

National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources in the Phosphoria Total Petroleum System of the Southwestern Wyoming Province, 2024

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 3 million barrels of oil and 666 billion cubic feet of gas in the Phosphoria Total Petroleum System of the Southwestern Wyoming Province.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in the Permian Phosphoria Total Petroleum System (TPS) in the Southwestern Wyoming Province of Wyoming, Utah, and Colorado (fig. 1). The assessment is based on the geologic elements of the Phosphoria TPS (petroleum source rocks, reservoir rocks, traps, seals, and timing), and on the exploration and discovery history of oil and gas fields. The Permian Phosphoria TPS was last assessed for undiscovered conventional oil and gas resources by the USGS in 2005 (Johnson, 2005).

Total Petroleum System

The USGS defined the Phosphoria TPS within the Southwestern Wyoming Province (fig. 1). The primary petroleum source rocks within the Phosphoria TPS are the Meade Peak Member and the Retort Phosphatic Shale Member of the Permian Phosphoria Formation. Both Members of the Phosphoria Formation occur in west-central Wyoming and eastern Idaho, and do not extend eastward across the TPS (Sheldon, 1967; Maughan, 1984). Phosphoria organic-rich mudstones have total organic carbon contents as much as 10 weight percent and contain Type IIS oil-prone kerogen; the Meade Peak Member is as much as 50 meters thick and the Retort Phosphatic Shale Member is as much as 33 meters thick (Maughan, 1984; Lillis and Selby, 2013). Phosphoria organic-rich mudstones in the west-central part of the TPS are modeled to have reached the thermal threshold for oil generation about 85 million years ago (Roberts and others, 2005). The eastward migration of oil generated from thermally mature Phosphoria mudstones is controversial, with the debate focused on the extent and timing of eastward migration (Sheldon, 1967; Lillis and Selby, 2013). Within the TPS, 18 sub-Cretaceous stratigraphic units have produced oil and gas sourced by the Permian Phosphoria Formation (Johnson, 2005). Sub-Cretaceous traps that contain petroleum accumulations are typically structural, although stratigraphic or combination traps may also occur (S&P Global Commodity Insights, 2023).

Assessment Unit

The USGS defined the Sub-Cretaceous Conventional Oil and Gas Assessment Unit (AU) to encompass the Southwestern Wyoming Province (fig. 1). The geologic model for the assessment is for oil and gas generated from organic-rich Phosphoria mudstones to have migrated eastward into reservoirs within pre-Laramide stratigraphic and structural traps, and some portion of the oil and gas later remigrated into reservoirs within Laramide-age traps. Oil and gas reservoirs in the AU are mainly within the Flathead Sandstone, Madison Limestone, Tensleep Sandstone, Weber Sandstone, Phosphoria Formation, Nugget Sandstone, and Morrison Formation, but most of the sub-Cretaceous oil and gas produced within the AU have been from the Pennsylvanian Tensleep and Weber Sandstones. Phosphoria oil trapped in reservoirs in the deeper, central parts of the Greater Green River Basin, Great Divide Basin, Washakie Basin, and Sand Wash Basin may have converted to gas, which is postulated to be the major potential resource in this assessment.

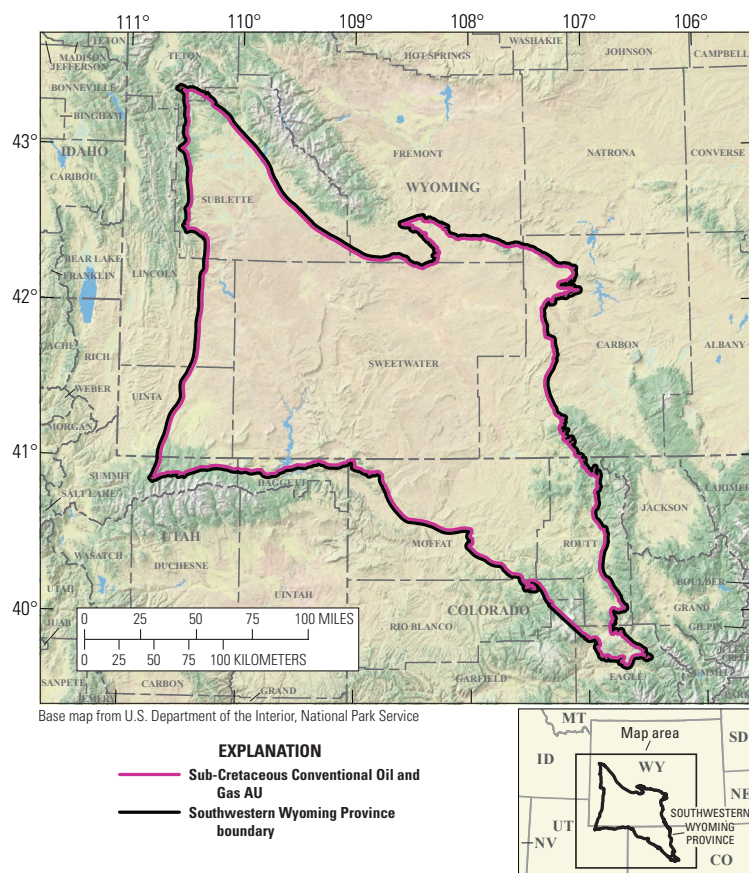


Figure 1. Maps showing the location of the Sub-Cretaceous Conventional Oil and Gas Assessment Unit (AU) in the Southwestern Wyoming Province.

More than 1,000 wells drilled in the Southwestern Wyoming Province have produced oil or gas from sub-Cretaceous rocks, but most wells have been drilled along the margins of the TPS where oil is the dominant resource (S&P Global Commodity Insights, 2023). The assessment input data for the Sub-Cretaceous Conventional Oil and Gas AU are summarized in [table 1](#) and Drake (2025).

Table 1. Key input data for one conventional oil and gas assessment unit in the Phosphoria Total Petroleum System of the Southwestern Wyoming Province.

[Gray shading indicates not applicable. AU, assessment unit; MMBO, million barrels of oil; BCFG, billion cubic feet of gas]

Assessment input data— Conventional AU	Sub-Cretaceous Conventional Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	3	6	3.1
Number of gas fields	1	20	80	22.1
Size of oil fields (MMBO)	0.5	0.7	10	0.9
Size of gas fields (BCFG)	3	12	1,000	30.1
AU probability	1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil and gas resources within the Sub-Cretaceous Conventional Oil and Gas AU in the Southwestern Wyoming Province ([table 2](#)). The estimated mean totals for conventional resources are 3 million barrels of oil (MMBO), with an F95–F5 range from 1 to 5 MMBO; 666 billion cubic feet of gas (BCFG), with an F95–F5 range from 187 to 1,480 BCFG; and 20 million barrels of natural gas liquids (MMBNGL), with an F95–F5 range from 6 to 44 MMBNGL.

Table 2. Results for one conventional oil and gas assessment unit in the Phosphoria Total Petroleum System of the Southwestern Wyoming Province.

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

Total petroleum system and assessment unit (AU)	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
Phosphoria Total Petroleum System														
Sub-Cretaceous Conventional Oil and Gas AU	1.0	Oil	1	3	5	3	3	5	10	5	0	0	0	0
		Gas					184	565	1,470	661	6	17	44	20
Total conventional resources			1	3	5	3	187	570	1,480	666	6	17	44	20

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For More Information

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

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