QUARTERLY TECHNICAL PROGRESS REPORT

Report Type: Quarterly
Reporting Period: October 1 - December 31, 1996

Principal Author(s) Mary K. Banken, Richard Andrews

Report Issue Date: 09/12/1997
Cooperative Agreement No. DE-FC22-93BC14956

Submitting Organization(s):
Oklahoma Geological Survey
University of Oklahoma
1000 Asp, Room 314
Norman, Oklahoma 73019
DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.
ABSTRACT

This document is provided as a Quarterly Technical Progress Report for the program entitled “Identification and Evaluation of Fluvial-Dominated Deltaic (Class I Oil) Reservoirs in Oklahoma”, covering the reporting period of October 1 - December 31, 1996.

Work is progressing as expected for the project. The FDD computer facility is fully operational. During this quarter, there were 37 industry “visits” to use the facility. The Cleveland and Peru Plays workshop was completed on October 17, 1996 with 85 attendees. The Red Fork Play workshop is scheduled for March 5 and 12, 1997. The Red Fork text was submitted for editing, and all figures, maps, and plates were submitted to cartography for drafting. The Tonkawa workshop is scheduled for June, 1997 although the exact time and place have yet to be determined. Regional work and field studies for that play are in progress.

This project is serving an extremely valuable role in the technology transfer activities for the Oklahoma petroleum industry, with very positive industry feedback.
EXECUTIVE SUMMARY

This document is provided as a Quarterly Technical Progress Report for the program entitled “Identification and Evaluation of Fluvial-Dominated Deltaic (Class I Oil) Reservoirs in Oklahoma”, covering the report period of October 1 - December 31, 1996.

The FDD computer facility is fully operational following a recent move from the OU Energy Center to a more accessible location just north of Norman, Oklahoma. During the fourth quarter, 24 industry individuals utilized the FDD computer facility. Several of these users had repeat visits, resulting in 37 total “visits” to the facility. The facility primarily was used for computer mapping, NRIS data retrieval, and plotter applications.

The Cleveland and Peru Plays workshop was completed October 17, 1996 in Bartlesville, Oklahoma with 85 attendees. Each play was presented individually using the adopted protocol of stratigraphic interpretations, a regional overview, and detailed field studies. Because of delays in manuscript preparation, the Cleveland-Peru play publication was not available for the workshop but is expected to be published during 1997. Materials distributed at the workshop consisted of preliminary maps and text. Overall, attendee evaluations of the workshop were positive, though not quite as high as for other workshops. The lesser enthusiasm mostly was due to the lack of future opportunity in these two plays.

The Red Fork Play workshop is scheduled for March 5, 1997 at the Norman Postal Service Technical Training Center and March 12, 1997 at the Phillips Petroleum Company Research Center in Bartlesville, Oklahoma. The Red Fork workshop will include three detailed field studies. The Red Fork text was completed and submitted for technical and grammatical editing in early November. Prior to this, all figures, maps, and plates were submitted to cartography for drafting.

The Tonkawa workshop is scheduled for June, 1997 although the exact time and place have yet to be determined. Regional work and field studies for that play are in progress.

This project is serving an extremely valuable role in the technology transfer activities for the Oklahoma petroleum industry, with very positive industry feedback. The popularity of the program is spreading with each workshop. It is fully expected that the three remaining play presentations for 1997 - the Red Fork, Tonkawa, and Bartlesville - will see a continued growth in industry responses.
INTRODUCTION

The Oklahoma Geological Survey (OGS), the Geo Information Systems department, and the School of Petroleum and Geological Engineering at the University of Oklahoma are engaged in a five-year program to identify and address Oklahoma's oil recovery opportunities in fluvial-dominated deltaic (FDD) reservoirs. This program includes the systematic and comprehensive collection and evaluation of information on all of Oklahoma's FDD reservoirs and the recovery technologies that have been (or could be) applied to those reservoirs with commercial success. This data collection and evaluation effort is the foundation for an aggressive, multifaceted technology transfer program that is designed to support all of Oklahoma's oil industry, with particular emphasis on smaller companies and independent operators in their attempts to maximize the economic producibility of FDD reservoirs.

Specifically, this project is identifying all FDD oil reservoirs in the State; grouping those reservoirs into plays that have similar depositional origins; collecting, organizing and analyzing all available data; conducting characterization and simulation studies on selected reservoirs in each play; and implementing a technology transfer program targeted to the operators of FDD reservoirs. By fulfilling these objectives, the FDD project is expected to help sustain the life expectancy of existing wells and provide incentive for development and exploratory drilling with the ultimate objective of increasing oil recovery.

