

Chapter 1

Executive Summary—2002 Assessment of Undiscovered Oil and Gas in the Denver Basin Province, Colorado, Kansas, Nebraska, South Dakota, and Wyoming

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Chapter 1 of

**Petroleum Systems and Assessment of Undiscovered Oil and Gas in the Denver Basin
Province, Colorado, Kansas, Nebraska, South Dakota, and Wyoming—USGS Province 39**

Compiled by Debra K. Higley

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Introduction

The U.S. Geological Survey (USGS) recently assessed undiscovered, technically recoverable oil and gas resources of the Denver Basin Province (fig. 1) that have the potential to be added to reserves in the next 30 years. Both conventional and continuous resources were assessed. Continuous-type accumulations include coalbed gas (CBG), low-permeability gas, and fractured shales, which differ from conventional accumulations in that they are not significantly affected by hydrodynamics, there is no downdip gas/water contact, and conventional methods of assessing sizes and numbers of accumulations are not appropriate (modified from Klett and others, 2000).

Using analyses based on the study of total petroleum systems, the U.S. Geological Survey mean estimates of petroleum potential in the Denver Basin Province are 104.23 million barrels of oil, 2,519 billion cubic feet of gas, and 51.81 million barrels of natural gas liquids (NGL). More than 95 percent of that gas volume is in continuous (unconventional) assessment units (AU).

Using a total petroleum system method of analysis, the USGS defined seven total petroleum systems (TPS) and twelve assessment units (AU) in the province. TPS and AU are defined in Magoon and Dow (1994) and Klett and others (2000). Sources of information include published reports and the NRG Associates, Inc. (2000) and PI/Dwights (1999a, b) databases.

Resource Summary

Estimates of the oil, gas, and natural gas liquids (NGL) potential for the Denver Basin Province are presented in table 1. Coalbed gas resources (CBG) of the Denver Formation Coal and Laramie Formation Coal, AUs 50390181 and 50390182, respectively, of the Coalbed Methane TPS 503901 were not assessed due to scarcity of drilling information and other data. The Fractured Pierre Shale AU 50390361 was not assessed

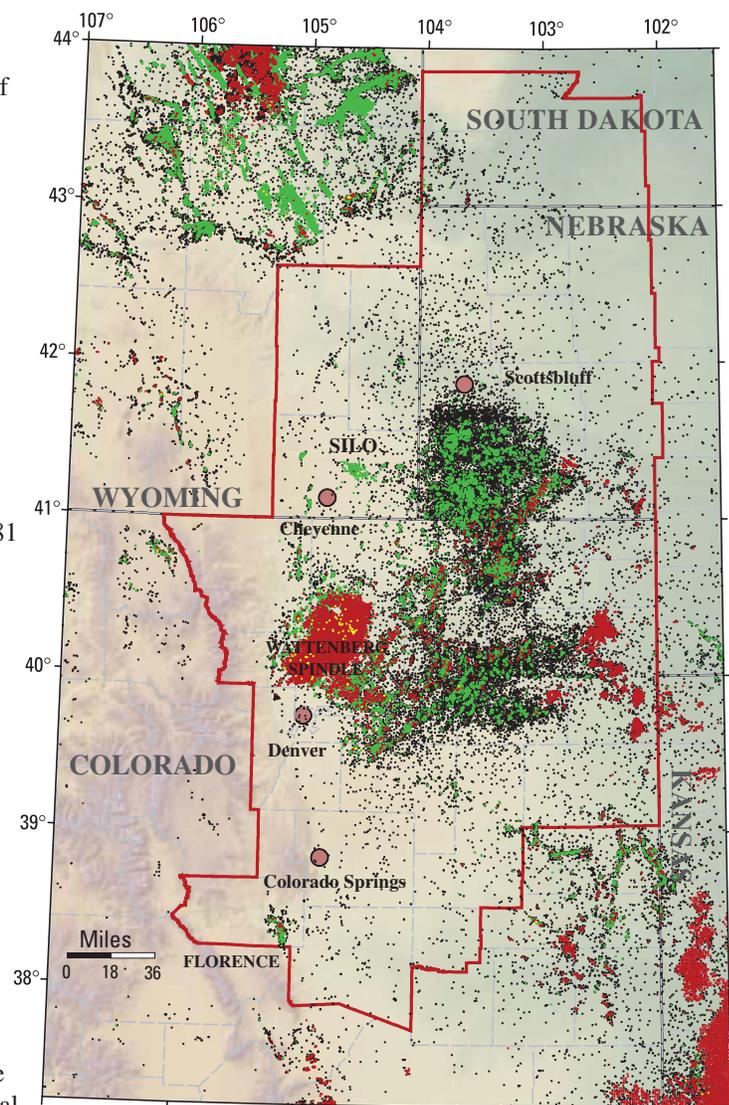


Figure 1. The Denver Basin Province (red line) of Colorado, Kansas, Nebraska, South Dakota, and Wyoming. Shown are oil (green), gas (red), oil and gas (yellow) and nonproductive (black) wells.

