

MAJOR OIL PLAYS IN UTAH AND VICINITY

QUARTERLY TECHNICAL PROGRESS REPORT

Reporting Period
Start Date: October 1, 2002
End Date: December 31, 2002

Edited and Compiled
by
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Utah Geological Survey



April 2003

Contract No. DE-FC26-02NT15133

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ABSTRACT

Utah oil fields have produced a total of 1.2 billion barrels (191 million m³). However, the 15 million barrels (2.4 million m³) of production in 2000 was the lowest level in over 40 years and continued the steady decline that began in the mid-1980s. The Utah Geological Survey believes this trend can be reversed by providing play portfolios for the major oil producing provinces (Paradox Basin, Uinta Basin, and thrust belt) in Utah and adjacent areas in Colorado and Wyoming. Oil plays are geographic areas with petroleum potential caused by favorable combinations of source rock, migration paths, reservoir rock characteristics, and other factors. The play portfolios will include: descriptions and maps of the major oil plays by reservoir; production and reservoir data; case-study field evaluations; summaries of the state-of-the-art drilling, completion, and secondary/tertiary techniques for each play; locations of major oil pipelines; descriptions of reservoir outcrop analogs; and identification and discussion of land use constraints. All play maps, reports, databases, and so forth, produced for the project will be published in interactive, menu-driven digital (web-based and compact disc) and hard-copy formats.

This report covers research activities for the second quarter of the first project year (October 1 through December 31, 2002). This work included (1) gathering field and pipeline data to produce a digital oil and gas field and pipeline map, and (2) Uinta Basin well database compilation. The oil and gas field map will help to delineate the various oil plays to be described later in the project. The map will also identify CO₂ resources, and will be useful in the planning and economic evaluation of best practices using CO₂ to flood mature oil reservoirs. The play descriptions will be enhanced with the updated oil and gas pipeline map. It can be used to plan economic evaluation of exploration activities and field development, particularly if H₂S is produced or CO₂ is needed for best practices. Well databases developed for the project will better define the limits of oil plays in the Uinta Basin and evaluate shows for potential new plays in the basin.

Technology transfer activities consisted of a technical presentation to the Utah Stake Holder Board Members belonging to the Uinta Basin Oil and Gas Collaborative Group. The project home page was updated on the Utah Geological Survey Internet web site.

EXECUTIVE SUMMARY

Utah oil fields have produced a total of 1.2 billion barrels (191 million m³). However, the 15 million barrels (2.4 million m³) of production in 2000 was the lowest level in over 40 years and continued the steady decline that began in the mid-1980s. The overall objectives of this study are to: (1) increase recoverable oil from existing field reservoirs, (2) add new discoveries, (3) prevent premature abandonment of numerous small fields, (4) increase deliverability through identifying the latest drilling, completion, and secondary/tertiary techniques, and (5) reduce development costs and risk.

To achieve these objectives, the Utah Geological Survey is producing play portfolios for the major oil producing provinces (Paradox Basin, Uinta Basin, and thrust belt) in Utah and adjacent areas in Colorado and Wyoming. This research is funded by the Preferred Upstream Management Program (PUMPII) of the U.S. Department of Energy, National Petroleum Technology Office (NPTO) in Tulsa, Oklahoma. This report covers research activities for the second quarter of the first project year (October 1 through December 31, 2002). This work included: (1) gathering field and pipeline data to produce a digital oil and gas field and pipeline map, (2) well database compilation, and (3) technology transfer activities.

A combination of depositional and structural events created the right conditions for oil generation and trapping in Utah. Oil plays are specific geographic areas with petroleum potential due to favorable source rock, migration paths, reservoir characteristics, and other factors. The new oil and gas field map will help to delineate the various oil plays to be described later in the project. It includes: (1) productive limits of active, shut-in, and abandoned fields, (2) predominant production type including carbon dioxide, (3) geologic age (s) and formation name(s) of the field reservoir(s), (4) number of active wells and cumulative production, (5) official field boundaries, (6) major structural basins and uplifts, (7) wilderness, national parks or monuments, Indian reservations, and (8) Precambrian and igneous outcrops. The map will provide an easy-to-use geologic, engineering, and geographic reference for petroleum companies to plan initial exploration and land-acquisition strategies. Identification of CO₂ resources will be useful in the planning and economic evaluation of best practices using CO₂ to flood mature oil reservoirs.

