UTAH GEOLOGICAL SURVEY

December 1999

Petroleum News

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PUBLICATION SALES

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UGS Awarded DOE Class II Grant To Study Ways of Increasing Oil Production in Paradox Basin

Over 400 million barrels of oil have been produced from shallow-shelf carbonate reservoirs in the Pennsylvanian Paradox Formation (primarily the Ismay and Desert Creek zones) in the Paradox Basin of Utah, Colorado, and Arizona. The Ismay zone is dominantly limestone consisting of approximately equal amounts of phylloid-algal buildup facies, and local, rapidly changing small-scale subfacies. The Desert Creek zone, dominantly dolomite, comprises highly aligned, linear facies tracts deposited along regional shoreline trends. With the exception of the giant Greater Aneth field *(see map on Page 2)*, each of the 75-plus oil fields in the basin typically contains 2 to 10 million barrels of original oil in place. Most of these fields are characterized by high initial production rates followed by a very short production life (primary) and hence early abandonment. Only 15 to 25 percent of the original oil in place is recoverable during primary production from conventional vertical development wells.

The total cost of the Utah Geological Survey (UGS) project will be $1.03 million. Funding will come from the U.S. Department of Energy's Reservoir Class Field Demonstration Program — Revisit, the UGS, the Colorado Geological Survey (CGS), and private industry. The 5-year project will study how to extract as much as another 50 million barrels of oil from existing wells in the basin. The study is entitled "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."

An extensive and successful horizontal drilling program has been conducted by Mobil and Texaco in the Greater Aneth field. However, to date, only two horizontal wells have been drilled in small Ismay and Desert Creek fields. The results from these wells were disappointing due to poor understanding of the carbonate facies and diagenetic fabrics which have created reservoir heterogeneity. The small fields in the Paradox Basin are at high risk of early abandonment. At least 200 million barrels of oil is at risk of being left behind in these small fields because of inefficient development practices that leave heterogeneous reservoirs undrained. With proper geological evaluation of the reservoirs, production may be increased by 20 to 50 percent through the use of horizontal, and possibly multi-lateral horizontal, drilling techniques that can be achieved at a cost lower than conventional drilling techniques. In addition, horizontal drilling allows for minimal surface disturbance during field development, particularly in the environmentally sensitive areas of southeastern Utah and southwestern

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New Paradox Study

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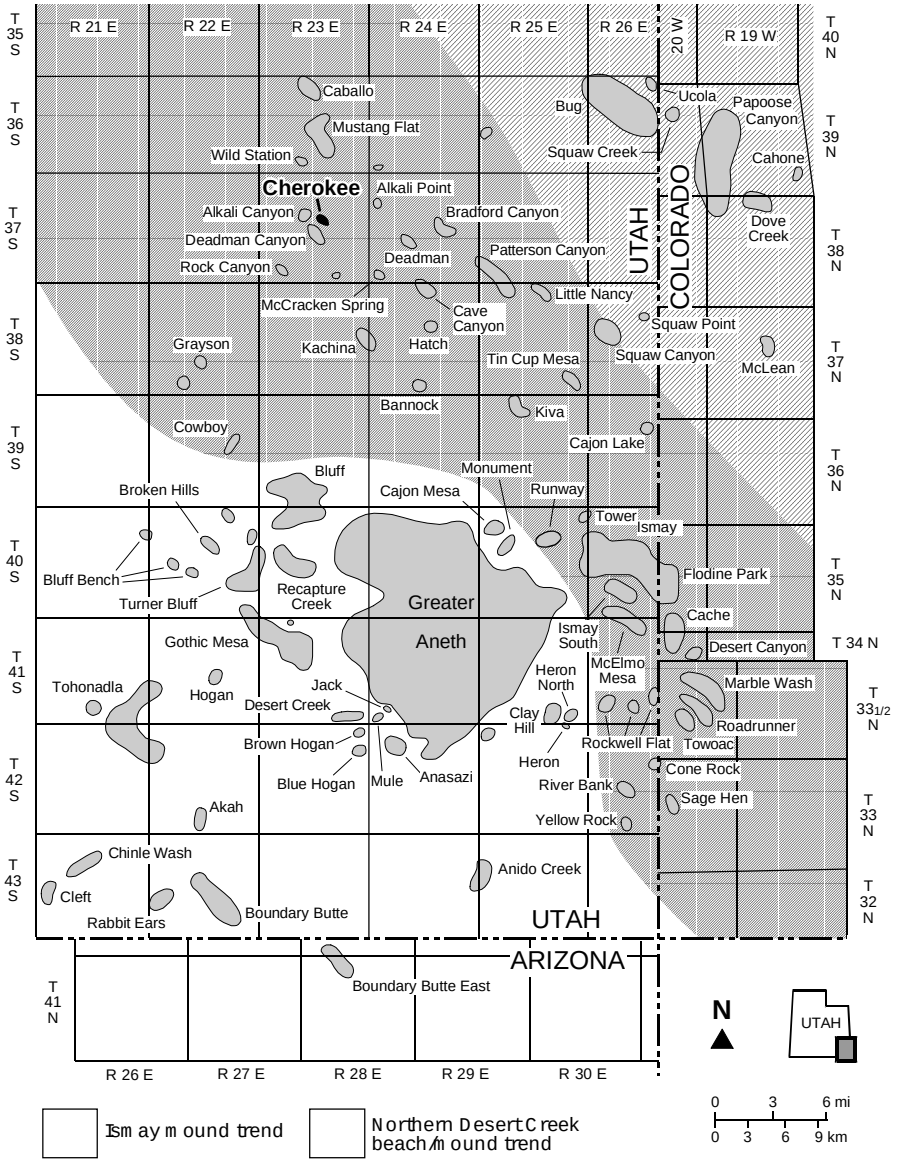
Colorado.

