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National and Global Petroleum Assessment

Assessment of Undiscovered Gas Resources in the Lewis Shale Total Petroleum System 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 2.6 trillion cubic feet of gas in the Lewis Shale Total Petroleum System 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 continuous, or unconventional, gas resources in the Lewis Shale of the San Juan Basin in New Mexico and Colorado (fig. 1). The Lewis Shale was last assessed by the USGS in 2002 as part of a broad assessment of oil and gas resources within Jurassic and Cretaceous reservoirs in the San Juan Basin Province (Dubiel, 2013). Gas resources in the Lewis Shale Total Petroleum System (TPS) are primarily produced from shoreface sandstones of the Cliff House Sandstone and from recompletions of existing Mesaverde Group wells within marine clastic facies of the Lewis Shale. Gas production from recompleted wells in the Mesaverde Group is commingled with Lewis Shale production (Fassett and Boyce, 2005; Dubiel, 2013).

Geologic Summary

Marine strata of the Lewis Shale in the San Juan Basin (Colorado and New Mexico) were deposited within the Cretaceous Western Interior Seaway. The Lewis Shale is composed of offshore marine shales, mudstones, siltstones, and sandstones, and interfingers with shoreface sandstones of the Cliff House Sandstone (informally known as the La Ventana and Chacra tongues) to the southwest of the central San Juan Basin. The Cliff House Sandstone tongues are units within the Mesaverde Group. The Lewis Shale has been informally divided into the Otero and Navajo City intervals below the Huerfanito Bentonite Bed, a distinct volcanic ash marker bed within the Lewis Shale, and the Ute interval above the Huerfanito Bentonite Bed, which was deposited during the maximum marine transgression in the Campanian. The upper part of the Lewis Shale forms a gradational boundary with progradational shoreface sandstones of the overlying Pictured Cliffs Sandstone. The Lewis Shale has a maximum thickness of approximately 2,400 feet in the northeastern section of the basin (Fassett and Boyce, 2005; Dubiel, 2013).

The Lewis Shale is considered a self-sourced reservoir, where organic-rich marine rocks (containing Type II kerogen) were buried deep enough to reach the gas-generation window during the Oligocene Period. Type III organic matter was also supplied to the basin from fluvial and deltaic systems to the southwest during Lewis Shale deposition. Gas resources migrated locally from the Lewis Shale into clastic parasequences of the Cliff House Sandstones, forming the Lewis Shale TPS (Dubiel, 2013).

Assessment Units

Three continuous assessment units (AUs) were defined for the Lewis Shale TPS: (1) Lewis Shale Continuous Gas AU, (2) Lewis-Cliff House Continuous Gas AU, and (3) Cliff House Fairway Continuous Gas AU (fig. 1). The Lewis Shale Continuous Gas AU encompasses marine rocks of the Lewis Shale from the deepest part of the central San Juan Basin to the maximum extent of the Lewis Shale to the northeast. The Lewis-Cliff House Continuous Gas AU includes the extent of the Lewis Shale to the southwest in the San Juan Basin and additional production from the informally named

