Marine Environmental Update

VOLUME FY97, NUMBER 4

FALL 1997

Beach Replenishment Using Dredged San Diego Bay Sand Temporarily Suspended

The Navy has temporarily suspended pumping dredged sand from San Diego Bay onto and near San Diego area beaches because of small amounts of ordnance found in the sand. On September 21, 1997, one live small-arms round, several .50-caliber blank rounds, and several spent small-arms casings were found at South Oceanside Beach, adjacent to Camp Pendleton Marine Corps Base, California. On September 25, 1997, a debris management team discovered an 81 mm practice mortar round during a sweep of the sand on that same beach.

Dredging in San Diego Bay is required due to the planned closure of Naval Air Station Alameda and the scheduled homeporting of a NIMITZ-class aircraft carrier in San Diego in 1998. The project involves the creation of a suitable turning basin and a 13.5-acre landfill on one side of North Island Naval Air Station. Suitable material dredged from the channel was being used for replenishment of several San Diego area beaches.

In a statement on September 26, 1997, to the San Diego Association of Governments (SANDAG) about the ordnance found on the beach, RADM Froman stated that the Navy has "decided to err on the side of safety" and has "therefore ceased operations until [the Navy] can reassess the situation and consider what options are available."

Statement by RADM Froman, COMNAVBASE San Diego, to SANDAG, Friday, September 26, 1997.

ALSO IN THIS ISSUE:

See also: http://environ.spawar.navy.mil/Programs/MESO/Newsltr/newsltr.html

Expansion Of Pollution Prevention Tops Navy's FY98 Environmental Priorities

The Navy is urging its installations to re-examine their pollution prevention (P2) plans to find ways the plans can be expanded to meet compliance requirements. The Navy's move follows a call by DOD environment chief Sherri W. Goodman last month for installation environmental managers to enlarge their P2 plans. This broadening of P2 is the next step in using P2 as a tool to both meet compliance requirements and lower life cycle costs.

One way the Navy will seek to maximize use of existing P2 plans is to compare them with its environmental compliance requirements to pinpoint ways P2 can be used as a means to achieve and maintain compliance. The Navy will also use the P2 plans as a way to prioritize environmental actions.

The Navy, along with the other services, is also focusing attention on ways to integrate P2 into the acquisition process. The Defense Department has developed a Defense Acquisition Deskbook, and the Navy is in the process of updating and expanding its portion of that reference tool for acquisition program managers. The Defense Acquisition Deskbook is part of the military's goal of incorporating environmental considerations into all aspects of its mission.

Defense Environment Alert, Volume 5, Number 20, September 24, 1997.

EPA Allows States Up To 13 Years To Implement TMDLs for Polluted Waters

In compliance with the requirements set forth in the Clean Water Act (CWA) the Environmental Protection Agency is requiring states to submit comprehensive plans for Total Maximum Daily Loads (TMDLs) of pollutants for polluted waters by April 1, 1998 and must include nonpoint source load allocations for water bodies impaired by polluted runoff. TMDLs for nonpoint sources in waters that are impaired by polluted runoff must include:

- Some type of assurance that these TMDLs will be complied with (by regulatory or non-regulatory means)
- Public participation; and
- A statement of any other watershed management programs currently enforced within that state.

States would then have eight to 13 years to implement these TMDLs. The eight to 13-year time frame may be allowed to vary, depending on certain criteria which include the number of waters the state has to

deal with; the number and complexity of the TDMLs; monitoring data availability; the length of the watersheds and their proximity to each other; and the significance of environmental threat.

If the states fail to set such TMDLs, the EPA will do so, as stated in Section 303(d) of the CWA. EPA intervention may include requiring states to update their state quality management plans; refusing discharge permits for the respective watersheds; and furnishing grants to those states that have complied with the non point source TMDLs.

Environment Reporter, Volume 28, Number 16, August 15, 1997, pp. 720-721.

California Proposes New Water Quality Control Plans

The California State Water Resources Control Board (SWRCB) will be holding public hearings in Sacramento, CA, on November 17, 1997, and in Newport Beach, CA, on December 3, 1997, to seek comments on the proposed "Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays, and Estuaries of California."