The play descriptions are further enhanced with the updated oil and gas pipeline map. It includes: (1) all pipelines with diameters greater than 6 inches, (2) pipeline products, and (3) current operator. The map can be used to plan economic evaluation of exploration activities and field development, particularly if H₂S is produced or CO₂ is needed for best practices. This map may also help pipeline companies plan future facilities and pipelines.

Well databases developed for the project will better define the limits of oil plays in the Uinta Basin and evaluate shows for potential new plays in the basin. Basin-wide cross sections generated from these databases will display the regional distribution of reservoirs in the Green River Formation.

Technology transfer activities included an oral technical presentation, describing project goals, tasks, and products, to the Utah Stake Holder Board Members belonging to the Uinta Basin Oil and Gas Collaborative Group. The project home page was updated on the Utah Geological Survey Internet web site.

INTRODUCTION

Project Overview

Utah oil fields have produced a total of 1.2 billion barrels (bbls) (191 million m³) (Utah Division of Oil, Gas and Mining, 2001). However, the 15 million bbls (2.4 million m³) of production in 2000 was the lowest level in over 40 years and continued the steady decline that began in the mid-1980s (figure 1) (Utah Division of Oil, Gas and Mining, 2001). Proven reserves are relatively high, at 283 million bbls (45 million m³) (Energy Information Administration, 2001). With higher oil prices now prevailing, secondary and tertiary recovery techniques should boost future production rates and ultimate recovery from known fields.

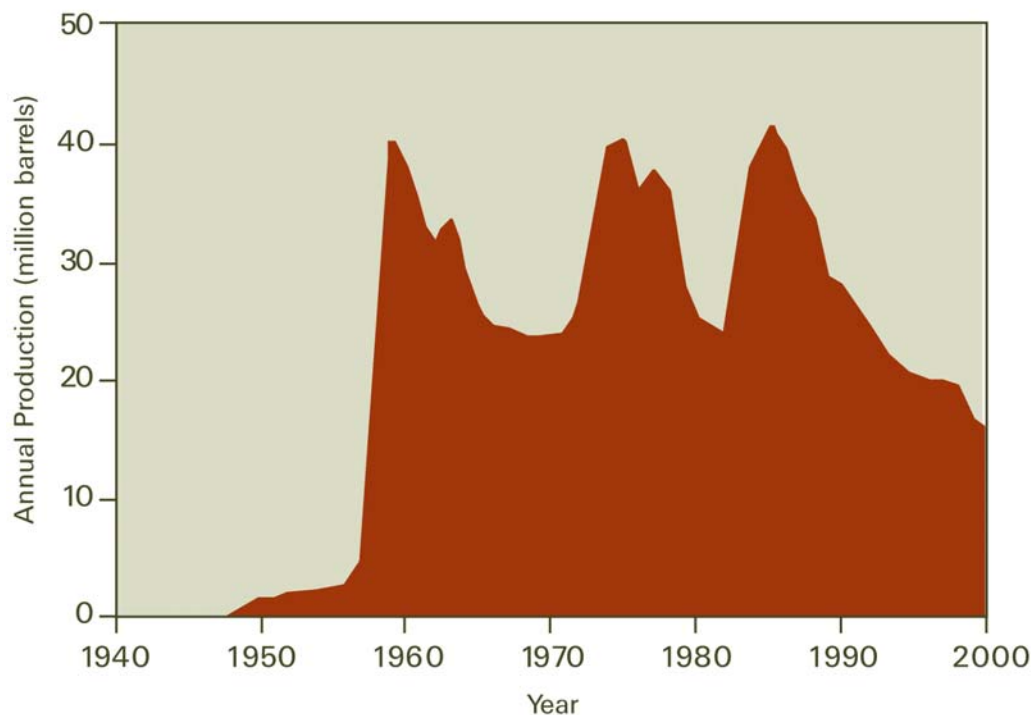
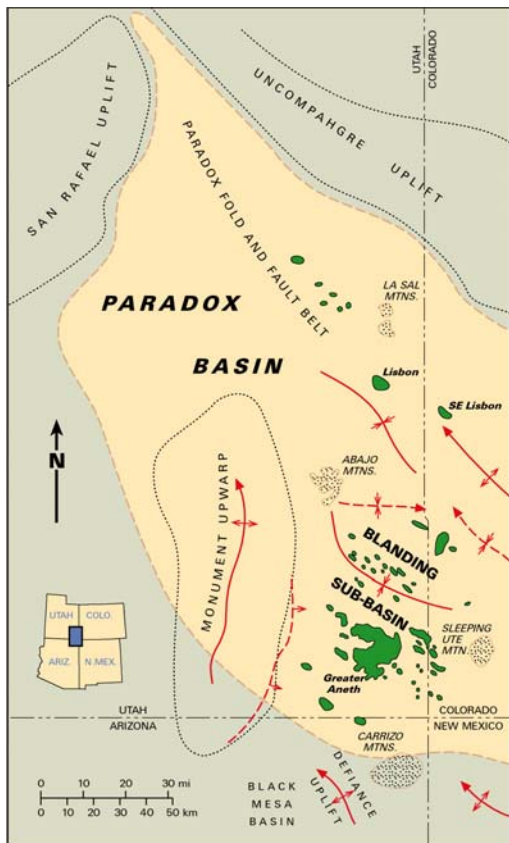


