

Frontier Areas for Coalbed-Gas Exploration in Utah

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Introduction

Since 1992, there has been remarkably successful development of Utah's gas deposits associated with the coals in the Ferron Sandstone Member of the Mancos Shale in central Utah's Emery coalfield. At the end of 2001, the Ferron coalbed-gas area, or play (figure 1), had over 490 producing gas wells, and these wells accounted for 28 percent of the state's total gas production for that year. Encouraged by the success of the Ferron play, petroleum companies are looking elsewhere in the state for new, economic, coalbed-gas plays.

There are currently six prospective coalbed-gas plays in Utah being explored (see table 1 and figure 1): 1) Blackhawk Formation coals in the Book Cliffs coalfield, 2) coals in the Emery Sandstone Member of the Mancos Shale in the Wasatch Plateau coalfield, 3) Neslen Formation coals in the Sego coalfield, 4) Dakota Sandstone coals in the Alton-Kolob coalfields, 5) Straight Cliffs Formation coals in the Johns Valley-Kaiparowits Plateau coalfields, and 6) the thick coals in the Frontier and Adaville Formations that extend south from Wyoming into the Henrys Fork coalfield in northern Utah. These plays have attracted varying levels of industry development interest.

Book Cliffs Play

The best defined, and most mature, frontier coalbed-gas play in Utah consists of the thick, gassy, high-volatile bituminous coals of the Blackhawk Formation in the Book Cliffs coalfield. Exploration in this play began in the early 1970s, and there was a modest amount of coalbed-gas production during the 1990s. The area may be poised for full-scale development if the current efforts can overcome the water-disposal and well-completion problems that plagued the earlier development efforts. Although the Book Cliffs coalfield has had extensive mining, there are still about 70,000 acres underlain by deeper and unmined coal in the Blackhawk Formation where the aggregate coal thickness ranges from 10 to 70 feet, and drilling depths range from 1,500 to 6,000 feet (table 1). The measured gas content of these coals ranges from a modest 60 cubic feet per ton, to an attractive 435 cubic feet per ton of coal. The in-place gas resource in the undeveloped play is estimated to range from 0.8 to 1.9 trillion cubic feet (Tcf). A joint venture of the J.M. Huber Corporation and the Patina Oil and Gas Corporation is redeveloping the previously abandoned Castlegate field, which is reported to contain over 27 billion cubic feet of proven gas reserves for its 17 producing wells. Meanwhile, the J-W Operating Company has recently completed drilling a six-well pilot test of the Blackhawk coals farther to the east.

Wasatch Plateau Play

The coalbeds in the Emery Sandstone Member of the Mancos Shale occur under the Wasatch Plateau, and are not exposed at the surface. These coals have never been mined, but are projected from a handful of oil and gas test wells to underlie about 180,000 acres of the Wasatch Plateau of central Utah. The coals are between the overlying Blackhawk Formation coals and underlying Ferron Sandstone coals. Up to 17 coalbeds, with an aggregate thickness of up to 120 feet, occur within the 1,600-foot-thick Emery strata. No gas content measurements are available for these high-volatile bituminous coals, but some beds are reported to be gassier than others.

Table 1. Comparison of attributes of frontier coalbed gas plays in Utah.

