The Detection of TNT & RDX from UXOs in Marine Environments with Passive Sampling

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Outline

- Research Objectives
- Passive Sampling
- Calibrations
- Field deployments
- Future Work

Research Objectives

1: Evaluate EVA sampler uptake and offloading rates for the target munitions compounds as a function of ambient concentration and film thickness.

2: Assess the stability of target compounds within the sampler film for deployment and retrieval timescales

3: Optimize sampler geometries and film thicknesses for the detection of target field concentrations (below nanograms per liter or as specified).

4: Deploy sampler onsite to demonstrate mapping of target compounds and identify depositional zones.

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Passive Sampling

- Why?
- How?
- What?

- a) EVA samplers on titanium plates deployed in Long Island Sound off the University of Connecticut's Central Sound Buoy

- b) EVA coated copper plates for stream sampling at EPA superfund site in Bennington, VT

- c) EVA coated copper ribbon used to obtain sediment vertical profiles in Sippewissett Salt marsh in Cape Cod, MA

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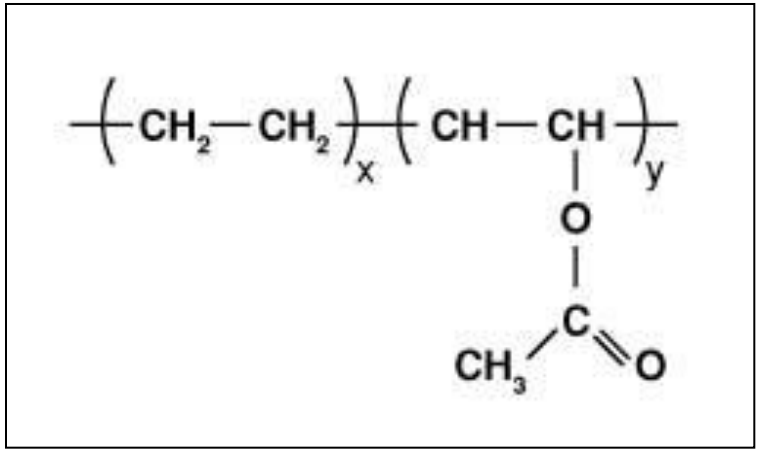
Structure of ethylene-vinyl acetate thin-film (EVA)



$$\text{Log } K_{\text{EVA-W}} = 1.04 \text{ Log } K_{OW} + 0.22$$

(St. George et al., 2010, Raub et al., 2015)

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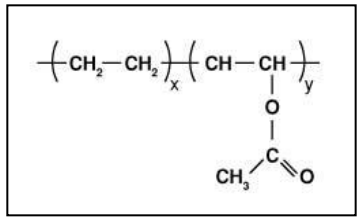