A three-phase, multidisciplinary approach will be used to increase production and reserves from the shallow-shelf carbonate reservoirs in the Ismay and Desert Creek zones within the Paradox Basin. ***Phase 1*** will be geological and reservoir characterization of selected, diversified small fields, including Cherokee field in San Juan County, Utah *(see figure below)*. The aim is to find a target for the pilot demonstration project among field(s) having the greatest potential for increased well productivity and ultimate recovery. Phase 1 will include: (a) determination of regional geological setting; (b) field-scale geologic analysis to focus on the reservoir heterogeneity, quality, and lateral continuity versus compartmentalization within the fields; (c) extensive reservoir mapping including lithologic, microfacies, porosity, permeability, and net pay maps; (d) determination of field reserves and recovery; and (e) integration of geological data in the planning of the horizontal well(s).

Phase 2 will be a demonstration project on the field(s) selected from the geologic and reservoir characterization study using the horizontal drilling technique(s) identified as having the greatest potential for increased well productivity and ultimate recovery. The demonstration project will involve drilling one or more horizontal development wells (possibly with multiple horizontal legs) to maximize production. If mechanically and more economically viable, existing wells may be re-entered and multiple horizontal laterals drilled to the zones of greatest potential.

Phase 3 will include: (a) reservoir management and production monitoring, (b) economic evaluation of the results, and (c) determination of the application(s) of the project results to similar fields both in the Paradox Basin and throughout the U.S.



Location of oil fields in the Paradox Basin. The testing will be done in the Cherokee field, San Juan County, Utah

Phases 1, 2, and 3 will have continuous but separate technology transfer activities including: (a) an industry outreach program and project newsletters; (b) core workshop/seminars in Salt Lake City; (c) publications and technical presentations; (d) project home pages on the UGS and OGS Internet web sites; (e) digital databases, maps, and reports; and (f) a summary of regulatory, economic, and financial needs.

DOE Secretary Bill Richardson, in announcing the grant, said, "The oil industry in the United States is increasingly an industry of smaller companies, many of which are family-owned businesses. These companies account for nearly half the oil produced in the lower 48 states. Our support will help them develop and deploy technologies that otherwise would probably never make it into the oil field, certainly not on a widespread basis. Our hope is that these projects will show hundreds of other small companies ways to keep their wells flowing."

The project management and technical team, headed by UGS Principal Investigator Thomas C. Chidsey, Jr., will include Seeley Oil Company of Salt Lake City, the OGS, and Eby Petrography & Consulting, Inc. The project will be guided by a technical advisory board, comprising industry partners who are currently operators of fields in the basin, and a stake-holders board, comprising representatives from Utah's and Colorado's governments, the Ute Mountain Ute Indian Tribe, and the U.S. Bureau of Indian Affairs.

Paradox Project Moves to Reservoir Diagenetic Analysis

U.S. Department of Energy
Class II Oil Program

Project Title
Increased Oil Production and Reserves Utilizing Secondary/Tertiary Recovery Techniques on Small Reservoirs in the Paradox Basin, Utah

Principal Investigator
Thomas C. Chidsey, Jr.

The primary objective of this project is to enhance domestic petroleum production by demonstration and technology transfer of an advanced oil recovery technology in the Paradox Basin, southeastern Utah. If this project can demonstrate technical and economic feasibility, the technique can be applied to about 75 additional small fields in the Paradox Basin alone, and result in increased recovery of 150 to 200 million barrels of oil.

This project is designed to characterize five shallow-shelf carbonate reservoirs in Desert Creek zone of the Pennsylvanian (Desmoinesian) Paradox Formation and choose the best candidate for a pilot demonstration project for either a waterflood or carbon dioxide (CO_2) flood project. The field demonstration, monitoring of field performance, and associated validation activities will take place in the Paradox Basin within the Navajo Nation. The results of this project will be transferred to industry and other researchers through a petroleum extension service, creation of digital databases for distribution, technical workshops and seminars, field trips, technical presentations at national and regional professional meetings, and publication in newsletters and various technical or trade journals.

Summary of Technical Progress

Two activities are part of the geological and reservoir characterization of productive carbonate buildups in the Paradox Basin: (1) reservoir diagenetic analysis of fields (Fig. 1), and (2) technology transfer.