In April 1991, the SWRCB submitted to Environmental Protection Agency for review and approval the original Inland Surface Waters Plan (ISWP) and Enclosed Bays and Estuaries Plan (EBEP). Shortly after the SWRCB adopted the ISWP and EBEP, several dischargers filed suit against the State alleging that it had not adopted the two plans in compliance with State law. In July of 1994 the Superior Court of California, County of Sacramento ordered the SWRCB to rescind the ISWP and EBEP. On September 22, 1994, the SWRCB formally rescinded the two statewide water quality control plans. Since then, the State of California has not been in compliance with Section 303(c)(2)(B) of the CWA.

On August 05, 1997, the EPA published its proposed numeric water quality standards for priority toxic pollutants for the State of California to fulfill the requirements of section 303(c)(2)(B) of the CWA in the state in the absence of the ISWP and EBEP (62 FR 42159). The EPA standards are expected to be withdrawn once the two state water quality control plans are approved and adopted.

The proposed policy represents Phase 1 of the development of two statewide water quality control plans: a new Inland Surface Waters Plan (ISWP) and Enclosed Bays and Estuaries Plan (EBEP) to comply with Section 303(c)(2)(B) of the Clean Water Act (CWA). Phase 2 will involve the establishment of state-adopted water quality objectives for priority pollutants and the incorporation of the Phase 1 policy in a new ISWP and EBEP.

All comments must be submitted by December 10, 1997. A copy of the proposed Policy and more information are available from the SWRCB at http://www.swrcb.ca.gov or by calling its voice mail box at (916) 657-1119.

Marine Environmental Research Update

Puget Sound Naval Shipyard Test Bed Survey

The R/V *ECOS*, the SPAWARSYSCEN SAN DIEGO (formerly NRaD) environmental research vessel, was shipped *via* lowboy truck/trailer to Puget Sound Naval Shipyard and performed an intensive data collection survey during the period of September 17, 1997, to September 28, 1997. The *ECOS* collected contaminant (metals and PAHs) distribution data near suspected sources. The data will serve as validation of a contaminant transport model, and will be used to develop contaminant Total Maximum Daily Loads (TMDLs) for Sinclair Inlet. This survey was conducted concurrent with a Congressionally-mandated and Naval Facilities Engineering Command-sponsored project to evaluate new environmental technologies at the shipyard.

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Characterizing Ecological Risks From Solid Waste Management Units At The Portsmouth Naval Shipyard, Kittery, Maine.

The ecological risk assessment to meet the CERCLA/RCRA requirements of the Portsmouth Naval Shipyard was submitted to Environmental Protection Agency Region I and the State of Maine Department of Environmental Protection (DEP) in May 1997. The document is currently undergoing regulatory review prior to final acceptance.

Developed in concert with EPA Region I, Maine DEP and resource trustees from NOAA and USFWS, a weight-of-evidence approach was used to characterize ecological risks from Solid Waste Management Units (SWMUs) at the Shipyard. Risks were characterized by evaluating the lines of evidence of risk to assessment endpoints in each area of concern (AOC). Providing an analysis framework for documenting the “thought process” of the risk assessment, the weight-of-evidence approach was used to evaluate measures of effect and measures of exposure to interpret the level of risk evident for each assessment endpoint. For each AOC, the outcomes of the measures were tabulated, plotted versus their ability to infer harm to the assessment endpoint (Figure 1), and summarized to develop the conclusions about risk. By relating evidence of risk to hypothesized exposure pathways, the ecological risks associated with

environmental media in each AOC were identified. Having defined the levels of risk present, a probabilistic approach was used to identify contaminants which could be potential risk drivers. Contaminants that had a greater probability ($p>.05$) of exceeding effects levels in AOCs than for reference conditions were identified as potential risk drivers (Figure 2). In addition, potential linkages to the SWMUs were identified and the uncertainties associated with risk characterization activities were documented.