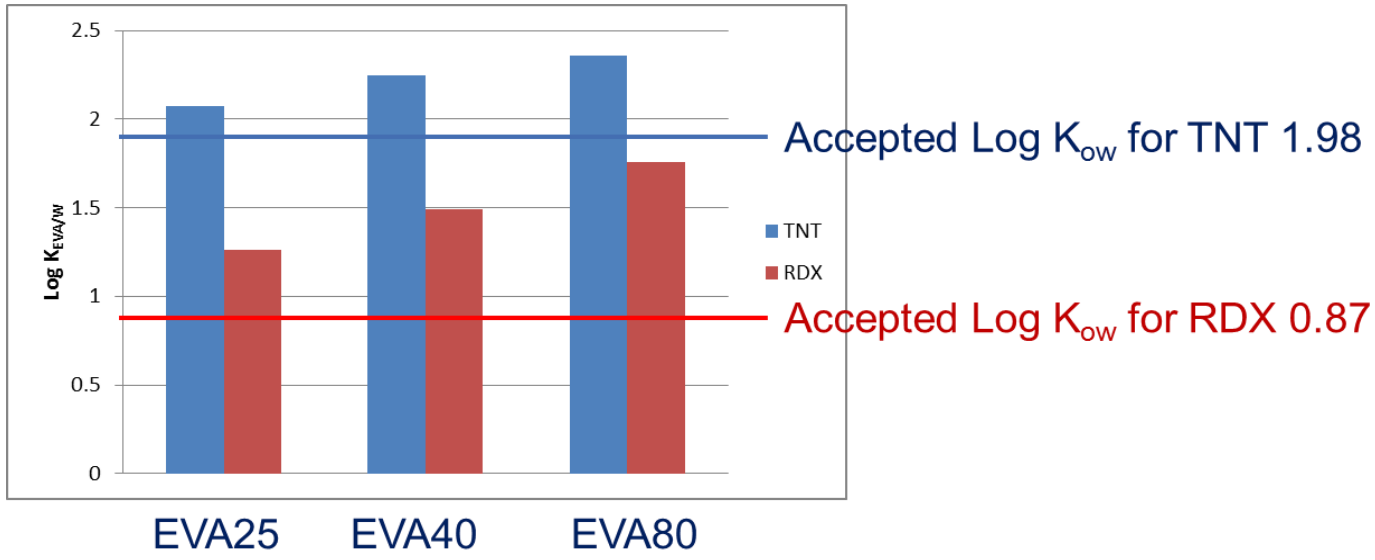

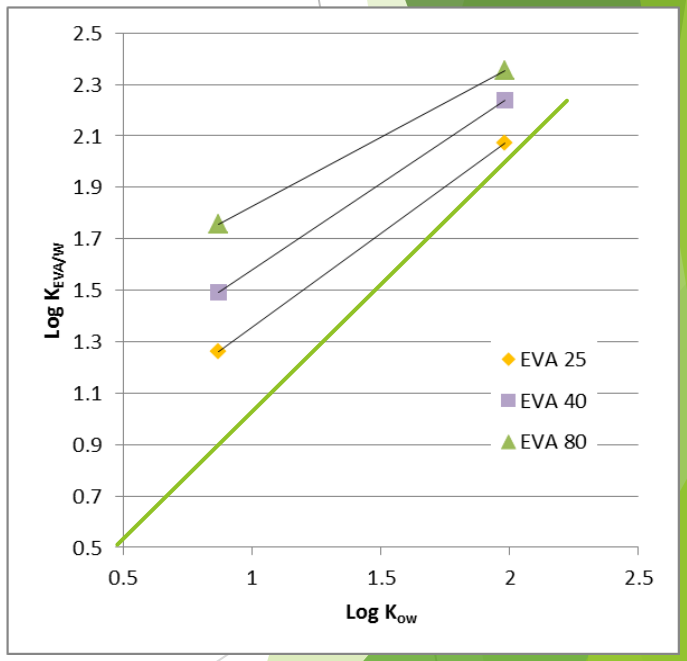

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