

Chapter 1

# **Executive Summary—Assessment of Undiscovered Oil and Gas Resources of the Southwestern Wyoming Province of Wyoming, Colorado, and Utah, 2002**



*Click here to return to*  
**Volume Title Page**

By USGS Southwestern Wyoming Province Assessment Team

Chapter 1 of

## **Petroleum Systems and Geologic Assessment of Oil and Gas in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah**

By USGS Southwestern Wyoming Province Assessment Team

U.S. Geological Survey Digital Data Series DDS-69-D

U.S. Department of the Interior  
U.S. Geological Survey

**U.S. Department of the Interior**  
Gale A. Norton, Secretary

**U.S. Geological Survey**  
Charles G. Groat, Director

U.S. Geological Survey, Denver, Colorado: Version 1, 2005

For sale by U.S. Geological Survey, Information Services  
Box 25286, Denver Federal Center  
Denver, CO 80225

For product and ordering information:  
World Wide Web: <http://www.usgs.gov/pubprod>  
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth, its natural and living resources, natural hazards, and the environment:  
World Wide Web: <http://www.usgs.gov>  
Telephone: 1-888-ASK-USGS

Although this report is in the public domain, permission must be secured from the individual copyright owners to reproduce any copyrighted materials contained within this report.

Any use of trade, product, or firm names in this publication is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Manuscript approved for publication May 10, 2005

ISBN= 0-607-99027-9

# Contents

Introduction ..... 1  
Resources Assessed ..... 1  
Resource Summary ..... 1  
USGS Southwestern Wyoming Province Assessment Team ..... 5  
References Cited ..... 5

## Figures

1. Southwestern Wyoming Province of Wyoming, Colorado, and Utah ..... 2  
2. Schematic diagram of the types of oil and gas resources assessed in provinces  
of the United States..... 3

## Table

1. Southwestern Wyoming Province assessment results ..... 4

# Executive Summary—Assessment of Undiscovered Oil and Gas Resources of the Southwestern Wyoming Province of Wyoming, Colorado, and Utah, 2002

By USGS Southwestern Wyoming Province Assessment Team

## Introduction

The U.S. Geological Survey (USGS) completed an assessment of the undiscovered oil and gas potential of the Southwestern Wyoming Province of southwestern Wyoming, northwestern Colorado, and northeastern Utah (fig. 1). The USGS Southwestern Wyoming Province for this assessment included the Green River Basin, Moxa arch, Hoback Basin, Sandy Bend arch, Rock Springs uplift, Great Divide Basin, Wamsutter arch, Washakie Basin, Cherokee ridge, and the Sand Wash Basin. The assessment of the Southwestern Wyoming Province is based on geologic principles and uses the total petroleum system concept. The geologic elements of a total petroleum system include hydrocarbon source rocks (source rock maturation, hydrocarbon generation, and migration), reservoir rocks (sequence stratigraphy, petrophysical properties), and hydrocarbon traps (trap types, formation, and timing). Using this geologic framework, the USGS defined 9 total petroleum systems (TPS) and 23 assessment units (AU) within these TPSs, and quantitatively estimated the undiscovered oil and gas resources within 21 of the 23 AUs.

## Resources Assessed

For each province in the United States that is to be assessed, the USGS defines conventional and continuous oil and gas resources (fig. 2). Conventional oil and gas accumulations are defined as discrete geographic entities with well-delineated hydrocarbon/water contacts. Conventional gas fields typically have relatively high matrix permeabilities, obvious seals and traps, and high recovery factors. Continuous accumulations (also called unconventional, tight sandstones, or basin-centered accumulations), based on the geologic model used by the USGS in 2002, are regional in extent; have diffuse boundaries; commonly have low matrix permeabilities; may not have obvious seals, traps, or hydrocarbon-water contacts; are abnormally pressured; are in close proximity to

source rocks; and have very low hydrocarbon recovery factors (Schenk and Pollastro, 2002). For this study, coalbed gas is considered to be a type of continuous accumulation (Schenk and Pollastro, 2002). Continuous accumulations commonly have transition zones that grade into more conventional gas accumulations.

