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TECHNICAL PROGRESS REPORT

TITLE:	HYDROGEOCHEMICAL AND PRODUCTION CONTROLS ON NORM IN OIL- AND GAS-FIELD OPERATIONS
CONTRACT ID NO.:	DE-AC22-92MT92011
INSTITUTION NAME:	BUREAU OF ECONOMIC GEOLOGY THE UNIVERSITY OF TEXAS AT AUSTIN UNIVERSITY OF TEXAS BOX X AUSTIN, TEXAS 78713-7508
REPORT DATE:	JULY 30, 1993
CONTRACT DATE:	MAY 5, 1992
ANTICIPATED COMPLETION DATE:	MAY 31, 1994
GOVERNMENT AWARD:	$160,500
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REPORTING PERIOD:	APRIL 1, 1993 - JUNE 30, 1993

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EXECUTIVE SUMMARY

This project is designed to investigate the geochemical, geological, and production parameters that control the occurrence of naturally occurring radioactive materials (NORM) in oil-and gas-field operations. Relations between reservoir setting and NORM content of brine and scale will be interpreted on the basis of chemical and isotopic analyses of produced waters and chemical and mineralogical analyses of production-equipment scales. Our goal is to develop screening criteria that will enable oil- and gas-field operators to identify geologic, geographic, and production characteristics that might lead to high NORM accumulations in equipment and waste.

Activities during the second quarter of 1993 focused on identifying field sample sites, identifying previously analyzed produced-water samples that are suitable for NORM analysis, establishing methods for analyzing radium in produced water and scale, and modifying existing geochemical modeling codes to predict radium coprecipitation with carbonate and sulfate scale on the basis of thermodynamic properties.

INTRODUCTION

The purpose of this project is to interpret the geochemical, geological, and production parameters that control the distribution of naturally occurring radioactive materials (NORM) in Texas oil- and gas-field operations. This will be performed using data on the chemical and radiological composition of produced brines, the chemical and mineralogical composition of production-equipment scales collected at selected field sites, a knowledge of the mineralogical composition, burial depth, and temperature of the reservoir, and thermodynamic modeling to quantify how radium is coprecipitated in equipment scale. Our ultimate goal is to develop screening criteria and a list of indicator species that can be used by both regulatory agencies and the oil and gas industry to identify geographic or geologic regions that are likely to produce water with high levels of naturally occurring radioactive materials and to identify production methods that cause NORM scale to form.

PROJECT DESCRIPTION

This program consists of four tasks:(1) Data Compilation and Identification of Field-Sample Sites, (2) Field Sampling, (3) Data Analysis, and (4) Technology Transfer. The Data Compilation and Identification of Field-Sample Sites task includes a literature

search on the occurrence of radioactive scale and brine in Texas; a literature search of the geologic occurrence and geochemical behavior of uranium, thorium, and radium; identification of major reservoir types in Texas containing NORM; identification and contact of operators in areas of interest for sharing data and as candidate sites for sample collection; and selection of field-sample sites. The Field Sampling task consists of preparation for field work, travel to sites, and collection of brines and scales at selected fields in Texas. The Data Analysis task will include compilation of analytical results for brines, scale, reservoir and production data; geochemical modeling of analytical results to determine saturation states of NORM-containing minerals and to compare brine and scale chemistry; and statistical evaluation and integration of geochemical, reservoir, and production data. The Technology Transfer task will be accomplished through detailed tabulation of factors that can and cannot be used to predict the occurrence of NORM in scale, publication in scientific journals, and presentations at professional meetings.

PROJECT STATUS

During the second quarter of 1993 we focused on four activities: (1) identifying areas in Texas where high levels of NORM in oil- and gas-field equipment have been reported, (2) identifying and screening previously analyzed produced-water samples that can be used in this study, (3) developing methods to measure radium activity in produced water samples, and (4) modifying existing computer codes so that radium coprecipitation with barite and calcite scale can be thermodynamically modeled.

We used the API national survey on NORM in petroleum-producing and gas-processing facilities to identify counties in Texas where high NORM levels have been reported. We then used the Bureau of Economic Geology Atlas of Major Texas Oil Reservoirs and Atlas of Major Texas Gas Reservoirs to determine which major oil and gas fields are in those counties. We are now identifying owners and operators of those fields so we can contact them for survey information and permission to sample produced water and scale. This task is complicated because many of the fields that were previously owned by major companies have been sold and are now operated by small companies. Identifying and contacting field managers is more time consuming than we originally anticipated.

Our second major activity was to identify a suite of several hundred produced-water samples that have been collected and analyzed for major, minor, and trace solutes as well as isotopic composition of oxygen, hydrogen, carbon, and strontium in conjunction with other research at the University of Texas Bureau of Economic Geology and the

Department of Geological Sciences. These produced-water samples represent a significant resource for the NORM study because they were collected from a wide variety of geographic areas and geologic formations, they have already been analyzed for a large number of chemical and isotopic constituents, and they represent fields and reservoirs that have since been shut in. Because the field name, formation, depth of production, and storage history of these samples is well documented, we intend to analyze some of these produced waters for radium activity. We are now determining what data exist, what formations and basins were sampled, the volume of fluid remaining, and the conditions of storage. We intend to select some samples for radium analysis from this suite. Doing so will allow us to ultimately collect much more data than if we analyze only produced water samples collected solely for this study.

We are investigating ways of analyzing these samples for radium activity. If we can successfully obtain radium measurements on these samples we will have access to a large suite of well characterized produced-water samples for the NORM study. During the second quarter of 1993 we also focused on developing methods to analyze water samples for radium isotope composition. We have an agreement to use analytical instruments in the Department of Geological Sciences for radium isotope analyses. We ordered and received a radium standard from the National Institute for Standards and Technology that will allow us to calibrate the detector. Because of the very limited volume of radium standard and the variable volumes of produced water samples, we are preparing a series of secondary standards to be used in the radium analysis.

One of our goals in the project is to thermodynamically predict the amount of radium that will coprecipitate with typical carbonate and sulfate scale under production conditions. We have decided to use the existing computer code SOLMINEQ.88 for this purpose. We have obtained thermodynamic data on radium incorporation in calcite and barite from the literature and are entering this information into the SOLMINEQ.88 data base.

PLANNED ACTIVITIES

We will conduct the following activities during the third quarter of 1993.

1. Continue to identify owners and operators of oil and gas field in Texas where high NORM levels exist.
2. Begin analyzing produced-water samples for radium activity.
3. Contact field operators and Texas regulatory agencies for information on NORM scale in production and processing equipment.

4. Conduct field sampling as necessary to obtain water and scale samples.
5. Complete modification of SOLMINEQ.88 to include radium coprecipitation in carbonate and sulfate scale minerals.

SUMMARY

The goal of this project is to investigate the geochemical, geological, and production parameters that control the occurrence of naturally occurring radioactive materials (NORM) in oil-and gas-field operations. Activities during the second quarter of 1993 focused on identifying field sample sites, identifying previously analyzed produced-water samples that are suitable for NORM analysis, establishing methods for analyzing radium in produced water and scale, and modifying existing geochemical modeling codes to predict radium coprecipitation with carbonate and sulfate scale on the basis of thermodynamic properties.

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