

# Actionable Science for Communities

## Evaluating the Relationship between Equilibrium Passive Sampler Uptake and Aquatic Organism Bioaccumulation - SHC 3.61.3

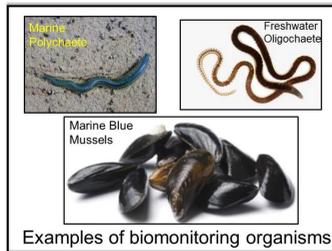
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### Purpose/Utility of Research

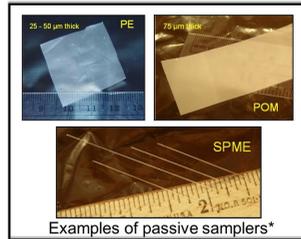
For decades, biomonitoring organisms have been used to assess the bioavailability of contaminants of concern (COCs) at contaminated sediment Superfund sites across the country:

- evaluating remedy effectiveness
- pre- and post-remediation monitoring



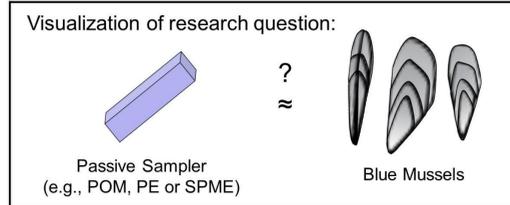
Passive samplers\* have been used to measure the freely dissolved

concentration ( $C_{free}$ ) of COCs in the water column and sediment interstitial waters



Recently, use of passive samplers as surrogates for biomonitoring organisms has been proposed for scenarios where organisms cannot be deployed or are not available

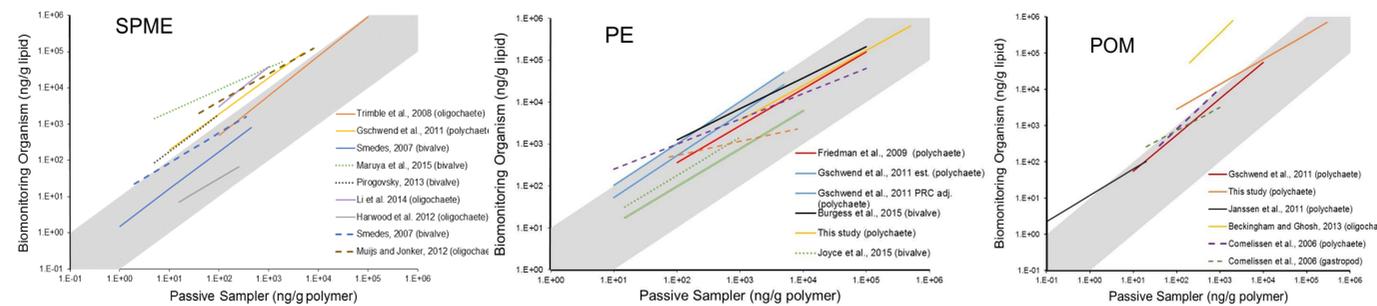
However, no comprehensive review has been performed to evaluate the strength of the relationship between passive sampler uptake and organism bioaccumulation:



This work was performed to assess (1) the strength of the relationship between passive sampling accumulation of contaminants compares to organism bioaccumulation and (2) the reliability of passive samplers as surrogates for biomonitoring organisms

### Highlights

- Based on an extensive literature review, 57 studies were found where both passive sampler uptake and organism bioaccumulation were measured, 19 of these investigations provided direct comparisons relating passive sampler uptake and organism bioaccumulation
- When bioaccumulation and passive sampler uptake were compared in the three types of passive samplers, predictive linear relationships were observed:



- Mean coefficients of determination ( $r^2$ ) for SPME, LDPE and POM were 0.76, 0.68 and 0.58, respectively
- Passive samplers accumulated COCs predictively when compared to biomonitoring organisms

### Application & Translation

This work has resulted in two publications demonstrating the credibility of the research and its findings:

Burgess RM, R Lohmann, J Schubauer-Berigan, P Reitsma, M Perron, L Lefkovitz, M Cantwell. 2015. Application of passive sampling for measuring dissolved concentrations ( $C_{free}$ ) of organic contaminants in the water column at three marine Superfund sites. *Environmental Toxicology and Chemistry* 34:1720-1733.

Joyce AS, LM Portis, AN Parks, RM Burgess. 201x. Evaluating the relationship between equilibrium passive sampler uptake and aquatic organism bioaccumulation. *Environmental Science and Technology (in press)*

In addition, this work contributed to a recent National Association of Remedial Project Managers (NARPM) workshop:

Burgess RM. 2016. Passive sampling for measuring freely dissolved contaminants in sediments: basics, concepts and principles. Platform presentation at the *Porewater Concentrations and Bioavailability: How You Can Measure Them and Why They Influence Contaminated Sediment Remediation* workshop, U.S. EPA 2016 NARPM meeting, Pittsburgh, PA, USA.

Cantwell MG, RM Burgess. 2016. Passive sampling methods for measuring metals in sediment porewaters. Platform presentation at the *Porewater Concentrations and Bioavailability: How You Can Measure Them and Why They Influence Contaminated Sediment Remediation* workshop, U.S. EPA 2016 NARPM meeting, Pittsburgh, PA, USA.

### Intended End users

Office of Superfund Remediation and Technology Innovation (OSRTI) and the Regions are the primary end-users of this research

Colleagues in OSRTI and the Regions have provided useful input on ORD's passive sampling research

### Lessons Learned

- This research demonstrates that in cases where biomonitoring organisms are not available or cannot be deployed at contaminated sediments Superfund sites, passive samplers can be used as reliable, cost-effective, and reproducible surrogates
- In addition to showing that passive samplers are reliable tools that complement conventional biomonitoring, this research advances the science by expanding the applications of passive sampling beyond the determination of  $C_{free}$

\* SPME = Solid phase microextraction; PE = Polyethylene; POM = Polyoxymethylene