## Resource Summary

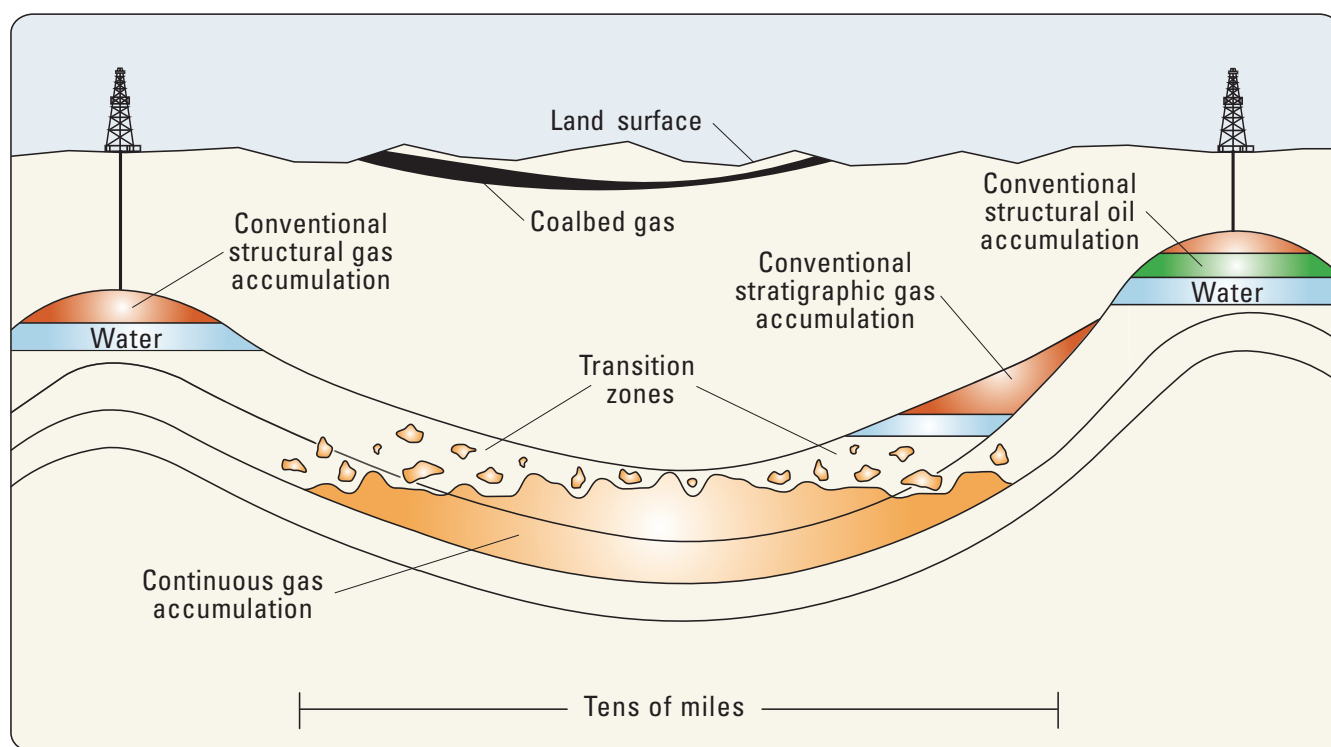
The USGS assessed undiscovered conventional and continuous (unconventional) oil and gas resources (USGS Southwestern Wyoming Province Assessment Team, 2002). The USGS estimated a mean of 84.6 trillion cubic feet of gas (TCFG), a mean of 131 million barrels of oil (MMBO), and a mean of 2.6 billion barrels of total natural gas liquids (BBNGL) in the nine TPSs. Nearly all of the estimated undiscovered gas resource (97 percent, or 82.1 TCFG) is continuous and distributed in six TPSs: Mowry Composite TPS (8.5 TCFG); Hilliard-Baxter-Mancos TPS (11.7 TCFG); Mesaverde TPS (25.8 TCFG); Mesaverde–Lance–Fort Union Composite TPS (13.7 TCFG); Lewis TPS (13.5 TCFG); and Lance–Fort Union Composite TPS (8.7 TCFG) (table 1). The remainder of the undiscovered gas is associated/dissolved gas within oil accumulations (0.13 TCFG) or is in conventional nonassociated gas accumulations (2.3 TCFG).

