

Heterogeneous Shallow-Shelf Carbonate Buildups in the Blanding Sub-Basin of the Paradox Basin, Utah and Colorado: Targets for Increased Oil Production and Reserves Using Horizontal Drilling Techniques

DE-AC26-00BC15128

Goal

The project goal is to increase production and reserves from the shallow shelf carbonate reservoirs in the Ismay and Desert Creek zones of the Pennsylvania age Paradox Formation, in the Paradox Basin of Utah and Colorado. The project proposed using horizontal laterals from existing vertical field development wells to optimize production.

Performers

Utah Geological Survey (UGS)
Salt Lake City, UT

Eby Petrography & Consulting, Inc.
Salt Lake City, UT

Colorado Geological Survey
Denver, CO

Seeley Oil Company

Results

Two San Juan County, Utah fields were evaluated for horizontal drilling potential: Cherokee and Bug, producing from the Ismay and Desert Creek zones of the Paradox Formation, respectively. Three-dimensional (3-D) thickness models indicate five porosity units have an untested northeastern area in the Cherokee case-study field, San Juan County, Utah. Based on Cherokee reserve calculations, the remaining recoverable oil and gas reserves are nearly 168,000 BO and 3 BCFG, suggesting the presence of additional undrained zones. For the Bug case-study field, the volume calculated for net feet of porosity greater than 10 percent is 99,057 acre-feet, as derived from 3-D models. This also suggests the presence of additional undrained zones. The lower Desert Creek may contain recoverable oil and gas reserves of nearly 2,440,000 BO and 5.7 BCFG. It was recommended by the UGS that horizontal drilling techniques be used to tap undrained reservoirs as a demonstration in these fields.

Benefits

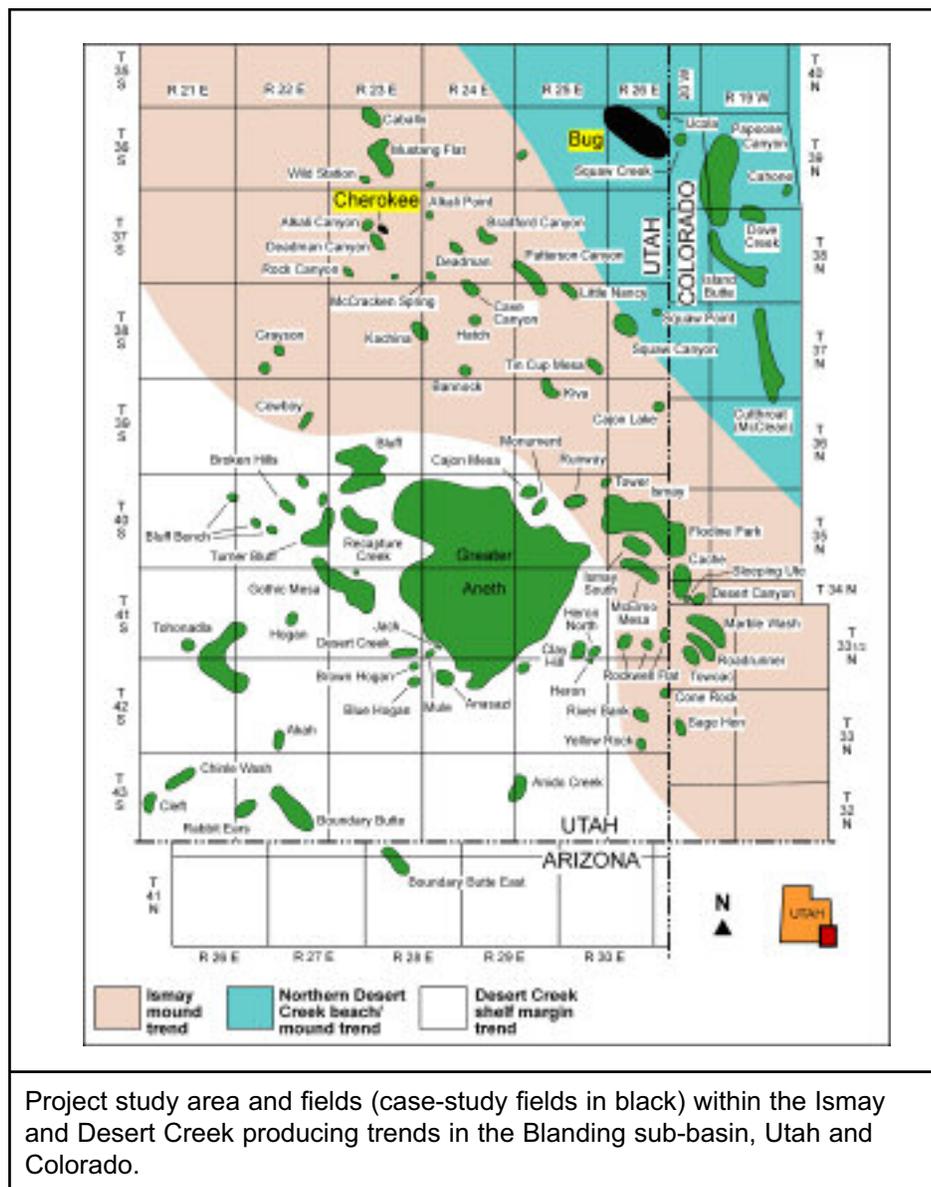
Detailed reservoir characterization and analysis of horizontal wells by the Utah and Colorado Geological Surveys will provide information and assessment of horizontal drilling of prospects in the Blanding Sub-basin of the Paradox Basin that small, independent operators could not afford on their own. Work by the geological surveys will not be restricted to individual leases or time constraints and can thus provide a more comprehensive and objective analysis available to all companies working in the area. Methodologies to identify drilling prospects in the over 100 small carbonate mound fields in the Paradox Basin holds the key to recovery of an estimated 200 million barrels of oil.