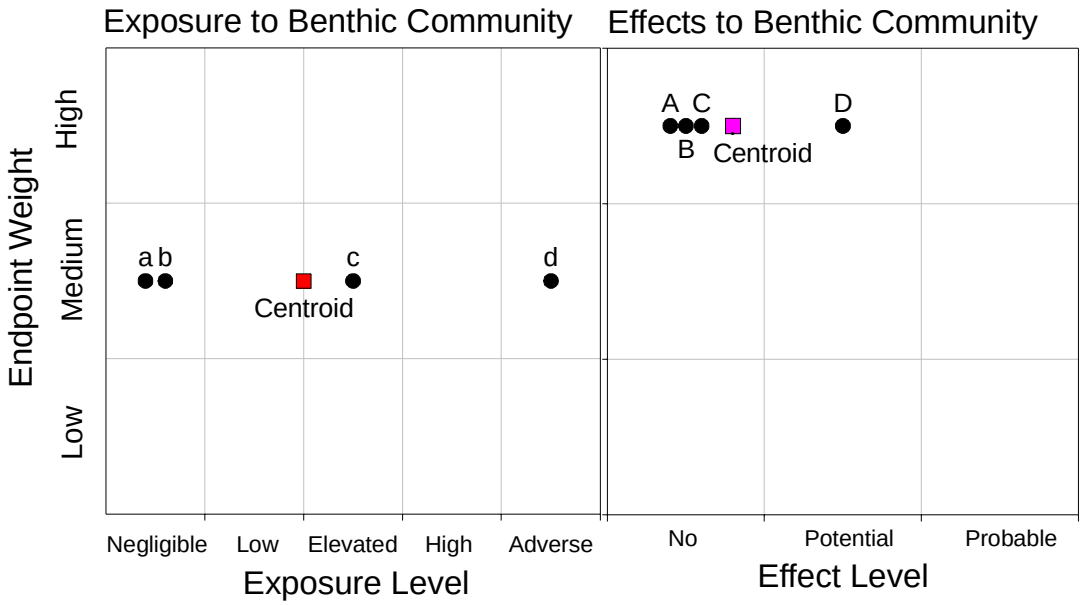

Figure 1. The outcomes for measures of exposure and effects to the benthic community in Clark Cove area of concern near the Portsmouth Naval Shipyard, Kittery, Maine. The centroid suggested by the weighted average of the measures is also shown. Measures of exposure plotted are AVS - SEM (a), predicted toxicity in pore waters (b), metal enrichment relative to crustal ratios (c) and chemical concentrations in bulk sediment (d). Measures of effect plotted are infauna density (A), toxicity to amphipods (B), infauna species richness (C), and infauna species evenness (D) (from MESO 1997).