The Niobrara TPS is estimated to contain a mean of about 103 MMB of continuous oil, or about 79 percent of all undiscovered oil in the Southwestern Wyoming Province. The Phosphoria TPS contains a mean of 16.6 MMBO, or about 12.5 percent of the undiscovered oil. The remainder of the undiscovered oil is in the Mowry Composite TPS, the Mesaverde TPS, and the Mesaverde–Lance–Fort Union Composite TPS (table 1). The Niobrara Continuous Gas AU and the Wasatch–Green River Continuous Gas AUs were not quantitatively assessed in this study.

2 Petroleum Systems and Geologic Assessment of Oil and Gas in the Southwestern Wyoming Province, Wyoming, Colorado, and Utah



Figure 1. Southwestern Wyoming Province of southwestern Wyoming, northwestern Colorado, and northeastern Utah.



**Figure 2.** Schematic diagram of the types of oil and gas resources assessed in provinces of the United States. Conventional and continuous resources are assessed. Coal bed gas is considered to be a continuous accumulation (Schenk and Pollastro, 2002).

**Table 1.** Southwestern Wyoming Province assessment results.

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas fields, all liquids are included under the NGL (natural gas liquids) category. Undiscovered gas resources are the sum of nonassociated and associated gas. F95 represents a 95-percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Gray shading indicates not applicable. CBG is coal bed gas]

