Compound Class Specific Evaluation of Hydrophobic Organic Contaminants from Sediment in the Hudson-Raritan Estuary

Anne McElroy and Adria Elskus*

Marine Sciences Research Center
State University of New York at Stony Brook
Stony Brook, NY 11794-5000

*T.H. Morgan School of Biological Sciences
101 Morgan Building
University of Kentucky
Lexington, KY 40506-0225

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EXECUTIVE SUMMARY

The objectives of this project were to: 1) develop methods to directly assess whether or not easily desorbable hydrophobic organic contaminants (HOCs) are the primary factors contributing to toxicity observed in bioassays of Hudson-Raritan sediments; and 2) to compare the relative sensitivities of commonly used invertebrate sediment bioassays with newly developed fish embryo/larval tests and the bacterial bioluminescent Microtox™/Mutatox™ tests. Both objectives have been met, and we expanded the original scope of the project to include an exciting new line of study.

An Amberlite XAD-4 polymeric resin technique was used to independently evaluate the contribution of easily desorbable hydrophobic organic contaminants (HOCs) to overall sediment toxicity. After incubation with native sediments, XAD resins were extracted with organic solvents, and material captured in the extracts amended back onto reference sediment either intact or after fractionation to isolate different compound classes. A variety of bioassays utilizing embryos from two fish species, *Menidia menidia*, and *Fundulus heteroclitus*, two species of invertebrates, the amphipod *Ampelisca abdita* and the mysid *Mysidopsis bahia*, exposed to whole sediments, and luminescent bacteria (Microtox™, Mutatox™) exposed to sediment extracts were then used to compare the toxicity of native sediments to reference sediments amended with XAD extracts, and to compare the relative sensitivity of the bioassays used. Toxicity observed with XAD extract amended reference sediment mirrored that observed for native sediments, strongly implicating HOCs as the primary source of toxicity resulting from exposure to sediments from the sites examined. Furthermore, fractionation studies provided direct evidence that PAHs were primarily responsible for the toxicity observed at the two sites most extensively investigated. Of the bioassays compared in this study, *Ampelisca abdita* was the most sensitive indicator of acute sediment toxicity. However, the bacterial Microtox™ provided the most discriminating power to compare the relative toxicity of various sediments and sediment extracts. Considering the relative cost and time requirements of the tests compared, the Microtox™ test provides a very cost and time effective approach for screening samples. The results of this portion of the work were presented at the Society of Environmental Toxicology and Chemistry (SETAC) annual meeting in 1997 and 1998, and at the American Society for Testing Materials Aquatic Toxicology meeting in 1999 (abstracts attached), and have been published in the symposium volume for this meeting (McElroy et al, 2000).

In an expansion of our original plan, we also began to investigate the use of the critical body residue approach in sediment toxicity testing by determining critical body residues (body burdens at fifty percent population mortality - CBR) for the common marine sediment toxicity test species *Ampelisca abdita*. Critical body residues associated with acute toxicity were determined in *A. abdita* exposed to spiked sediments. Nonylphenol and 2,2',4,4'-tetrachlorobiphenyl CBRs were 1.1 μmol/g wet tissue and 0.57 μmol/g wet tissue, respectively. These values are near the low end of the CBR range expected for compounds acting via narcosis. The polycyclic aromatic hydrocarbons tested, benzo(α)pyrene and benz(α)anthracene, were not acutely toxic at exposure concentrations of up to 1280 μg/g dry sediment (BaP) and body burdens up to 1.2 μmol/g wet tissue. Neither PAH was significantly metabolized by *A. abdita*. The microextraction technique employed here allowed residue analysis of samples containing as few as 3 amphipods (0.33 mg dry weight). The results of this aspect of the work formed the basis for Amanda Fay's MS thesis

at MSRC and were presented at the SETAC annual meeting in 1998 (Fay et al., abstract attached) and have been published in the journal Environmental Toxicology and Chemistry (Fay et al, 2000).

Results of both portions of this work were presented at a seminar given by Anne McElroy at the Hudson River Foundation in June, 2000, and in December, 2000 in a talk presented by collaborator Bruce Brownawell at a Sea Grant sponsored conference at MIT titled Options for Dredged Material Disposal management in a special workshop entitled Sediment Toxicity Risk Assessment Tools: Where Are We and Where Should We be Going? A manuscript is being prepared for the proceedings of this conference titled "Alternative Approaches to Sediment Toxicity Testing: Reverse-TIE and Critical Body Residues", A. McElroy, and B Brownawell. Two additional manuscripts titled Development of Fish Embryo Sediment Toxicity Tests, and Use of XAD Resins to Conduct Reverse-TIE are also in preparation. Finally the results of this project led to the successful submission of a follow-up study which was also funded by the Hudson River Foundation entitled: Sediment Toxicity Testing with *Ampelisca abdita*: Evaluating Identity of Responsible Organic Contaminants using Critical Body Residue and Reverse-TIE that is currently underway. Copies of all abstracts and both manuscripts resulting from this work are attached.

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