

PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Petroleum Exploration
and Production

02/2004

PARTNERS

Pioneer Natural Resources
Irving, TX

Texas A&M University
College Station, TX

EPIC Consulting
Calgary, Canada

MAIN SITE

O Daniel Field
Midland, TX

DE-FC22-95BC14942

ADVANCED RESERVOIR CHARACTERIZATION AND EVALUATION OF CARBON DIOXIDE GRAVITY DRAINAGE IN THE NATURALLY FRACTURED SPRABERRY RESERVOIR

Research discovers how to waterflood the Spraberry

Background/Problem

Low recovery (10%) from the Spraberry Trend including marginally economic waterflood recovery has marked the Spraberry Trend with its 8 billion bbl remaining oil-in-place as a target for enhanced oil recovery. However, the fractured nature of the reservoir had precluded previous CO₂ flooding, and resulted in a lack of confidence in the application of water injection.

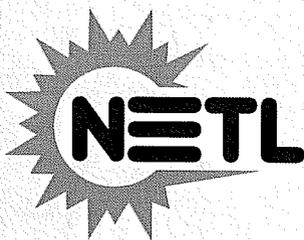
The objective of this project is to demonstrate the economic viability of recovering incremental oil reserves from the Spraberry Reservoir covering over one half million acres in the Permian Basin of West Texas. The pilot study indicates that additional 5-8% of additional oil in place can be recovered by more efficient practices and would increase recoverable reserves in the Spraberry by 500 to 800 million barrels of oil. The expansion of the original Class project as a (PUMP) project studied the waterflood response and demonstrated successful waterflood strategies for the Spraberry.

Project Description/Accomplishments

Extensive reservoir characterization, including the first cores taken from over 3,400 wells, has defined the natural fractures and identified 3 major fault directions. One of the major surprises of the project has come from identification of the fracture systems, and understanding of how to implement waterflooding in relationship to the fractures. In the pilot area of O Daniel field waterflooding has dramatically increased oil production 6-fold. On-trend wells responded to waterflooding dispelling the previously held notions that production wells aligned on-trend with injection wells will experience rapid channeling via fractures and give no incremental production. Each of 7 on-trend wells represents an incremental gain of 65-70 BOPD. Increased oil production indicates that the on-trend waterflood is now contacting unswept rock in area that had been previously waterflooded.



Water injection facilities O Daniel Field Spraberry Trend, Texas.



ADVANCED RESERVOIR CHARACTERIZATION AND EVALUATION OF CARBON DIOXIDE GRAVITY DRAINAGE IN THE NATURALLY FRACTURED SPRABERRY RESERVOIR

Research discovers how to waterflood the Spraberry

CONTACT POINTS

William Knight
Principal Investigator
Pioneer Natural Resources
Phone: (972) 969-3910
E-mail: knightw@pioneernc.com

David Schechter
Principal Investigator (PUMP)
Texas A&M University
Phone: (970) 843-2255
E-mail: schech@spindletop.tmau.edu

Roy Long
Technology Manager
U.S. DOE
Phone (918) 699-2017
E-mail: roy.long@netl.doe.gov

Daniel Ferguson
Project Manager
U.S. DOE
Phone: (918) 699-2047
E-mail: daniel.ferguson@netl.doe.gov

TOTAL ESTIMATED COST

\$15,210,000

COST SHARING

DOE - \$5,720,000
Non-DOE - \$9,490,000

WEBSITE

www.netl.doe.gov

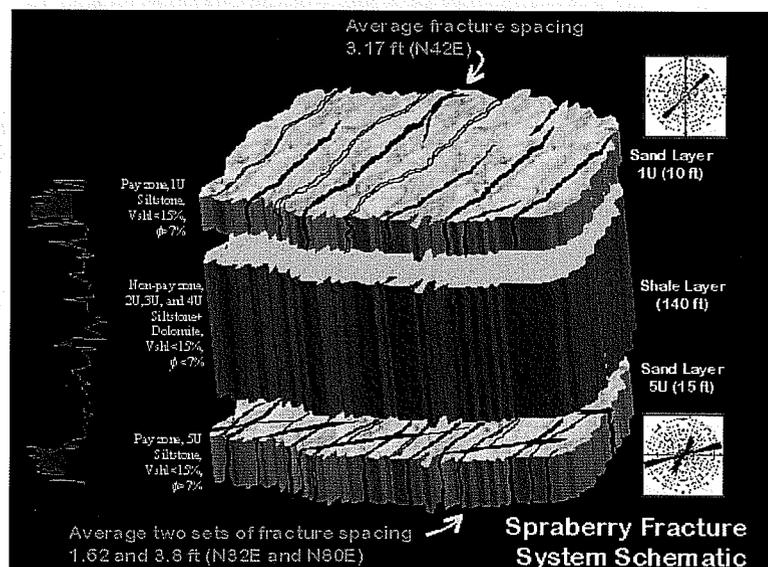
High water injection rates in the O Daniel pilot area have restored the reservoir pressure making CO₂ flooding possible. Laboratory analysis of cores taken from the Spraberry indicate that CO₂ gravity drainage will result in additional incremental oil after the higher water injection rates over larger area of the Spraberry Trend have restored reservoir pressure. CO₂ injection began in February 2001 in the O Daniel pilot. Initial results show that large volumes of CO₂ are being retained in the reservoir as is expected to mobilize oil to the production wells. Pioneer Natural Resources preliminary analysis is that CO₂ injection has potential. However, the discovery of a successful way to waterflood the Spraberry will put CO₂ tertiary recovery on hold.

Benefits/Impacts

Oil production in the pilot area has increased from 10-15 BOPD for each of 4 wells before the current water injection rates to 80 BOPD per well. Cumulative incremental production after 2.5 years is over 150,000 barrels of oil for the pilot.

Due to the positive results of improved waterflooding Pioneer Natural Resources is expanding waterflooding in O Daniel field and acquiring new leases in the Spraberry Trend.

The DOE pilot project has demonstrated that improved waterflooding techniques, and CO₂ flooding at near miscible conditions combined with gravity drainage are viable means of significantly increased production from a naturally fractured reservoir. The revised waterflood technology will be applicable to a significant number of leases in the 250,000 sq. mile Spraberry Trend. Waterflood production is estimated to recover an additional 15% of OOIP over the next 20 years.



Fracture model based on logs and core from Spraberry well.

Spraberry04