



Project Summary

Drill Mud Assessment Chemical Analysis Reference Volume

AMENDED
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The reference volume documents chemical characterization data for 11 industry-supplied drill fluid mixtures and one commercial drill-fluid additive. Used drilling fluids from the Gulf of Mexico were supplied to the U.S. Environmental Protection Agency (EPA), Environmental Research Laboratory at Gulf Breeze, Florida, by the Petroleum Equipment Suppliers. The Gulf Breeze laboratory then provided Science Applications, Inc., with samples as part of a multi-disciplinary effort to assess and catalogue the acute aquatic toxicity and chemical composition of the drilling fluids. Each drilling fluid was analyzed chemically for heavy metal and hydrocarbon content. The analysis for each of the 11 drilling fluids is presented in four parts: (1) drilling fluid elemental concentrations, (2) whole drilling fluid organic concentrations, (3) particulate phase organic concentrations, and (4) dissolved phase organic concentrations.

This Project Summary was developed by EPA's Environmental Research Laboratory, Gulf Breeze, FL, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

EPA is required to issue permits for the discharge of drilling fluids into waters of the Outer Continental Shelf under the National Pollutant Discharge Elimination System (NPDES). Knowledge of the concentrations of aromatics, aliphatics, metals, and other constituents of drilling fluid is necessary in order to predict the impact of the fluids on the marine environment

Drilling fluids in general are mineral-based, typically enriched in barium (in the form of barite BaSO_4), chromium or zinc,

to name a few elements, and are fortified with a variety of other (usually synthetic materials) to obtain desired consistencies for drill-line lubrication and well-hole pressure control. The mineral base is usually a mixture of barite and various clays, and other additives are predominantly organic-based but can contain relatively high concentrations of heavy metals. Presumably, drilling fluids discharged offshore will not contain harmful concentrations of additives such as petroleum-derived compounds and other suspected toxicants.

Methods

Each drilling fluid sample was chemically analyzed for heavy metal and hydrocarbon content in three distinct phases. (1) the bulk or whole mud, (2) a suspended particulate phase derived from the bulk mud sample, and (3) a dissolved phase.

After freeze drying and powdering, aliquots of bulk muds were removed for barium analysis by instrumental neutron activation and for analysis for iron, aluminum, chromium, lead, zinc, cadmium, copper, strontium, and calcium by atomic absorption analysis. Analysis of the suspended particulate material was similar, but barium was also analyzed by atomic adsorption spectrophotometry. This was also true for the dissolved phase.

The aromatic and aliphatic content of the three phases was determined by extraction and subsequent fractionation by column chromatography. The hexane eluant would include aliphatic hydrocarbons and PCBs, if these were present in the samples tested. The hexane:benzene eluant would contain aromatic hydrocarbons varying from toluene to polynuclear aromatics, if these were present in the samples tested. The third fraction, the methylene chloride:methanol eluant, would contain polar acids and more polar

pesticides, if these were present in the samples tested. However, no PCBs, dioxins or pesticides were reported to be present in the samples tested.

Data Presentation

Metal concentrations were expressed as percent or $\mu\text{g/g}$ dry weight for bulk or whole mud and the particulate phase and mg/g wet weight for the dissolved phase. All gas chromatographic data were recorded and reduced to digital format by computerized data reduction programs. All concentrations of resolved component peaks have been reported on a microgram or nanogram per liter of bulk drilling fluid basis. Water content measurements were made so that conversion of concentration data to dry weight could also be made.

In the reference volume, analytical procedures are documented, as well as measurements in the form of concentrations and chemical identifications. It is readily apparent from the organic analysis that a number of samples contain substantial amounts of petroleum-derived hydrocarbons. It was not possible to identify the sources of hydrocarbons in these fluids, although the analytical evidence is against crude oil contamination from the bore-hole. Instead, in the cases of noticeable hydrocarbon presence, these components appear to have been refined petroleum fractions.

This Project Summary was prepared by staff of Science Applications, Inc., La Jolla, CA 92038

Thomas W. Duke is the EPA Project Officer (see below).

The complete report, entitled "Drill Mud Assessment Chemical Analysis Reference Volume," (Order No. PB 84-170 000, Cost. \$22.00, subject to change) will be available only from:

*National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4650*

The EPA Project Officer can be contacted at:

*Environmental Research Laboratory
U.S. Environmental Protection Agency
Gulf Breeze, FL 32561*

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