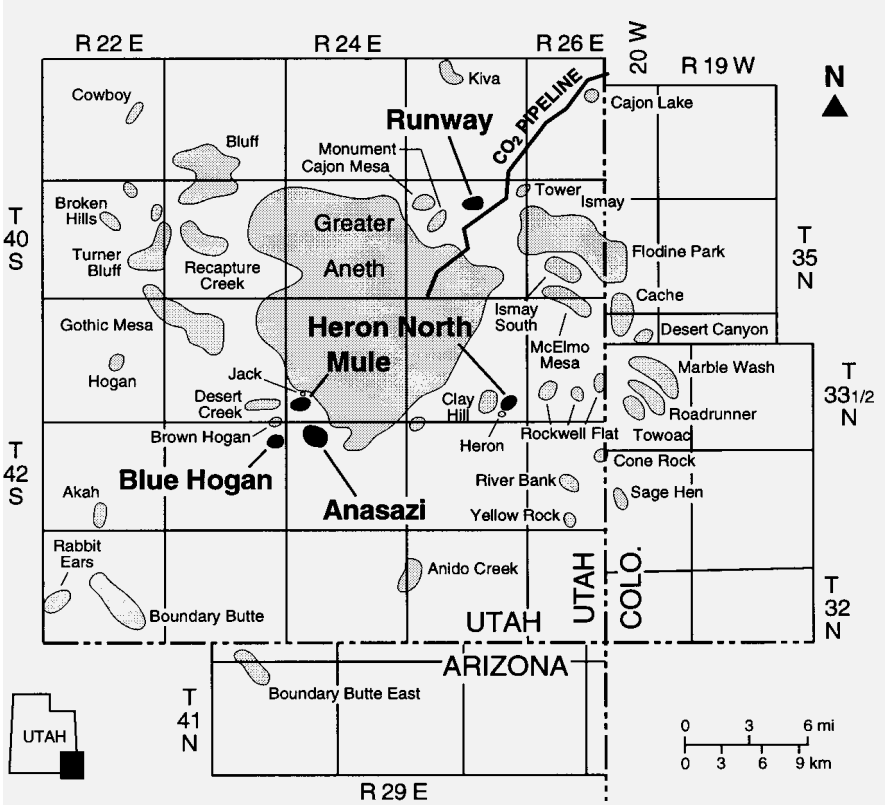


Figure 1. Location of project fields (dark shaded areas with names in bold type) in southwestern Paradox Basin on the Navajo Nation, San Juan County, Utah

Reservoir Diagenetic Analysis of Project Field Reservoirs

The diagenetic fabrics and porosity types found in the various hydrocarbon-bearing rocks of each field can be indicators of reservoir flow capacity, storage capacity, and potential for water and/or CO_2 flooding. Researchers analyzed the reservoir diagenetic fabrics and porosity types of these carbonate buildups to: (1) predict facies patterns, (2) determine the sequence of diagenetic events, and (3) provide data input for the reservoir modeling and simulation studies. In order to determine the diagenetic histories of the various Desert Creek reservoirs, 50 thin sections of representative samples were selected from the conventional cores of each field for petrographic description and to evaluate shallow-shelf/shelf-margin phylloid-algal, bryozoan, and calcarenite carbonate buildups.

Diagenetic characterization focused on reservoir heterogeneity, quality, and compartmentalization within each of the five project fields. All depositional, diagenetic, and porosity information was placed into the context of the production history of each

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Paradox Project

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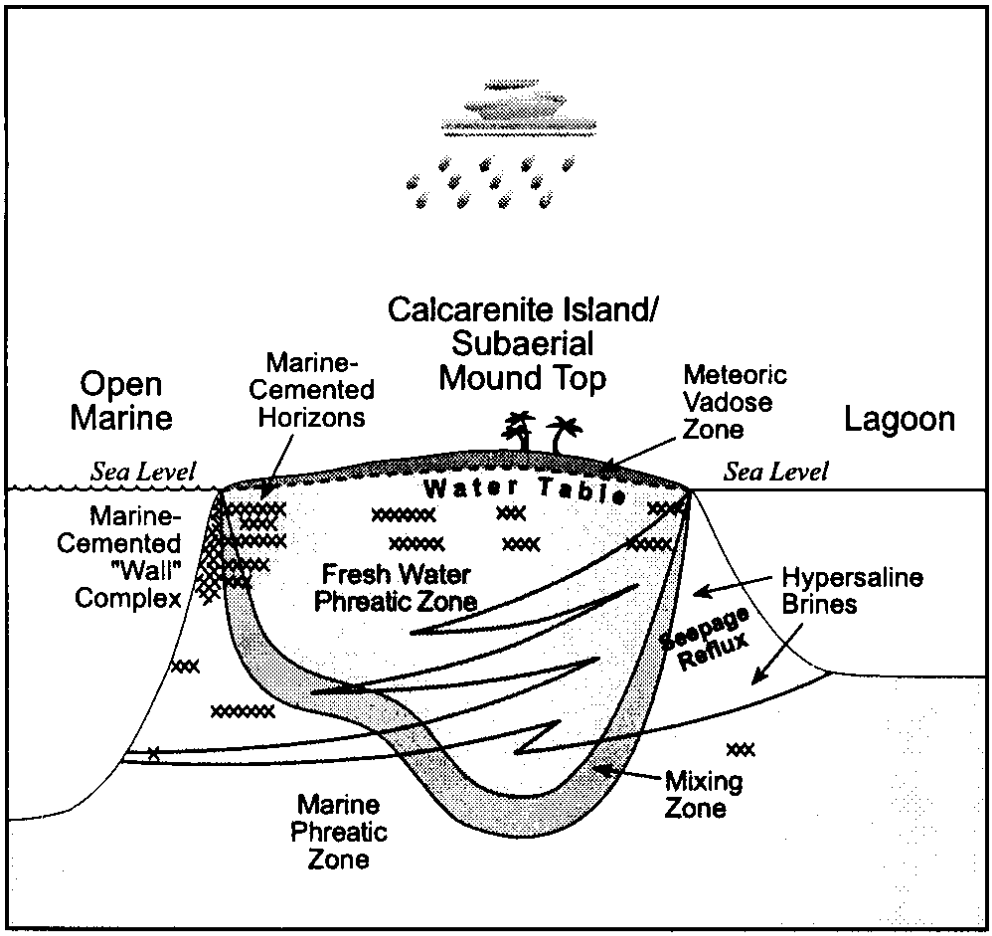
field in order to construct a detailed overview for each enhanced recovery candidate. Determination of the most effective pore systems for oil drainage versus storage is of special interest to reservoir engineers.

Diagenetic Environments

Most shallow-shelf/shelf-margin carbonate buildups or mounds were subaerially exposed when sea level fell during various times in the Pennsylvanian. This setting produced four major, generally early, diagenetic environment zones (Figs. 2 and 3): (1) a fresh-water (meteoric) vadose zone (above the water table, generally at or near sea level), (2) a meteoric phreatic zone (below the water table), (3) a marine phreatic zone, and (4) a mixing zone. The "iceberg" principle (the Ghyben-Herzberg theory) can generally be applied to both carbonate mound and island buildups. This principle states that for every foot the water table rises above sea level there may be 20 feet of fresh water below the water table, a 1:20 ratio. Neomorphism, leaching/dissolution, and fresh-water cementation (dog-tooth, stubby, and small equant calcite) took place within the vadose and fresh-water phreatic zones.