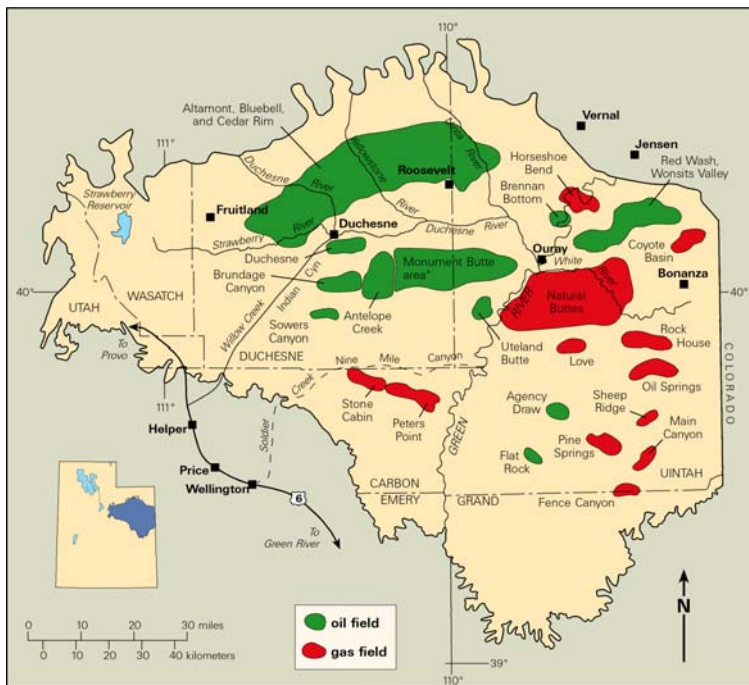
Figure 1. Oil production in Utah through 2000 (Utah Division of Oil, Gas and Mining, 2001).

Utah's drilling history has fluctuated greatly due to discoveries, oil price trends, and changing exploration targets. During the boom period of the early 1980s, activity peaked at over 500 wells per year. Sustained high prices are likely to entice less risk-averse exploration investment (more wildcats), resulting in new discoveries.

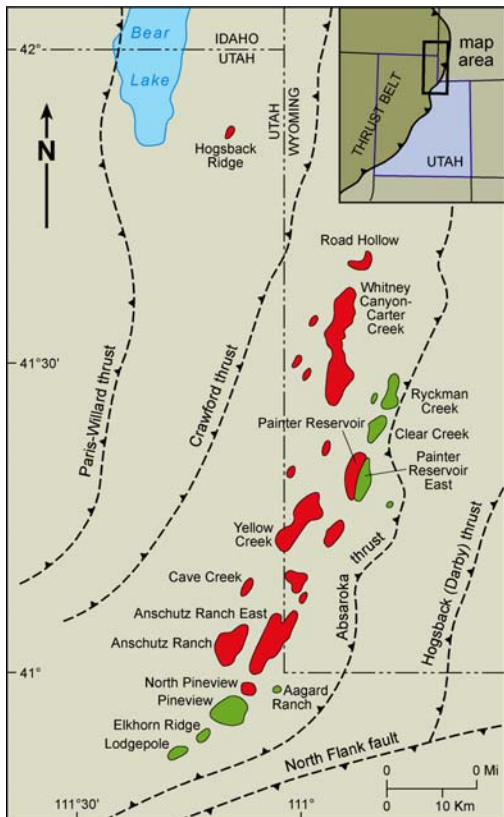
Utah still contains large, promising areas that are virtually unexplored. There is significant potential for increased recovery from existing fields by employing improved reservoir characterization and the latest drilling, completion, and secondary/tertiary technologies. New exploratory targets may be identified from three-dimensional (3D) seismic surveys. Development of potential prospects is within the economic and technical capabilities of both major and independent operators.



