

National and Global Petroleum Assessment

Assessment of Undiscovered Oil and Gas Resources in the Uteland Butte Member of the Eocene Green River Formation, Uinta Basin, Utah

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean undiscovered resources of 214 million barrels of oil, 329 billion cubic feet of associated/dissolved natural gas, and 14 million barrels of natural gas liquids in the informal Uteland Butte member of the Green River Formation, Uinta Basin, Utah.

Introduction

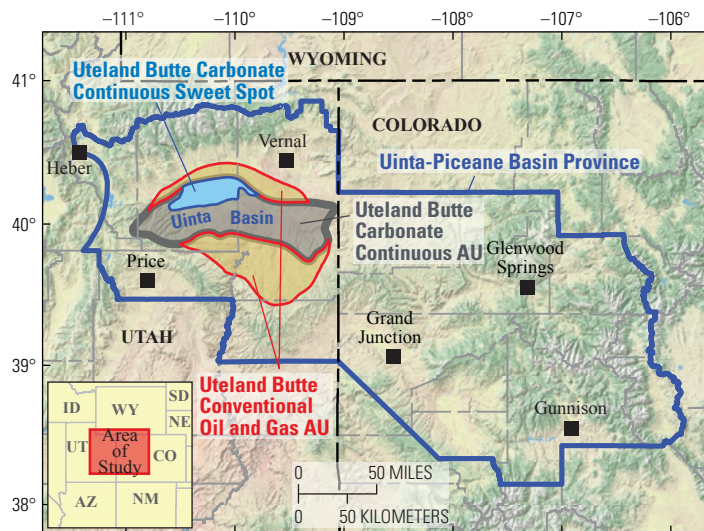
The U.S. Geological Survey (USGS) recently completed a geology-based assessment of conventional and continuous (unconventional) oil and gas resources of the informal Uteland Butte member (Osmond, 1992) of the Eocene Green River Formation, Uinta Basin, Utah (fig. 1). The recent successful development of a tight oil play in the informal Uteland Butte member, using modern horizontal drilling and hydraulic fracturing techniques (Durham, 2013; Anderson and Roesink, 2013; Vanden Berg and others, 2014), has spurred a renewed interest in the tight oil potential of lacustrine rocks.

Assessment Units

The USGS defined a Green River Total Petroleum System (TPS) and two assessment units (AU) within the TPS: (1) the Uteland Butte Carbonate Continuous Oil Assessment Unit; and (2) the Uteland Butte Conventional Oil and Gas Assessment Unit (fig. 1). Key input data used to assess the informal Uteland Butte member are in table 1.

The Uteland Butte Carbonate Continuous Oil AU covers much of the deep central part of the Uinta Basin (fig. 1) and consists largely of organic-rich offshore lacustrine carbonate and shale. The most productive reservoir rock and the main target for horizontal drilling is highly porous, largely impermeable dolomite beds, but significant oil is also present in adjacent organic-rich shale and micritic limestone beds. The Uteland Butte Carbonate Continuous Sweet Spot or area with unusually high estimated ultimate recoveries (EURs), is present in the north-central part of the AU in an area of abnormally high formation pressures. Overpressure appears to be the most important factor in predicting Uteland Butte production, but other factors also play a role including: (1) total thickness of the Uteland Butte member; (2) total thickness of dolomite beds; (3) organic richness; and (4) thermal maturity. The overpressured sweet spot was defined using drilling mud weights (Anderson and Roesink, 2013) and drill stem tests.

The Uteland Butte Conventional Oil and Gas AU is divided into two areas, one along the north margin of the basin and the other in the south-central part of the basin (fig. 1). The two areas are in quite different geologic settings. The north area is in marginal lacustrine rocks along the deep basin trough where thermal maturities are high and overpressure is locally encountered. Oil is trapped by the updip pinch out of marginal lacustrine clastic and carbonate reservoirs into offshore lacustrine carbonate and shale of the Uteland Butte Carbonate Continuous Oil AU to the south.



Source: National Park Service (2015)

Figure 1. U.S. Geological Survey Uinta-Piceance Basin Province of Utah and Colorado, the Uteland Butte Conventional Oil and Gas Assessment Unit (AU), the Uteland Butte Carbonate Continuous Oil Assessment Unit and the geologic sweet spot within the assessment unit.

The south area of the Uteland Butte Conventional Oil and Gas AU, in contrast, is in marginal lacustrine rocks along the south margin of the basin where thermal maturity is low and formation pressures are near normal. Trapping mechanism in the south segment is probably the updip pinch out of individual marginal lacustrine clastic units into alluvial mudstone.