Modified from Longman, 1980

Fig. 2. Diagrammtic cross section showing distribution of the early diagenetic environments of subaerially exposed shallow-shelf margin carbonate buildups of mounds found in the Desert Creek zone of the Paradox Formation, Southern Paradox Basin

The meteoric and marine phreatic zones were separated by a mixing zone (fresh and sea water); the location of these zones changed with sea level fluctuation. Dissolution creating molds, vugs, and channels, is the dominant porosity-enhancing process of meteoric diagenesis. Locally, meteoric diagenesis enhances reservoir performance. Extensively leached intervals may have both excellent storage and flow capacity, and should be considered candidates for CO_2-flooding projects. Microporosity, from lime mud and dissolution, increases storage capacity but limits fluid recovery. Early dolomitization took place in the mixing zone. Most carbonate buildups (fields) have a mixing zone as well as a fresh-water overprint. Locally, mixing-zone dolomitization may reduce or enhance reservoir performance. Affected intervals may have a modest to good storage capacity; flow capacity can be highly variable.

That portion of the carbonate buildup facing the open-marine environment was generally a steep-wall complex where early-marine cements (such as fibrous isopachous, botryoidal, and radiaxial cements) were deposited from invading sea water flowing through the system. The opposite side of the mound typically bordered a hypersaline lagoon filled with dense brine that seeped into the phreatic zone (seepage reflux) to form a wedge-shaped zone of low-temperature dolomite, both early replacement dolomite and dolomite cement. Seepage reflux dolomization is usually complete dolomitization. Little original fabric/matrix remains. Locally, seepage reflux dolomitization can enhance both reservoir flow and storage capacity. Those reservoirs with excellent storage capacity may be considered candidates for CO_2-flooding projects.

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Paradox Project

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Late (post-burial) diagenesis included syntaxial cementation, silicification, late calcite spar, saddle dolomite, stylolitization, bitumen plugging, and anhydrite replacement (Fig. 3). There is an observed progression from least to most important (syntaxial cementation to anhydrite replacement) in terms of the effects on reservoir quality in the case-study fields. Syntaxial cementation and silicification have relatively little effect whereas anhydrite replacement can greatly reduce reservoir quality. Some of these late diagenetic products create barriers and baffles to fluid flow, increasing reservoir heterogeneity. They are not observed on seismic records, are difficult to predict, and locally influence reservoir performance, storage capacity, and drainage. Finally, these post-burial diagenetic processes are not as significant in the case-study fields as earlier diagenetic modifications.

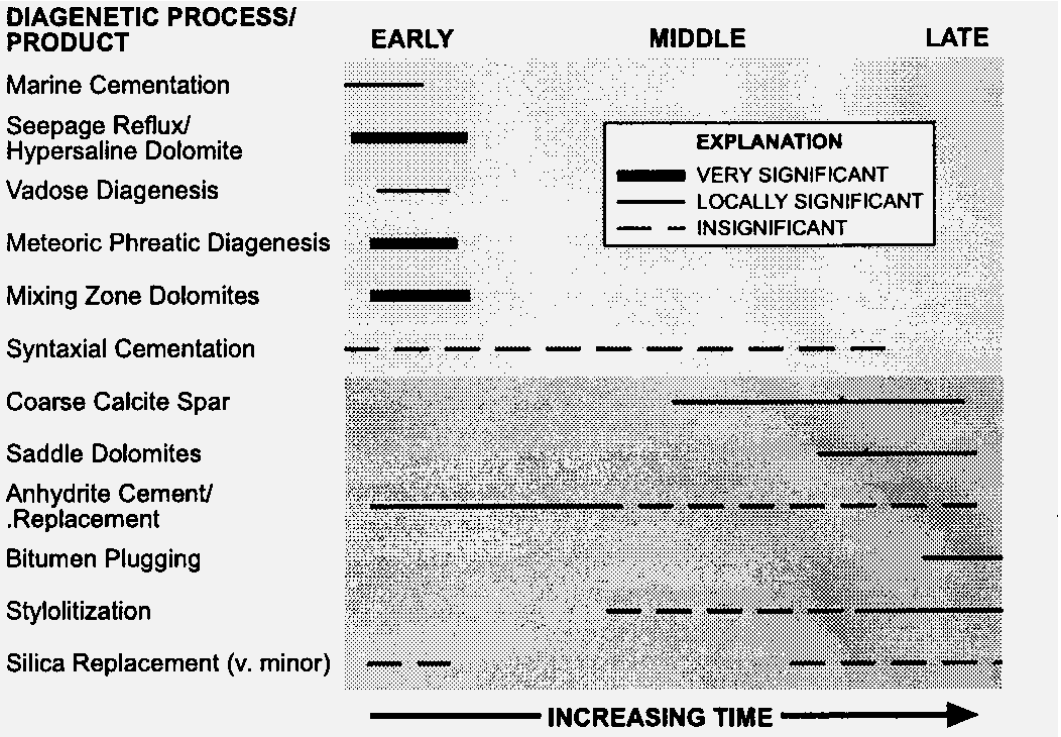

Fig. 3. Ideal diagenetic sequence through time, including processes and products

Based on this work, the UGS is preparing a compact disc-catalogue of Desert Creek zone diagenetic fabrics and porosity types. The CD should be available in 2000.