A



B



C

Figure 2. Major oil-producing provinces of Utah and vicinity. (A) Oil and gas fields in the Paradox Basin of Utah and Colorado. (B) Oil and gas fields in the Uinta Basin of Utah. (C) Oil and gas fields, uplifts, and major thrust faults in the Utah-Wyoming thrust belt.

The primary goal of this study is to increase recoverable oil reserves from existing field reservoirs and new discoveries by providing play portfolios for the major oil producing provinces (Paradox Basin, Uinta Basin, and thrust belt) in Utah and adjacent areas in Colorado and Wyoming (figure 2). These play portfolios will include: descriptions (such as stratigraphy, diagenetic analysis, tectonic setting, reservoir characteristics, trap type, seal, and hydrocarbon source) and maps of the major oil plays by reservoir; production and reservoir data; case-study field evaluations; summaries of the state-of-the-art drilling, completion, and secondary/tertiary techniques for each play; locations of major oil pipelines; and descriptions of reservoir outcrop analogs for each play. Also included will be land use constraints to development such as wilderness or roadless areas, and national parks within oil plays.

Project Benefits

The overall benefits of this multi-year project will be enhanced petroleum production in the Rocky Mountain region. Specifically, the benefits expected from the project are:

- (1) increasing oil production and reserves by improved reservoir characterization,
- (2) preventing premature abandonment of numerous small fields in the Paradox and Uinta Basins,
- (3) increasing recoverable reserves by identifying the type of untapped compartments created by reservoir heterogeneity (for example, diagenesis and rapid facies changes),
- (4) increasing deliverability through identifying the latest drilling, completion, and secondary/tertiary techniques,
- (5) identifying reservoir trends for field extension drilling and stimulating exploration in producing fairways,
- (6) encouraging technology used in other identified basins or trends with similar types of reservoirs,
- (7) reducing development costs and risk by reducing the number of wells needed to successfully drain the reservoir,
- (8) allowing limited energy investment dollars to be used more productively, and
- (9) increasing royalty income to the Federal Government; Utah, Wyoming, and Colorado state and local governments; the Navajo Nation and Ute Mountain Ute Indian Nation; and fee owners.

The Utah play portfolios produced by this project will provide an easy-to-use geologic, engineering, and geographic reference to help petroleum companies plan exploration and land-acquisition strategies. These portfolios may also help pipeline companies plan future facilities and pipelines. Other users of the portfolios will include petroleum engineers, petroleum land

specialists, landowners, bankers and investors, economists, utility companies, manufacturers, county planners, and numerous government agencies.

The results of this project will be transferred to industry and other interested parties through establishment of Technical Advisory and Stake Holder Boards, an industry outreach program, and technical presentations at national and regional professional meetings. All of this information will be made public (1) through the Utah Geological Survey (UGS) Internet web site, (2) as an interactive, menu-driven digital product on compact disc, and (3) as hard copy publications in various technical or trade journals.

UTAH OIL AND GAS FIELD AND PIPELINE MAPS

Oil and Gas Field Map

As part of determining the major oil plays in Utah, an oil and gas field map is being produced. There are over 170 oil and gas fields in Utah, most located in the three major oil-producing provinces but others are isolated accumulations with unique geologic attributes scattered throughout the state. The current energy resource map for Utah, which includes oil and gas fields, was published in 1983 – twenty years ago (Utah Geological and Mineral Survey, 1983). There have been many new oil and gas discoveries and significant field extensions over this time period. The new map includes: (1) productive limits of active, shut-in, and abandoned fields, (2) predominant production type such as oil, conventional hydrocarbon gas, coalbed methane, or carbon dioxide (CO₂), (3) geologic age(s) and formation name(s) of the field reservoir(s), (4) number of active wells and cumulative oil, gas, and water production, (5) official field boundaries as defined by the Utah Division of Oil, Gas and Mining (DOG M), the state's oil and gas regulatory agency, (6) major structural basins and uplifts, (7) wilderness areas, national parks or monuments, Indian reservations, and (8) Precambrian and igneous outcrops. This map will be available in hard copy and digital format (portable document format [.pdf]).

To create the new oil and gas field map, DOGM provided base maps with all well locations posted (over 9,000 abandoned, producing, or injection wells). The productive limits of the fields were delineated using these well locations taking into account regional structural and stratigraphic trends (figure 3). Production and completion records, published field studies and summaries, and the 1983 energy resource map, were checked to determine the current status, predominant production, and producing reservoirs. ArcView® shape files for wilderness areas, national parks, and Indian reservations were provided by the Utah School and Institutional Trust Lands Administration. Precambrian and igneous outcrop locations were generated from a digital geological map of Utah (Hintze and others, 2000). Boundaries of basins and uplifts were modified from various geologic and reservoir maps of Utah (Chidsey and others, 1993a, 1993b).