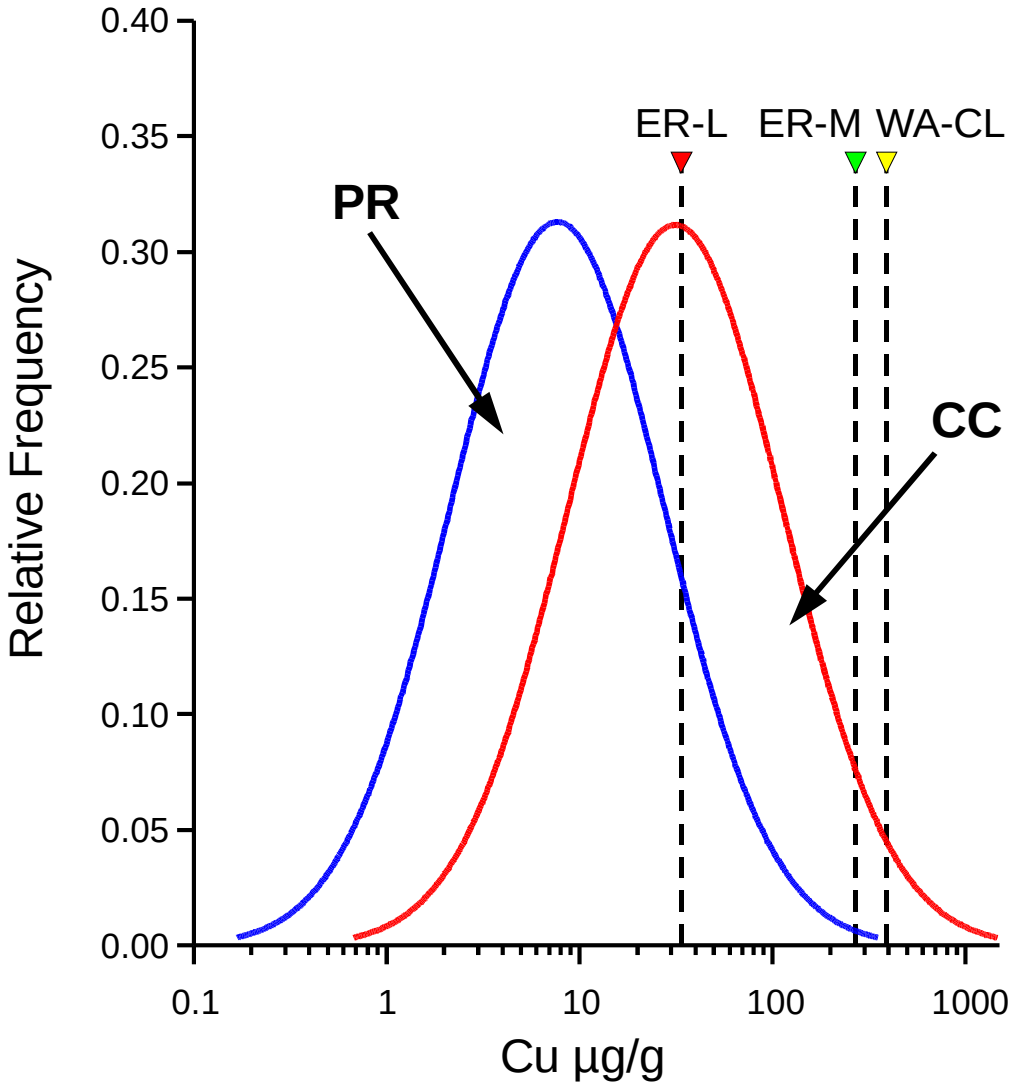

Figure 2. Example of exposure distributions for copper measured in sediment samples from an area of concern adjacent to Portsmouth Naval Shipyard - Clark Cove (CC) and ambient conditions determined from reference locations in the lower Piscataqua River (PR). Figure shows the probability of exceeding benchmark concentrations (area under the curve to the right of the benchmark) for Effects Range-Low (ER-L), Effects Range-High (ER-M), and State of Washington sediment cleanup levels (WA-CL).

The conclusion obtained from these data was “high confidence of no effect and medium confidence of elevated exposure to the benthic community in Clark Cove” (MESO 1997).

Incremental risk was determined by subtracting the probability determined for the reference area from the probability determined for the area of concern. For example, there is about a 12% chance that Cu concentrations will exceed the ER-L threshold under ambient conditions (the distribution for PR) and about a 48% chance that the ER-L threshold will be exceeded in Clark Cove. This means that receptors within Clark Cove have a 36% (48%-12%) higher chance of receiving exposure above the ER-L in Clark Cove than from ambient exposure. Similarly receptors within Clark Cove have a higher probability (.0475-.00262=.0449) of receiving Cu exposures above the ER-M than receptors in reference areas. Chemicals that had an incremental risk greater than 0.05 in exceeding a non-conservative benchmark (e.g. ER-M) were identified as Potential Risk Drivers for the feasibility study.

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Environmental Analysis of U.S. Navy Shipboard Solid Waste Discharges

The project to assess the potential impact of U.S. Navy shipboard solid waste discharges was conducted at the Naval Command, Control and Ocean Surveillance Center RDT&E Division (NRaD, renamed SPAWAR Systems Center San Diego on September 30, 1997) as part of the Navy’s overall effort to evaluate solid waste discharge compliance alternatives. The Marine Environmental Quality Branch was tasked by the Naval Sea Systems Command (NAVSEA 03R16) to perform an environmental analysis of pulped paper and cardboard and shredded metal and glass in MARPOL Special Areas. The study involved a review of pertinent literature, characterization of the waste streams, model simulations, and field tests. The literature review focused on the regulatory framework of Special Areas, their environmental characteristics, the bulk waste stream constituents, general ocean discharge, and Navy vessel operational parameters. The waste stream characterization included physical, chemical, and biological assays as well as degradation and corrosion studies. Dispersion and fate modeling efforts entailed scaling analysis, ship wake dilution, and ambient dilution for the pulped material only. Small scale field tests were conducted to develop test methodologies and to begin to validate the model simulations. A subsequent full scale field test was conducted to collect dispersion data from a naval vessel and complete model comparisons.