| Total Petroleum Systems (TPS) and Assessment Units (AU) | Field type | Oil (MMBO)                  |               |               |               | Total undiscovered resources Gas (BCFG) |                  |                   |                  | NGL (MMBNGL)    |                 |                 |                 |
|---|------------|-----------------------------|---------------|---------------|---------------|---|------------------|-------------------|------------------|-----------------|-----------------|-----------------|-----------------|
|   |            | F95                         | F50           | F5            | Mean          | F95                                     | F50              | F5                | Mean             | F95             | F50             | F5              | Mean            |
| <b>Phosphoria TPS</b>                                   |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Sub-Cretaceous Conventional Oil and Gas AU              | Oil        | 3.80                        | 12.70         | 43.60         | 16.60         | 6.70                                    | 24.00            | 85.90             | 32.20            | 0.20            | 0.80            | 3.20            | 1.20            |
|   | Gas        |                             |               |               |               | 206.20                                  | 1,069.00         | 3,480.00          | 1,350.70         | 5.90            | 31.20           | 107.20          | 40.60           |
| <b>Mowry Composite TPS</b>                              |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Mowry Conventional Oil and Gas AU                       | Oil        | 1.70                        | 5.70          | 14.80         | 6.60          | 2.70                                    | 9.40             | 25.90             | 11.20            | 0.30            | 1.30            | 3.70            | 1.60            |
|   | Gas        |                             |               |               |               | 85.80                                   | 196.30           | 301.40            | 195.10           | 1.60            | 3.80            | 6.70            | 3.90            |
| <b>Hilliard-Baxter-Mancos TPS</b>                       |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Hilliard-Baxter-Mancos Conventional Oil and Gas AU      | Gas        |                             |               |               |               | 4.60                                    | 13.80            | 31.90             | 15.50            | 0.30            | 0.90            | 2.10            | 1.00            |
| <b>Mesaverde TPS</b>                                    |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Mesaverde Conventional Oil and Gas AU                   | Oil        | 0.90                        | 2.10          | 4.00          | 2.30          | 7.40                                    | 17.30            | 34.80             | 18.80            | 0.30            | 0.60            | 1.40            | 0.70            |
|   | Gas        |                             |               |               |               | 13.40                                   | 34.00            | 69.40             | 36.90            | 0.10            | 0.40            | 0.90            | 0.40            |
| <b>Mesaverde-Lance-Fort Union Composite TPS</b>         |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Mesaverde-Lance-Fort Union Conventional Oil and Gas AU  | Oil        | 0.90                        | 2.10          | 4.00          | 2.30          | 3.80                                    | 9.10             | 18.30             | 9.80             | 0.20            | 0.40            | 0.90            | 0.40            |
|   | Gas        |                             |               |               |               | 101.40                                  | 297.70           | 558.80            | 310.40           | 4.20            | 13.00           | 26.90           | 14.00           |
| <b>Lewis TPS</b>  |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Lewis Conventional Oil and Gas AU                       | Gas        |                             |               |               |               | 103.70                                  | 188.90           | 304.00            | 194.60           | 3.70            | 7.40            | 13.30           | 7.80            |
| <b>Lance-Fort Union Composite TPS</b>                   |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Lance-Fort Union Conventional Oil and Gas AU            | Gas        |                             |               |               |               | 75.00                                   | 229.20           | 465.90            | 245.60           | 0.70            | 2.20            | 5.00            | 2.50            |
| <b>Total Conventional Resources</b>                     |            | <b>7.30</b>                 | <b>22.60</b>  | <b>66.40</b>  | <b>27.80</b>  | <b>610.70</b>                           | <b>2,088.70</b>  | <b>5,376.30</b>   | <b>2,420.80</b>  | <b>17.50</b>    | <b>62.00</b>    | <b>171.30</b>   | <b>74.10</b>    |
| <b>Continuous Gas Resources</b>                         |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| <b>Mowry Composite TPS</b>                              |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Mowry Continuous Gas AU                                 | Gas        |                             |               |               |               | 6,745.90                                | 8,461.90         | 10,614.40         | 8,542.80         | 110.90          | 165.80          | 247.90          | 170.90          |
| <b>Niobrara TPS</b>                                     |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Niobrara Continuous Oil AU                              | Oil        | 66.90                       | 100.50        | 151.00        | 103.60        | 34.90                                   | 59.10            | 99.90             | 62.20            | 1.90            | 3.50            | 6.50            | 3.70            |
| Niobrara Continuous Gas AU                              | Gas        | Not quantitatively assessed |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| <b>Hilliard-Baxter-Mancos TPS</b>                       |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Hilliard-Baxter-Mancos Continuous Gas AU                | Gas        |                             |               |               |               | 4,895.10                                | 10,542.00        | 22,703.40         | 11,753.20        | 286.50          | 661.10          | 1,525.20        | 752.20          |
| <b>Mesaverde TPS</b>                                    |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Almond Continuous Gas AU                                | Gas        |                             |               |               |               | 10,013.50                               | 13,166.10        | 17,311.30         | 13,349.70        | 113.50          | 190.60          | 319.90          | 200.20          |
| Rock Springs-Ericson Continuous Gas AU                  | Gas        |                             |               |               |               | 8,768.90                                | 11,962.80        | 16,320.00         | 12,178.00        | 89.20           | 140.70          | 221.70          | 146.10          |
| Mesaverde Coal-Bed Gas AU                               | CBG        |                             |               |               |               | 126.10                                  | 232.10           | 427.30            | 248.70           | 0.00            | 0.00            | 0.00            | 0.00            |
| <b>Mesaverde-Lance-Fort Union Composite TPS</b>         |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Mesaverde-Lance-Fort Union Continuous Gas AU            | Gas        |                             |               |               |               | 8,320.10                                | 13,122.00        | 20,695.40         | 13,635.20        | 329.20          | 578.60          | 1,016.90        | 613.60          |
| Mesaverde Coalbed Gas AU                                | CBG        |                             |               |               |               | 13.70                                   | 25.40            | 47.30             | 27.30            | 0.00            | 0.00            | 0.00            | 0.00            |
| Ft. Union Coalbed Gas AU                                | CBG        |                             |               |               |               | 35.30                                   | 73.20            | 151.90            | 80.80            | 0.00            | 0.00            | 0.00            | 0.00            |
| <b>Lewis TPS</b>  |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Lewis Continuous Gas AU                                 | Gas        |                             |               |               |               | 8,764.90                                | 13,132.80        | 19,677.40         | 13,535.70        | 305.00          | 514.70          | 868.70          | 541.40          |
| <b>Lance-Fort Union Composite TPS</b>                   |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Lance-Fort Union Continuous Gas AU                      | Gas        |                             |               |               |               | 4,450.60                                | 7,255.80         | 11,829.10         | 7,583.30         | 39.40           | 71.10           | 128.40          | 75.80           |
| Lance Coalbed Gas AU                                    | CBG        |                             |               |               |               | 78.20                                   | 152.00           | 295.50            | 165.00           | 0.00            | 0.00            | 0.00            | 0.00            |
| Fort Union Coalbed Gas AU                               | CBG        |                             |               |               |               | 513.90                                  | 891.20           | 1,545.40          | 942.50           | 0.00            | 0.00            | 0.00            | 0.00            |
| <b>Wasatch-Green River Composite TPS</b>                |            |                             |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Wasatch-Green River Continuous Gas AU                   | Gas        | Not quantitatively assessed |               |               |               |   |                  |                   |                  |                 |                 |                 |                 |
| Wasatch-Green River Coalbed Gas AU                      | CBG        |                             |               |               |               | 27.80                                   | 58.40            | 122.60            | 64.70            | 0.00            | 0.00            | 0.00            | 0.00            |
| <b>Total continuous resources</b>                       |            | <b>66.90</b>                | <b>100.50</b> | <b>151.00</b> | <b>103.60</b> | <b>52,788.90</b>                        | <b>79,134.80</b> | <b>121,830.90</b> | <b>82,169.10</b> | <b>1,275.60</b> | <b>2,326.10</b> | <b>4,335.20</b> | <b>2,503.90</b> |
| <b>Total undiscovered oil and gas resources</b>         |            | <b>74.20</b>                | <b>123.10</b> | <b>217.40</b> | <b>131.40</b> | <b>53,399.60</b>                        | <b>81,223.50</b> | <b>127,207.20</b> | <b>84,589.90</b> | <b>1,293.10</b> | <b>2,388.10</b> | <b>4,506.50</b> | <b>2,578.00</b> |

