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National and Global Petroleum Assessment

Assessment of Undiscovered Oil and Gas Resources in the Mancos-Menefee Composite and Underlying Todilto Total Petroleum Systems of the San Juan Basin Province, New Mexico and Colorado, 2020

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 12 million barrels of oil and 27 trillion cubic feet of gas in the Mancos-Menefee Composite and underlying Todilto Total Petroleum Systems of the San Juan Basin Province, New Mexico and Colorado.

Introduction

The U.S. Geological Survey (USGS) completed a geology-based assessment of undiscovered, technically recoverable conventional and continuous, or unconventional, oil and gas resources in the Mancos-Menefee Composite Total Petroleum System (TPS) and underlying Todilto TPS (figs. 1–3). Reservoir rocks in the Mancos-Menefee TPS include (1) Dakota Sandstone, (2) Gallup Sandstone, (3) Mancos Shale and associated sandstones of the Tocito Sandstone Lentil and El Vado Sandstone Member, and (4) Mesaverde Group. These units have primarily produced oil and gas from vertical drilling, where commingling of productive intervals is common. In recent years, horizontal drilling has been utilized, particularly in the Mancos Shale (IHS Markit®, 2019). The Todilto TPS consists of the Jurassic

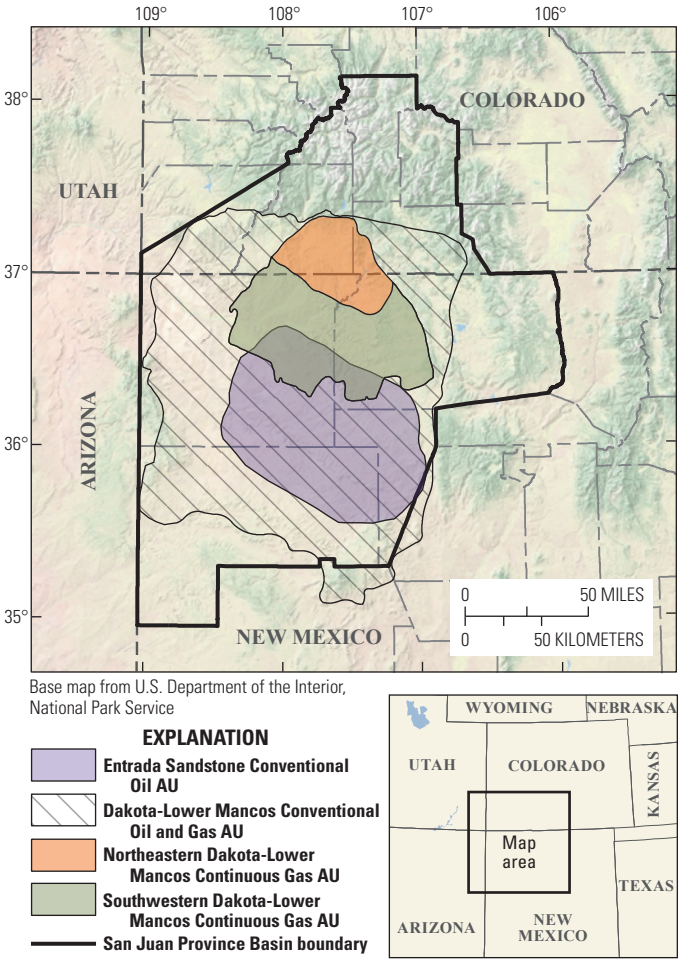

Figure 1. Map showing the San Juan Basin Province in New Mexico and Colorado and the extents of the Entrada Sandstone Conventional Assessment Unit (AU), Dakota-Lower Mancos Conventional Oil and Gas AU, Northeastern Dakota-Lower Mancos Continuous Gas AU, and Southwestern Dakota-Lower Mancos Continuous Gas AU.