In January 1996 a Report of Findings was published which detailed the study’s methodologies and results, and analyzed the potential environmental effect of the shipboard solid waste discharges. The study found that the techniques of pulping and shredding are an improvement over previous methods. The pulped material, which is composed primarily of cellulosic organic material, will dilute on the order of 100,000X in the wake of a moving vessel and sink rapidly to the sea floor. The material contains no significant amounts of toxic chemicals and no biological effects would be expected for concentrations found in the water column after wake dispersion. The shredded material primarily consists of tin-coated

steel and glass. The material is packaged in burlap bags and sinks rapidly to the sea floor with minimal shoreward transport. The elemental constituents are not unlike those naturally occurring in the marine environment, with only iron and tin enhanced in the waste stream relative to the concentrations found in typical marine sediments. Any biological effects were shown to occur only at concentrations that are found within a few centimeters of the bags themselves. The findings of the study suggest that the discharge of paper, cardboard, metal, and glass as proposed will have no significant environmental consequences on a local, regional, or basin-wide scale.

Legislation was passed by Congress to allow for the use of pulpers and shredders, and a similar legislative change is pending to allow submarines to use their trash disposal units for solid waste discharges. Continued efforts and completed studies, including a study on coral reef impacts and endangered and threatened species, are being compiled for publication in an Addendum to the January 1996 report. In addition, a parallel study on submarine solid waste discharges was conducted and published in May 1997, with a similar finding of no significant impact.

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Sediment Quality Characterization - Naval Station San Diego

The objective of this project was to provide an assessment of the extent and potential ecological consequences of sediment contamination in the area of the Naval Station San Diego (NAVSTA). The study focused on two issues: the characterization of contaminated sediments and the evaluation of processes which control the levels, transport and biological exposure of this contamination. Sediments were characterized on the basis of a range of physical, chemical, and toxicological testing. Processes which were evaluated included contaminant sources, sediment transport, sediment-water exchange, and degradation. As part of the project, new technologies for assessment and remediation were demonstrated and validated alongside traditional methods.

There were four components to the study: data management, sediment characterization, sediment processes, and treatability. The data management effort entailed compiling data on the historical spatial and temporal distribution of contaminants in San Diego Bay as a baseline; storing measurement data taken as part of the project using typical database applications; conducting quality assurance of both historical and project data in terms of completeness, consistency, and accuracy; and sharing data among investigators working on different aspects of the research objectives. The sediment characterization effort used a “weight of evidence” approach including the characterization of sediment chemistry, toxicology and benthic community composition. In-situ bioaccumulation and biomarker studies were conducted as part of this effort. A major component of the effort focused on trying to understand what processes have led to the current levels of contamination, and what processes control biological exposure and response, as well as remobilization and transport of the contaminants. Treatability was approached from two aspects: biodegradability of hydrocarbon products in the sediment and, contaminant separation as a

function of grain size. Conclusions from each component were drawn together to provide an integrated view of both the current status in the NAVSTA region, and the processes which act to control it. A Draft Final Report was published with these conclusions in October 1996 entitled “Sediment Quality Characterization - Naval Station San Diego.”

This work will continue through FY98. The draft report was reviewed by the NAVSTA and other peers and is currently in revision. Ongoing work includes further sampling and analysis of the sediment and pore water near the NAVSTA in order to establish a complete matrix of the contaminant levels. In addition, a new bioaccumulation and biomarker study was conducted in August 1997. Infaunal mussels, *Musculista senhousia*, were deployed at the NAVSTA and reference stations for 32 days. Growth, contaminant bioaccumulation and levels of DNA damage were measured. The mussels have been deployed and retrieved and biomarker and chemical analyzes are in progress.

