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Final

**INCREASED OIL PRODUCTION AND RESERVES
UTILIZING SECONDARY/TERTIARY RECOVERY
TECHNIQUES ON SMALL RESERVOIRS
IN THE PARADOX BASIN, UTAH
(Contract No. DE-FC22-95BC14988)**

TECHNICAL PROGRESS REPORT

Submitted by

Utah Geological Survey
Salt Lake City, Utah 84109
May 30, 1995



Contract Date: February 9, 1995
Anticipated Completion Date: February 8, 2000
Government Award (fiscal year): \$786,880
Program Manager: Thomas C. Chidsey, Jr.
Principal Investigator: M. Lee Allison

Contracting Officer's Representative

Rhonda P. Lindsey
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Bartlesville, OK 74005

Reporting Period: January 1 - March 31, 1995

US/DOE Patent Clearance is not required prior to the publication of this document.

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OBJECTIVES

The primary objective of this project is to enhance domestic petroleum production by demonstration and technology transfer of an advanced oil recovery technology in the Paradox basin, southeastern Utah. If this project can demonstrate technical and economic feasibility, the technique can be applied to approximately 100 additional small fields in the Paradox basin alone, and result in increased recovery of 150 to 200 million barrels of oil. This project is designed to characterize five shallow-shelf carbonate reservoirs in the Pennsylvanian Paradox Formation and choose the best candidate for a pilot demonstration project for either a waterflood or carbon dioxide-flood project. The field demonstration, monitoring of field performance, and associated validation activities will take place in the Paradox basin within the Navajo Nation. The results of this project will be transferred to industry and other researchers through a petroleum extension service, creation of digital databases for distribution, technical workshops and seminars, field trips, technical presentations at national and regional professional meetings, and publication in newsletters and various technical or trade journals.

SUMMARY OF TECHNICAL PROGRESS

During the first quarter of the project (January 1 through March 31, 1995), planning and initial activities for the five-year effort began. An amendment to the primary contract between the Utah Geological Survey (UGS) and the U.S. Department of Energy (DOE) was submitted. The subcontractor agreement between the UGS and Harken Southwest Corporation (Harken) was submitted and modified. Most task work was delayed pending approval of the contract amendment and the subcontract. Areas of progress during the quarter included development well permitting and technology transfer.

Drilling of Development Wells

A team of geologists, reservoir engineers, and geophysicists from Harken evaluated potential development locations for the project fields. Two development wells will be drilled to increase the well density from 80 acres (32.3 ha) per well to 30 to 40 acres (12-16 ha) per well. Permitting is underway for the first well, the Anasazi 6H No. 1, located in the SE1/4NE1/4 section 6, T. 42 S., R. 24 E., Navajo Nation, San Juan County, Utah in the Anasazi field (figure 1). The proposed total depth is 5,872 feet (1,790 m). The principal reservoir to be evaluated, an algal mound in the Desert Creek zone of the Paradox Formation, is projected to be penetrated at 5,624 feet (1,714 m).

The well data will enable the team to assess: (1) the frequency of reservoir compartments (reservoir heterogeneity) in a given area, (2) the amount of communication between compartments, (3) how a waterflood or CO₂ flood will move from one compartment to another, and (4) the areal extent of an average compartment. The following new well information will be used in the geologic and reservoir characterization:

1. more accurate descriptions of the general reservoir geology and reservoir compartmentalization/continuity,
2. pressure data in drawn down areas from current producers,
3. wettability and relative permeability data from fresh cores,

4. pressure transient data to determine communication with other fields (determine communication with adjacent reservoirs previously thought separate), and
5. increased data for the reservoir simulation history match to allow for better construction of models used in CO₂/water flow simulations.

Technology Transfer

The UGS, Harken, and DOE sponsored a core workshop to examine several cores from the Paradox basin of southeastern Utah to determine oil reservoir characteristics of several types of algal mounds that comprise the five fields targeted for detailed study. The workshop was held during the American Association of Petroleum Geologists (AAPG) annual convention in Denver, Colorado, June, 1994. Thirty-two participants attended the free workshop. This workshop was the first of several planned in the future as part of the technology transfer activities for the project.

The core workshop was a "hands-on" introduction to the relation between production and reservoir characteristics of algal mounds in the Paradox Formation. Representative cores from five types of oil-producing algal mounds in the Paradox basin were discussed and examined. Planned activities for this DOE project were described during the workshop. Participants were encouraged to ask questions and discuss all aspects of the project and make suggestions or recommendations concerning the project. The UGS plans to publish the workshop course notes in the near future.

Project materials were displayed at the UGS booth during the AAPG annual convention, in Houston, Texas, March 1995 as well as the 1994 AAPG annual convention, and at the 1995 regional convention of the Society of Petroleum Engineers.