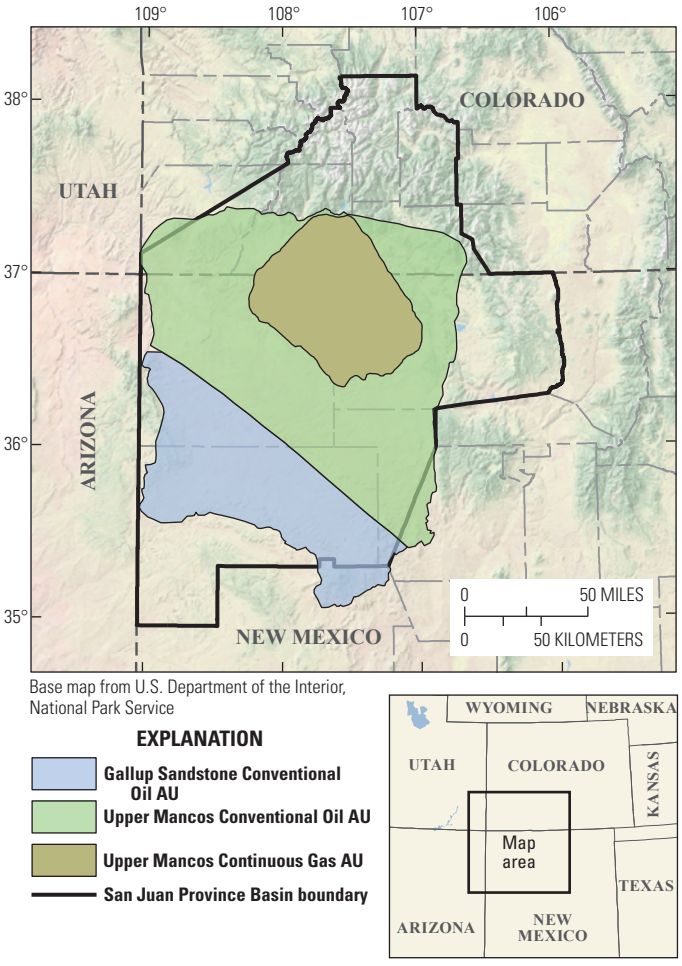

Figure 2. Map showing the San Juan Basin Province in New Mexico and Colorado and the extents of the Gallup Sandstone Conventional Oil Assessment Unit (AU), Upper Mancos Conventional Oil AU, and Upper Mancos Continuous Gas AU.

Table 1. Key input data for four conventional and six continuous assessment units (AUs) in the San Juan Basin Province, New Mexico and Colorado.

[Well drainage area, success ratio, and estimated ultimate recovery are defined partly using U.S. analogs. The average EUR input is the minimum, median, maximum, and calculated mean. Gray shading indicates not applicable. AU, assessment unit; %, percent; EUR, estimated ultimate recovery (per well); MMBO, million barrels of oil; BCFG, billion cubic feet of gas]

Assessment input data—Conventional AUs	Entrada Sandstone Conventional Oil AU				Dakota-Lower Mancos Conventional Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	2	3	2	1	2	4	2.1
Size of oil fields (MMBO, oil)	0.5	1	4	1.1	0.5	1	6	1.2
Number of gas fields					1	2	3	2.0
Size of gas fields (BCFG, gas)					3	6	25	6.7
AU probability	0.7				0.8			
Assessment input data—Conventional AUs	**Gallup Sandstone Conventional Oil AU**				**Upper Mancos Conventional Oil AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	2	3	2	1	3	5	3.0
Size of oil fields (MMBO, oil)	0.5	1	4	1.1	0.5	2	5	2.1
AU probability	0.7				1.0			
Assessment input data—Continuous AUs	**Northeastern Dakota-Lower Mancos Continuous Gas AU**				**Southwestern Dakota-Lower Mancos Continuous Gas AU**			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	100,000	400,000	730,000	410,000	500,000	1,000,000	1,784,000	1,094,667
Average drainage area of wells (acres)	40	80	120	80	40	80	120	80
Area untested in AU (%)	70	85	95	83.3	55	70	85	70
Success ratio (%)	70	80	90	80	70	80	90	80
Average EUR (BCFG, gas)	0.8	1	2	1.06	0.8	1.2	2	1.24
AU probability	1.0				1.0			
Assessment input data—Continuous and Coalbed AUs	**Upper Mancos Continuous Gas AU**				**Menefee Coalbed Gas AU**			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	500,000	1,942,300	814,433	1,000	1,000,000	5,291,000	2,097,333
Average drainage area of wells (acres)	100	160	240	166.7	60	80	160	100
Area untested in AU (%)	90	95	98	94.3	100	100	100	100
Success ratio (%)	70	80	90	80	10	50	90	50
Average EUR (BCFG, gas)	0.1	0.6	3	0.73	0.02	0.08	0.25	0.09
AU probability	1.0				0.9			
Assessment input data—Continuous AUs	**Northeastern Mesaverde Continuous Gas AU**				**Southwestern Mesaverde Continuous Gas AU**			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	50,000	400,000	749,000	399,667	200,000	700,000	1,236,200	712,067
Average drainage area of wells (acres)	40	80	120	80	40	80	120	80
Area untested in AU (%)	65	78	90	77.7	30	50	75	51.7
Success ratio (%)	50	70	90	70	70	80	90	80
Average EUR (BCFG, gas)	0.8	1	2	1.06	1.6	1.8	2.5	1.84
AU probability	1.0				1.0			

Todilto Limestone Member of the Wanakah Formation and the underlying Entrada Sandstone. The Mancos-Menefee Composite TPS and Todilto TPS were last assessed by the USGS in 2002, as part of a broad assessment of oil and gas resources within the Jurassic and Cretaceous reservoirs of the San Juan Basin (Ridgley and Hatch, 2013; Ridgley and others, 2013).