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Single Cell Gel/Comet Assay Applied to the Analysis of Pollution-Induced DNA Damage in the Mud Whelk *Nassarius tegula* and the Ribbed Mussel *Musculista senhousia*

The Asian mussel, *Musculista senhousia* is a suspension feeder that typically lives in intertidal and subtidal soft sediments of bays and estuaries. *M. senhousia* is native to Asia; it has invaded various coasts along the Mediterranean Sea (via the Suez Canal) and the Pacific Ocean. In San Diego, California there are several well established populations including those in Naval Station San Diego. The Mud Whelk (or Western Mud Nassa), *Nassarius tegula*, lives on intertidal and subtidal sand and mud, from San Francisco, California to Baja California. This gastropod scavenges carrion and can reach abundant densities in San Diego Bay. *N. tegula* can coexist with *M. senhousia* in intertidal and subtidal habitats.

The single cell gel (SCG)/comet assay has been used successfully for assessing pollution-induced DNA damage and repair. This technique provides data on the integrity of DNA in single cells, is sensitive, quantitative and is applicable to diverse cell populations. In this technique cells are embedded in agarose gel on a microscope slide, the cells are lysed by detergents and high salt and the liberated but immobile DNA electrophoresed under alkaline conditions. When the DNA contains breaks, it moves from the brightly fluorescent core (or nucleus) to the anode, forming an image resembling a comet (when viewed by fluorescent microscopy after staining with a suitable dye). Cells with increased DNA damage display longer migration of DNA towards the anode. The SCG/comet assay has been used successfully at NRaD for assessing pollution-induced DNA damage and repair, mostly in the blue mussel, *Mytilus edulis*, which primarily lives in the water column attached to pilings and other structures.

The objective of this study is to evaluate and test the SCG/comet assay in *M. senhousia* and *N. tegula*, which can live in direct contact with contaminated sediment, in order to select a suitable test organism and cell type(s) to perform future studies using the comet technique.

Exposure experiments to the standard DNA damaging agent hydrogen peroxide indicate DNA damage in *N. tegula* hemocytes increases along with exposure levels reaching higher DNA damage at 200-400 micromolar. Hemocytes from *N. tegula* were less sensitive to hydrogen peroxide than those of *Mytilus edulis*, which suffered higher DNA damage at 25 micromolar. Exposure experiments indicate DNA damage in *N. tegula* hemocytes and muscle cells usually increased with higher copper chloride concentrations (0, 20, 100 and 200 ppb) both at 24 and 96 hours. DNA migration was lower in hemocytes at all concentrations and exposure times. However, qualitatively hemocytes are better suited to use in the comet assay because the fluorescence intensity of the DNA trailing tail in muscle cells is very low and is difficult to define from background fluorescence. Sediment exposure experiments were performed using sediments from Naval Station San Diego Pier 4 mixed with sediments from a control station; organisms were recovered and sampled from a continuously flowing seawater system after 3 and 10 weeks. These experiments indicate DNA damage was highest in hemocytes after a 3 week exposure to 100% concentration of contaminated sediment from Naval Station San Diego Pier 4. A drawback of using *N. tegula* is that hemocyte extraction is a long process and resulting cell density is very low.

M. senhousia cell types used were: “a-type,” nucleus diameter >4 µm; “b-type,” nucleus diameter, >8-12 µm, and “c-type,” nucleus diameter >20 µm. Hydrogen peroxide exposure experiments in *M. senhousia* show striking increases in DNA damage at 10-100 micromolar in all cell types used. DNA damage in all cell types used increased most of the time with higher copper chloride concentrations (0, 20, 100 and 200 ppb) both at 24 and 96 hours. Greater damage at all exposure levels was detected in “a-type” cells. In sediment exposure experiments “b-type” cells appear to be better indicators of pollution than other cell types since DNA damage levels increased along with contaminated sediment concentration after 3 weeks exposure; these cells seem to be better indicators of sediment pollution than other cell types, including those of *N. tegula*. *M. senhousia* is also advantageous because cell suspensions with appropriate densities are easier to extract and test protocol is faster to prepare.

These results indicate the SCG/comet assay can be used successfully in both species. *M. senhousia* is better suited to use than *N. tegula*, both quantitatively and qualitatively, and “b-type” cells respond better than other cell types.