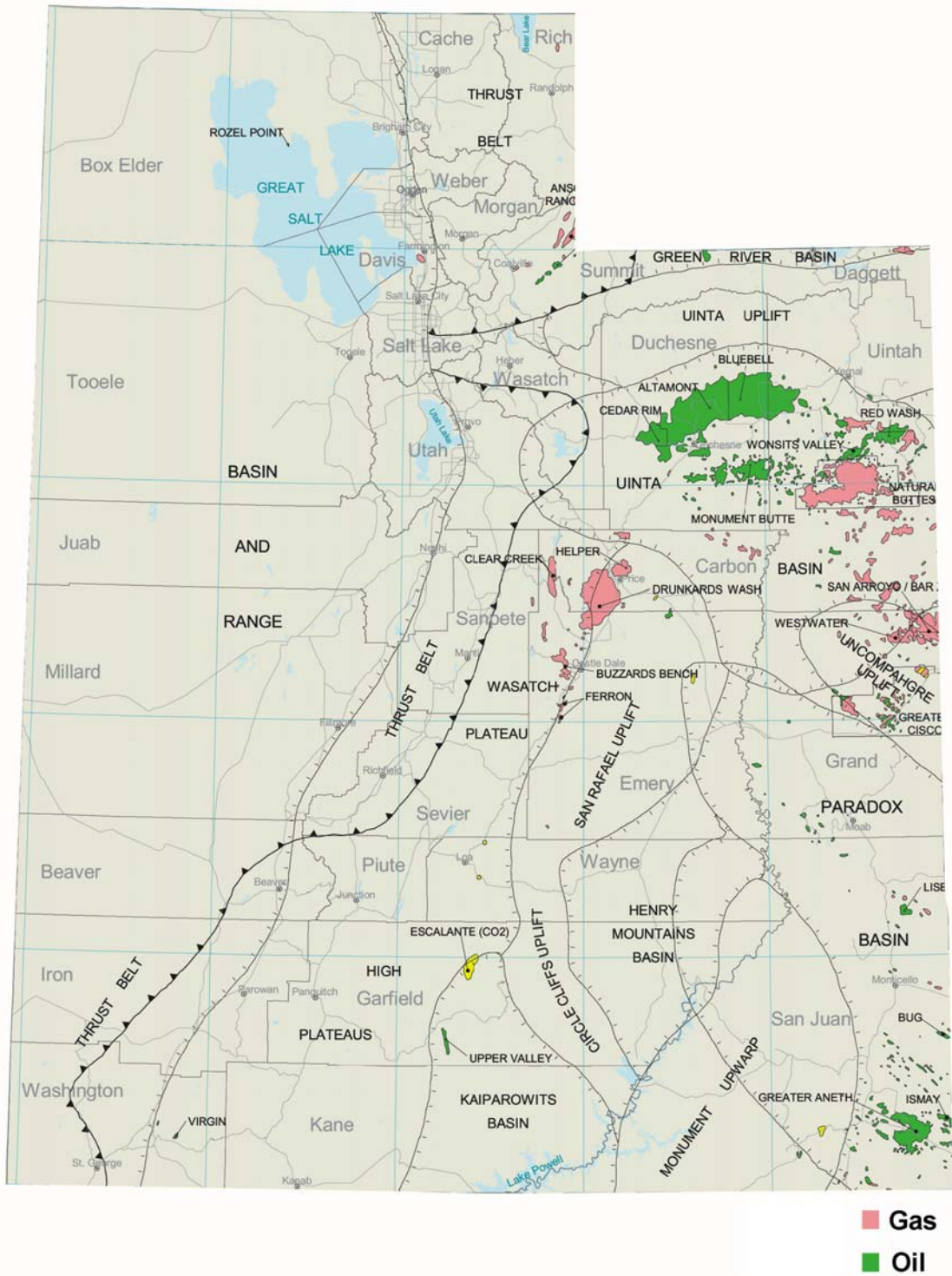


Figure 3. Preliminary map of oil and gas fields, uplifts, and basins in Utah.

