Quality Assurance Plan for the Use of Sediment Traps

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1.0 Project Title

Use of Sediment Traps for Environmental/Ecosystem Indicator Measurements in the Great Lakes.

2.0 General Overview

Sediment traps, which passively collect particulate material settling out of the water column, have been used with success in the Great Lakes and elsewhere. Traps provide an efficient tool for the collection of integrated samples for detailed analysis. Measuring the mass collected allows us to calculate the gross downward flux of particulate matter and associated constituents and to calculate settling velocities. The difference between this measurement of gross downward flux and the net sediment accumulation rate is a good long term approximation of the flux due to sediment resuspension. Under stable, stratified conditions, shorter term resuspension fluxes can be estimated from trap flux profiles at a single station.

In the Great Lakes, as in most aquatic systems, the rapid and efficient processes of sorption and settling scavenge contaminants from the water column with the result that the largest fraction of persistent trace contaminant inventories presently reside in sediments. However, studies of the long-term behavior of certain fallout radionuclides and stable contaminants in the Great Lakes have shown that higher levels persist in the lakes than expected if settling and burial were the sole transport process. Materials return from sediments due primarily to resuspension. Constituents initially transferred to sediments are homogenized via bioturbation creating a mixed layer corresponding to a decade or more of accumulation. These are resuspended back into the water column during the isothermal period and are available for uptake by pelagic biota. It is now accepted that the internal recycling caused by the coupled processes of bioturbation and resuspension are responsible for the continuing elevated concentrations of trace contaminants (e.g. PCB, DDT) in fish and the lag in lake response to nutrient abatement.

Since 1977, GLERL has been examining the processes of particle flux and resuspension through the use of sediment traps, passive cylinders deployed to intercept materials settling to the bottom. We have learned much about the transport of mass, contaminants and tracers and the results are now routinely incorporated into program sampling and modeling strategies and management considerations. Although the traps themselves are relatively inexpensive, the logistics of deployment and retrieval are quite expensive restricting both where and how frequently we can sample.

Simple next generation traps, that have sequencing capability for multiple samples per deployment, were developed by several investigators but we were not able to identify sufficient funds until recently. After discussions with a number of scientists around the world that use traps, careful consideration of working designs, our own experience with trapping in the lakes, and the types of experiments that we wanted to conduct, we settled on a design with 23 sampling intervals per deployment. After almost a year of effort, the prototype was completed in July, 1990. The trap was subsequently deployed for three long tests, including an overwinter deployment. All deployments were completely successful. Six slightly modified copies of this trap were subsequently constructed. We see this instrument as a major tool in our future investigations of lake processes (such as short term sediment transport immediately after ice-out, high frequency bottom boundary fluxes and other logistically difficult experiments) and a valuable integrating sampler for the EMAP program.

3.0 Objectives

3.1 To quantify the seasonal flux of particulate matter.

3.2 To provide subsamples for diatom analysis to EPA-EMAP.

4.0 Experimental Design Features

Since the lake is shallow, many nuisance and toxic constituent concentrations and removal rates are mediated by internal recycling dominated by episodic sediment resuspension. Sediment traps that collect sufficient mass of settling particulate matter over relatively short time scales (weeks) have been built and successfully tested by our laboratory. These have been deployed in southern Lake Michigan and subsamples will be made available for EMAP analysis. Initial analysis is restricted to diatom counting, but other EMAP-useful parameters may be developed.

GLERLs 7 autosequencing traps were deployed at its long term station (35 Km offshore in southeastern Lake Michigan; 100 m total depth) in mid-October, 1991. The 23 samplers in each trap were programmed for equal time intervals of 15 days with retrieval scheduled for late September 1992. The traps were deployed on a single line at depths of 15, 35 (duplicate), 75, 90, and 95 (duplicate) meters. There will be (7*23=161) samples, including 46 duplicates.

Upon retrieval, the samples will be allowed to settle, the overlying water siphoned off and the slurry will be freeze dried in an ultra clean freeze drier. Samples will be weighed and fluxes calculated. The samples will be split and a portion made available for diatom analysis by Dr E. Stoermer (U MI), who will be quantifying diatoms for EMAP. The major fraction of these samples will be analyzed by GLERL or distributed to other collaborating investigators as arranged prior to any EMAP discussions.