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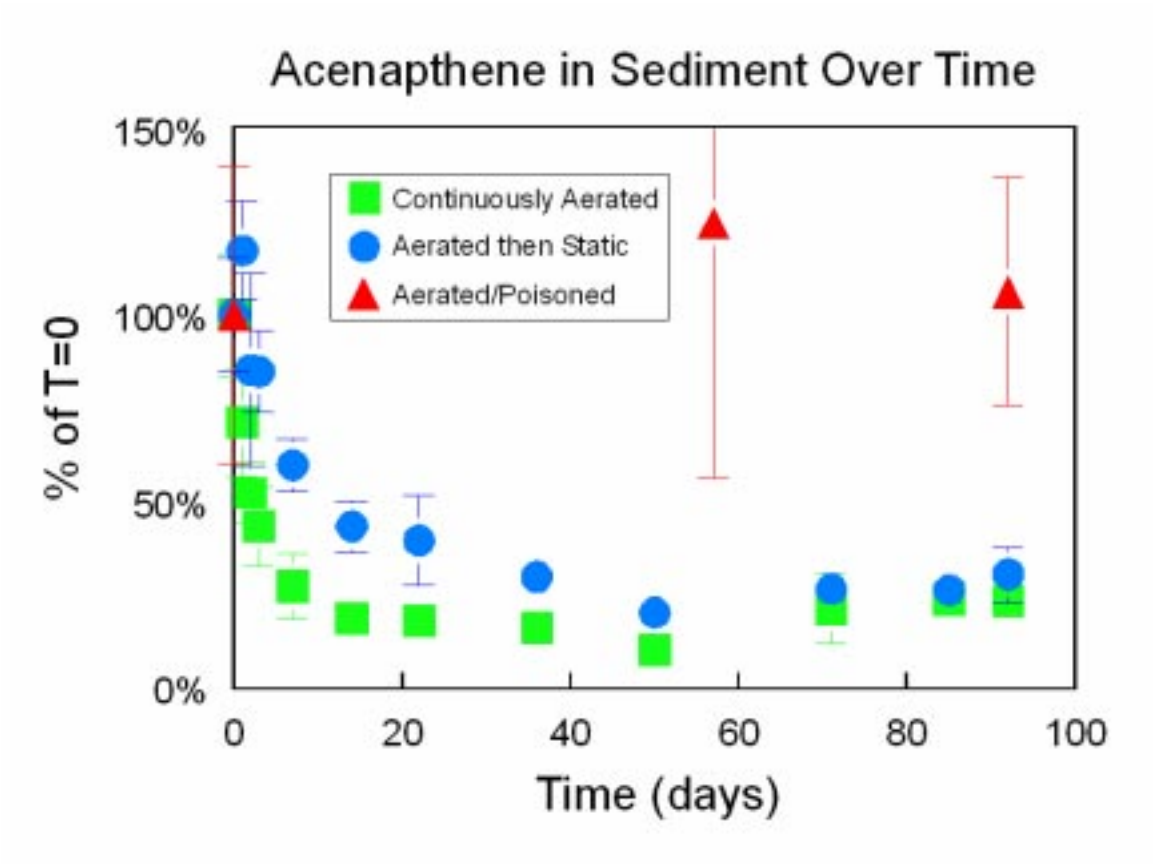
Fate of Complex Aromatic Petroleum Hydrocarbons in Marine Sediments: Biological Transformation, Degradation, and Sequestration

This program, funded by ONR 34, examines sediment characteristics that influence the fate of complex polycyclic aromatic hydrocarbon (PAH) mixtures in marine sediments. Since PAHs are important anthropogenic pollutants in marine bays and coastal waters, it is critical to understand their fate under typical marine conditions. Determination of the important controlling variables from this research will lead directly to better predictions on the long-term fate and effects of PAHs in marine sediments, under both natural and engineered conditions.

