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Sediment Mixing in Coastal Regions: The Impact of Animal Digestion on Radionuclide Tracers

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LONG-TERM GOALS

We wish to further our understanding of the solubilization of metallic elements during passage of marine sediments through the digestive systems of deposit feeders. Of particular interest are the implications of this solubilization for the dissolution of metallic contaminants in sediments and the metallic radionuclides used in measuring sediment bioturbation.

OBJECTIVES

We will test for the chemical mechanisms by which various metals are solubilized by the ligands present in digestive fluids. We hope to isolate specific ligand groups involved in binding the metals. We will also see if the metallic radionuclides used in bioturbation, such as Th-234 and Pb-210, are significantly solubilized by digestive fluids. If so, we will assess what matrices holding these radionuclides are particularly vulnerable to the dissolution process. Implications for bioturbation modelling will be assessed based on these results.

APPROACH

My general approaches will be (1) to conduct incubation experiments with gut fluids of a variety of deposit feeders to assess the amount of metallic radionuclides solubilized from the sediments, (2) to determine both intrinsic (organismal) and extrinsic (sedimentary) factors contributing the solubilization, and (3) to corroborate the incubation experiments with *in vivo* solubilization and bioaccumulation measurements. Zhen Chen, one of my postdocs, conducted a series experiments to identify ligands in gut fluids responsible for Pb solubilization from sediments.

WORK COMPLETED

Several ligand identification experiments have been conducted. However, an extended period may be needed to obtain a clear picture on the mechanisms of Pb solubilization by gut fluids, because of unexpected results from the experiments to date. I conducted a thorough review of radioactivity-measuring equipment and vendors, and have ordered a gamma-alpha counting system. Lab renovations to accommodate the new equipment are to begin shortly. I have also recruited a postdoctoral associate who will work on radionuclide measurement and bioturbation models.

RESULTS

Blocking experiments ruled out cysteine and histidine residues in gut fluids responsible for Pb binding and solubilization. Carboxyl groups accounted for significant Pb solubilization (30%) in gut fluids of

Arenicola marina, but were not significant in the case of *Parastichopus carlifornicus*. These unexpected results suggest that unlike Cu, Pb-binding in gut fluids may not be due to specific, stronger ligand complexation. Rather, chelation involving multiple, weaker ligands may be important for Pb solubilization in guts of deposit feeders.

IMPACT/APPLICATIONS

These findings will allow us to better understand how bioavailability differs among metals and metallic radionuclides with different biogeochemical behaviors.

TRANSITIONS

These results and experimental procedures will be useful for an ongoing project, involving *in vitro* digestion procedures, to determine the mechanisms of sedimentary Hg solubilization.

RELATED PROJECTS

Don Weston, Rob Mason and I have proposed to investigate bioavailability of Hg and Se in deposit feeding fish and invertebrates. Part of this proposed project parallels the technical approaches for Pb solubilization. Related work for the Army Corps of Engineers is being discussed.

REFERENCES

R.L. Lundblad (1995) Techniques in protein modification. CRC Press, Boca Raton. pp 288.

PUBLICATIONS

none

PATENTS

none