PROJECT ID:
593

Evaluating Potential Effects to Marine Biota from Small-scale, Legacy Radioactive Objects

Radium painted dials like the one on this ship's clock can contain small, usually microscopic, radioactive particles and are sometimes found in the marine environment at Department of Navy locations.
(Photo Credit: Jovan Popovic)

OBJECTIVE

This project was formed to evaluate the potential for detrimental effects on marine biota of small-scale objects containing radioactive material relevant to the U.S. Navy.

PROBLEM STATEMENT

Discrete radioactive particles are small, usually microscopic, radioactive particles that are sometimes found in the marine environment at Department of Navy locations. These particles are usually discarded commodities from Navy ships such as radium painted dials or paint chips. Though the effects of discrete radioactive material (RAM) are not well understood, such particles can become lodged in living tissue, and have the potential to affect the food chain.

Current practices to remediate sites with discrete RAM involve removal of the material, which can incur significant costs and project delays. Knowledge regarding the detrimental effects of discrete RAM on the marine biota is a necessary first step toward informed remediation.

DESCRIPTION

Following Department of Energy (DOE) technical standard 1153 as well as international recommendations, this project will follow a three-step approach. The first task will be a literature

survey of radium behavior in marine systems, with a particular focus on dose assessment. This will be one of the first literature reviews calculated to provide a detailed understanding of the geochemical processes controlling the bioavailability of radium. The literature survey will be coupled with calculations of the expected concentrations of radium within sediments. These calculations will be compared to maximum acceptable limits set by the International Atomic Energy Agency (IAEA), and Biota Concentration Guides (BCG) set by the DOE.

Task 2 for this team will be determining how much RAM is leaching from radium dials and paint chips. Using marine sediment from RAM-impacted sites, the team will perform a series of tests to determine leach rates.

Using the information from the literature review and data from Task 2, accurate constants for sorption and ion exchange reactions will be determined to develop a fully robust geochemical model capable of describing radium solubility and sorption across a wide range of geochemical conditions. The project team will collaborate with Clemson University, which has a suite of analytical and radioanalytical capabilities to measure virtually any type of radioactivity or environmental contaminant.

If predicted concentrations exceed the international de minimus radiation levels and BCGs, the project will continue into task 3 with laboratory testing of site-specific sediment and water and sentinel organisms (mussels and algae) that are expected to be the most impacted. Expected absorbed dose rates based on experimentally determined water, sediment and organism concentrations will be calculated. Organism effects will be evaluated as visual observations as well as stress response at the genomic level. Additional modeling will be used to predict the concentrations of RAM at higher levels on the food chain.

RETURN ON INVESTMENT

The Navy could potentially save millions of dollars of unnecessary screening and disposal fees by demonstrating that discrete items are not detrimental to the ocean biota. Screening at sites would still be required to identify de minimis status. However, once screening is complete, it is expected that the information provided by this study would provide further evidence that certain disposal practices are warranted. During a recent pier dredging on the west coast, discrete RAD was discovered. Screening the RAD objects from sediment for this site would have increased the cost of the project by approximately $40 million and delayed it by two years. Payback from this proposed investment could be reached in 0.05 years assuming implementation at 20 sites.

NAVY BENEFITS

Understanding the effects of de minimis RAD objects in sediment will help to determine the best disposal management practices, develop a better understanding of the potential risk, if any, to ecological receptors in the marine environment and, in many cases, validate the efficacy of open ocean disposal.

TRANSITION DESCRIPTION

Data generated and conclusions drawn from this work will be shared through various Navy technology transfer platforms like the Remediation Innovative Technology Seminar and environmental restoration remedial program manager (RPM) training. The project team will circulate final reports to help inform Navy practitioners and will publish their findings in the peer-reviewed scientific literature. Navy RPMs could be early consumers of information obtained from this work.

CONTACT

For more specific information about this project, contact the Principal Investigator at 805-982-6081.

ABOUT THE NESDI PROGRAM

The Navy Environmental Sustainability Development to Integration (NESDI) program is the Navy's environmental research and development, demonstration and validation (6.4) program, sponsored by the Chief of Naval Operations, Energy and Environmental Readiness Division (OPNAV N45) and managed by the Naval Facilities Engineering Systems Command (NAVFAC) out of the Engineering and Expeditionary Warfare Center (EXWC) in Port Hueneme, CA.

The mission of the program is to provide solutions by demonstrating, validating and integrating innovative technologies, processes, materials, and filling knowledge gaps to minimize operational environmental risks, constraints and costs while ensuring Fleet readiness and lethality. The program accomplishes this mission through the evaluation of cost-effective technologies, processes, materials and knowledge that enhance environmental readiness of naval shore activities and ensure they can be integrated into weapons system acquisition programs.

The program is the Navy's complement to the Department of Defense's Environmental Security Technology Certification Program which conducts demonstration and validation of technologies important to the tri-Services, U.S. Environmental Protection Agency and Department of Energy.

For more information, visit the NESDI program web site at www.navfac.navy.mil/nesdi or contact Ken Kaempffe, the NESDI Program Manager at 805-982-4893, DSN: 551-4893 or ken.kaempffe@navy.mil.