This project examines PAH metabolism with a range of systems, from field contaminated sediments to synthetic sediments with labeled, surrogate contaminants. Since surface sediments in many bays are periodically aerated by disturbance, bioturbation, etc., the focus here will be on aerobic activity, though samples will be shared with collaborators with an anaerobic focus. Biodegradability of PAHs in field-contaminated sediments of various compositions (*e.g.*, % fines, % organic carbon) will be examined in flask studies. Sterile uncontaminated natural sediments will be amended with mixtures of labeled and unlabeled PAHs and allowed to age. After six months they will be inoculated with native bacteria and the fate of the PAHs and growth of bacterial populations will be quantified. This study will elucidate the distinction between bioavailable PAHs and PAHs sequestered in the sediment matrix. In cases when experimental results suggest that sediment matrices affect biodegradability, studies will be performed on sediments synthesized from simplified components to confirm these observations.

Aerobic biodegradation experiments were carried out with field-contaminated sediments from San Diego Bay. In the one experiment, some sediments were continuously aerated with nutrients (CA), while some were aerated once and then left static (ATS). Controls were poisoned, then aerated (PC). The main results of this sediment remediation study included: TPH and TPAH decreased about 25% and 50%, respectively, within about two weeks under CA conditions; some PAHs appeared to have decreased in concentration by as much as 75%; other PAHs did not appear to decrease. For PAHs that did decrease, most decreased to a lesser extent in ATS samples than in CA samples. However, several PAHs in both the CA and the ATS treatments showed very similar decreases. This suggested that aerobic degradation of some PAHs could occur in the sediments with minimal handling (see figure below). Those that did not degrade to a notable extent may have been too low in concentration (TPAH in these sediments were very low, ~40 ppm, while natural organic matter was about 2%) or somehow sequestered so that they were not bioavailable to the microorganisms.



In this experiment, some PAHs in sediments which were aerated once and then left static appeared to degrade to the same extent as those which were continuously aerated (in a bioreactor).

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Naval Station San Diego Geographic Information System

The goal of this project is to incorporate data for Naval Station San Diego into a database and provide access to that data through an “off the shelf” geographic information system (GIS). The GIS software allows the user to combine previously disparate data sets in a graphic setting to better see relationships in the data and make decisions. To date, data have been collected from several sources and the digital information is being loading into a database.

The scope of the data includes:

- Facility Information;
- Natural Resources Data;
- Environmental Compliance Data;
- Environmental Cleanup/Restoration Data; and
- Digital Imagery.

These data encompass the area of the Naval Station and surrounding environs. Future goals of the project include setting the system up for access *via* the World Wide Web. This will allow more users access to the system, reduce software maintenance costs, and provide a more cost effective solution.

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MESO Change Of Address

The Space and Naval Warfare Systems Command (SPAWARSYSCOM) officially completed its move and transition from the Washington, D.C. area to San Diego on October 1, 1997. The Naval Command, Control and Ocean Surveillance Center (NCCOSC) was disestablished, and the NCCOSC Research, Development, Test and Evaluation Division (NRaD) became the Space and Naval Warfare Systems Center (SPAWARSYSCEN) San Diego. The resulting changes of address (command, e-mail and WWW) for the Marine Environmental Support Office are reflected in the "About the *Marine Environmental Update*" inset at the end of this newsletter.

The relocation of SPAWARSYSCOM's headquarters from Crystal City, in the Washington, D.C. area, to San Diego came about as a result of a 1995 Base Closure and Realignment Commission (BRAC) decision. The move of the SPAWAR headquarters staff and an associated program executive office staff began in April of 1996. SPAWAR directs the development, acquisition, and life cycle management of command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) systems for Navy, Marine Corps, selected joint service, allied nation and other government agency programs.

ABOUT THE *MARINE ENVIRONMENTAL UPDATE*

This newsletter is produced quarterly by the Marine Environmental Support Office (MESO), and is dedicated specifically to inform the Navy about marine environmental issues that may influence how the Navy conducts its operations. MESO is located at the Space and Naval Warfare Systems Command (SPAWAR) Systems Center San Diego, California. The mission of MESO is to provide Navy-wide technical and scientific support on marine environmental science, protection and compliance issues. This support covers a broad spectrum of activities, including routine requests for data and information, technical review and consultation, laboratory and field studies, comprehensive environmental assessments, and technology transfer. Significant developments in marine environmental law, policy, and scientific advancements will be included in the newsletter, along with references and points of contact for further information.

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