Geologic Summary

In the Todilto TPS, the Middle Jurassic Todilto Limestone Member hosts organic-rich limestone beds, deposited in a marine-lacustrine system, that are thermally mature in some regions of the San Juan Basin. The Entrada Sandstone is an extensive eolian sandstone deposit with dune topography. Minor downward migration of oil from the Todilto into dune crests of the underlying Entrada formed localized conventional oil accumulations (Ridgley and Hatch, 2013).

Within the overlying Mancos-Menefee Composite TPS, Cretaceous reservoir strata range from the base of the Dakota Sandstone to the lowermost part of the Cliff House Sandstone of the Mesaverde Group. Rock units of the Mancos-Menefee Composite TPS were deposited during transgressive and regressive episodes along the Cretaceous Western Interior Seaway. The Mancos Shale is a primary source of oil and gas resources in the San Juan Basin and consists of marine shale (with Type II organic matter), siltstone, and fine-grained sandstones. The Mancos Shale is more than 2,000 feet thick in some areas of the basin. In the upper part of the Mancos Shale, shoreface sandstones of the Tocito Sandstone Lentil and El Vado Sandstone Member form significant oil and gas reservoirs. The overlying Menefee Formation of the Mesaverde Group consists of fluvial channel sandstones, as well as carbonaceous shale and coal beds, which may also have generated hydrocarbons. Both the Mancos Shale and Menefee Formation were sufficiently buried to generate oil and gas from the Eocene to the Miocene. Hydrocarbons from the Mancos Shale, with possible contributions from the Menefee Formation, migrated into adjacent reservoir rocks to form the Mancos-Menefee Composite TPS (Ridgley and others, 2013; Broadhead, 2015).

Assessment Units

One conventional assessment unit (AU), the Entrada Sandstone Conventional Oil AU, was defined for the Todilto TPS (fig. 1).

Table 2. Results for five conventional and six continuous assessment units (AUs) in the San Juan Basin Province, New Mexico and Colorado.

[Results shown are fully risked estimates. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. Gray shading indicates not applicable. MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids; CBG, coal bed gas]

Total petroleum systems 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
Todilto Total Petroleum System														
Entrada Sandstone Conventional Oil AU	0.7	Oil	0	2	3	2	0	2	3	2	0	0	0	0
Mancos-Menefee Composite Total Petroleum System														
Dakota-Lower Mancos Conventional Oil and Gas AU	0.8	Oil	0	2	4	2	0	3	6	3	0	0	0	0
		Gas					0	12	20	11	0	0	1	0
Gallup Sandstone Conventional Oil AU	0.7	Oil	0	2	3	2	0	0	1	0	0	0	0	0
Upper Mancos Conventional Oil AU	1.0	Oil	4	6	9	6	22	34	49	35	0	1	1	1
Mesaverde Updip Conventional Oil AU		Oil	Not quantitatively assessed											
Total undiscovered conventional resources			**4**	**12**	**19**	**12**	**22**	**51**	**79**	**51**	**0**	**1**	**2**	**1**
Mancos-Menefee Composite Total Petroleum System														
Northeastern Dakota-Lower Mancos Continuous Gas AU	1.0	Gas					1,617	3,555	6,362	3,716	1	2	4	2
Southwestern Dakota-Lower Mancos Gas AU	1.0	Gas					5,289	9,302	15,810	9,759	35	65	114	68
Upper Mancos Continuous Gas AU	1.0	Gas					480	2,033	6,963	2,649	8	33	112	42
Menefee Coalbed Gas AU	0.9	CBG					0	647	2,307	836	0	0	0	0
Northeastern Mesaverde Continuous Gas AU	1.0	Gas					1,064	2,789	5,316	2,940	0	1	3	1
Southwestern Mesaverde Continuous Gas AU	1.0	Gas					3,067	6,597	12,362	7,009	12	26	50	28
Total undiscovered continuous resources							**11,517**	**24,923**	**49,120**	**26,909**	**56**	**127**	**283**	**141**
Total undiscovered resources			**4**	**12**	**19**	**12**	**11,539**	**24,974**	**49,199**	**26,960**	**56**	**128**	**285**	**142**

A total of four conventional AUs were delineated for the Mancos-Menefee Composite TPS (figs. 1–3): (1) Dakota-Lower Mancos Conventional Oil and Gas AU, (2) Gallup Sandstone Conventional Oil AU, (3) Upper Mancos Conventional Oil AU, and (4) Mesaverde Updip Conventional Oil AU.

