

Assessment of Undiscovered Gas Resources in the Williston Basin Province, 2020

Using a geology-based assessment methodology, the U.S. Geological Survey estimated a mean of 2,438 billion (2.4 trillion) cubic feet of gas resources in the Williston Basin Province, in North Dakota, Montana, and South Dakota.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable conventional and continuous gas resources in the Williston Basin Province in North Dakota, Montana, and South Dakota (fig. 1). Three geologic assessment units (AUs) were defined, one within the Ordovician Winnipeg Total Petroleum System (TPS) and two within the Upper Cretaceous–Paleogene Biogenic Gas TPS. Each AU was assessed for undiscovered gas and natural-gas liquid (NGL) resources.

The Williston Basin Province is a major petroleum-producing region. The purpose of this fact sheet is to present the potential for nonassociated conventional gas and continuous gas resources. Organic-rich shales within the Icebox Formation of the Ordovician Winnipeg Group are at a sufficient level of thermal maturity and have adequate geologic properties to host a potential shale-gas accumulation. The primary key to a viable shale-gas accumulation within the Icebox Formation of the Winnipeg Group is the organic richness of the informally named Government Creek shale that forms the lower part of the Icebox Formation of the Winnipeg Group (Ulishney and others, 2005; Nesheim and Nordeng, 2013). The informal Government Creek shale contains Type I and Type II organic matter, total organic carbon (TOC) values up to 4.3 weight percent, and calculated hydrogen index values of as much as 600 milligrams hydrocarbon per gram TOC. The total thickness of the Icebox Formation of the Winnipeg Group can be more than 120 feet, but the organic-rich section is much less (Nesheim and Nordeng, 2013).

The shallow strata of the Williston Basin Province include Upper Cretaceous and Cenozoic coals, lignites, and carbonaceous shales. The organic matter in these rocks can be consumed by bacteria, thus producing shallow biogenic gas (Shurr, 1998). This process to produce biogenic gas is common across the northern Great Plains of the United States and Canada (Rice and Claypool, 1981; Shurr and Ridgley, 2002; Payenberg and others, 2003; Anna, 2010). Key assessment input data for the three AUs within the Williston Basin Province are shown in table 1.

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional gas, continuous gas, and natural-gas liquid resources within the Williston Basin Province, in North Dakota, Montana, and South Dakota (table 2). The fully risked mean totals are 2,438 billion cubic feet of gas (BCFG), or 2.4 trillion cubic feet, with an F95–F5 range from 430 to 6,093 BCFG; and 100 million barrels of natural gas liquids (MMBNGL), with an F95–F5 range from 18 to 242 MMBNGL.

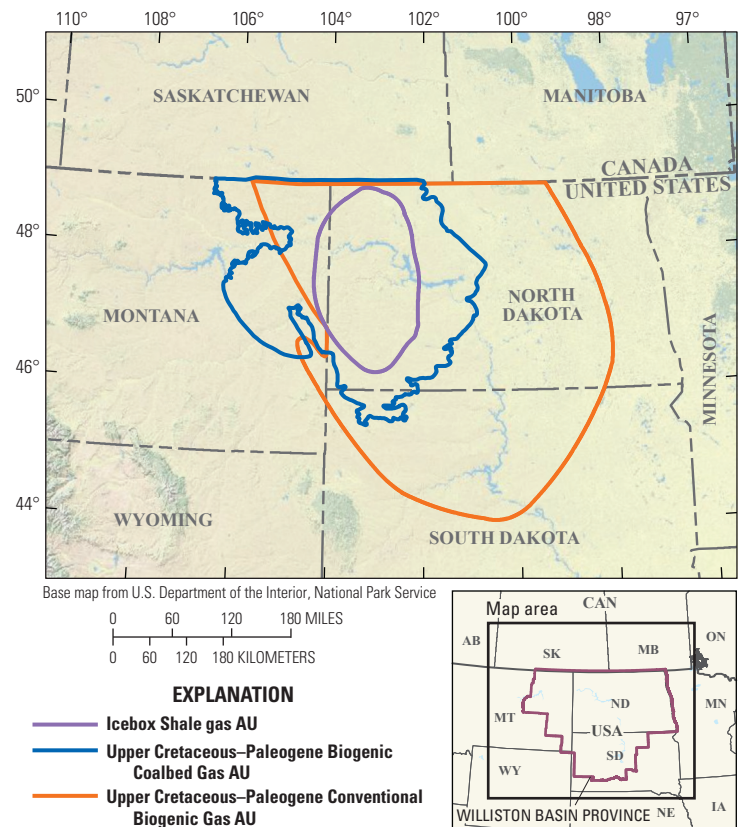


Figure 1. Map showing the location of three gas assessment units (AUs) in the Williston Basin Province, North Dakota, Montana, and South Dakota. Adjacent lines indicate a shared boundary at the outermost line.

Table 1. Key input data for three gas assessment units in the Williston Basin Province, North Dakota, Montana, and South Dakota.

[Shading indicates not applicable. AU, assessment unit; %, percent; EUR, estimated ultimate recovery; ; BCFG, billion cubic feet of gas]

Assessment input data— Continuous AUs	Icebox Shale Gas AU				Upper Cretaceous–Paleogene Biogenic Coalbed Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	1,630,000	9,871,000	3,834,000	1,000	5,000,000	27,370,000	10,790,333
Average drainage area of wells (acres)	60	120	180	120	40	100	160	100
Area untested in AU (%)	100	100	100	100	100	100	100	100
Success ratio (%)	10	50	90	50	2	7	15	8.0
Average EUR (BCFG)	0.04	0.08	0.12	0.081	0.04	0.08	0	0.092
AU probability	1				1			
Assessment input data— Conventional AU	Upper Cretaceous–Paleogene Conventional Biogenic Gas AU							
	Minimum	Median	Maximum	Calculated mean				
Number of gas fields	1	15	75	17.1				
Size of gas fields (BCFG)	3	6	800	16.8				
AU probability	1							

Table 2. Results for three gas assessment units in the Williston Basin Province, North Dakota, Montana, and South Dakota.

[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 systems and assessment units (AUs)	AU probability	Accumulation type	Total undiscovered resources							
			Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean
Ordovician Winnipeg Total Petroleum System										
Icebox Shale Gas AU	1	Gas	237	1,103	3,230	1,339	18	83	242	100
Upper Cretaceous–Paleogene Biogenic Gas Total Petroleum System										
Upper Cretaceous–Paleogene Biogenic Coalbed Gas AU	1	Gas	133	631	2,107	811	0	0	0	0
Total undiscovered continuous resources			370	1,734	5,337	2,150	18	83	242	100
Upper Cretaceous–Paleogene Conventional Biogenic Gas AU	1	Gas	60	221	756	288	0	0	0	0
Total undiscovered conventional resources			60	221	756	288	0	0	0	0
Total undiscovered resources			430	1,955	6,093	2,438	18	83	242	100

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For More Information

Assessment results are also available at the USGS Energy website, <https://www.usgs.gov/energy-and-minerals/energy-resources-program/>.

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