Coalfield/play	1 Book Cliffs	2 Wasatch Plateau	3 Sego	4 Alton-Kolob	5 Johns Valley/ Kaiparowits	6 Henry's Fork	
Criteria							
Resources							
Formation Name	Blackhawk	Emery Ss	Neslen	Dakota	Straight Cliffs	Frontier	Adaville
Fmtn. Thickness (ft)	600 to 1,000	1600	400 to 700	140 to 450	600 to 1,600	2,000 to 2,800	1,500 to 2,000
Coal Thickness Range (ft)	10 to 70	10 to 120	10 to 30	7 to 25	10 to 80	10 to 100	10 to 230
Coal Thickness Average (ft)	35	40	14	13	40	50	100
Play Area (acres)	70,000	180,000	240,000	400,000	130,000	15,000	35,000
Coal Resource	4.4 billion tons	16.2 billion tons	6.0 billion tons	9.36 billion tons	9.36 billion tons	1.3 billion tons	6.3 billion tons
Coal Rank	hvCb to hvAb	hvCb-hvBb	hvCb-hvBb	subB-subA	subB-subA	hvCb-hvBb	hvCb-hvBb
Ash Content (%)	2.7-20.8	NA	2.7-27.9	2.5-32.6	2.9-29.9	NA	NA
Vitrinite Reflectance (Ro)	0.42 to 0.84	0.65 to 0.80?	0.58 to 0.76	NA	0.44 to 0.60?	0.65 to 0.80	0.55 to 0.65
Gas Content (desorbed)	60-435 cu.ft./ton	NA	0-48 cu.ft./ton	0-14 cu.ft./ton	0-7 cu.ft./ton	NA	NA
Samples Desorbed	> 100	0	26/5 wells	2/2wells	13/3 wells	0	0
Gas Content (estimated)	180-430 cu.ft./ton	50-200 cu.ft./ton	50-300 cu.ft./ton	0-100 cu.ft./ton	0-100 cu.ft./ton	50-300 cu.ft./ton	0-100 cu.ft./ton
GIP (Tcf)	0.8 to 1.9	0.8 to 3.2	0.3 to 1.8	0 to 0.93	0 to 0.93	0.06 to 0.39	0 to 0.63
Structure							
Dip (degrees)	2 to 12 NE	1 to 6 NW	1 to 5 NW	1 to 5 N	1 to 6 NW	30 W	30 W
Faulting	E-SE-trending, high-angle, normal flts.	N-trending, high-angle, normal flts	E-SE-trending, high-angle, normal flts.	N-trending, high-angle, normal flts	NE-trending, high-angle, normal flts	N-NE-trending, thrust flts.	N-NE-trending, thrust flts.
Folding	minor	a few anticlines	minor	minor	monoclinial folds	moderate	moderate
Face Cleat(s)/Joint(s)	N55-65W	N5-35E, N65-85W	N55-85W	N20-45W, N15-30E	N15-30E?	N35-55E, N	N35-55E, N
Igneous Activity	none	Olig.-Mio. mafic dikes	none	Quat. Basalt flows	Quat. Basalt flows	none	none
Depth to coal (ft)	1500 to 6000	1500 to 6000	500 to 5000	500 to 5000	1000 to 6000	1500 to 5000	1500 to 5000
Reservoir Properties							
Formation Pressure	500 - 2500 psi	NA	220 - 2200 psi	NA	NA	NA	NA
Overpressure	none	none	slight	NA	NA	NA	NA
Fmtn Temperature (est)	110 F	(80 - 110 F)	(80 - 130 F)	(80 - 110 F)	(70 - 100 F)	(90 - 100 F)	(75 - 100 F)
TDS of produced water	8000	NA	NA	640-2200	NA	NA	NA
Coal Porosity (%)	0.4-13.25	NA	2.99-12.74	NA	NA	NA	NA
Coal Permeability	10 md	NA	NA	NA	NA	NA	NA
Industry Activity							
Well Data in Area	-50 O&G wells	< 20 wells	200-250 wells	< 20 wells	< 40 wells	1 well	1 well
Gas Shows	Numerous	Mud-log shows	Mud-log shows	Mud-log shows	none reported	gassy mines	none reported
CBM Wells	32	A few strat tests	A few strat tests	24 CBM APDs	none	A few tests in WY	A few tests in WY
Companies Active	3	2 to 3	2 to 3	2 to 3	1	0	0
Gas Production	3.38 Bcf	none	none	none	none	none	none
Water Production	8.5 million bbls	none	none	none	none	none	none
Pipelines	1 across area	1 across area	several in area	30 to 60 miles W	60 miles W	1 across area	1 across area

The in-place gas resource for this play is estimated to range from 0.8 to 3.2 Tcf. Prima Energy Corporation is actively exploring this play on its 71,000 net acres of leases in the area. Several other petroleum companies have drilled wells in this play in the past few years.