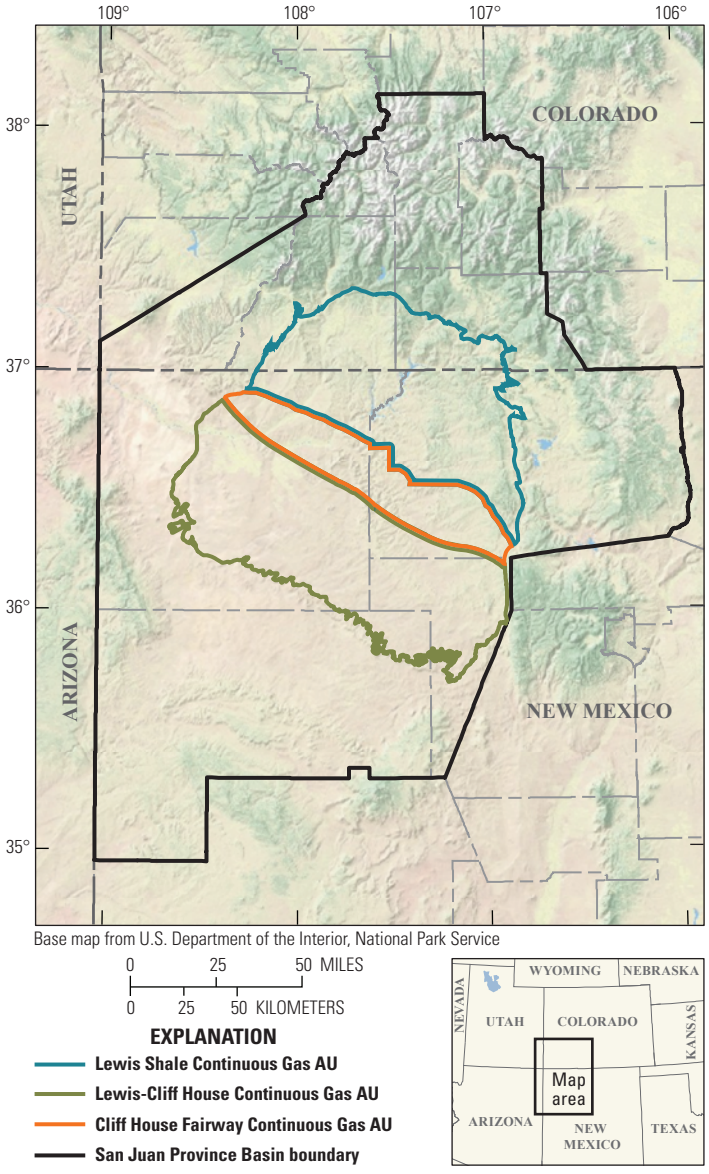

Figure 1. Map showing the San Juan Basin Province, New Mexico and Colorado, and the extents of the three continuous assessment units (AUs) in the Lewis Shale Total Petroleum System. Adjacent lines indicate a shared boundary.

Table 1. Key input data for three continuous assessment units (AUs) in the Lewis Shale Total Petroleum System of the San Juan Basin Province, New Mexico and Colorado.

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

Assessment input data—Continuous AUs	Lewis Shale Continuous Gas AU				Lewis-Cliff House Continuous Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	50,000	800,000	1,900,000	916,667	1,000	500,000	2,187,000	896,000
Average drainage area of wells (acres)	80	120	160	120	80	120	160	120
Area untested in AU (%)	96	97	99	97.3	98	99	100	99
Success ratio (%)	50	70	90	70	40	50	70	53.3
Average EUR (BCFG)	0.18	0.2	0.5	0.216	0.07	0.1	0.18	0.104
AU probability	1.0				1.0			

Assessment input data—Continuous AUs	Cliff House Fairway Continuous Gas AU			
	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	50,000	400,000	719,000	389,667
Average drainage area of wells (acres)	80	120	160	120
Area untested in AU (%)	70	80	90	80
Success ratio (%)	70	80	90	80
Average EUR (BCFG)	0.3	0.5	0.8	0.512
AU probability	1.0			

Lewis Shale Total Petroleum System Assessment Team

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Table 2. Results for three continuous assessment units (AUs) in the Lewis Shale Total Petroleum System of 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. Shading indicates not applicable. BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids]

Total petroleum system and assessment units (AUs)	AU probability	Accumulation type	Total undiscovered resources							
			Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean
Lewis Shale Total Petroleum System										
Lewis Shale Continuous Gas AU	1.0	Gas	361	1,066	2,112	1,133	1	2	5	2
Lewis-Cliff House Continuous Gas AU	1.0	Gas	102	374	853	414	0	0	1	0
Cliff House Fairway Continuous Gas AU	1.0	Gas	419	1,053	1,808	1,076	1	1	3	1
Total undiscovered continuous resources			**882**	**2,493**	**4,773**	**2,623**	**2**	**3**	**9**	**3**

Chacra and La Ventana sandstone trends to the south. The Cliff House Fairway Continuous Gas AU is defined to the northeast by the reservoir-pool line established by the New Mexico Oil Conservation Division for the Chacra sandstone producing interval. The southwest boundary follows established production in shelf-sandstone beds of the informal Chacra sandstone trend. Key input data used to assess the Lewis Shale TPS are listed in table 1.

Undiscovered Resources Summary

The USGS assessed undiscovered, technically recoverable continuous gas resources for three AUs in the Lewis Shale TPS (table 2). Total estimated mean resources are 2,623 billion cubic feet of gas (BCFG), or 2.6 trillion cubic feet of gas, with an F95–F5 range from 882 to 4,773 BCFG and 3 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 2 to 9 MMBNGL.

References Cited

Dubiel, R.F., 2013, Geology, sequence stratigraphy, and oil and gas assessment of the Lewis Shale Total Petroleum System, San Juan Basin, New Mexico and Colorado, chap. 5 *of* U.S. Geological Survey San Juan Basin Assessment Team, comps., Total petroleum systems and geologic assessment of undiscovered oil and gas resources in the San Juan Basin Province, exclusive of Paleozoic rocks, New Mexico and Colorado: U.S. Geological Survey Digital Data Series 69–F, 45 p.

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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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