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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 July 1 - September 30, 1997.

Work is progressing as expected for the project. The Tonkawa Play workshop was completed as scheduled on July 9, 1997 in Norman Oklahoma. It was attended by 101 people of whom about 55 were operators. The Bartlesville workshop is scheduled for October and November 1997, in three different sites including Tulsa, Bartlesville, and Norman, Oklahoma. The FDD computer facility is fully operational. During this quarter, there were 10 industry individuals who used the computer facility.

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

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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 July 1 - September 30, 1997.

The Tonkawa Play workshop was completed as scheduled on July 9, 1997 in Norman Oklahoma. It was attended by 101 people of whom about 55 were operators. The OGS Special Publication accompanying the workshop (SP 97-3) included 2 field studies, one waterflood simulation study, and an introduction to FDD concepts. The Bartlesville workshop is scheduled for October and November 1997, in three different sites including Norman, Tulsa, and Bartlesville, Oklahoma. The Special Publication for this play (SP 97-6) is complete and includes 3 field studies, one secondary recovery study, and the introduction to FDD concepts. A special appendix is included that shows scanned images of Bartlesville core with supporting interpretations. A complete lithologic description and log suite of the cores are also provided.

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 second quarter, 10 industry individuals utilized the FDD computer facility. The facility primarily is used for computer mapping, NRIS data retrieval, instructional classes, and plotter applications.

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 within industry is spreading with each workshop. It is fully expected that the remaining presentation for 1997 - the Bartlesville play, will see continued growth in 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

Many maps, tables, and specialty illustrations that have been used in the Tonkawa and Bartlesville Special Publications and in poster displays were made using *NRIS MAPS* - a user-friendly computer program designed to access *NRIS* data. The most commonly used maps include well-spot base maps superimposed upon a land grid, 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 display posters have been made showing well production codes, formation show codes, well spud dates, and well status codes. These regional maps are used to illustrate areas of development and exploration potential, production trends, and drilling periods of wells completed in the Tonkawa and Bartlesville. Registrations for the workshops are completed utilizing the mail-out program that identifies operators having production from the targeted plays.

During the second quarter, 10 industry individuals utilized the FDD computer facility. Six of the 10 users during this quarter were first-time users. The facility primarily was used for computer mapping, *NRIS* data retrieval, and plotter applications. Training sessions for geologic software applications are normally conducted at the computer facility although none were held during this quarter. About 12 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. From this table, it is apparent that about 100-200 participants attend each workshop regardless the number of operators. Generally speaking, about 40 to 60% of the total number of attendees are classified as operators. Although we see many "repeat" attendees, many of the participants at each workshop are first-timer's. This may indicate that the program is reaching out to a broad spectrum of operators and geologists in addition to attracting professionals interested in learning more about FDD in Oklahoma. Verbal comments by many attendees indicate they are extremely interested in these types of workshops and have benefited greatly. Following Table 1 is a brief summary of plays completed or in progress during the quarter.

**Table 1: Summary of Technology Transfer Activities for FDD Plays
as of September 30, 1997**

<u>Play</u>	Workshop Dates & Locations	# of Regis- trants	# of play operators	Play Operators		Opera- tors not in play	Total Wrkshp Operators
				@ reduced rate	@ regular rate		
1. Morrow	June 1 & 2, 1995 Norman, OK	215	604	90	5	5	100
2. Booch	September 11, 1995 Muskogee, OK	128	432	31	0	20	51
3. Layton & Osage- Layton	April 17, 1996 OKC, OK	103	466	15	6	25	46
4. Prue & Skinner (2 plays combined)	June 19, 20, & 26, 1996 OKC & Bartlesville, OK	201	1527	36	36	23	129
5. Cleveland & Peru (2 plays combined)	October 17, 1996 Bartlesville, OK	85	516	11	13	14	38
6. Red Fork	March 5 & 12, 1997 OKC & Bartlesville	195	1478	29	40	29	98
7. Tonkawa	July 9, 1997 Norman, OK	101	242	10	0	45	55
8. Bartlesville	October 29, 30, & Nov. 12, 1997		1420				
TOTALS		1,028	6,685	222	100	161	517

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 Tonkawa Play:

Primary authors:

Jock Campbell, Carlyle Hinshaw, Kurt Rottmann

Contributing authors:

Roy Knapp, Zahiid Samad, ChenXia Xie

Workshop date:

July 9, 1997

Workshop site:

*Postal Service Technical Training Center,
Norman, OK.*

Publication:

*Oklahoma Geological Survey SP 97-3, Fluvial-
Dominated Deltaic (FDD) Oil Reservoirs in
Oklahoma: The Tonkawa Play.*

A one day workshop for the Tonkawa play was completed July 9, 1997 with a high degree of industry interest. Of the 101 registrants, an estimated 55 were operators in the play. Many people in the central Mid-Continent Region are somewhat familiar with

this reservoir yet in the past, have pursued deeper reservoirs. Because of this, the Tonkawa is largely overlooked as an FDD oil reservoir in the shallower portion of the Anadarko Basin. However, recent trends in exploration have focused on Tonkawa gas from marine sands in the more sparsely drilled areas of the deep Anadarko Basin. For these reasons, the Tonkawa was identified as a reservoir with significant potential for additional oil and gas development. To date, this reservoir has produced about 50 MMBO and 1 TCF gas throughout its regional extent in Oklahoma, Texas, and Kansas.