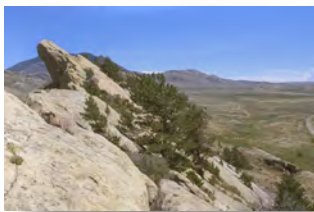
## USGS Southwestern Wyoming Province Assessment Team

Mark A. Kirschbaum (Task Leader), Thomas M. Finn, Robert D. Hettinger, Edward A. Johnson, Ronald C. Johnson, Joyce Kibler, Paul G. Lillis, Philip H. Nelson, Laura N.R. Roberts, Stephen B. Roberts, Ronald R. Charpentier, Troy A. Cook, Robert A. Crovelli, Timothy R. Klett, Richard M. Pollastro, and Christopher J. Schenk.

## References Cited

Schenk, C.J., and Pollastro, R.M., 2002, Natural gas production in the United States: U.S. Geological Survey Fact Sheet FS-113-01, January 2002. [Also available at URL <http://pubs.usgs.gov/fs/fs-0113-01/>, accessed on February 6, 2002]

USGS Southwestern Wyoming Province Assessment Team, 2002, Assessment of undiscovered oil and gas resources of the Southwestern Wyoming Province, 2002: U.S. Geological Survey Fact Sheet FS-145-02, November 2002. [Also available at URL <http://pubs.usgs.gov/fs/fs-0145-02/>, accessed on December 2, 2002]



***Click here to return to  
Volume Title Page***