The only analytical measurement being proposed by GLERL is for the calculation of mass flux: the procedure for this is well developed and frequently reported on by GLERL. Briefly, 8" diameter cylindrical sediment traps of aspect ratio 5:1 will be deployed and retrieved after 23 equally spaced 15 day intervals. The collection efficiency of these traps is close to 100% and precision, as represented by a coefficient of variation, is approximately 10%. Trap samples will be stored at 4°C in transport. After settling for 24 hours, overlying water will be carefully siphoned off and the remainder will be freeze dried, weighed and the mass flux calculated. Subsamples will be separated for diatom analysis with the help of Dr. Stoermer (UMI).

5.0 Workshop - Longer Term EMAP Strategy

Sediment traps and sediments are sample matrices that are important in the EMAP program but have not been well thought through. Much has been learned over the past 20 years about how to interpret sediment trap samples and the information stored in sediments. Since similar analyses will be made on both sediments and traps, GLERL will convene a small workshop to develop a sampling protocol for these media that meets the goals of the program and is technically defensible. Core participants should include:

David Edgington	U Wisconsin-Milwaukee	radionuclides
John Robbins	NOAA/GLERL	radionuclides
Alena Mudroch	CCIW/NWRI	geochemistry
J Val Klump	U Wisconsin-Milwaukee	geochemistry
Rick Bourbonniere	CCIW/NWRI	organics
Steve Eisenreich	U Minnesota	contaminants
Anders Andren	U Wisconsin-Madison	contaminants
Gene Stoermer	U Michigan	diatoms
Another Biologist (Russ Kreis ?)		
Brian Eadie	NOAA/GLERL	traps, carbon
Fernando Rosa	CCIW/NWRI	traps, nutrients

6.0 Project Timetable

This project will begin on May 1, 1992 and continue through September 30, 1993.

Item	1991 Oct	1992 Jan	Apr	Jul	Oct	1993 Jan	Apr	Jul	Oct
Proposal			X						
Funding				X					
Initial Deployment	X								
Retrieval					X				
Redeployment undecided									
Mass Measurements						XX			
Sample Distribution						XX			
Deployment Final Report							XX		
Workshop							XX		
Workshop Report/Recommendations									XX

7.0 Project Responsibilities

Brian J. Eadie (313) 668-2281 will be the principal investigator. A student will be hired to assist in the field work during the summer and sample preparation during Fall and Winter.

8.0 Communications

Regular, daily contact will be maintained between Dr. Eadie and others working on this project. Progress will be discussed with the EPA-EMAP contract officer at quarterly intervals. A final report will be submitted at the completion of the project.

9.0 Quality Control/Quality Assurance

9.1 Trap Collections: Duplicate traps have been deployed at two depths in this study. GLERL has completed a study of trap precision and has found the sample collection/handling coefficient of variation to be less than 10%.

9.2 Sample Tracking Procedure: Trap samples will be stored prior to freeze drying in precleaned 60 mL poisoned (5 mL $CHCl_3$) polyethylene bottles. After drying, they will be weighed and transferred into precleaned scintillation vials for storage in a freezer. Data sheets will be kept by Dr. Eadie and all data will be entered into a PC for ready availability by interested parties.

9.3 Calibration Procedures and Preventive Maintenance: All trap samples will be weighed on a GLERL analytical balance, regularly maintained by a service contract and calibrated with known standard weights.

9.4 All pertinent data will be entered into computer files for easy access. Data reduction procedures established at GLERL will be used. The PI will review all data for validity. Data will be reported to the EPA and to other EMAP participants upon request.

Parameter	Reference	Conditions	Precision	Accuracy
Mass Flux	Eadie, et al., 1984	Post Collection	±10%	±10%

10.0 Reporting

A report will be generated on the biweekly mass fluxes at the collection site. A separate report, with recommendations for sample strategy using traps/sediments for EMAP goals, will be a product of the proposed workshop.