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ADVANCED RESERVOIR CHARACTERIZATION IN THE ANTELOPE SHALE TO ESTABLISH THE VIABILITY OF CO_2 ENHANCED OIL RECOVERY IN CALIFORNIA's MONTEREY FORMATION SILICEOUS SHALES

Quarterly Technical Progress Report
July 1, 1998-September 30, 1998

By
Michael F. Morea

Report Issue Date: October 15, 1998

Performed Under Contract No. DE-FC22-95BC14938

Chevron USA Production Company
Bakersfield, California

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Advanced Reservoir Characterization in the Antelope Shale to Establish the Viability of CO_2 Enhanced Oil Recovery in California's Monterey Formation Siliceous Shales

By
Michael F. Morea

November 1999

Work Performed Under Contract No. DE-FC22-95BC14938

Prepared for
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Government Award for Budget Period # 1 **$2,334,048**

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Anticipated Completion Date for Budget Period # 1 **March 31, 1999**

DOE Project Manager **Gary Walker, National Petroleum Technology Office**

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Objective

The primary objective of this research is to conduct advanced reservoir characterization and modeling studies in the Antelope Shale reservoir. Characterization studies will be used to determine the technical feasibility of implementing a CO_2 enhanced oil recovery project in the Antelope Shale in Buena Vista Hills Field. The Buena Vista Hills pilot CO_2 project will demonstrate the economic viability and widespread applicability of CO_2 flooding in fractured siliceous shale reservoirs of the San Joaquin Valley. The research consists of four primary work processes: Reservoir Matrix and Fluid Characterization; Fracture Characterization; Reservoir Modeling and Simulation; and CO_2 Pilot Flood and Evaluation. Work done in these areas is subdivided into two phases or budget periods. The first phase of the project will focus on the application of a variety of advanced reservoir characterization techniques to determine the production characteristics of the Antelope Shale reservoir. Reservoir models based on the results of the characterization work will be used to evaluate how the reservoir will respond to secondary recovery and EOR processes. The second phase of the project will include the implementation and evaluation of an advanced enhanced oil recovery (EOR) pilot in the United Anticline (West Dome) of the Buena Vista Hills Field.

Summary of Technical Progress

Based on our results, we will not proceed with a Phase II field trial in Buena Vista Hills. Although we had numerous technical successes (i.e., high resolution crosswell seismic, mineral model based saturation algorithm) and completed a detailed reservoir characterization, we could not overcome the siliceous shale's very low oil saturation and heterogeneity at Buena Vista Hills. However, reservoir characterization work has demonstrated that under the right conditions, CO_2 is a viable enhanced recovery process for siliceous shales.

In order to find a more promising reservoir, we have received approval for a Phase I extension to March 31, 1999. Based on our studies, we have decided to submit a detailed proposal and budget for a Phase II CO2 pilot in the Belridge Diatomite at Lost Hills field, about 30 miles north of Buena Vista Hills. We will spend the next few months working on our Lost Hills Phase II project pilot design and costs estimates. We plan to submit our Lost Hills proposal in January.

Technology Transfer

3rd Quarter:

Dholakia, S. K., Aydin, A., Pollard, D. D., and Zoback, M. D., 1998, Fault controlled hydrocarbon pathways in the Monterey Formation, California, AAPG Bulletin, v. 82, no. 8, p. 1551-1574.

Langan, R. T., Julander, D. R., Morea, M. F., Addington, C. M., and Lazaratos, S. K., 1998, Crosswell seismic imaging in the Buena Vista Hills, San Joaquin Valley: A case history, Annual International Meeting, Society of Exploration Geophysicists, New Orleans, LA.

Wang, G., Harris, J. M., Magalhaes, C., Julander, D. R., and Morea, M. F., 1998, Buena Vista Hills 3-D attenuation and velocity tomography, Annual International Meeting, Society of Exploration Geophysicists, New Orleans, LA.

Washbourne, J. K. and Rector III, J. W., 1998, Crosswell seismic in three dimensions, Annual International Meeting, Society of Exploration Geophysicists, New Orleans, LA.

4th Quarter:

Tang, R. W., Zhou, D., Beeson, D. Ulrich, R. L., and Morea, M. F., 1998, Immiscible CO2 Floods in Low Permeability Reservoirs, International Energy Agency, Collaborative Project on Enhanced Oil Recovery, 19th Workshop and Symposium, Carmel, CA.