Technology Transfer

David E. Eby presented *Upper Devonian Carbonate Buildups Impersonating Paradox Basin Phylloid Algal Mounds* as a talk at the monthly meeting of the Rocky Mountain Section of the SEPM (Society for Sedimentary Geology) on April 29, 1999, and as a poster session at the 11th Bathurst Conference, July 13-15, 1999, at Cambridge University, United Kingdom. The presentations compared the geologic characterization of carbonate mound buildups within the Paradox Basin to potentially hydrocarbon-productive Devonian buildups in western Canada and eastern Europe.

Project material was displayed at the UGS booth during the American Association of Petroleum Geologists (AAPG) annual convention held in San Antonio, Texas, April 11-14, 1999, and at the Rocky Mountain Section AAPG meeting in Bozeman, Montana, August 7 - 11, 1999. At the San Antonio convention, Paradox team members presented a poster entitled *Diagenetic Characterization of Shallow-Shelf Carbonate Reservoirs, Pennsylvanian Paradox Formation, Southern Paradox Basin, Utah*, describing reservoir pore types and diagenesis (summarized above) in the five project fields, and how these factors were used in the modeling and flow simulations.

A talk entitled *Increased Oil Production and Reserves Utilizing Secondary/Tertiary Recovery Techniques on Small Reservoirs in the Paradox Basin, Utah*, by T.C. Chidsey, Jr. and C.D. Morgan, was presented at the DOE-sponsored 1999 Oil & Gas Conference, "Technology Options for Producer Survival," in Dallas, Texas, June 29. The presentation summarized the project results to date and plans for the CO_2 pilot flood demonstration. A summary paper is available in the DOE/Federal Energy Technology Center's Proceedings Volume.

A summary article was published in the *Oil & Gas Journal* (May 1999) describing the facies and reservoir characteristics of the project fields, and the Anasazi field and Runway field modeling and simulation results. A poster entitled *Mule Field in the Paradox Basin in Southeastern Utah: A Case Study for Small Carbonate Buildups, Horizontal Drilling, and Carbon Dioxide Flooding* was presented at the AAPG Rocky Mountain Section meeting in Bozeman, Montana, August 10, 1999.

The project home page on the UGS Internet web site **(www.ugs.state.ut.us/paradox.htm)** was updated with the latest quarterly technical report.

Bluebell Field Study Completed

A five-year study of ways to increase primary oil production from the Bluebell field, Uinta Basin, Utah, officially concluded on September 30, 1999. A research team headed by the Utah Geological Survey (UGS) conducted a reservoir characterization study and field demonstration under the auspices of the U.S. Department of Energy's National Petroleum Technology Office, Class I Field Demonstration Program.

U.S. Department of Energy
Class I Oil Program

Project Title
Increased Oil Production and Reserves from Improved Completion Techniques in the Bluebell Field, Uinta Basin, Utah

Principal Investigator
Craig D. Morgan

Overview

While operators have recovered large amounts of oil from the Bluebell field, significant reserves remain untapped due to a lack of detailed understanding of the reservoir properties and inefficient completion practices. Hydrocarbons from the Bluebell field are contained in the Tertiary-age Green River and Colton Formations, but productive intervals consist of thousands of feet of interbedded, fractured clastic and carbonate beds deposited in a lacustrine environment. The primary recovery technique of perforating 40 or more beds in 1,000- to 3,000-vertical-foot intervals, then acid-stimulating the entire interval, may have damaged potentially productive beds and left others untreated.

Objective

The UGS-led research team used three wells to test two different completion methods. The Michelle Ute 7-1 and John Chasel 3-6A2 wells were intended to be three-stage, high-diversion, high-pressure acid treatments. Each stage consisted of a 500-foot vertical interval with more than 10 beds perforated in each interval, but both demonstrations were severely hampered by mechanical problems and did not return usable data. The Malnar Pike 1-17A1E well, designed to be an acid treatment at the bed scale and intended to isolate and treat four individual beds, did improve the oil-production rate, but not to a degree considered significant.

Conclusions

Although disappointing, the results from the three demonstrations provided operators with insights into reservoir behavior that could lead to improved completion methods. Beds with fractures generally took most of the acid while beds without fractures took little to no acid. The pressure used to treat both the Michelle Ute and Malnar Pike wells was probably too low to hydraulically induce new fractures. Based on the experience of other operators in the Bluebell field, the multi-staged completion technique may be the most effective method for new wells and recompletion of older wells. But after a well has been recompleted numerous times, the cost-effectiveness of continuing to do large, multi-stage treatments rapidly decreases. At that point, the smaller bed isolation recompletion technique used in the Malnar Pike well may be more efficient.

Based on the experience of the Malnar Pike demonstration, operators in the Bluebell field may want to consider the following when using the bed isolation completion technique:

1. Set both the upper and lower packer between perforated intervals that are at least 50 feet apart to reduce the risk of fluid communication.
2. Use the anisotropy and dual-burst thermal decay time logs and select beds that are fractured and have relatively low water saturation.
3. Use a treating pressure high enough to fracture the formation, especially if the anisotropy log indicates that some of the beds being treated do not have fractures.

Technology Transfer

Project Manager Craig D. Morgan presented a poster display at the American Association of Petroleum Geologists Annual Convention in San Antonio, Texas, in April 1999 entitled *Detailed Gamma-Ray Log Correlations to Understand Depositional Patterns of a Fluvial-Deltaic Lacustrine Reservoir.* He also presented a poster session entitled *Bed-Isolation Treatments of a Mature Well in the Bluebell Field of the Uinta Basin, Utah, That has Undergone Numerous High Volume Shotgun Completions* at the June 1999 Oil and Gas Conference on Technology Options for Producer Survival in Dallas, Texas. The conference was sponsored by the DOE, Office of Fossil Energy,

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Bluebell Project

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Federal Energy Technology Center and NPTO.