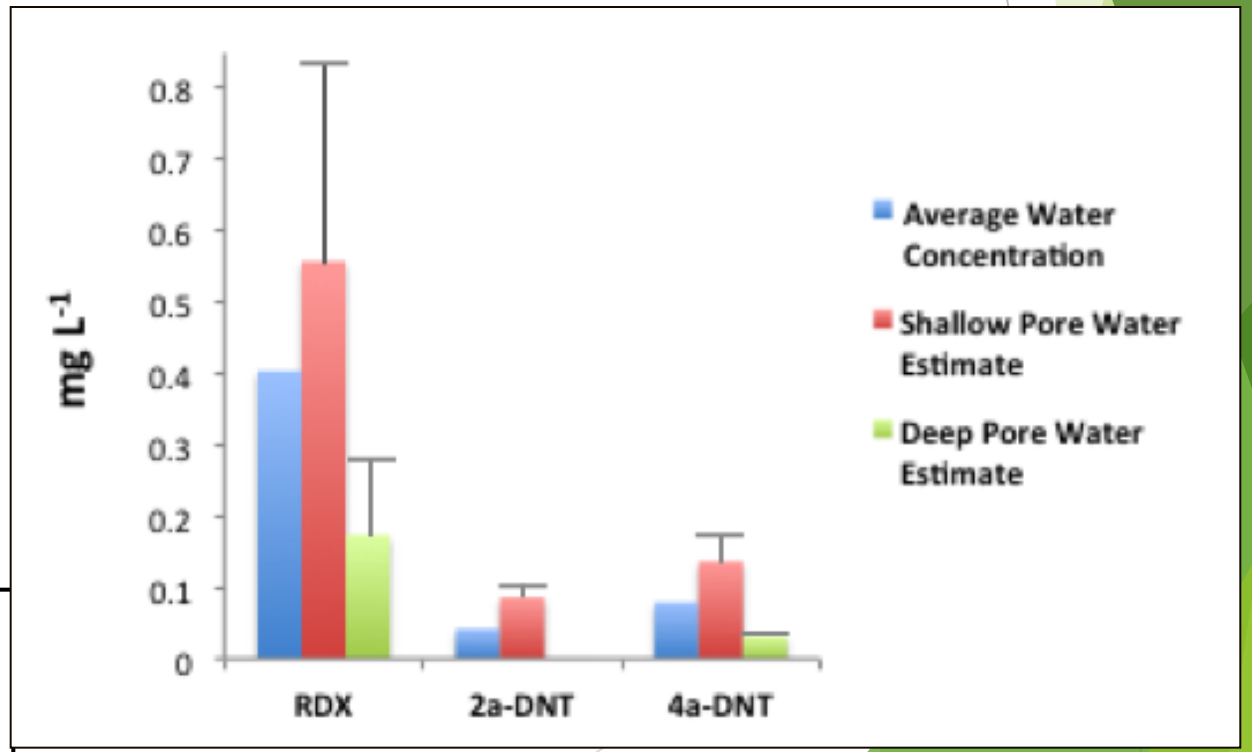
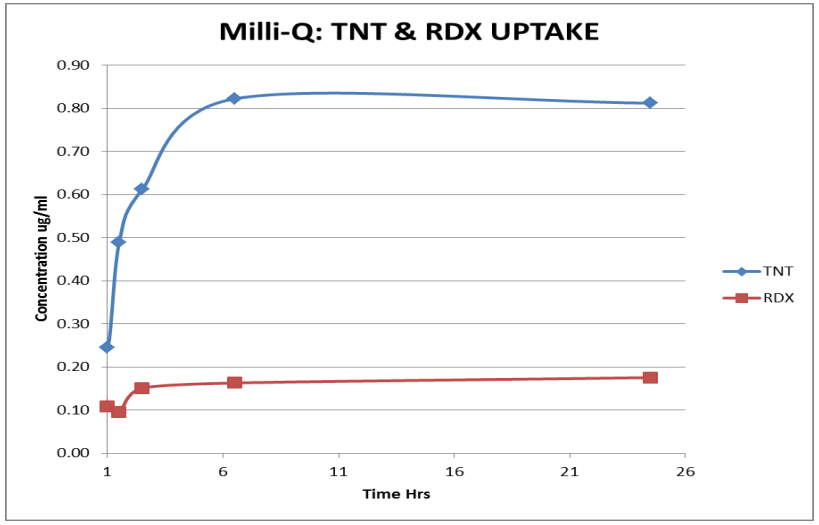
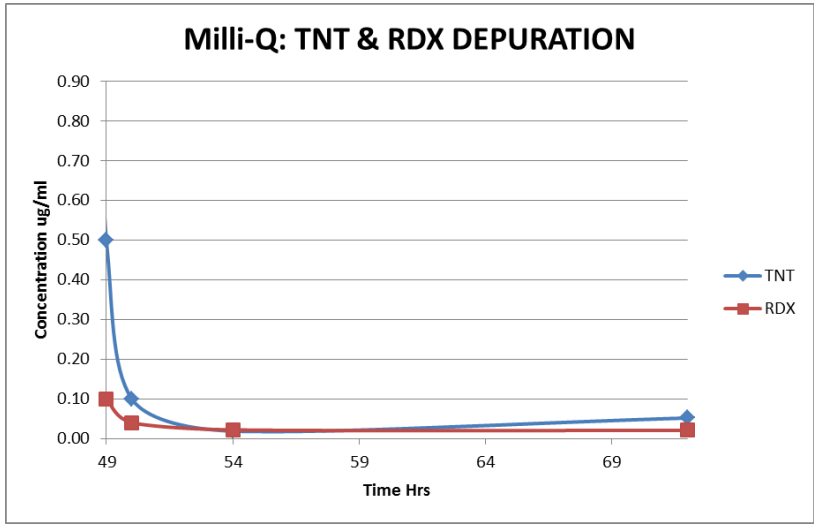
Porewaters Profiles