The Uteland Butte Conventional Oil and Gas AU consists largely of sandstone, siltstone, carbonate, and mudstone deposited in a marginal lacustrine setting. Oil migrated into this AU from thermally mature, organic-rich offshore lacustrine rocks of the informal Uteland Butte member. The Uteland Butte Conventional Oil and Gas AU is thought to contain mainly undiscovered oil fields but some gas fields are also likely to be present. There is abundant evidence for vertical migration of gas in the basin from deeper, gas-prone source rocks in the underlying Upper Cretaceous interval (Rice and others, 1992). Some of this gas has migrated into the marginal lacustrine facies of the informal Uteland Butte member and may be trapped where an adequate seal is present.

Resource Summary

The USGS assessed undiscovered, technically recoverable continuous (unconventional) and conventional resources in the informal Uteland Butte member. Mean resources for the Uteland Butte Carbonate Continuous Oil AU are 177 million barrels of oil (MMBO); 218 billion cubic feet of gas (BCFG); and 10 million barrels of natural gas liquids (MMBNGL) (table 2). Mean resources for the Uteland Butte Conventional Oil and Gas AU are 37 MMBO; 111 BCFG; and 4 MMBNGL (table 2).

Table 1. Key assessment input data for one continuous and one conventional assessment unit in the informal Utland Butte member, Uinta-Piceance Basin Province.

[EUR, estimated ultimate recovery per well; MMBO, million barrels of oil; BCFG, billion cubic feet of gas; AU, assessment unit; %, percent. The average EUR input is the minimum, median, maximum, and calculated mean]

Assessment input data—continuous AU				
Utland Butte Carbonate Continuous Oil AU	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	400,000	700,000	1,373,000	824,333
Average drainage area of wells (acres)	120	160	200	160
Percentage of total AU area that is untested (%)	98	99	99.5	98.8
Success ratio (%) in sweet spots	80	95	100	91.7
Average EUR (MMBO) in sweet spots	0.06	0.085	0.14	0.088
Success ratio (%) in nonsweet spots	30	50	70	50.0
Average EUR (MMBO) in nonsweet spots	0.03	0.044	0.09	0.046
AU probability	1.0			
Assessment input data—conventional AU				
Utland Butte Conventional Oil and Gas AU	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	12	40	12.93
Number of gas fields	1	4	10	4.19
Sizes of oil fields (MMBO)	0.5	2	30	2.86
Sizes of gas fields (BCFG)	3	12	180	17.08
AU probability	1.0			

Table 2. Assessment results for continuous and conventional oil and gas resources in the informal Utland Butte member, Uinta-Piceance Basin Province.

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids; TPS, total petroleum system; AU, assessment unit. Results shown are fully risked estimates. For gas accumulations, all liquids are included under the NGL (natural gas liquids) category. F95 represents a 95 percent chance of at least that amount tabulated. Other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Shading indicates not applicable]

Total Petroleum System (TPS) and Assessment Units (AUs)	AU probability	Accumulation type	Total undiscovered resources											
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Green River TPS														
Utland Butte Carbonate Continuous Oil AU	1.0	Oil	104	170	272	177	98	205	383	218	4	9	20	10
Total unconventional resources			104	170	272	177	98	205	383	218	4	9	20	10
Green River TPS														
Utland Butte Conventional Oil and Gas AU	1.0	Oil	15	34	70	37	15	35	74	39	1	1	3	2
		Gas					27	63	148	72	1	1	3	2
Total conventional resources			15	34	70	37	42	98	222	111	2	2	6	4
Total undiscovered resources			119	204	342	214	140	303	605	329	6	11	26	14

References Cited

Anderson, J.G., Roesink, J.G., 2013, Reservoir characterization of the Utland Butte Formation in the Uinta Basin: American Association of Petroleum Geologists, Search and Discovery Article #50888, 2 oversized sheets.

Durham, L.S., 2013, Unconventional Utland Butte sparks new Utah activity: American Association of Petroleum Geologists Explorer, June 2013.

Osmond, J.C., 1992, Greater Natural Buttes gas field, Uintah County, Utah, *in* Fouch, T.D., Nuccio, V.F., and Chidsey, T.C., Jr., eds., Hydrocarbon and mineral resources of the Uinta Basin, Utah and Colorado: Utah Geological Association Guidebook No. 20, p. 143–163.

Rice, D.D., Fouch, T.D., and Johnson, R.C., 1992, Influence of source rock type, thermal maturity, and migration on composition and distribution of natural gases, Uinta Basin, Utah, *in* Fouch, T.D., Nuccio, V.F., and Chidsey, T.C. Jr., eds.,

Hydrocarbon and mineral resources of the Uinta Basin, Utah and Colorado: Utah Geological Association Guidebook No. 20, p. 95–110.

Vanden Berg, M.D., Wood, R.E., Carney, S.M., Morgan, C.D., 2014, Geological characterization of the Utland Butte Member of the Eocene Green River Formation—An emerging unconventional carbonate tight oil play in the Uinta Basin, Utah: *in* Program and Abstracts, Rocky Mountain Association of Geologist—American Association of Petroleum Geologists Annual Meeting, July 20–22, 2014, p. 44.

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