Morgan also wrote Application of the *Bed-Isolation Completion Technique in a Mature Well in the Bluebell Field, Uinta Basin, Utah,* which was published in the summer 1999 DOE/NPTO's newsletter *The Class Act* , volume 5/2.

The Final Technical Report is currently being reviewed by the DOE. After the report is accepted, an Acrobat™ pdf-format file of the report will be put on CD-ROM along with the five annual technical reports. The CD will be submitted to the UGS for release as a digital publication. All reports are available on the web site.

Two reports have been submitted for consideration as UGS Bulletins:

1. *Characterization of the Bluebell Oil and Gas Field, Uinta Basin, Utah* by Craig D. Morgan, M.L. Allison, J. Wallace Gwynn, Utah Geological Survey; Richard Curtice, Halliburton Energy Services; Milind D. Deo, University of Utah Department of Chemical and Fuels Engineering; Thomas H. Morris, Brigham Young University Department of Geology; and Carol N. Tripp, Consulting Geologist; with a section on *Log-Derived Porosity and Lithology* by Richard Jarrard, University of Utah Department of Geology and Geophysics.
2. *The Utah Geological Survey and U.S. Department of Energy's Well Demonstration Program in the Bluebell Field, Uinta Basin, Uintah and Duchesne Counties, Utah* by Craig D. Morgan, Utah Geological Survey, and Milind D. Deo, University of Utah Department of Chemical and Fuels Engineering.

In addition, the UGS maintains a web site with a Bluebell home page containing a description of the project, a list of project participants, each of the Quarterly Technical Progress Reports, portions of the Annual Technical Progress Reports with information on where to obtain complete reports, a reference list of all publications that are a direct result of the project, an extensive selected reference list for the Uinta Basin and lacustrine deposits worldwide, and daily activity reports of the demonstration wells. The home page address is ***www.ugs.state.ut.us/bluebell.htm.***

Utah Geological Survey Prepares Digital Geologic Resource Atlas of Utah

The Utah Geological Survey (UGS) has compiled a half-century's worth of the state's geographic and geologic information on a single compact disc. The Digital Resource Atlas of Utah contains selected geologic and geographic spatial data, including energy- and mineral-related files compiled by the UGS and other government agencies. It was compiled by UGS Senior Geologist Douglas A. Sprinkel.

Although a comprehensive resource assessment is necessary to fully evaluate the geologic resources or land-use conflicts of an area, reviewing the data in an atlas such as this is the first step in any comprehensive resource evaluation. The information can help industry, decision-makers, and other interested parties identify exploration trends and understand energy, mineral, and water development as it relates to land-use issues.

The CD contains more than 600 megabytes of illustrations and distribution information on Utah's geologic resource in each of the state's 30 x 60-minute quadrangle maps. A copy of ESRI™ ArcExplorer™ is included on the CD to allow users to view the data and construct derivative maps. Several geographic information systems (GIS) themes, or map layers, are also included. The user can display geologic resource themes or layers in context with familiar geographic themes such as county boundaries, cities, and roads using GIS software.

Geologic-based spatial data are mostly from the database files of the UGS, and some files of the U.S. Bureau of Land Managment. Statewide resource data include locations of coal mines, oil and gas wells, oil shale and tar sand deposits, and geothermal sites. In addition, the CD contains spatial data from the Division of Water Rights, as well as layers showing roads, airports, bodies of water, streams and rivers, transportation lines, cities, land ownership, and proposed wilderness areas gleaned from information available from the Automated Geographic Reference Center, the School and Institutional Trust Lands Administration, the U.S. Bureau of Mines, and the U.S. Census Bureau. The CD is also loaded with the metadata and a technical manual.

The CD is available from the Natural Resources Map & Bookstore for $49.95.

Lower Green River Formation Reservoir Characterization Study Begins

Under a grant from the U.S. Department of Energy's (DOE) National Petroleum Technology Office, the Utah Geological Survey (UGS) and its university and industry partners began a three-year study on October 1, 1998, to find ways to increase oil production in existing fields and to identify prospective areas for new fields in the Uinta Basin. The study is part of the ongoing research being conducted under the DOE's Fundamental Geoscience for Reservoir Characterization Program.

The UGS's partners in the study are Milind Deo, Ph.D., University of Utah Department of Chemical and Fuels Engineering; S. Robert Bereskin, Ph.D., Tesseract Corp.; Inland Resources Inc.; and Halliburton Energy Services.

U.S. Department of Energy
Fundamental Geoscience for Reservoir Characterization Program

Project Title
Reservoir Characterization of the Lower Green River Formation, Southwest Uinta Basin, Utah

Principal Investigator
Craig D. Morgan

Overview

The research team will investigate the subsurface and surface geology of the Green River Formation in the Monument Butte and Roan Cliffs areas of the Uinta Basin. The project will be divided into eight tasks: (1) subsurface correlations, (2) surface correlations, (3) petrophysics, (4) geological modeling, (5) hydraulic fracture analysis, (6) geostatistics and numerical simulation modeling, (7) technology transfer, and (8) administration. The first, second, fourth, fifth, and sixth tasks are well underway, while the third is just beginning. The last two tasks are ongoing activities carried out during the entire project period.

Subsurface Correlations

The research team has identified 22 log cycles and has recorded boundaries, feet of sandstone per cycle, and feet of sandstone with 10 percent or more porosity per cycle. Currently, about 600 wells are correlated and have data entered into a spreadsheet which will be added to an ArcView™ project file and used for mapping. In addition, the team has begun describing core from the study area. These descriptions help in interpreting depositional environments and determining what factors characterize reservoir-quality rock. Core study also includes thin section and scanning electron microscope analysis to help interpret the regional diagenesis of the rock.