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for continuous resources because of low undrilled potential based on analysis of estimated ultimate recovery of current wells. Mean estimates of the remaining five TPSs are 104.23 million barrels of oil (MMBO), 2,519 billion cubic feet of gas (BCFG), and 51.81 million barrels of NGL (MMBNGL) (table 1).

More than 95 percent of the gas potential, or 2,408 BCFG, is in continuous AUs, the greatest gas resources being in the Dakota Group Basin-Center Gas AU (1094.70 BCFG) and the Niobrara Chalk AU (984.08 BCF biogenic gas). Approximately 38 percent of the oil potential is within continuous AUs, although the greatest single AU oil resource (36.27 MMBO) is located within sandstones of the Dakota Group and D Sandstone conventional AU (table 1). The continuous Niobrara-Codell (Wattenberg area) AU has the second largest mean oil resource volume at 32.17 MMB. The following are generalized descriptions of the assessment units.

Coal-bed Methane TPS 503901

1. Denver Formation Coals AU 50390181—Hypothetical continuous coalbed gas from the Upper Cretaceous and Paleocene Denver Formation in the central Denver Basin Province.
2. Laramie Formation Coals AU 50390182—Hypothetical continuous coalbed gas from the Upper Cretaceous Laramie Formation in the central Denver Basin Province.

Upper Cretaceous Fractured Niobrara TPS 503902

1. Fractured Niobrara Limestone Transitional AU 50390201—Conventional; located in the central Denver Basin Province and excludes areas of AUs 50390261 and 50390761.
2. Fractured Niobrara Limestone (Silo Field Area) AU 50390261—Continuous; mostly oil production from the Upper Cretaceous Niobrara Formation in the Silo field area (fig. 1).

Upper Cretaceous Pierre Shale (Florence Field) TPS 503903

1. Fractured Pierre Shale AU 50390361—Continuous; oil production from the Upper Cretaceous Pierre Shale in the Florence field area (fig. 1).

Lower Cretaceous TPS 503904

1. Dakota Group and D Sandstone AU 50390401—Conventional; Cretaceous Muddy (J) Sandstone reservoirs located across the central third of the province.
2. Subthrust Structural AU 50390402—This hypothetical conventional assessment unit of Cretaceous and Paleozoic formations is located under and along the eastern edge of the Rocky Mountains.

Permian-Pennsylvanian TPS 503905

1. Permian-Pennsylvanian Reservoirs AU 50390501—conventional; structural traps in limestones and sandstones concentrated in the northwestern half of the province.

Cretaceous Composite TPS 503906

1. Pierre Shale Sandstones AU 50390601—Conventional reservoirs in the Upper Cretaceous Richard, Terry (Sussex) and Hygiene (Shannon) Sandstones, Spindle field area (fig. 1).
2. Niobrara-Codell (Wattenberg Area) AU 50390661—Continuous; oil and gas production from Upper Cretaceous sandstone and limestone, Spindle field area (fig. 1).
3. Dakota Group Basin-Centered Gas AU 50390662—Continuous gas accumulation is the Wattenberg gas field (fig. 1). Production is primarily from the Lower Cretaceous Muddy (J) Sandstone.

Upper Cretaceous Niobrara Biogenic Gas TPS 503907

1. Niobrara Chalk AU 50390761—Continuous; biogenic gas from the Niobrara Formation is located in the eastern third of the province and extends eastward into Kansas and northward into North Dakota.

Table 1. Denver Basin Province assessment results listed by name and code of total petroleum system (TPS) and assessment unit (AU).

