"INCREASING WATERFLOOD RESERVES IN THE WILMINGTON OIL FIELD THROUGH IMPROVED RESERVOIR CHARACTERIZATION AND RESERVOIR MANAGEMENT"

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City of Long Beach, Department of Oil Properties
Stanford University, Stanford, CA
Magnetic Pulse, Inc. (MPI), Houston, TX

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Objectives

The objectives of this quarterly report are to summarize the work conducted under each task during the reporting period July-September 1995, and to report all technical data and findings as specified in the "Federal Assistance Reporting Checklist".

The main objective of this project is the transfer of technologies, methodologies, and findings developed and applied in this project to other operators of Slope and Basin Clastic Reservoirs. This project will study methods to identify sands with high remaining oil saturation and to recomplete existing wells using advanced completion technology.

The identification of the sands with high remaining oil saturation will be accomplished by developing a deterministic three dimensional (3-D) geologic model and by using a state of the art reservoir management computer software. The wells identified by the geologic and reservoir engineering work as having the best potential will be logged with a pulsed acoustic cased-hole logging tool. The application of the logging tools will be optimized in the lab by developing a rock-log model.

The wells that are shown to have the best oil production potential will be recompleted. The recompletions will be optimized by evaluating short radius and ultra-short radius lateral recompletions.

Summary of Technical Progress

- **Reservoir Characterization**

Further progress has been made on developing rock-log and fluid-log models needed to calibrate acoustic log data which will be compared to theoretical expectations. Stanford has made laboratory measurements on dry core samples from the Upper Terminal Zone of Fault Block IV to determine the dynamic and static properties of the dry rock frame. Investigators will resaturate the sample and repeat the measurements. The end result will be a dry and saturated elastic moduli to test the Biot-Gassmann model for fluid effects in these materials. Stanford is also writing a computer application to investigate the relationships among log properties and the volumes of clay, quartz, feldspars, mica, water, and oil.

Acoustic logs were run in two cased hole aquifer wells, two cased hole recompletion candidate well, and an open hole new well. The new well will also be

logged after casing is set in order for investigators to examine the difference in the two situations. This data will help in the interpretation of all the cased hole acoustic logs. The new well also had a 30 ft conventional core successfully recovered in the Upper Terminal Zone of Fault Block IV. This will give investigators information on in-situ fluid saturations and pore structure which will go into building our rock-log and fluid-log models.

- **Reservoir Engineering**

All injection and production data from Fault Block IV of the Wilmington Field have been inputted into the computer and quality controlled for missing wells, missing years, duplicated wells, duplicated zones, etc. These data must now be converted to a database and then exported to a reservoir management software program. This program will generate production and injection bubble maps, isocut maps, isobaric maps, net oil sand thickness maps, cumulative production and injection maps, etc. With these data, candidates for logging and recompletion will be generated.

- **Deterministic 3-D Geologic Modeling**

Tidelands has completed inputting directional surveys and quality controlling the sub-zone markers and fault picks for each well in the project databases. Unfortunately, the NEWILMA database was found deficient in its subsidence correction and other program subroutines. Investigators are modifying the NEWILMA code and recompiling the program. New maps will be generated which will help identify production units and potential logging candidates. Production units are sands which are isolated and can be exploited from existing wells along with selective reperforation of idle penetrating wells.

- **Pulsed Acoustic Logging**

A total of five wells were logged with acoustic tools from Magnetic Pulse Incorporated (MPI) and Schlumberger. Well FY-67 (Aquifer well) was logged with a Schlumberger tool string consisting of the Ultra-Sonic Imager, Dipole Sonic Imager, and orientation device. The log showed a good casing to cement bond and recorded good compressional wave data, but poor and unreliable shear wave data. Schlumberger processors attribute the lack of shear wave recovery to the fact the shear slowness of the formation is less than the shear slowness of the mud wave thereby masking the desired acoustic wave recovery. MPI ran the XACT acoustic tool and found similar problems with shear wave recovery, but obtained good compressional wave recovery.

Well 167-W (Aquifer well) was also logged with the same Schlumberger and MPI acoustic tools. They found a poorer cement bond than well FY-67 but also obtained

a good compressional wave. Likewise, no reliable shear wave was recovered. MPI believes with further processing a low resolution shear wave can be processed.

Aquifer wells were logged in order to obtain a baseline response to the acoustic devices in a sand which was water saturated at or near 100%. Two logging companies were utilized to gather the same data at a different frequency, power, and tool design for comparative purposes. Results for the two companies are in excellent agreement in areas of good compressional wave recovery.

Wells X-32 and Y-67 were only logged with the MPI acoustic tool. Results were similar to the aquifer wells; good compressional wave recovery but poor shear wave recovery. This circumstance is attributed to poor casing-cement-formation bond, and/or eccentered casing, and/or eccentered tools, and/or gas or other fluids behind the casing which prevents recording of dipole data.

New well 169-W was logged open hole by both Schlumberger and MPI. In addition a 30 ft conventional core was recovered in the Upper Terminal Zone of Fault Block IV. Results are being processed and are not yet available. This well will also have acoustic log run after casing has been cemented in place.

- **Technology Transfer**

Technical transfer activities include planning a field trip to the Wilmington Field for the American Association of Petroleum Geologists (AAPG) in association with their 1996 national meeting in San Diego. An article will also be placed in the AAPG guidebook for the national meeting.

Stanford has updated the DOE waterflood project homepage on the World Wide Web (WWW) and have received inquiries from all over the world. This historical record will be updated as developments warrant.

Stanford has submitted an abstract entitled "Application of Laboratory and Theoretically Derived Rock Physics Relationships for Clastic Rocks to Log Data - Example from the Wilmington Field, CA" to the American Geophysical Union.

Investigators attended a meeting of the Log Characterization Consortium Special Interest Group on Shear Wave Logging (LCC-SIG) in Houston.

References and Publications

None