Background

Most of the Pennsylvania Paradox

Formation fields are characterized by high initial production rates followed by a very short production life (primary). Only 15 to 25 percent of the original oil-in-place (OOIP) is recoverable during primary production with conventional vertical wells. The previous DOE Class II study of the Paradox Basin demonstrated that secondary recovery by waterflood is not as effective as carbon dioxide flooding.

The small Ismay and Desert Creek fields are at risk of premature abandonment. At least 200 million barrels of oil is at risk of being left behind in them because of inefficient development practices that leave undrained these very heterogeneous reservoirs. Because of the widespread nature of the carbonate mound fields, the Desert Creek and Ismay zones have not been adequately characterized. Small, independent operators of single fields do not have the



Project study area and fields (case-study fields in black) within the Ismay and Desert Creek producing trends in the Blanding sub-basin, Utah and Colorado.

time, money, or expertise to perform this analysis. The Utah Geological Survey serves the public by conducting regional studies which small companies cannot undertake by themselves.

The proposal suggested a three-phase, multi-disciplinary approach to increase production and reserves from the shallow-shelf carbonate reservoirs in the Ismay and Desert Creek zones of the Paradox Formation using horizontal laterals from existing vertical field development wells: 1) conduct detailed geologic analysis of fields, 2) drill horizontal wells from existing vertical wells to test hypothesis developed in Phase 1, and 3) extended monitoring to determine impact of Phases 1 and 2.

Summary

- Data from representative field and wildcat wells was used to correlate logs and construct regional maps and cross sections of facies for the Desert Creek and Ismay zones.
- Three-dimensional models were constructed of environmental facies and potential undrained zones that may be suitable for horizontal drilling.
- Diagenesis has been determined to be the main control of reservoir quality of Desert Creek and Ismay reservoirs.
- Reservoir characterization of the Ismay and Desert Creek zones has identified Bug and Cherokee fields as the best candidates for horizontal wells.
- Potential horizontal drilling targets are based on analysis of the porosity distribu-

tion, which is highly dependent on the diagenetic history of each facies.

- At Cherokee field the best production zones are related to microporosity in the phylloid-algal mound and crinoid/fusulinid facies of the Ismay zone.
- At Bug field the best production zones are related to micro-box-work porosity of the Desert Creek phylloid-algal mound and shoreline carbonate island facies.
- Remaining reserves were calculated for Cherokee and Bug fields using the 3-D models.
- Determined and recommended horizontal drilling targets, directions, and lengths for Cherokee and Bug fields.
- Technology transfer activities over the course of the project - displayed project goals and results at nine professional meetings, ten technical presentations, seven publications (not counting Semi-Annual Technical Progress Reports), one short course, and established and updated UGS project Web site, project page <http://geology.utah.gov/emp/Paradox2/index.htm> containing all Semi-Annual Technical Progress Reports and poster presentations. Several press releases were distributed requesting industry proposals for drilling a horizontal well(s) in the Ismay or Desert Creek zones as part of the Phase II Demonstration.

