

Assessment of Undiscovered Continuous Oil and Gas Resources in the Domanik-Type Formations of the Volga-Ural Region Province, Russia, 2017

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean undiscovered, technically recoverable continuous resources of 2.8 billion barrels of oil and 34 trillion cubic feet of gas in the Domanik-type formations of the Volga-Ural Region Province, Russia.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable continuous oil and gas resources in the Volga-Ural Region Province of Russia (fig. 1). This study focused on the geologic evaluation and assessment of oil and gas source-reservoir rock systems (petroleum systems) and potential resources of the Upper Devonian–Lower Carboniferous (Tournaisian) Domanik-type formations. These include the Domanik Formation and Domanikoids (younger rocks overlying the Domanik Formation).

For this assessment, the USGS defined continuous oil and gas systems that (1) contain at least 2 weight percent or more total organic carbon, (2) occur within the thermal maturity window for oil or natural gas generation, (3) have thick (15 meters or more) organic-rich shale, and (4) contain Type I or Type II organic matter (Charpentier and Cook, 2011). Many studies have been published on the Domanik-type formations, providing information on source-rock characteristics, tectonic history, thermal history, and timing of the maturation and generation of hydrocarbons (Zaydelson and others, 1991; Fadeeva and others, 2016). Several conventional oil and some gas fields or accumulations have been discovered in the Volga-Ural region that produce from reservoirs, commonly in structural traps and reefs (Ulmishek, 1988). Reports on the number of wells that produce directly from Domanik-type formations but not from conventional accumulations were unavailable for this study.

The Domanik Total Petroleum System and three assessment units (AUs) were defined for this assessment (fig. 1). The Domanik Formation Continuous Oil AU was delineated over much of the eastern part of the province. The Domanik Formation source rock was deposited during a maximum transgression of sea level during the Late Devonian (early Frasnian) above older nearshore sediments (Ulmishek, 1988). The Domanikoid Continuous Oil AU was deposited above the Domanik Formation in elongated areas (troughs) between reefs and carbonate platforms. The Domanikoid Continuous Oil AU is younger than the Domanik Formation Continuous Oil AU (Peterson and Clarke, 1983). Both the Domanik Formation Continuous Oil and Domanikoid Continuous Oil AUs are thermally mature with respect to oil generation. The Domanik Formation Foredeep Continuous Gas AU was delineated in the eastern part of the region in a foredeep basin along the Ural Mountains where the Domanik source rock is deeper and presumably thermally mature with respect to gas generation.

Detailed production data for continuous resources outside of the United States are difficult to obtain, so the USGS assessment methodology uses production data of continuous oil and gas accumulations from the United States, which serve as analogs. Specifically, mean estimated ultimate recoveries from populations of continuous oil and gas wells, the mean drainage areas of drilled wells, and ranges of average well success ratios were used to estimate undiscovered continuous oil and gas resources. Principal input data used in the assessment are listed in table 1.



- EXPLANATION**
- Domanik Formation Continuous Oil AU
 - Domanikoid Continuous Oil AU
 - Domanik Formation Foredeep Continuous Gas AU
 - Volga-Ural Region Province boundary

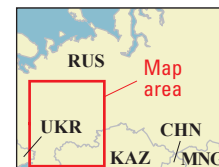


Figure 1. Location of the three assessment units (AUs) in the Volga-Ural Region Province, Russia.

Geologic Model

Continuous oil production has been reported from the fractured Domanik Formation in the southern part of the basin. The Domanik Formation is a self-sourced, organic-rich mudstone (total organic carbon content of at least 2 weight percent); contains mostly Type II kerogen; and is thermally mature with respect to oil generation (Ulmishek, 1988). Undiscovered continuous oil accumulations most likely exist between structural highs. The Domanik Formation

Continuous Oil AU area does not include areas of discovered conventional fields (and [or] accumulations).

No continuous gas production has been reported from the Domanik Formation Continuous Oil AU or Domanikoid Continuous Oil AU. The Domanik Formation Foredeep Continuous Gas AU is thermally mature with respect to gas generation, but few gas fields have been discovered. Undiscovered continuous gas accumulations most likely exist between structural highs. The Domanik Formation Foredeep Continuous Gas AU area does not include areas of discovered conventional fields on structural highs.

Undiscovered Resources Summary

The USGS quantitatively assessed oil and gas resources in three AUs in the Volga-Ural Region Province of Russia (table 2). For undiscovered, technically recoverable oil and gas resources, the estimated means are 2,787 million barrels of continuous oil (MMBO), or 2.8 billion barrels of oil, with an F95–F5 range from 663 to 6,072 MMBO; 33,558 billion cubic feet of natural gas (BCFG), or 34 trillion cubic feet of natural gas, with an F95–F5 range from 7,823 to 71,455 BCFG; and 1,343 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 308 to 2,884 MMBNGL.

Table 1. Key assessment input data for three continuous assessment units in the Volga-Ural Region Province, Russia.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; MMBO, million barrels of oil; BCFG, billion cubic feet of gas. The average EUR input is the minimum, median, maximum, and calculated mean. Shading indicates not applicable]

Assessment input data—Continuous AUs	Domanik Formation Continuous Oil AU				Domanikoid Continuous Oil AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	15,936,500	31,873,000	15,936,833	1,000	7,484,000	14,967,000	7,484,000
Average drainage area of well (acres)	120	180	240	180	120	180	240	180
Success ratio (%)	10	30	70	36.7	10	25	60	31.7
Average EUR (MMBO)	0.03	0.06	0.15	0.065	0.02	0.05	0.1	0.052
AU probability	1.0				1.0			
Assessment input data—Continuous AU	Domanik Formation Foredeep Continuous Gas AU							
	Minimum	Mode	Maximum	Calculated mean				
Potential production area of AU (acres)	1,000	14,755,000	29,510,000	14,755,333				
Average drainage area of wells (acres)	80	120	160	120				
Success ratio (%)	10	50	90	50				
Average EUR (BCFG)	0.2	0.5	1.0	0.522				
AU probability	1.0							

Table 2. Assessment results for three continuous assessment units in the Volga-Ural Region Province, Russia.

[MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas accumulations, all liquids are included in the NGL category. 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 system 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
Domanik Total Petroleum System														
Domanik Formation Continuous Oil AU	1.0	Oil	494	1,831	4,599	2,098	236	899	2,364	1,049	9	35	98	42
Domanikoid Continuous Oil AU	1.0	Oil	169	612	1,473	689	81	300	757	344	3	12	32	14
Domanik Formation Foredeep Continuous Gas AU	1.0	Gas					7,506	28,875	68,334	32,165	296	1,145	2,754	1,287
Total undiscovered continuous resources			663	2,443	6,072	2,787	7,823	30,074	71,455	33,558	308	1,192	2,884	1,343

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Volga-Ural Region Province Assessment Team

Timothy R. Klett, Michael E. Brownfield, Thomas M. Finn, Stephanie B. Gaswirth, Phuong A. Le, Heidi M. Leathers-Miller, Kristen R. Marra, Tracey J. Mercier, Janet K. Pitman, Christopher J. Schenk, Marilyn E. Tennyson, and Cheryl A. Woodall

For More Information

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