Elements of the technology transfer program include developing and publishing play portfolios, holding workshops to release play analyses and identify primary and secondary oil recovery opportunities in each of the plays, and establishing a computer laboratory that is available for industry users. The laboratory contains the play data files, as well as other oil and gas data files, together with the necessary hardware and software to analyze the information. Technical support staff are available to assist interested operators in the evaluation of their producing properties, and professional geological and engineering outreach staff are available to assist operators in determining appropriate recovery technologies for those properties.
RESULTS AND DISCUSSION
(SUMMARY OF TECHNICAL PROGRESS)

Computer Applications, Database, and User Lab Developments

The FDD computer facility is fully operational following a recent move from the OU Energy Center to a more accessible location just north of Norman, Oklahoma. The new location is just off Rock Creek Road where the facility shares space with the Oklahoma Marginal Well Commission. Recently acquired hardware includes four Pentium 5-150 MHz computers, one HP Designjet 755CM inkjet plotter, one Dataproducts Typhoon 8 - 1200 dpi PS laser printer capable of doing B-size prints, and a Neuralog log scanner. The computer facility is coordinated by Jane Weber of the OGS.

Many maps, tables, and specialty illustrations were made for the Red Fork and Cleveland-Peru plays using NRIS MAPS - a user-friendly computer program designed to access NRIS data. These include maps for detailed field studies such as well base maps and lease production maps. Tables with individual lease production records were generated by NRIS MAPS for use in decline curves and in determining cumulative field production. Large illustration maps using NRIS MAPS were made showing well production codes, formation show codes, well spud dates, and well status codes. These regional maps were used to illustrate areas of by-passed oil production, field trends, and time periods of development for the Cleveland and Red Fork plays. Registrations for the Cleveland/Peru workshop were completed utilizing the mail-out program that identifies operators having production from the targeted plays.

During the fourth quarter, 24 industry individuals utilized the FDD computer facility. Several of these users had repeat visits, resulting in 37 total “visits” to the facility. Sixteen of the 24 users during this quarter were first-time users. The facility primarily was used for computer mapping, NRIS data retrieval, and plotter applications. One GeoGraphix seminar was given and about 64 hours of computer time were logged by users.
Play Analyses, Publications, & Workshops

Table 1 summarizes the level of activity and industry responsiveness to the FDD workshop and publication series.

### Summary of FDD Play Workshops

<table>
<thead>
<tr>
<th>Play</th>
<th>Workshop Dates &amp; Locations</th>
<th># Registered</th>
<th># of play operators</th>
<th>Play operators @ reduced rate</th>
<th>Play operators @ regular rate</th>
<th>Operators not in play</th>
<th>Total Wrkshp Operators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Morrow</td>
<td>June 1 &amp; 2, 1995 Norman</td>
<td>215</td>
<td>604</td>
<td>90</td>
<td>5</td>
<td>5</td>
<td>100</td>
</tr>
<tr>
<td>2. Booch</td>
<td>September 11, 1995 Muskogee</td>
<td>128</td>
<td>432</td>
<td>31</td>
<td>0</td>
<td>20</td>
<td>51</td>
</tr>
<tr>
<td>3. Layton &amp; Osage-Layton</td>
<td>April 17, 1996 OKC</td>
<td>103</td>
<td>342</td>
<td>15</td>
<td>6</td>
<td>25</td>
<td>46</td>
</tr>
<tr>
<td>5. Cleveland &amp; Peru (2 plays combined)</td>
<td>October 17, 1996 Bartlesville</td>
<td>85</td>
<td>516</td>
<td>11</td>
<td>13</td>
<td>14</td>
<td>38</td>
</tr>
<tr>
<td>6. Red Fork</td>
<td>March 5 &amp; 12, 1997 Norman &amp; Bartlesville</td>
<td>1478</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Tonkawa</td>
<td>July 9, 1997 Norman</td>
<td>347</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Bartlesville</td>
<td>October, 1997</td>
<td>1420</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**TOTALS:** 732 6,738 183 60 87 364

**All of these statistics are based on registration records and a post hoc linking to the gross production records. Because of this, it is possible that some company identifications and operator designations have been missed. Therefore, these should be considered “conservative” estimates of the operator contacts through the FDD program.

