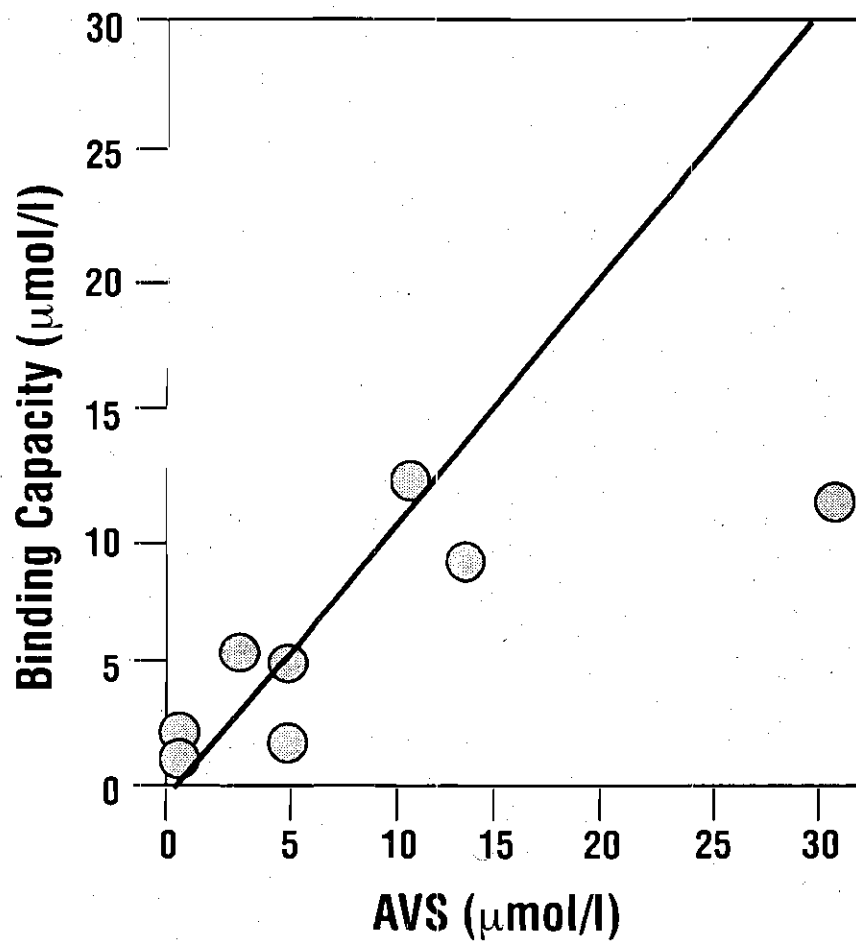
To study the effects of reoxidation of the sediment on the reversibility of binding.

Original Proposal Objective

"Evaluate the response of pore water-AVS relationship to various isolation approaches."

Modified to be more relevant to the Southeastern Atlantic and Gulf Coasts:

"Evaluate the effectiveness of sediment capping strategies for the isolation of mercury in contaminated marine sediments."



To Voltmeter

$N_2 + 0.05\%CO_2$

Reference Electrode

Cadmium Electrode

Sediment Slurry

Frit

Stir Rod

MIXER

Timed Titration Reactor

