ADVANCED SCIENCE RESEARCH CENTER
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Environmental Forensics: Seeking Linkages Across Unique Chemical Transformations

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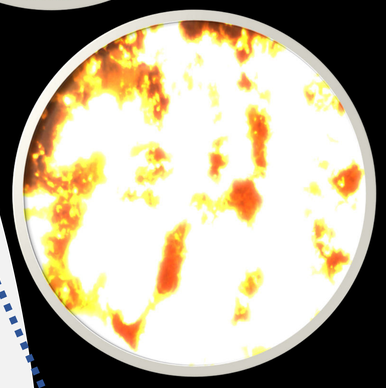
Introduction

Explosives can enter the environment in their intact form but also by detonation or partial detonation. A discontinuity exists in the lifecycle of these materials. Linkages between pre- and post-blast residues are unexplored environmental concerns. It is a significant knowledge gap — how do intact and detonated energetics differ, what is their environmental fate, and can we find a linkage between them?

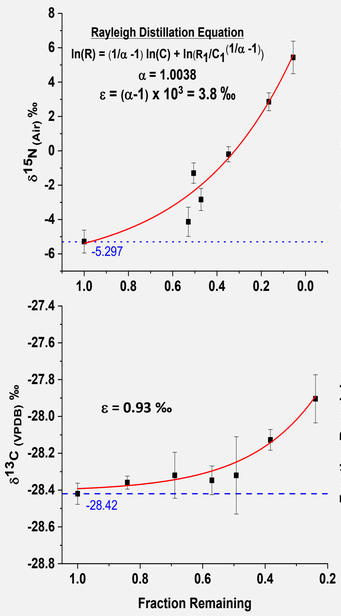
Objectives

- Characterize if/how chemical and isotopic fingerprints of an explosive changes during detonation and in post-blast residue
- Determine of isotopic signature of post-blast residue can be used to establish provenance and identification.
- Evaluate changes in isotopic signatures and growth of transformation products during 'environmental aging'.
- Perform a full lifecycle analysis of energetic materials from manufacture, through detonation, and environmental ageing processes.

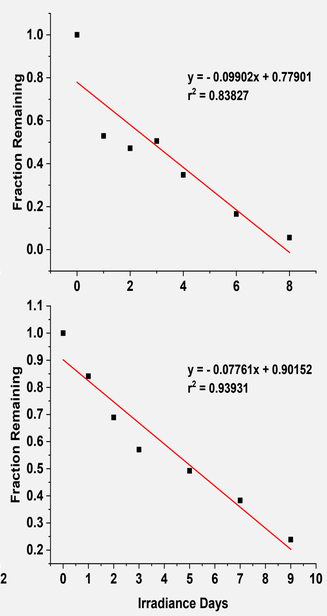
Environmental Simulations



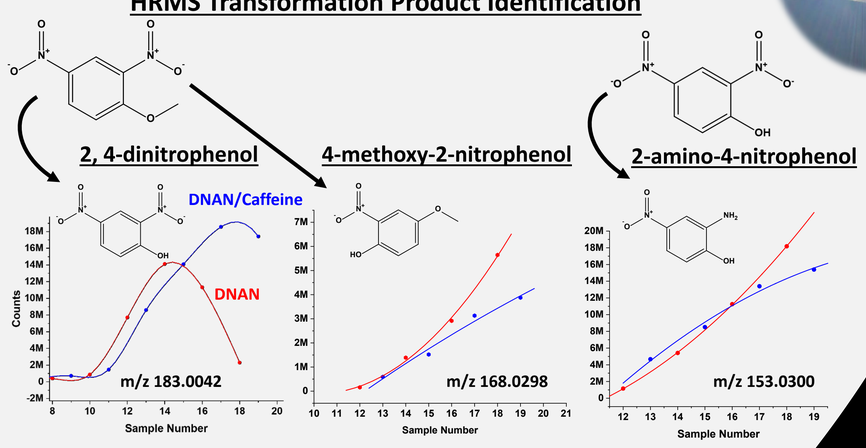
Rayleigh Distillation Plots



Normalized Time Course of DNAN Photodegradation



HRMS Transformation Product Identification



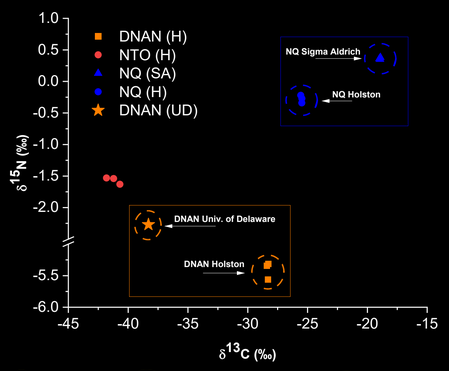
Technical Approach

- Stable Isotope Ratio Mass Spectrometry
- High Resolution Mass Spectrometry
- Using a combination of insensitive (DNAN, NTO, NQ) and legacy (TNT, RDX, HMX) munitions

Chemical Provenance

Materials obtained from:

- Holston Army Ammunition Lab (H)
- Sigma Aldrich (SA)
- Univ. of Delaware (UD)



Barriers & Next Steps

DNAN Picatinny Arsenal

δ13C				δ15N			
EA-IRMS	GC-IRMS			EA-IRMS	GC-IRMS		
Pure	Solution	Sand	Soil	Pure	Solution	Sand	Soil
-27.87 (±0.29)	-27.47 (±0.4)	-27.60 (±0.18)	-27.21 (±0.37)	-26.43 (±0.12)	-27.14 (±0.62)	-27.00 (±0.56)	-25.92 (±0.53)

New materials from Picatinny Arsenal:

- Significantly depleted δ15N value
- Challenge to find isotopic reference

Funding from:
ARO W911NF2110046
ARO W911NF10077