**The Cleveland and Peru Plays:** **Play leaders:** Robert Northcutt - Peru Play Jock Campbell - Cleveland Play

This workshop was completed October 17, 1996 in Bartlesville, Oklahoma with 85 attendees. Each play was presented individually using the adopted protocol of stratigraphic interpretations, a regional overview, and detailed field studies. Although a field study was completed for each play, the Pleasant Mound Cleveland oil pool was the only one for which a waterflood simulation was performed. The Peru field study was not considered suitable for waterflood simulation because of the lack of production data. Instead, a guest lecturer, Mr. Bruce Carpenter, presented a talk on formation evaluation of the Peru sand in the Hogshooter oil field.

Because of delays in manuscript preparation, the Cleveland-Peru play publication was not available for the workshop but is expected to be published during 1997. Materials distributed at the workshop consisted of preliminary maps and text.
Overall, attendee evaluations of the workshop were positive, though not quite as high as for other workshops. The average “rating” for the overall workshop was 3.85 in a range of 1 (poor) to 5 (great). The lesser enthusiasm mostly was due to the lack of future opportunity in these two plays. Selected comments from attendees include:

- “A great job as usual.”
- “All of the presenters did a really good job, however I was left with the feeling that there is not a lot of future to these two reservoirs. Neither of the field studies were very economic, or was that the point?”
- “The seminar proved valuable by showing a zone which we always wondered about but never had time to map.”
- “I felt the Peru portion was practically a waste of time due to the lack of economic significance of this reservoir. Based on the presentation, I don’t know many operators that would re-complete this zone, much less drill for it.”
- “Overall the series has been great. Please keep the program expanding even into other geologic areas.”

**The Red Fork Play:**

*Play leader:* Richard Andrews

This workshop is scheduled for March 5, 1997 at the Norman Postal Service Technical Training Center and March 12, 1997 at the Phillips Petroleum Company Research Center in Bartlesville, Oklahoma. Considerable effort has been made to upgrade the “Introduction to FDD Principals” section of the play presentation in order to avoid repetitiveness of previous workshops. To that end, this part of the program will include low-level air photography of present-day fluvial systems and related bar morphologies, channel bar trenching to show bedding characteristics of point bars versus longitudinal bars, slides of Red Fork outcrops showing reservoir geometry, and a brief conceptual summary using selected figures from previous publications.

The Red Fork workshop will include three detailed field studies, two by Richard Andrews, and one by consulting geologist Kurt Rottmann. One field has a good secondary recovery history, another is currently in the early phases of waterflooding (N. Carmen for which a waterflood simulation is being done), and a third is identified as an excellent waterflood candidate.

The Red Fork text was completed and submitted for technical and grammatical editing in early November. Prior to this, all figures, maps, and plates were submitting to cartography for drafting. Red Fork cores from three wells were slabbed and prepared for workshop display. A brief description and visual images of the cored intervals will be incorporated in an appendix to the publication. This kind of material is in great demand by geologists and has been very useful in their interpretations of FDD systems.
The Tonkawa workshop is scheduled for June, 1997 although the exact time and place have yet to be determined.

The FDD oil portion of the Tonkawa is limited in areal extent with only scattered oil production in the north-central part of Oklahoma. However, the Tonkawa is becoming a very active play in the deeper portion of the Anadarko basin where it produces primarily gas from marine facies. More recent work by project staff has found references of Tonkawa FDD extending into western Oklahoma, almost entirely within the known gas producing portion of the Anadarko basin. Because of this interesting relationship, the project team decided to add a gas component to the Tonkawa workshop. Current plans are to hold the Tonkawa FDD oil workshop in the morning, complete with the standard FDD publication. A Tonkawa gas presentation will be held that afternoon, sponsored by the Petroleum Technology Transfer Council (PTTC) project.

The regional work on the Tonkawa FDD oil is being completed by Jock Campbell. Two detailed field studies are in progress by consulting geologist Kurt Rottmann - one of an FDD oil reservoir and a second of a marine facies gas reservoir. Segments of the regional Tonkawa play that extend into the gas-prone portion of the Anadarko basin are being interpreted and mapped by Carlyle Hinshaw, Geo Information Systems staff geologist.

CONCLUSION

This project is serving an extremely valuable role in the technology transfer activities for the Oklahoma petroleum industry. Industry feedback to the program is very positive, with numerous comments stating that this is the most valuable program that has been sponsored by the Oklahoma Geological Survey. The popularity of the program is spreading with each workshop. It is fully expected that the three remaining play presentations for 1997 - the Red Fork, Tonkawa, and Bartlesville - will see a continued growth in industry responses.