PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Petroleum Environmental Solutions

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GULF OF MEXICO SYNTHETIC-BASED MUDS MONITORING PROGRAM

PARTNERS

Minerals Management Service
Herndon, VA

Shell Global Solutions
Houston, TX

MAIN SITES

Gulf of Mexico

Retrieving a box core with samples of sediment taken from the Gulf of Mexico seafloor.

Background/Problem

The need to drill increasingly difficult offshore oil and gas wells, coupled with the economic and safety advantages of ocean discharge of cleaned cuttings, has led the offshore oil and gas industry to develop synthetic-based drilling muds (SBMs). These are drilling muds in which synthetic materials are the carrier fluid. They are designed to be less toxic and degrade faster in marine sediments than oil-based drilling muds while providing comparable cost advantages of faster drilling with less downtime in drilling difficult wells.

The U.S. Environmental Protection Agency (EPA) regulates discharges to water from offshore operations. In 1996, EPA recognized SBMs as a new class of drilling muds and began reviewing cuttings treatment technologies and the environmental impacts of drilling cuttings disposal options. In addition to the requirements for Effluent Limitation Guidelines (ELGs), EPA Region 6 general permits call for operators to either conduct seabed surveys at each location where cuttings drilled with SBMs are discharged or to participate in a joint industry seabed survey study.

Industry joined with DOE and the Minerals Management Service to fund a project investigating the environmental impacts of discharged cuttings. The objective of this study was to assess the fate and physical, chemical, and biological effects of SBM cuttings discharged from offshore platforms on the benthic environment of the Gulf of Mexico continental shelf and slope. Such determinations would be used to help EPA devise a science-based permit regime covering the discharge of cleaned SBM cuttings that would benefit the marine ecosystem without imposing unnecessary and costly regulations on offshore oil and gas operators.

Project Description/Accomplishments

All 4 sampling cruises were completed by June 1, 2002. Initially, 10 sites on the continental shelf were surveyed, and 3 were chosen for extensive sampling and analysis. Three locations on the continental slope also were selected for surveys during the third and fourth cruises. Researchers collected samples for analysis of grain size and mineralogy, SBMs and total petroleum hydrocarbons, metals (aluminum, barium, mercury, and iron), total organic carbon, and carbonate. Fauna samples and sediment toxicity samples also were collected and analyzed. During the second cruise, two cores were collected at each of 8 sites and vertically sectioned in 1-2 cm (or other appropriate) increments and were analyzed for grain size, metals, and SBM to investigate vertical layering. Sediment profile camera images were collected in the field and were analyzed.

Elevated concentrations of barium (a drilling mud tracer), the synthetic chemical carrier fluid, and total petroleum hydrocarbons were detected in sediments from the near-field and mid-field zones at the research sites. Most cuttings were deposited within 100-250

meters of the discharge site on both continental and continental slope sites. Based on observations, sediment concentrations of metals (other than barium) associated with drilling muds were within the range of concentrations for uncontaminated marine sediments. Metal ratios indicated that much of the finer-grained sediments near the offshore platforms were from terrigenous sources.

Measurements of oxygen, total organic carbon, reduction/oxidation potential, and manganese in sediments—all indicators of possible SBM cuttings-related organic enrichment, indicated that such enrichment occurred near the discharge locations. Samples collected from multiple survey cruises indicated that the severity of disturbance in the sediments near the discharge location decreased or that the sites recovered over time.

Sediment toxicity was measured using a non-indigenous, coastal benthic amphipod. Amphipod survival exceeded 75% in all far-field samples on continental shelf and continental slope sites, and these sediments were not considered toxic. At a small number of sites less than 250 meters from the discharge locations amphipod survival was less than 50%, and sediment toxicity and SBM concentrations were correlated. One-year tests of the sites suggested that the habitat quality of the sediments had not been seriously degraded by a long history of discharges at these sites.

Benefits/Impacts

This study provided input for the development of ELGs that include technology-based limitations for the discharge of cuttings generated during drilling with SBMs. Most sediment concentrations of metals associated with drilling muds were within the range of concentrations for uncontaminated marine sediments. There was a sharp decrease in concentrations of cuttings and chemicals in sediments some distance from the discharge sites, which indicates that drill cuttings solids, especially from SBM cuttings, are deposited close to the discharge site. No large, multi-meter-thick cuttings piles, such as those seen in the North Sea, were detected at any of the 15 sites visited in the study.

Evidence was found that indicated that organic enrichment of discharge sites from physical and chemical disturbance recovered over time. Significant improvement was observed in the one year between sampling cruises. In general, sediment quality and biological communities were not severely affected, and impacts were limited to the vicinity of the discharge (<250 meters).

EPA has developed cuttings discharge guidelines and is in the process of modifying discharge permits. Of interest to the agency and to industry are the environmental impacts to the seabed from the discharge of drilling cuttings. The information gathered in this study will be used by EPA to decide whether to continue to allow the discharge of cuttings drilled with SBMs and establish science-based permit restrictions.

Sieving macroinfauna samples taken from the Gulf of Mexico seafloor.

A ban on the discharge could be prohibitively expensive, resulting in reduced drilling activity and thus hobbling recovery of offshore oil and gas resources at a time when the deepwater Gulf of Mexico is the fastest-growing regional source of the Nation's oil production.

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CUSTOMER SERVICE

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