In addition, six continuous AUs were defined for the Mancos-Menefee Composite TPS (figs. 1–3): (1) Northeastern Dakota-Lower Mancos Continuous Gas AU, (2) Southwestern Dakota-Lower Mancos Continuous Gas AU, (3) Upper Mancos Continuous Gas AU, (4) Menefee Coalbed Gas AU, (5) Northeastern Mesaverde Continuous Gas AU, and (6) Southwestern Mesaverde Continuous Gas AU.

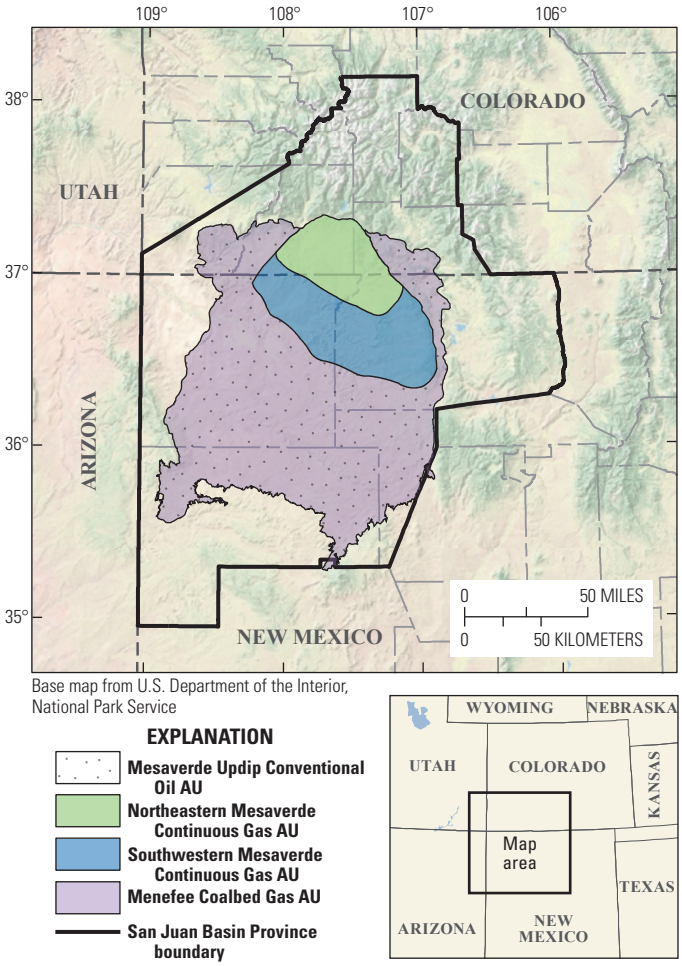

Figure 3. Map showing the San Juan Basin Province in New Mexico and Colorado and the extents of the Mesaverde Updip Conventional Oil Assessment Unit (AU; not assessed), Northeastern Mesaverde Continuous Gas AU, Southwestern Mesaverde Continuous Gas AU, and Menefee Coalbed Gas AU.

Assessment unit boundaries were primarily defined based on the regional extent of formations in the San Juan Basin and differences in gas to oil ratios. Key input data used to assess the Todilto and Mancos-Menefee Composite TPSs are listed in table 1.

Undiscovered Resources Summary

The USGS assessed undiscovered, technically recoverable continuous and conventional oil and gas resources for 1 AU in the Todilto TPS and 10 AUs in the Mancos-Menefee TPS; the Mesaverde Updip Conventional Oil AU was not quantitatively assessed (table 2). Total estimated mean resources are 12 million barrels of oil (MMBO) with an F95–F5 range from 4 to 19 MMBO; 26,960 billion cubic feet of gas (BCFG), or 27 trillion cubic feet of gas, with an F95–F5 range from 11,539 to 49,199 BCFG; and 142 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 56 to 285 MMBNGL.

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For More Information

Assessment and methodology information can also be accessed at the USGS Energy Resources Program website at https://energy.usgs.gov.

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