Surface Correlations

The team's field work has included measuring, describing, and gathering gamma-ray data from more than 1,900 feet of continuous exposures in Willow Creek Canyon and about 1,300 feet of continuous exposures in Nine Mile Canyon. The gamma-ray data were used to generate two logs that will be compared with gamma-ray logs run in oil wells. This will provide much more detailed subsurface-to-surface correlation than previously possible. Future field work will involve selecting one or more study sites in Nine Mile Canyon, where the team will study a 30- to 90-foot-thick depositional cycle in detail as an analog for the oil production in the Monument Butte area north of Nine Mile Canyon.

Geostatistics and Numerical Simulation Modeling

The team has begun modeling the Monument Butte field and is incorporating in the model the effects of hydraulically induced fractures on the reservoir performance.

Technology Transfer

The UGS presented a poster display at the American Association of Petroleum Geologists Regional Meeting in Bozeman, Montana, August 10, 1999, entitled *A Log-Based Correlation Scheme for the Middle and Lower Members of the Green River Formation, Southwest Uinta Basin.*

The project has its own information page on the UGS website at ***www.ugs.state.ut.us/greenriv.htm***

Sample Library Trust Fund Receives Major Donation

Amoco donated $50,000 to the Utah Geological Survey's Sample Library trust fund, and provided 100 drill holes of Sunnyside tar sand core from Carbon County, eight core examination tables, a work table, core saw, trimmer, drill press, and metal strapping machine, and supporting documents containing maps, reports, articles, and other miscellaneous material pertaining to the Sunnyside tar sands.

The Sample Library also received a total of 386,902 feet of drill core and cuttings from January 1 through November 5, 1999, including 87,858 feet of core and 299,044 feet of cuttings. The number of wells/drill holes donated totaled 244, including core from 160 and cuttings from 84. In addition, there were 1,050 requests for information, including 518 from industry, 37 from the federal government, six from state government, 479 from educational institutions, and 10 from the general public. The types of requests included 46 for core, 60 for cuttings, 852 for data, 81 for oils, one for tar sands, and 10 for tours. Mobil Oil conducted a short course attended by 19 people, the University of Utah held a core workshop for 25 students and one professor, and the Prehistory Week Open House attracted over 500 Utah school children, Boy Scouts, Girls Scouts, and Cub Scouts.

Number of wells/drill holes donated per county:

Beaver	4	Emery	8	Uintah	27
Carbon	119	Grand	1	Utah	1
Duchesne	2	San Juan	21	Out of state	61

Other data donated:

Gas Chromatography – Flame Ionization Detector (EGI)
Outcrop, subsurface, and seismic mapping of a basal transgressive sand (W.O. Abbott)
AAPG Memoir 26 (W.O. Abbott)
Clastic core workshop binders with core photographs (W.O. Abbott)
Logs and technical data regarding Quintana Oil Exchange

Geotechnical reports for the following wells:

Balcron #23-25 Monument Federal
Balcron #33-8 Monument Butte Federal
Balcron #33-11J Monument Butte
Balcron #23-25 Federal
Inland 3A-35 Monument Butte
Celsius #16 Island Unit
Diamond Shamrock 34-5 Allen
Diamond Shamrock 34-8 Paiute
Natural Gas Corp 13-16J State
Sunnyside tar sand wells
Cactus Mine 520-1, 2, 3, 4 (EGI)

Cuttings and Core

The following is a breakdown by region of the drill cuttings and core received from January 1 to November 5, 1999 (all locations are relative to the Salt Lake Base Line and Meridian (SLBM) unless identified as being within the Uinta Base Line and Meridian (UBM

Basin and Range

EGI donated 16,843 feet of core from the following wells:

Well Name/No	County	Location
Cactus Mine 520-1	Beaver	3-27S-13W
Cactus Mine 520-2	Beaver	10-27S-13W
Cactus Mine 520-3	Beaver	3-27S-13W
Cactus Mine 520-4	Beaver	4-27S-13W

Castle Valley

Amoco donated 64,732 feet of Sunnyside Tar Sand cores from Carbon County. The drill holes are too numerous to list here but information concerning them may be obtained by calling the Utah Geological Survey Sample Library at **801-537-3359.**

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Ferron Coalbed Methane Fairway

Anadarko Petroleum donated 51,404 feet of drill cuttings from the following wells:

Well Name/No	County	Location
Helper Federal B-13	Carbon	28-13S-10E
Helper Federal B-14	Carbon	28-13S-10E
Helper Federal B-2	Carbon	33-13S-10E
Helper Federal B-3	Carbon	33-13S-10E
Helper Federal B-4	Carbon	33-13S-10E
Helper Federal B-10	Carbon	34-13S-10E
Helper Federal B-11	Carbon	34-13S-10E
Helper Federal B-12	Carbon	34-13S-10E
Helper Federal D-4	Carbon	35-13S-10E
Helper State E-1	Carbon	36-13S-10E
Helper State E-2	Carbon	36-13S-10E
SE Investments A-1	Carbon	6-14S-10E
Helper Harmond A-1	Carbon	7-14S-10E
Helper Federal F-1	Carbon	8-14S-10E
Oliveto Federal A-2	Carbon	8-14S-10E
Helper State A-14	Carbon	11-14S-10E
Miller Creek State A-1	Carbon	36-15S-8E
Miller Creek C-1	Carbon	12-16S-8E

Paradox Basin

Ballard Petroleum donated 74,432 feet of core and cuttings from the Paradox Basin: 28,500 feet from San Juan County, Utah, and 45,932 feet from the Colorado portion of the basin.

Thrust Belt

Doris Glass donated several spot cores from the Thrust Belt.