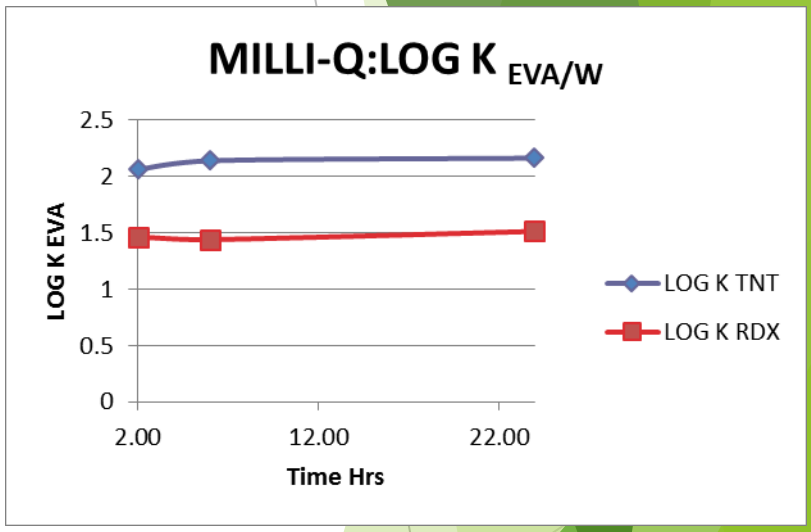
- HPLC determined concentration over a 45 day time series.
- EVA coated plates were placed approximately 1 cm deep in the sandy sediments of spiked mesocosms. (n = 3)