Sego Play

The Neslen Formation coalbeds are known from the Sego coalfield where they are exposed along the Book Cliffs of Grand County; these coalbeds can be traced northward into the subsurface in Uintah County near the Colorado-Utah state line, and underlie roughly 240,000 acres. The 400- to 700-foot-thick Neslen Formation contains an average of 14 feet of coal in one to seven beds. Shallow core samples taken near the outcrop of the beds provided gas-content measurements only as high as 48 cubic feet per ton of coal, but there are indications that the deeper coals may be gassier. CDX

Rockies, LLC has drilled a well to test the gas content of deeper coalbeds in the Uintah County portion of the play, but no results have been released. The in-place gas resource of this play is estimated to range from 0.3 to 1.8 Tcf.

Alton-Kolob Play

The coalbeds of the Dakota Sandstone are best developed in southern Utah in the Alton-Kolob coalfields, and this is the area that has drawn company exploration interest. The 140- to 450-foot-thick Dakota Sandstone in this play contains two subbituminous coal zones, an upper one named Smirl, and a lower one named Bald Knoll. These two, lenticular coal zones can collectively contain up to 18 feet of coal, and they have an average aggregate thickness of about 13 feet. To date, only two gas-content measurements have been reported for shallow coal core samples, and they revealed low gas contents of 0 to 14 cubic feet per ton. This 400,000-acre play could contain nearly 1 Tcf of gas if the average gas content of the deeper coalbeds is only 100 cubic feet per ton. Several companies have leased 84,000 acres or more in the play. Legend Energy of Utah is the most active of these companies, and has staked 23 drill hole locations; drilling began at two locations in November 2002.

Johns Valley-Kaiparowits Plateau Play

The thick coals of the Straight Cliffs Formation have attracted some company interest in the Johns Valley area and the northern part of the Kaiparowits Plateau coalfield outside the Grand Staircase-Escalante National Monument in Garfield County. The 130,000-acre play contains an average aggregate thickness of 40 feet of coal within the 600- to 1,600-foot-thick John Henry Member of the Straight Cliffs Formation. The 13 gas measurements taken from relatively shallow coal cores were not encouraging, with gas contents of less than 7 cubic feet per ton of coal. A group of investors with a significant fee position in the Johns Valley portion of the play is attempting to put together a drilling program to evaluate the coals and their gas content in this part of the play. They expect that deeper subbituminous coalbeds will be gassier because their gas has not leaked to the surface. This play could contain 0.93 Tcf of gas if the deeper coalbeds contain at least 100 cubic feet of gas per ton of coal.

Henrys Fork Play

This frontier coalbed gas play lies north of the Uinta Mountains in eastern Summit County. This is actually a dual play, where the thick coals in both the Frontier and overlying Adaville Formations can be traced south from Wyoming, where they crop out, into northern Utah, where they are poorly exposed or buried by younger rocks. The coals appear to have a high-volatile bituminous rank in Utah, which is slightly higher in rank than the corresponding coals in Wyoming. These two coalbed gas plays occur as parallel, north-trending belts, with the Adaville play covering roughly 35,000 acres, and the Frontier play covering about 15,000 acres. Data from two Utah wells indicate that the Adaville Formation has an average aggregate coal thickness of 100 feet, while the Frontier Formation's coals average an aggregate of 50 feet thick. No activity is known on the Utah portion of the play, but at least two companies have drilled wells to test the gas content of these coals in Wyoming, although no test results have been released. As a result, little is known of the gas content of these coals. The total in-place coalbed gas resource for these two formations is estimated to range from 0.06 to 0.99 Tcf.

In summary, Utah has six frontier coalbed gas plays that are in various stages of testing or development. The undeveloped portions of these six plays are estimated to contain in-place gas resources ranging from 1.96 to 9.78 Tcf.