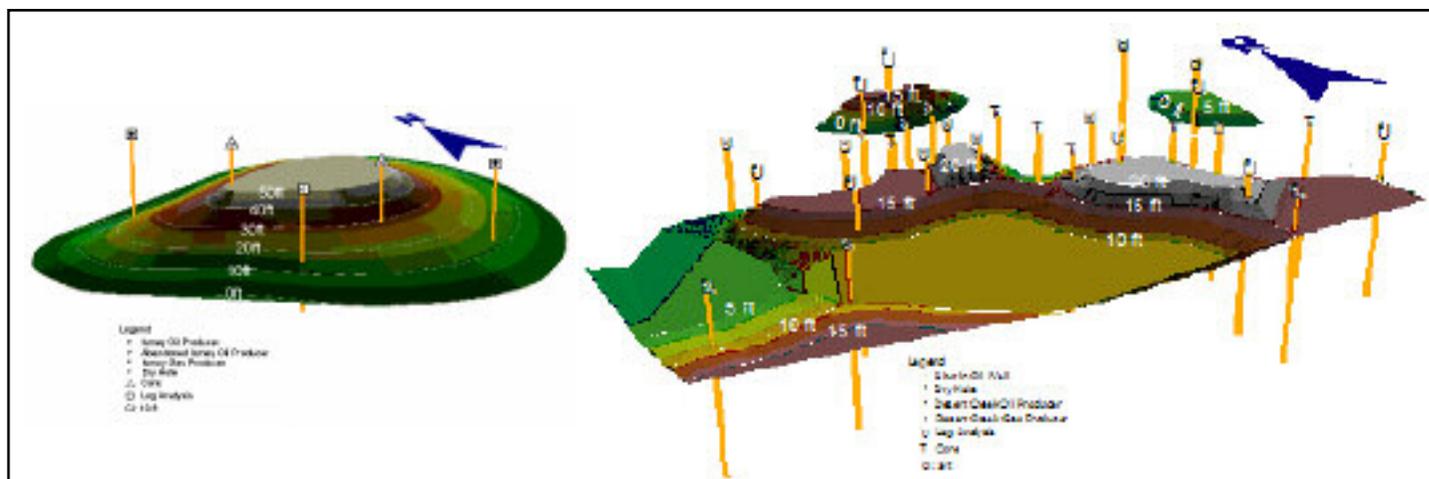
Current Status (June 2006)

Budget Period I began April 6, 2000 and will end June 30, 2006. There have been seven no-cost extensions, mainly to allow

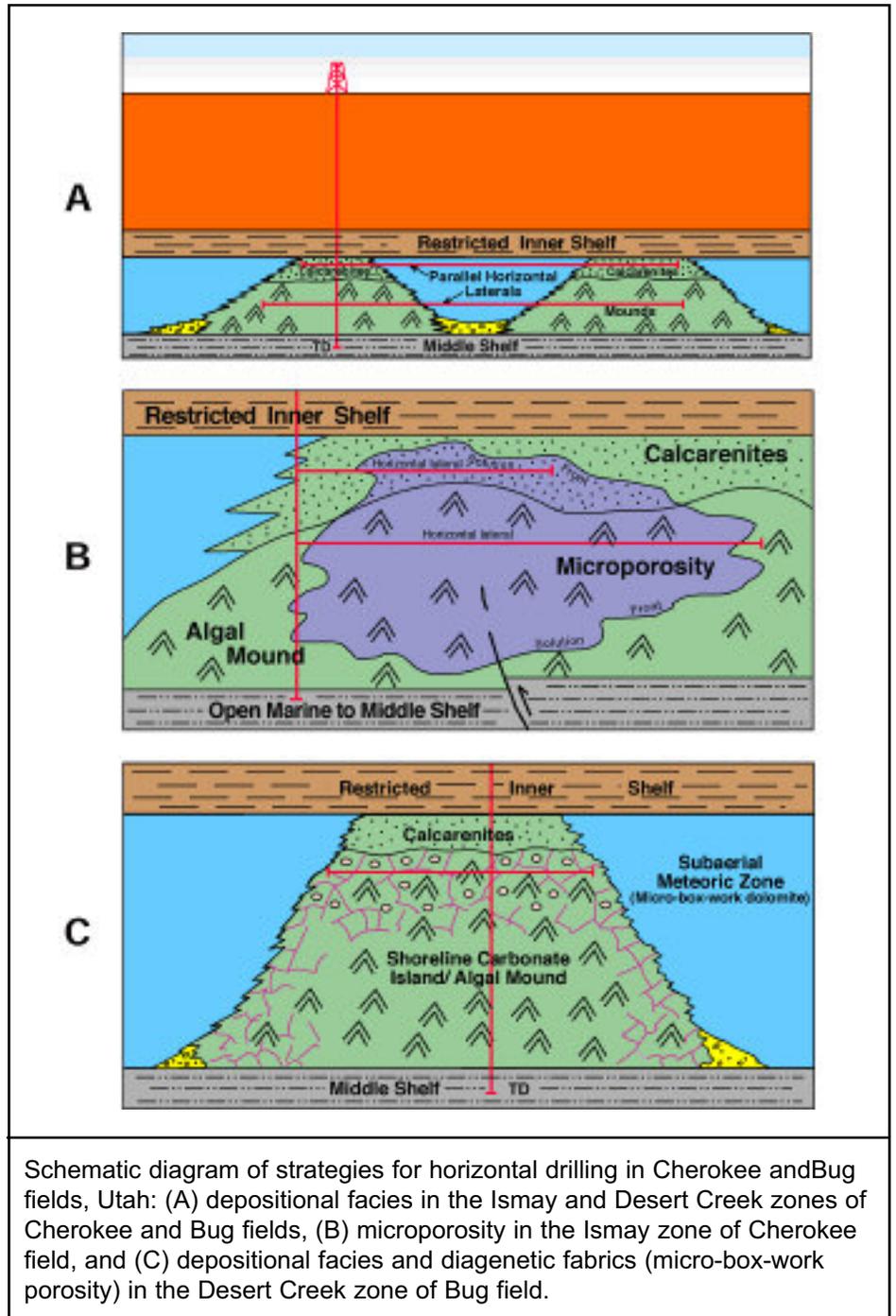
time to find a new industry partner willing to participate in the field demonstration (Budget Period II). Although the study found horizontal drilling would be economically increasing production and reserves extending of the Bug and Cherokee case-study fields, the operators (industry partners) decided not to participate in the field demonstration. The primary reasons for these decisions were drilling commitments for gas plays elsewhere, the unavailability of rigs, drilling costs way above those at the time the project was proposed, and limited overall budgets of the small operators of the fields. The project team has made presentations to numerous potential industry partners, issued press releases inviting horizontal drilling proposals from operators of fields similar to the case-study fields, and displayed project objectives and goals at various AAPG meetings. The UGS and DOE have decided to end the project, and publish all project results and recommendations in a Final Report at the end of June 2006.