Uinta Basin

CNG Producing donated 43,142 feet of drill cuttings from the following wells:

Well Name/No	County	Location
West Willow Creek 3-25B	Uintah	25-9S-19E
RBU 13-34B	Uintah	36-9S-19E
RBU 2-14E	Uintah	14-10S-19E
State (Wildhorse Bench) 1-36E	Uintah	36-10S-19E
RBU-13-3F	Uintah	13-10S-20E
RBU 15-14F	Uintah	14-10S-20E
RBU 3-16F	Uintah	16-10S-20E
RBU 7-20F	Uintah	20-10S-20E
RBU 6-23F	Uintah	23-10S-20E

Coastal Oil and Gas Corporation donated 51,512 feet of drill cuttings from the following wells:

Serawop 34-48	Uintah	34-8S-21E
Tribal 31-62	Uintah	31-8S-22E
Hall 31-61	Uintah	31-8S-22E
McCook 1-66	Uintah	1-9S-21E
Ouray 5-68	Uintah	5-9S-21E
Jenks 5-41	Uintah	5-9S-21E
Ouray 5-72	Uintah	5-9S-21E
Ouray 6-82	Uintah	6-9S-21E

Chandler Incorporated donated 6,650 feet of drill cuttings from the following well:

Well Name/No	County	Location
Glen Bench 2-36-8-21	Uintah	36-8S-21E

Coastal Oil and Gas Corporation donated 53,260 feet of drill core and cuttings from the following wells:

Well Name/No	County	Location
Ute 2-5C6	Duchesne	5-3S-6W
Vincent 1-19	Uintah	19-5S-23E
Tribal 35-51(re-entry)	Uintah	35-8S-21E
State Tribal 35-52(re-entry)	Uintah	35-8S-21E
Ouray 35-80	Uintah	35-8S-21E
Glen Bench 12-36-8-21	Uintah	36-8S-21E
Tribal 36-53	Uintah	36-8S-21E
Ouray 5-67	Uintah	5-9S-21E
Ouray 6-66	Uintah	6-9S-21E

Uncompahgre Uplift

The Gulf Canada Seismosaur Federal #1, Grand County, Section 20, T21S, R20E was released from confidential status February 1999 with drill cuttings totaling 10,580 feet.

Utah/Colorado/Wyoming

Ward O. Abbott donated cores from Utah, Colorado, and Wyoming representing various types of sands: eolian, braided stream, shoreface delta, fluvial channel, point bar, distributary channel, shelf, basal transgressive, turbidite.

Drill core from one confidential well was donated.

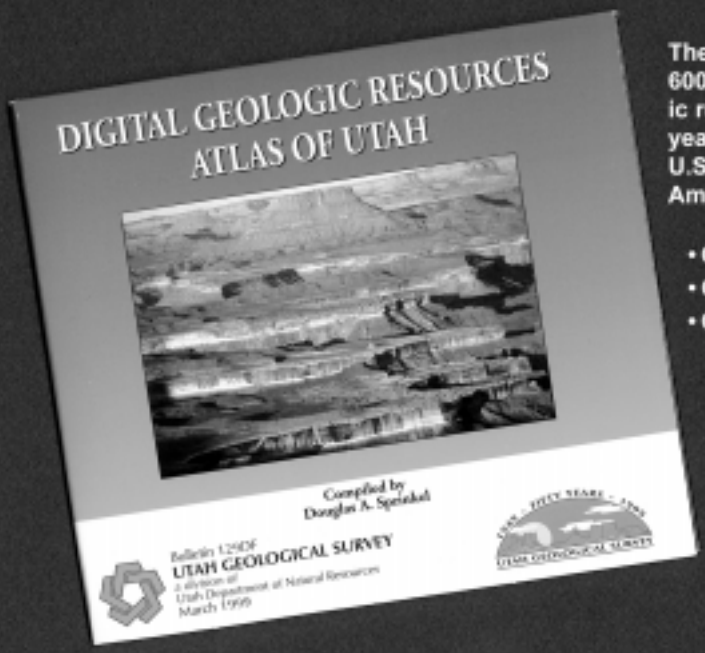
UGS on the Web

The UGS's home page on the Internet includes a page under the heading **Economic Geology Program,** which describes the UGS/DOE cooperative studies, contains the latest issue of ***Petroleum News,*** and has a link to the DOE web site. Each cooperative study also has its own page. Each page contains a project location map, a description of the project, a list of project participants and their postal addresses and phone numbers, executive summaries from annual reports, all **Quarterly Technical Progress** reports, a reference list of all publications that are a direct result of the project, and a listing of available project publications. The web site addresses are:

UGS home page — http://www.ugs.state.ut.us

Ferron Sandstone Project — http://www.ugs.state.ut.us/ferron1.htm
Bluebell Project — http://www.ugs.state.ut.us/bluebell.htm
Paradox Project — http://www.ugs.state.ut.us/paradox.htm
Green River Project — http://www.ugs.state.ut.us/greenriver.htm

In addition, the UGS has established a hot link to the **Midway-Sunset Project** web site, which is maintaind by the University of Utah's Energy & Geoscience Institute.



The Digital Geologic Resources Atlas of Utah contains over 600 megabytes of ArcView® shape files gleaned from geologic resource data that have been collected for more than 50 years by the Utah Geological Survey, U.S. Geological Survey, U.S. Bureau of Mines, and the Bureau of Land Management. Among the layers are:

- Coal
- Geothermal
- Mineral
- Oil and Gas
- Oil Shale
- Tar Sands
- County Boundaries
- Cities and Towns
- Roads
- Streams and Bodies of Water
- Land Ownership and Management

This CD-ROM is ideal for government agencies and mineral and energy exploration companies.

The Atlas is the first of several new digital products of the Utah Geological Survey and comes with ArcExplorer 1.1®.

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Utah Geological Survey
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