

TITLE: IMPROVED OIL RECOVERY IN MISSISSIPPIAN CARBONATE RESERVOIRS OF KANSAS -- NEAR TERM -- CLASS 2

Cooperative Agreement No.: DE-FC22-93BC14987

Contractor Name and Address: The University of Kansas Center for Research Inc.

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DOE Cost of Project: \$ 3,169,252 (Budget Period 1 09/18/94 -- 09/17/96)

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Objectives

The objective of this project is to demonstrate incremental reserves from Osagian and Meramecian (Mississippian) dolomite reservoirs in western Kansas through application of reservoir characterization to identify areas of unrecovered mobile oil. The project addresses producibility problems in two fields: Specific reservoirs target the Schaben Field in Ness County, Kansas, and the Bindley Field in Hodgeman County, Kansas. The producibility problems to be addressed include inadequate reservoir characterization, drilling and completion design problems, non-optimum recovery efficiency. The results of this project will be disseminated through various technology transfer activities.

At the Schaben demonstration site, the Kansas team will conduct a field project to demonstrate better approaches to identify bypassed oil within and between reservoir units. The approach will include:

- Advanced integrated reservoir description and characterization, including integration of existing data, and drilling, logging, coring and testing three new wells through the reservoir intervals. Advanced reservoir techniques will include high-resolution core description, petrophysical analysis of pore system attributes, and geostatistical analysis and 3D visualization of interwell heterogeneity.
- Computer applications will be used to manage, map, and describe the reservoir. Computer simulations will be used to design better recovery processes, and identify potential incremental reserves.
- Comparison of the reservoir geology and field performance of the Schaben Field with the previously described by slightly younger Bindley Field in adjacent Hodgeman, County.

- Drilling of new wells between older wells (infill drilling) to contact missed zones;
- Demonstration of improved reservoir management techniques, and of incremental recovery through potential deepening and recompletion of existing wells and targeted infill drilling.

Summary of Technical Progress

Progress is reported for the period from 1 April 1996 to 30 June 1996. Work in this quarter has continued to concentrate on reservoir characterization (Task 1.2), and technology transfer efforts (Task 1.3).

Task I.1 -- Acquisition and Consolidation of Available Data (Target Completion Date: 4/2/95). Delayed Completion (3/31/96).

This task is complete except for the continuing addition of production data from the demonstration site and the results of the NMR analyses from the final new well.

Task I.2 -- Reservoir Characterization (Target Completion Date: 3/3/96) Delayed Completion (10/15/96).

The geologic reservoir characterization for the Schaben Field is complete and has been presented at the national meeting of the AAPG and at the DOE/BDM Class 2 Workshop. Oil production has been estimated for every well in the field using productivity tests and lease data. The detailed production data is available on-line at both the lease and well levels (The Uniform Resource Locator {URL} is <http://www.kgs.ukans.edu:80/DPA/Schaben/Wells/schabenWell1.html>) The geologic reservoir characterization combined with the production data were used to generate estimates of original oil in place, cumulative oil recovered and remaining oil in place. These maps show a number of areas that have potential for targeted infill wells or a possible horizontal well. Variations in production and remaining potential appear to be related to variations in reservoir quality that can be mapped across the demonstration site. When the first pass reservoir simulation is complete we can evaluate the results and make appropriate modifications to the geologic model. All the geologic and production information, including maps, cross-sections and core analyses, is being published as part of an on-line field atlas. (URL= <http://www.kgs.ukans.edu:80/DPA/Schaben/schabenMain.html>).

Work to summarize and evaluate the Mississippian production in Kansas including production from the Schaben demonstration site is complete. The results of the summary and the detailed Schaben work have resulted in a number of inquiries as to the potential of horizontal drilling in known Mississippian fields in Kansas.

The expected completion date for the initial reservoir simulation is 15 September with a final simulation and revised geologic model available 15 October.

Task I.3 -- Technology Transfer (Target Completion Date: 8/4/96).

Technology transfer is an ongoing process that includes access to information through the Internet, almost daily inquiries and formal presentations. Presentations at professional meetings and workshops have been well received and resulted in an increased number of inquiries. Workshops include: Platform Carbonates Workshop in Norman, Oklahoma (3/96);

SIPES National Meeting in Dallas, Texas (3/96); AAPG/SEPM Carbonate Reservoir Session and the Kansas Geological Survey booth at the National AAPG meeting, (5/96); BDM Class II workshop in Midland Texas, (5/96); and the Gulf Coast SEPM conference on Advanced Wireline and Geophysical Technology in Houston, Texas, (12/96). A manuscript on the pseudoseismic approach as demonstrated at Schaben Field has been submitted and accepted as part of the publication related to the Gulf Coast SEPM conference (Appendix A).

We will continue our work with Kansas operators on application of the technologies developed as part of the Class II project. We are providing access to the digital data and results from the project through an on-line (Internet) accessible format.

Appendix A

Title and abstract of manuscript submitted to the Gulf Coast SEPM publication entitled Advanced Wireline and Geophysical Technology. A copy of the manuscript is available from the authors.

Pseudoseismic Transforms of Wireline Logs: A Seismic Approach to Petrophysical Sequence Stratigraphy

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ABSTRACT

Stratigraphic interpretation from wireline logs is typically drawn from multiple log traces or from crossplots of log data. Both techniques can readily depict vertical changes in lithology or reservoir quality, but lateral relationships are not readily visualized. Significant improvement in the geologic interpretation of wireline log data can be achieved through transformation and treatment of the transformed data as "seismic" traces for the purposes of processing, interpretation and display. This combination of wireline logs with a seismic interpretive approach is labeled *pseudoseismic*. The pseudoseismic transform can combine data from multiple logging tools generating a convolved 'crossplot log' for each well. A well-designed transformation of wireline log data across multiple wells maximizes both spatial and compositional information contents, and provides a readily interpretable image of the subsurface geology. Various filters and transformations can be applied to emphasize different aspects of the subsurface geology.

The transformed wireline log data are loaded into a computer workstation and interpreted as a set of 2D pseudoseismic traces or as a 3D pseudoseismic volume. Use of interpretation and visualization packages developed for seismic data offers flexibility in displaying and picking horizons, and increased efficiency of sequence stratigraphic interpretation. The treatment of wireline logs as a data volume permits comprehensive and cost-effective sequence stratigraphic and reservoir analysis of data sets that were previously considered intractable.

Examples from western Kansas, at both the regional and field scale, illustrate the utility and efficiency of sequence stratigraphic interpretation using the pseudoseismic approach. The pseudoseismic approach to the analysis of wireline log data from multiple wells opens new dimensions in log interpretation and provides significant insight into complex stratigraphic geometries associated with lithology, reservoir quality, and fluids.