Funding

This project was in response to DOE's solicitation DE-PS26-00BC15144, Reservoir Class Field Demonstration Program – Class Revisit. The goal of the Class Program was to extend economic production of domestic fields, by slowing the rate of well abandonment, preserving industry infrastructure, and to increase ultimate recovery using improved reservoir characterization and advanced technologies.



Three-dimensional models of net feet of porosity, as determined by geophysical log analysis, for greater than 10 percent porosity. (left) Upper Ismay zone, Cherokee field, and (right) lower Desert Creek zone, Bug field.



Publications

Eby, D.E., and Chidsey, T.C., Jr., 2001, Heterogeneous carbonate buildups in the Blanding sub-basin of the Paradox Basin, Utah and Colorado - targets for increased oil production using horizontal drilling techniques [abs.]: American Association of Petroleum Geologists Annual Convention, Official Program with Abstracts, v. 10, p. A55.

Chidsey, T.C., Jr., 2002, Carbonate buildups in the Paradox Basin, targeted for horizontal drilling: U.S. Department of Energy, The Class Act, v. 8, no. 1, p. 3-6.

Chidsey, T.C., and Eby, D.E., Jr., 2002, Reservoir diagenesis and porosity development in the upper Ismay zone, Pennsylvanian Paradox Formation, Cherokee field, southeastern Utah [abs.]: American Association of Petroleum Geologists Rocky Mountain Section Meeting Official Program Book, p. 20-21.

Chidsey, T.C., Jr., 2003, An up close and personal view of Cherokee oil field, San Juan County, Utah: Utah Geological Survey, Survey Notes, v. 35, no. 2, p. 1-3.

Eby, D.E., Chidsey, T.C., Jr., Morgan, C.D., and McClure, K., 2003, Regional facies trends in the upper Ismay zone of the Blanding sub-basin of the Paradox Basin, Utah – aids for identifying possible targets for horizontal drilling [abs.]: American Association of Petroleum Geologists Annual Convention, Official Program with Abstracts, v. 12, p. A48.

Chidsey, T.C., Jr., Morgan, C.D., and McClure, K., 2004, Outcrop analogs in Utah – templates for reservoir modeling [abs.]: American Association of Petroleum Geologists Annual Convention, Official Program with Abstracts, v. 13, p. A24.

10 Semi-Annual Technical Progress Reports U.S. Department of Energy, DOE/BC15128-1-10.

Project Start: April 6, 2000

Project End: June 30, 2006

Anticipated DOE Contribution: \$358,854

Performer Contribution: \$668,726 (65 percent of total)

Other Government Organizations Involved: Geologic Surveys of Colorado and Utah

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