Oil and Gas Pipeline Map

Oil from many of Utah's oil fields, particularly Uinta Basin fields, is trucked to refineries in Salt Lake City. However, oil pipelines do service a large number of fields. There are also numerous natural gas pipelines, one pipeline capable of carrying hydrogen sulfide (H₂S) in the thrust belt, and two pipelines that deliver carbon dioxide for secondary/tertiary oil recovery projects in Utah's Greater Aneth field in the Paradox Basin (figure 2) and Rangely field in western Colorado. The most recent oil and gas pipeline map for Utah was published in 1994 (Anderson and Chidsey, 1994). Like the oil and gas fields, there have been many new pipelines constructed in Utah over this time period. The ownership of many of the existing pipelines seems to be in a constant state of change. As part of describing the major oil plays in Utah, an oil and gas pipeline map is being produced. The new map includes: (1) all pipelines with diameters greater than 6 inches, (2) identification of what the pipeline carries, such as oil, gas, hydrocarbon products, H₂S, or CO₂, and (3) current operator. This map will be merged with the oil and gas field map in hard copy and digital format.

To create the new pipeline map (figure 4), the locations of transmission, distribution, and gathering pipelines were compiled and digitized from a variety of sources. These sources included donated maps (some digital) and files from field operators, utilities, and transmission and refining companies, as well as published maps.

WELL DATABASES

To better define the limits of oil plays in the Uinta Basin (figure 2) and evaluate shows for potential new plays in the basin, several well databases have been compiled. The well data have been divided into Excel® files containing wells that penetrated the (1) Paleozoic, (2) Mesozoic, and (3) Cenozoic.

All of the wells in the Uinta Basin that penetrated the Paleozoic have been correlated and the formation drill depths have been entered into the Paleozoic database.

Wells in the southern portion of the Uinta Basin were previously correlated as part of a School and Institutional Trust Lands Administration- (SITLA-) funded study of the Cretaceous Dakota Sandstone in Grand County. The formation drill depths from the SITLA-funded study have been entered into the Mesozoic database.

Wells penetrating the Cenozoic (primarily the Eocene Green River Formation) in the southwestern (greater Monument Butte area) and northern (Bluebell field) Uinta Basin were correlated as part of two separate DOE-funded studies (Morgan and others, 2000; Morgan and others, 2002). The formation and marker-bed drill depths from the two previous studies have been entered into the Cenozoic database.

Regional cross sections of the Green River Formation are being constructed. The basin-wide cross sections will show the regional distribution of reservoirs in the Green River Formation. The cross sections extend from the:

1. greater Monument Butte area northward to the Bluebell field,
2. Bluebell field to the western limits of the basin,
3. Monument Butte area to the Red Wash field (northeast Uinta Basin), and
4. Monument Butte area to the southern limits of the basin.