NEXT QUARTER ACTIVITIES

Activities planned for the next quarter (April 1 through June 30, 1995) include:

1. A management plan, hazardous substance plan, cost plan, milestone schedule/plan, and notice of energy R&D project will be completed. The amended DOE contract and Harken subcontract will be finalized and signed.
2. The project team will attend the first coordinating meeting to plan activities for the quarter and review project goals.
3. Data collection will begin. Well information such as production; completion and testing; oil, gas, and water analyses; core descriptions; reservoir tops; and other data will be entered into the UGS database for manipulation.
4. Drilling operations will commence on the Anasazi 6H No. 1 development well located in the SE1/4NE1/4 section 6, T. 42 S., R. 24 E., Navajo Nation, San Juan County, Utah in the Anasazi field.
5. Suitable base maps will be obtained and updated.

6. A core workshop will be held to familiarize the project team with representative cores from the five Harken fields. Photomosaics of Paradox outcrop will be discussed in terms of sequence stratigraphy. Outcrops will be selected for detailed field evaluation.

7. Preparations will be made for the Contractor Review Meeting in Oklahoma in June 1995. The UGS Class II presentation will be made as part of the field demonstration session on June 27.

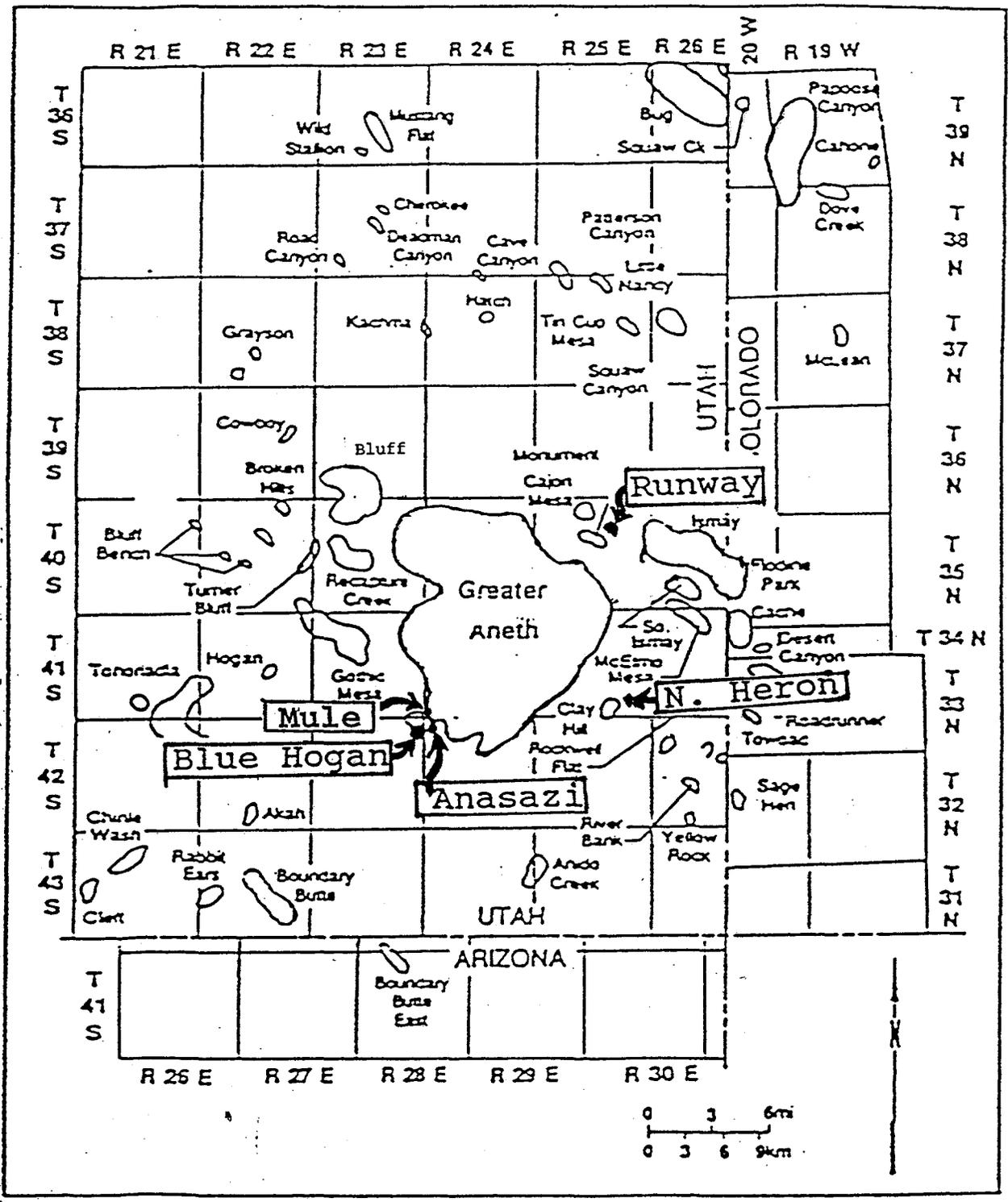


Figure 1. Location of the five Harken fields targeted for geological and reservoir characterization. The first project development well, the Anasazi 6H No. 1, will be drilled in the Anasazi field, Navajo Nation, San Juan County, Utah.