Uptake and Depuration Curves: DI Water







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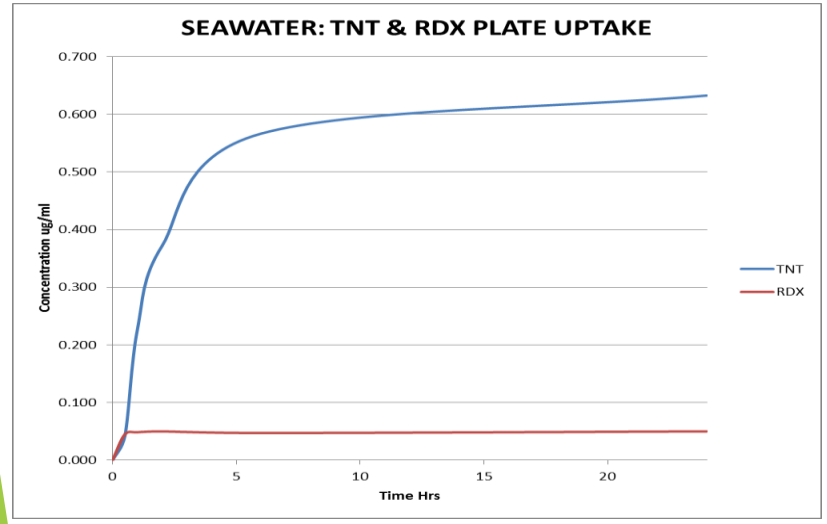
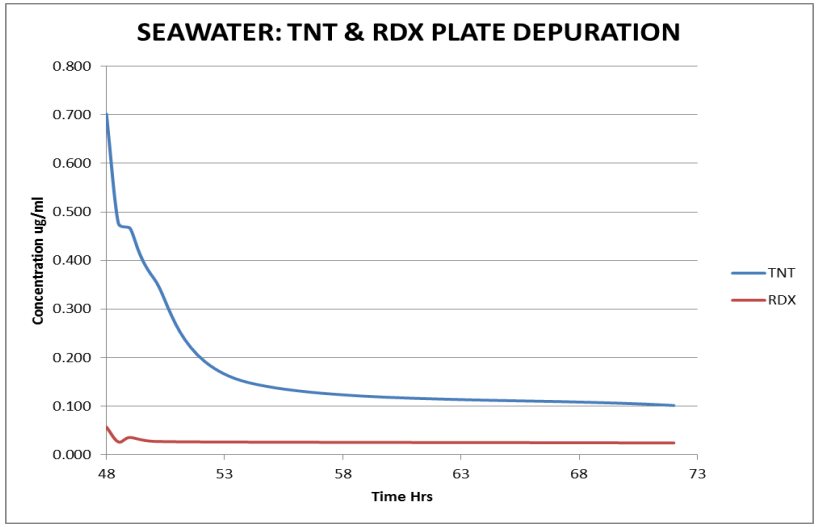
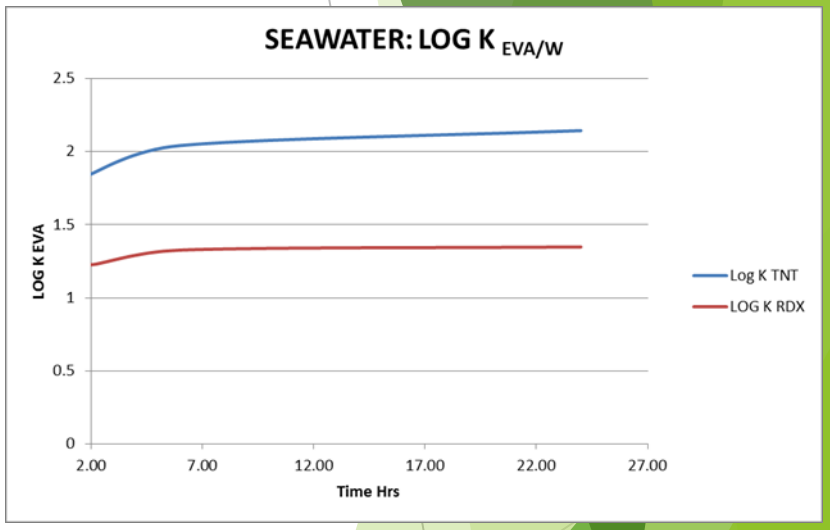
Uptake and Depuration Curves: Seawater







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Design of the Sampler for Specific applications & target concentrations

- The required mass of EVA (M_{EVA}) can be determined using the expected field concentration ranges (C_W) and the analytical detection limits in grams or moles per unit volume (N_{target}). where ρ_{EVA} is the density of EVA (0.93 g cm^{-3}).