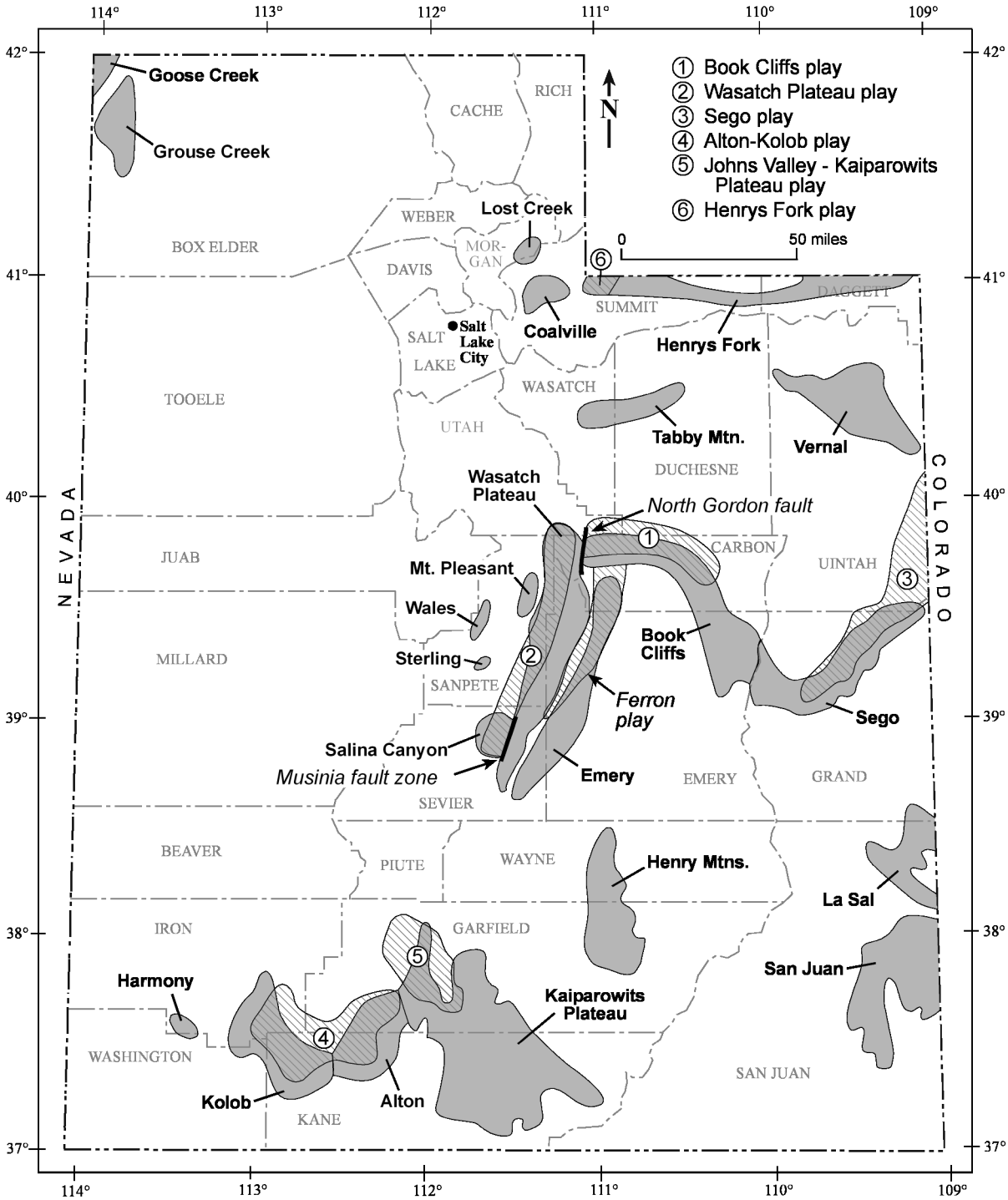


Figure 1. Location of coal fields (solid) and coalbed gas plays (hachured) in Utah.