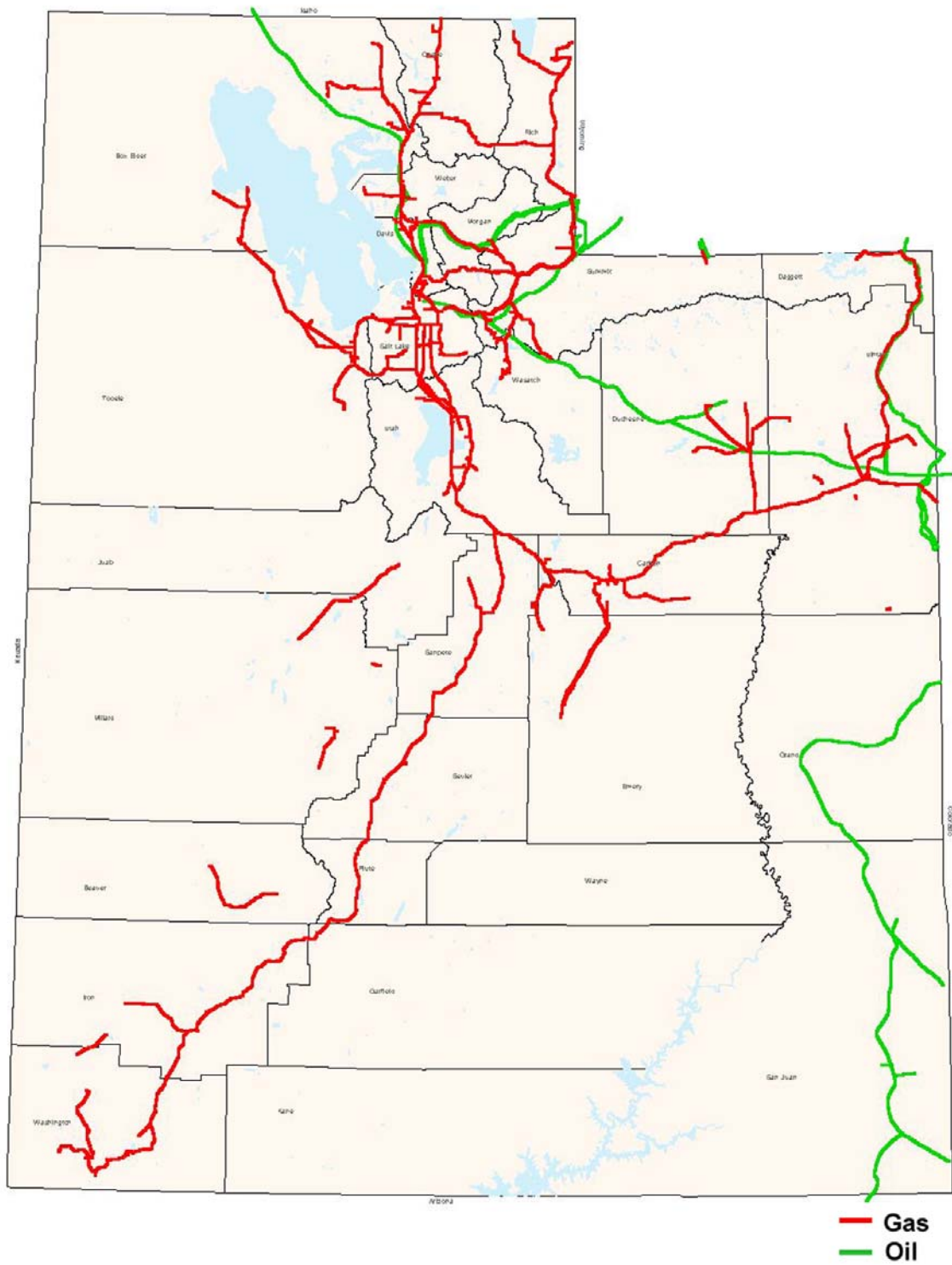


Figure 4. Preliminary map of major oil and gas pipelines in Utah.

TECHNOLOGY TRANSFER

The UGS is the Principal Investigator and prime contractor for the PUMPII project and three government-industry cooperative petroleum-research projects. These projects are designed to improve recovery, development, and exploration of the nation's oil and gas resources through use of better, more efficient technologies. The projects involve detailed geologic and engineering characterization of several complex heterogeneous reservoirs. Two Class II Oil projects include practical oil-field demonstrations of selected technologies in the Paradox Basin. The third project involves establishing a log-based correlation scheme for the Tertiary Green River Formation in the southwestern Uinta Basin to help identify new plays and improve the understanding of producing intervals. The DOE and multidisciplinary teams from petroleum companies, petroleum service companies, universities, private consultants, and state agencies are co-funding the three projects.

All play maps, reports, databases, and so forth, produced for the PUMPII project will be published in interactive, menu-driven digital (web-based and compact disc) and hard-copy formats by the Utah Geological Survey and presented to the petroleum industry. Syntheses and highlights will be submitted to refereed journals, as appropriate, such as the *American Association of Petroleum Geologists (AAPG) Bulletin* and *Journal of Petroleum Technology*, and to trade publications such as the *Oil and Gas Journal*. This information will also be released through the UGS periodical *Survey Notes* and on the UGS project Internet web page.

The technology-transfer plan includes a Technical Advisory Board and a Stake Holders Board. The Technical Advisory Board advises the technical team on the direction of study, reviews technical progress, recommends changes and additions to the study, and provides data. The Technical Advisory Board is composed of field operators from the oil-producing provinces of Utah that may also extend into Wyoming or Colorado. This board ensures direct communication of the study methods and results to the operators. The Stake Holders Board is composed of groups that have a financial interest in the study area including representatives from the State of Utah (SITLA and Utah Division of Oil, Gas and Mining) and the Federal Government (BLM and U.S. Bureau of Indian Affairs). The members of the Technical Advisory and Stake Holders Boards receive all quarterly technical reports and copies of all publications, and other material resulting from the study. They will also provide field and reservoir data, especially data pertaining to best practices.

Utah Geological Survey *Survey Notes* and Internet Web Site

Survey Notes provides non-technical information on contemporary geologic topics, issues, events, and ongoing UGS projects to Utah's geologic community, educators, state and local officials and other decision makers, and the public. *Survey Notes* is published three times yearly. Single copies are distributed free of charge and reproduction (with recognition of source) is encouraged.