Because of emerging interest in the entire Tonkawa play, the FDD team decided to try something new by combining both FDD (oil) and non-FDD (gas) portions of the play into a single workshop. This effort resulted in regional evaluations of the Tonkawa from shelf to basin specifically dealing with both the oil and gas portions of the play. Funding was therefore, divided between FDD (fluvial oil reservoirs) and PTTC (marine gas reservoirs). The project resulted in new interpretations of regional depositional environments that will significantly change the way trends within the Tonkawa can be exploited. Detailed field studies included one FDD oil reservoir (with accompanied waterflood modeling) and one marine gas reservoir. This workshop was structured for anyone involved in this play within Oklahoma and surrounding states of Kansas and Texas.

Regional evaluation of the Tonkawa FDD play was the responsibility of Jock Campbell, OGS geologist. This involved primarily the organization of stratigraphic nomenclature, regional sand trend mapping, interpretation of general depositional environments, and regional cross sections. This work is supported by two detailed field studies by consulting geologist Kurt Rottmann - one of an FDD oil reservoir (Blackwell field) and a second of a marine facies gas reservoir (Waynoka NE field). The FDD oil field study was used for waterflood simulation by Knapp, Samad, and Xie.

Segments of the regional Tonkawa play that extend into the gas-prone portion of the Anadarko Basin and Shelf were interpreted and mapped by Carlyle Hinshaw, Geo Information Systems staff geologist. This work was of the same nature as that of Campbell's and extended subsurface mapping and reservoir evaluation of the Tonkawa play into the Texas panhandle and southern Kansas. The Oklahoma Geological Survey SP 97-3 however, will include only information and maps relevant to the Tonkawa FDD (oil) play. Information concerning the Tonkawa gas play in the predominantly marine facies of the Anadarko Basin is printed as an OGS open file report #3-97.

The Bartlesville Play:

Primary authors:

Contributing authors:

Guest speaker:

Scheduled workshop dates:

Scheduled workshop sites:

Robert Northcutt, Richard Andrews

Roy Knapp, Zahiid Samad, and ChenXia Xie

Greg Riepl

October 29, 30, and November 12, 1997

*Postal Service Technical Training Center,
Norman, OK.; Phillips Petroleum Co. Research
and Development Center, Bartlesville, OK.;*

Publication:

*and the US Army Corps of Engineers Center,
Tulsa, OK.
Oklahoma Geological Survey SP 97-6, Fluvial-
Dominated Deltaic (FDD) Oil Reservoirs in
Oklahoma: The Bartlesville Play.*

The Bartlesville play will be the subject of the last FDD workshop in the DOE sponsored series. It is scheduled to be presented 3 times and places: in Tulsa on October 29, in Bartlesville on October 30, and in Norman on November 12. The workshop will have a similar protocol as in preceding workshops: an introduction to FDD concepts followed by a regional overview of stratigraphy and sandstone trend mapping. Accompanying the introduction to depositional environments will be a series of 35 mm slides showing reservoir characteristics of the Bartlesville sandstones as seen in outcrops. Three detailed field studies and core displays will also be provided. Responsibilities have been divided between two primary authors; Robert Northcutt will complete the regional work and Richard Andrews will complete the three field studies and core work. As a special contribution to this last FDD workshop, a guest speaker will be discussing the applications of seismic stratigraphy in delineating thick Bartlesville channel sandstones. Greg Riepl, who is an active independent geologist, has utilized this technology successfully over the past few years. His talk will most likely be of extreme interest to attendees, but it will not be incorporated into the SP publication because of confidentiality concerns.

Roy Knapp and graduate student assistants will attempt waterflood modeling of the Paradise field. This field began secondary recovery about a year ago and has had mixed results to date. The field appears to be relatively simple geologically; however, fracturing in the reservoir and into the underlying limestone appears to control the path of injected water. As a result, water break-through within the Bartlesville reservoir occurs almost immediately. In other places within the field, injected water is lost to the underlying limestone without passing through the Bartlesville sandstone. This situation may turn out to be an excellent example of a waterflood going terribly wrong due to unexpected reservoir problems. The exercise will be extremely valuable to our program in understanding enhanced recovery for this type of reservoir, particularly in regards to fracture awareness and in applying certain remedies in correcting the loss of injected water.

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 remaining presentation for 1997 - the Bartlesville play, will see continued growth in responses.