[TPS, total petroleum system; AU, assessment unit; MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids. Type refers mainly to oil or gas accumulations in the assessment unit. Fractiles are fully risked estimates. F95 denotes 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 shade indicates not applicable or not assessed. CBG, coal-bed gas, N/A, not quantitatively assessed or not applicable]

	Total Petroleum Systems (TPS) and Assessment Units (AU)	Type	Total Undiscovered Resources												
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)				
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean	
Conventional Oil and Gas	Upper Cretaceous Fractured Niobrara TPS 503902														
	Fractured Niobrara Limestone	Oil	0.00	0.00	3.99	1.16	0.00	0.00	2.08	0.58	0.00	0.00	0.21	0.06	
	Transitional AU 50390201	Gas					0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Lower Cretaceous TPS 503904														
	Dakota Group and D Sandstone AU 50390401	Oil	12.37	33.51	68.79	36.27	4.52	13.05	29.16	14.48	0.33	1.02	2.46	14.48	
		Gas					9.66	28.13	61.64	30.95	0.58	1.81	4.29	2.04	
	Subthrust Structural AU 50390402	Oil	0.00	0.00	57.42	14.37	0.00	0.00	29.15	7.19	0.00	0.00	2.98	0.72	
		Gas					0.00	0.00	9.58	33.62	0.00	0.00	9.58	2.22	
	Permian-Pennsylvanian TPS 503905														
	Permian-Pennsylvanian Reservoirs AU 50390501	Oil	2.11	9.43	23.70	10.74	1.03	4.65	12.55	5.45	0.06	0.27	0.79	0.33	
		Gas					0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Cretaceous Composite TPS 503906														
	Pierre Shale Sandstones AU 50390601	Oil	0.53	1.75	3.67	1.86	1.39	6.83	15.57	7.45	0.11	0.67	1.63	0.75	
		Gas					3.20	10.06	19.85	10.69	0.13	0.60	1.26	0.64	
Total Conventional Resources			15.02	44.69	157.57	64.40	19.81	62.73	312.66	110.41	1.21	4.36	23.20	7.91	
Continuous Oil and Gas	Cretaceous Composite TPS 503906														
	Niobrara-Codell (Wattenberg Area) AU 50390661	Oil	16.41	30.07	55.08	32.17	157.71	298.43	564.71	321.73	14.24	29.24	60.02	32.17	
	Dakota Group Basin-Center Gas AU 50390662	Gas	0.00	0.00	0.00	0.00	793.09	1,076.03	1,459.92	1,094.70	6.71	10.54	16.55	10.95	
	Upper Cretaceous Niobrara Biogenic Gas TPS 503907														
	Niobrara Chalk AU 50390761	Gas	0.00	0.00	0.00	0.00	337.63	843.01	2,104.85	984.08	0.00	0.00	0.00	0.00	
	Upper Cretaceous Fractured Niobrara TPS 503902														
	Fractured Niobrara Limestone (Silo Field Area) AU 50390261	Oil	4.32	7.29	12.27	7.66	4.09	7.34	13.17	7.82	0.37	0.72	1.41	0.78	
	Upper Cretaceous Pierre Shale (Florence Field) TPS 503903														
	Fractured Pierre Shale AU 50390361	Oil													
	Coalbed Methane TPS 503901														
	Denver Formation Coals AU 50390181	CBG													
	Laramie Formation Coals AU 50390182	CBG													
	Total Continuous Resources			20.74	37.35	67.35	39.83	1,292.52	2,224.81	4,142.64	2,408.33	21.33	40.50	77.98	43.90
	Total Resources			35.75	82.04	224.92	104.23	1,312.33	2,287.53	4,455.30	2,518.74	22.54	44.86	101.19	51.81

Denver Basin Province Assessment Team

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For Further Information

Supporting geologic studies of total petroleum systems and assessment units for the Denver Basin Province are in progress. Assessment results from the 1995 National Oil and Gas Assessment project are located at <http://energy.cr.usgs.gov/oilgas/noga/>

References Cited

- Klett, T.R., Schmoker, J.W., Charpentier, R.R., Ahlbrandt, T.S., and Ulmishek, G.F., 2000, Glossary, in U.S. Geological Survey World Energy Assessment Team, U. S. Geological Survey World Petroleum Assessment 2000—Description and Results: U.S. Geological Survey DDS 60, 4 CD-ROMs. <http://greenwood.cr.usgs.gov/energy/WorldEnergy/DDS-60>
- Magoon, L.B., and Dow, W.G., 1994, The petroleum system, in L.B. Magoon, and W.G. Dow, eds., The Petroleum System—from Source to Trap: American Association of Petroleum Geologists Memoir 60, p. 3-23.
- NRG Associates, Inc., 2000, Significant oil and gas fields database: Colorado Springs, Colorado, NRG Associates, Inc. [Database available from NRG Associates, Inc., P.O. Box 1655, Colorado Springs, CO 80901 U.S.A.]

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PI/Dwights Well History Control System database, 1999a,
available from IHS Energy, 4100 Dry Creek Road, Littleton,
CO 80122.

PI/Dwights petroROM Production Data on CD-ROM, 1999b,
available from IHS Energy, 4100 Dry Creek Road, Littleton,
CO 80122.



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