

Assessment of Continuous Gas Resources in the Montney and Doig Formations, Alberta Basin Province, Canada, 2018

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 47.6 trillion cubic feet of gas and 2.2 billion barrels of natural gas liquids in the Montney and Doig Formations of the Alberta Basin Province in Canada.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable continuous (unconventional) gas resources in the Triassic Montney and Doig Formations of the Alberta Basin Province of Canada (fig. 1). In this study, the upper Montney Formation siltstones were assessed as a tight-gas accumulation (Chalmers and Bustin, 2012), and the Doig Formation phosphatic shales were assessed as a potential shale-gas accumulation (Chalmers and others, 2012).

Total Petroleum Systems and Assessment Units

The USGS defined an Upper Montney Total Petroleum System (TPS) and a Doig TPS. The upper part of the Montney Formation consists of organic-bearing siltstones that represent distal shelf, slope, and basinal turbidite deposits. These siltstones contain mainly Type II organic matter, have organic carbon contents of as much as 4 weight percent, have hydrogen index values of as much as 450 milligrams of hydrocarbon per gram of organic carbon, are overpressured, and can be as much as 200 meters thick (Chalmers and Bustin, 2012; Schmitz and others, 2014; Crombez and others, 2017). Phosphatic shales of the Doig Formation contain Type II organic matter, have organic carbon contents of as much as 11 weight percent, have hydrogen index values of as much as 485 milligrams of hydrocarbon per gram of organic carbon, are overpressured, and are as much as 180 meters thick (Chalmers and Bustin, 2012). Thermal maturity maps of the Doig Formation show that much of the formation (and underlying part of the upper Montney) is thermally mature for gas generation in the western part of the basin where the upper part of the Montney and Doig are overpressured (Creaney and others, 1994; Ducros and others, 2017). Late Cretaceous through Paleogene foreland burial is generally considered to have thermally matured Montney and Doig source rocks (Chalmers and Bustin, 2012; Ducros and others, 2017).

The geologic model for the Upper Montney TPS is for oil and gas to have been generated in distal organic-bearing siltstones, the oil to have cracked to gas within the overpressured zone, and some of the gas to have been retained within the upper part of the Montney Formation siltstones following migration. The Upper Montney Tight Gas Assessment Unit (AU) was defined to encompass areas of organic-rich siltstones within the overpressured gas-generation window. The geologic model for the Doig TPS is for oil and gas to have been generated from condensed, phosphatic Middle Triassic shales from Late Cretaceous–Paleogene burial. Within the overpressured area, oil thermally cracked to gas, which was partially retained within the shales following migration updip into conventional traps. The Doig

Shale Gas AU was defined to encompass areas of organic-rich shale within the overpressured gas-generation window.

Assessment input data are summarized in table 1. Input data from wells within drainage areas in the upper part of the Montney are based mainly on Schmitz and others (2014) and Kwan (2015). Drainage areas (for shales of the Doig Formation), success ratios, and estimated ultimate recoveries of wells are taken from geologic analogs in the United States.

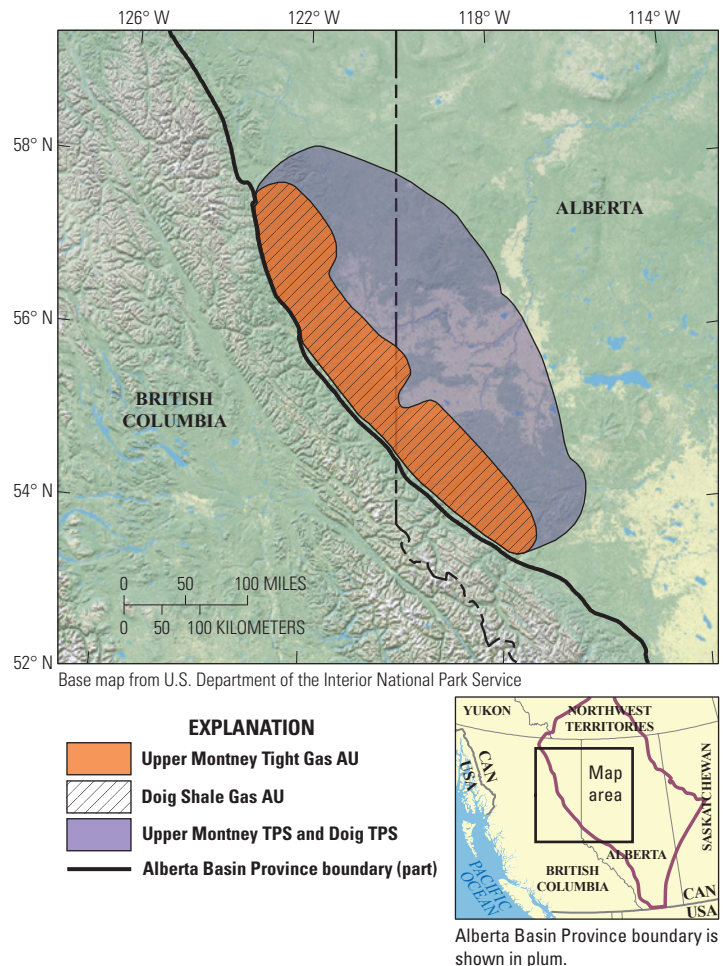


Figure 1. Map showing the two continuous assessment units (AUs) in the Montney and Doig Formations of the Alberta Basin Province in Canada. Province boundary is from Klett and others (1997).

Undiscovered Resources Summary

The USGS quantitatively assessed continuous gas resources in two assessment units (table 2). For undiscovered, technically recoverable continuous gas resources, the mean totals are 47,616 billion cubic feet

of gas (BCFG), or 47.6 trillion cubic feet of gas, with an F95–F5 fractile range from 12,634 to 93,746 BCFG and 2,237 million barrels of (associated) natural gas liquids (MMBNGL), or 2.2 billion barrels of (associated) natural gas liquids, with an F95–F5 fractile range from 579 to 4,552 MMBNGL.

Table 1. Key input data for two continuous assessment units (AUs) in the Montney and Doig Formations of the Alberta Basin Province in Canada.

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

Assessment input data— Continuous AUs	Upper Montney Tight Gas AU				Doig Shale Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	5,650,500	11,301,000	5,650,833	1,000	2,000,000	11,301,000	4,434,000
Average drainage area of wells (acres)	160	200	240	200	80	120	160	120
Untested area (%)	85	90	95	90	91	95	99	95
Success ratio (%)	75	85	95	85	10	50	90	50
Average EUR (BCFG)	0.6	1.5	2.5	1.536	0.4	0.8	1.4	0.825
AU probability	1.0				1.0			

Table 2. Results for two continuous assessment units (AUs) in the Montney and Doig Formations of the Alberta Basin Province in Canada.

[BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. Fractiles are additive under the assumption of perfect positive correlation. Shading indicates not applicable]

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
Upper Montney Total Petroleum System										
Upper Montney Tight Gas AU	1.0	Gas	9,969	32,192	59,143	33,072	479	1,574	3,109	1,655
Doig Total Petroleum System										
Doig Shale Gas AU	1.0	Gas	2,665	12,101	34,603	14,544	100	471	1,443	582
Total undiscovered continuous resources			12,634	44,293	93,746	47,616	579	2,045	4,552	2,237

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For More Information

Assessment results are also available at the USGS Energy Resources Program website at <https://energy.usgs.gov>.

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