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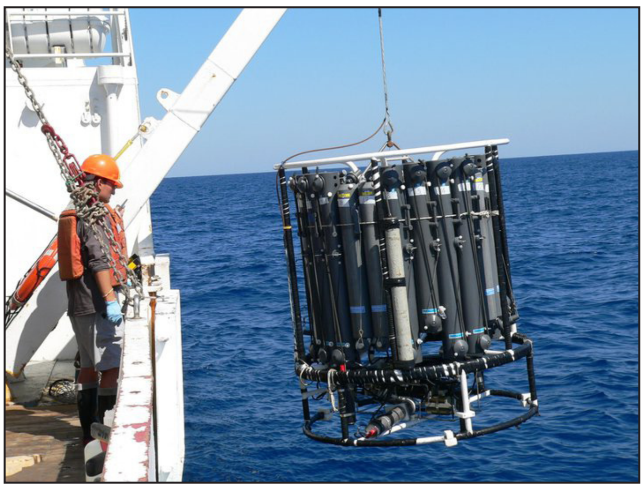
Chemical Effects of the Oil Spill: Mississippi Sound

Since the explosion of the Deepwater Horizon oil rig, scientists from a variety of backgrounds have been hard at work collecting samples to monitor the effects of the oil on marine environments. Dr. Alan Shiller, a chemical oceanographer from the University of Southern Mississippi (USM), has been studying both direct and indirect chemical effects from the spill. Direct effects include the spread of crude oil and the physical and chemical changes of the oil over time while indirect effects pertain to changes in natural ocean processes. This includes the prevention of exchange of oxygen at the surface of the water because of the presence of an oil slick. His observations provide other oil spill researchers with valuable information in seeking to understand ecosystem effects of the oil spill.



Researcers deploy a water sampling device to measure conductivity, temperature and depth (CTD) at different points of the water column. Photo credit: Alan Shiller USM

Shiller and his colleagues have been collecting samples in areas both offshore, close to the Deepwater Horizon site, and in near-shore areas of the Mississippi River delta region. Their goal has been to examine the distributions of ***dissolved organic matter***, ***optical properties***, nutrients, oxygen, metals, polycyclic aromatic hydrocarbons (PAHs), and methane. His team has collected samples from both contaminated and uncontaminated waters, and control samples of Louisiana light sweet crude oil and the chemical dispersant, Corexit 9500, have been obtained to compare findings.

One topic of particular interest to Shiller is the presence of ***metals*** in the ocean as a result of the spill. Many crude oils have measureable concentrations of certain metals, such as nickel and vanadium, which presents the potential for toxic levels to be released into the environment. Variations in the concentrations of metals can allow scientists to fingerprint or identify the origin of a sample of oil. Oil from the Macondo well was unusually low in most metals so direct metal contamination appears to have been limited. However, small enrichments in certain elements, including cobalt and barium, have been detected.

Another focus of Shiller's work has been on ***oil-eating microorganisms***. Oil and ***methane gas*** released during the spill are organic materials. Some microorganisms have been found to consume these materials as food. Like all living things, oil-eating microorganisms have specific nutrient requirements to function properly. Similar to flowers or garden vegetables, microorganisms also need nitrogen and phosphorous. Shiller has found depletions of oxygen and these nutrients in sub-surface plumes of oil. These findings are a good indicator that oil has been consumed by large numbers of these microorganisms. On a positive note, Shiller has also detected some conditions return to normal with fairly natural concentrations of subsurface methane recorded near the well in October of 2011.

Shiller's work has also helped identify and describe deep submerged plumes of oil through investigations of PAHs. Different crude oils have different mixtures of PAH compounds. His team is examining how the mixtures are altered as oil begins to break down in the environment.

Education Extension

Key Terms: *oil, hydrocarbon, methane, microbe, bacteria, bioremediation*

Classroom Activity: Oil-Munching Microbes

Oil, from natural seeps in the ocean floor, continuously flows into the environment. Some microbes, including bacteria, are specially adapted to survive exposure to hydrocarbons and are even able to use it as food. In this lesson, students will learn about natural oil seeps, the Gulf of Mexico oil spill, and how microbes are helping clean up our environment. An experiment may be added to this lesson so students can observe and evaluate the effectiveness of oil-eating microbes.

Ocean Literacy Principles: 5. The ocean supports a great diversity of life and ecosystems, 6. The ocean and humans are inextricably interconnected

National Science Standards: A. Science as Inquiry: Abilities necessary to do scientific inquiry, Understanding about scientific inquiry; C. Life Science: Interdependence of organisms; E. Science in Personal and Social Perspectives: Natural and Human Induced Hazards, Environmental Quality

Supplies: *water, machine oil, soil sample, fertilizer, jars, aquarium tubing and air pumps*

Directions: 1) Obtain soil samples from an oil-contaminated area like a gas station or heavily used parking lot (be sure to get permission first). Also prepare sterilized soil samples by microwaving or baking potting soil. 2) Prepare several experiment jars with water and oil, and various treatments with different soils and concentrations of fertilizer. Be sure to label the jars with their contents. 3) Observe the jars for 30 days then perform a greasy spot test with a water sample and piece of brown paper. For detailed instructions visit **http://www.cosee.net/resources/themes/oilspills/**

Visit **http://dhp.disl.org/resources.html** for lesson plans and additional marine-related activities.

**Use the key terms above to search for additional lesson plans on the web!*

Did You Know...

Dissolved organic matter (DOM) is a complex mixture of molecules primarily the result of the life and death of phytoplankton. It is important in the global carbon cycle and marine food webs. DOM can affect the amount of light that enters the ocean, the exchange of gases at the surface and the availability of metals and other nutrients.

Optical properties refer to the behavior and characteristics of light including how it interacts with matter in the water. The properties measured include light absorption, attenuation, fluorescence (emission of light) and scattering (a measure related to turbidity).

Oil-eating microorganisms, including bacteria, are believed to have consumed the majority of the methane gas that was released during the Deepwater Horizon oil spill.

Methane gas is the primary component of natural gas and was the most abundant hydrocarbon released during the oil spill. It is produced naturally by grazing animals, erupting volcanoes and some plants. Methane is also released from landfills, burning of fossil fuels and coal mining.

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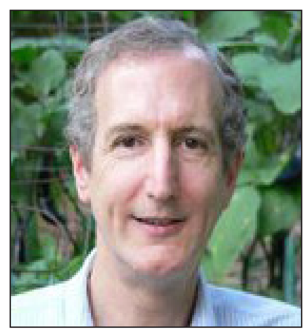

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The Northern Gulf Institute (NGI) is a National Oceanic and Atmospheric Administration (NOAA) Cooperative Institute addressing the research needs of the northern Gulf of Mexico. Mississippi State University leads this collaboration of the University of Southern Mississippi, Louisiana State University, Florida State University, Alabama's Dauphin Island Sea Lab, and NOAA scientists at laboratories and operational centers.

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