- $$M_{EVA} = N_{target}\ \rho_{EVA}\ (K_{EVA/W}\ C_W)^{-1}$$

- Able to target the Detection limits in environment and optimize

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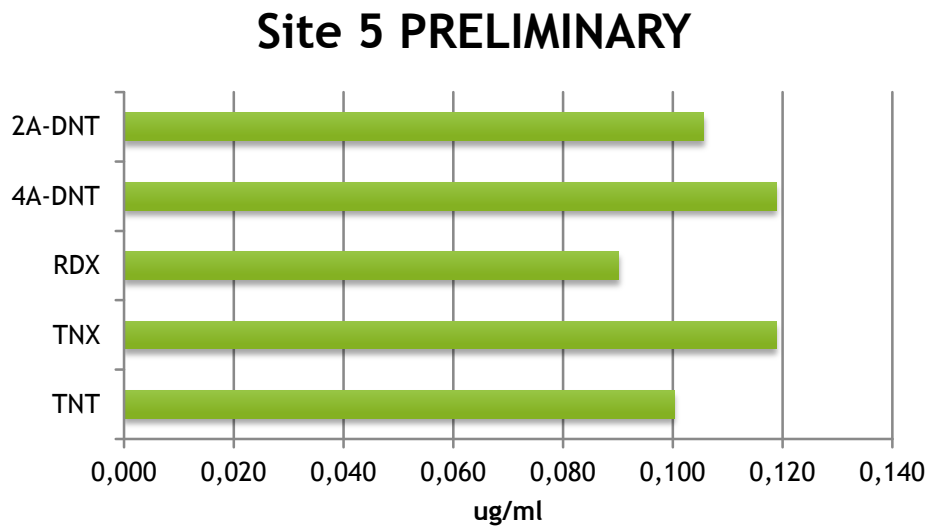
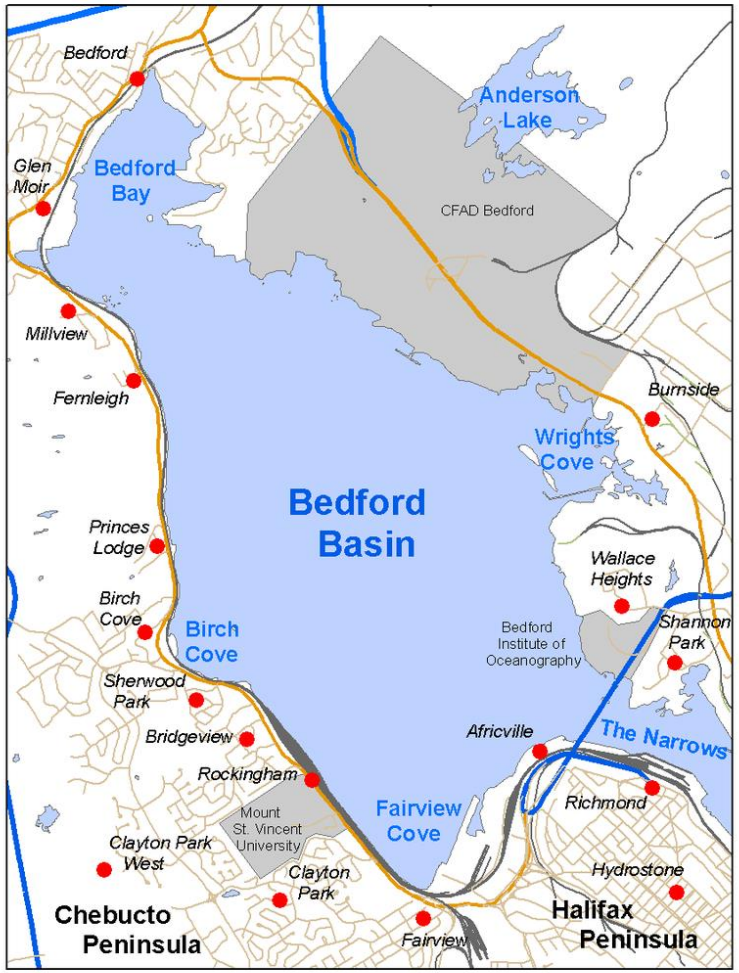
Results From Field Deployments -In Progress: Halifax





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Results From Field Deployments -In Progress

- Long time scale exposures
- One site recovered: Shipwreck
- Known dumping of conventional and chemical munitions (CHEMSEA Project)

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Summary

- The sampler has shown a high affinity for munitions in marine environments
- The sampler can be used as an integrative or thin film sampler
- Uptake and offloading rates have been determined
- Extraction procedures have been streamlined
- Field sampling has shown positive detection at underwater demolition sites

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Future Work

- Complete field sample analysis
- Increase field sampling scope for spatial mapping
- Increase the range of target munitions
- Deployment/Recovery

THANK YOU

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