The UGS maintains a web site on the Internet, <http://geology.utah.gov>. The UGS site includes a page under the heading *Utah Geology/Oil and Energy*, which describes the UGS/DOE cooperative studies (PUMPII, Paradox Basin [two projects], Ferron Sandstone, Bluebell field, Green River Formation), and has a link to the DOE web site. Each UGS/DOE

cooperative study also has its own separate page on the UGS web site. The PUMPII project page (figure 5), <http://geology.utah.gov/emp/pump/index.htm>, contains: (1) a project location map, (2) a description of the project, (3) a reference list of all publications that are a direct result of the project, and (4) quarterly technical progress reports.

[ugs / utah geology / oil & energy / pump II](#)

Preferred Upstream Management Practices (PUMP II)

Major Oil Plays of Utah and Vicinity DOE Project

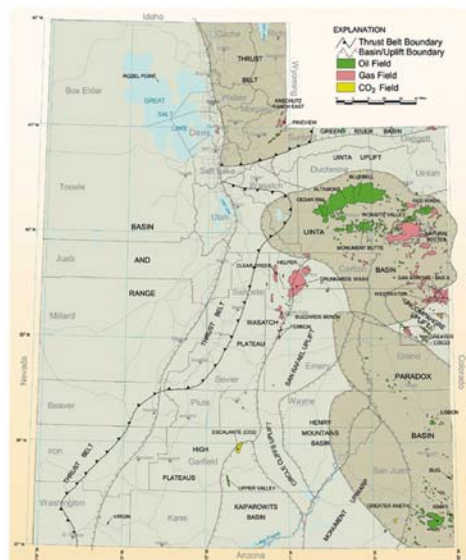
[Reports](#) || [Project Area Map](#) || [Project Summary](#) || [Contact](#)

Reports

- [Abstract](#) (pdf)
- [Statement of Work](#) (pdf)

Project Summary

- [Project Description](#)



Play Portfolios	Products	Technology Transfer
<ul style="list-style-type: none"> • Description of Reservoir Characteristics • Case Study Field Evaluations • Best Practices • Pipelines • Outcrop Analogs • Land Usage 	<ul style="list-style-type: none"> • Play Maps • Reports • Databases • Digital and Hard Copy Format 	<ul style="list-style-type: none"> • Technical Advisory Board • Stake Holders Board • Publications • Technical Presentations • Geologic Societies and Public Meetings

Contact



For more information on the DOE PUMP II project, contact Tom Chidsey, 801-537-3364, email: tomchidsey@utah.gov.

Figure 5. The PUMPII project page, <http://geology.utah.gov/emp/pump/index.htm>, from the UGS Internet web site.

Technical Presentation

The following technical presentation was made during the quarter as part of the technology transfer activities:

"Major Oil Plays of Utah and Vicinity," by Thomas C. Chidsey, Jr., describing project goals, tasks, and products, to the Utah Stake Holder Board Members belonging to the Uinta Basin Oil and Gas Collaborative Group, December 5, 2002. Maps, cross sections, diagrams, and other information were part of the presentation.

CONCLUSIONS

A combination of depositional and structural events created the right conditions for oil generation and trapping in Utah. Oil plays are specific geographic areas with petroleum potential due to favorable source rock, migration paths, reservoir characteristics, and other factors. A new oil and gas field map will help to delineate the various oil plays to be described later in the project. The map will provide an easy-to-use geologic, engineering, and geographic reference for petroleum companies to plan initial exploration and land-acquisition strategies. Identification of CO₂ resources will be useful in the planning and economic evaluation of best practices using CO₂ to flood mature oil reservoirs.

The play descriptions are further enhanced with the updated oil and gas pipeline map. It can be used to plan economic evaluation of exploration activities and field development, particularly if H₂S is produced or CO₂ is needed for best practices. This map may also help pipeline companies plan future facilities and pipelines.

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ACKNOWLEDGMENTS

Funding for this ongoing research was provided as part of the DOE Preferred Upstream Management Program (PUMP II) of the U.S. Department of Energy, National Petroleum Technology Office, Tulsa, Oklahoma, contract number DE-FC26-02NT15133. The Contracting Officer's Representative is Rhonda P. Lindsey.

The well databases for the Uinta Basin were compiled and described by Craig Morgan, UGS. Jim Parker and Vicky Clarke of the UGS prepared the figures. This report was reviewed by Dave Tabet and Mike Hylland of the UGS. Cheryl Gustin, UGS, formatted the manuscript for publication.

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