

Assessment of Undiscovered Oil and Gas Resources in the Santa Maria Basin Province, California, 2024

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 67 million barrels of oil and 56 billion cubic feet of gas in the Santa Maria Basin Province of California.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional and continuous (unconventional) oil and gas resources within the Santa Maria Basin Province of California (fig. 1). The assessment encompasses the onshore and State waters part of the province and does not include the Federal offshore. The Santa Maria Basin Province has a long history of oil exploration, beginning with the discovery of the Orcutt oil field in 1901 based on the occurrence of oil seeps. Most oil fields were discovered by 1956, and one more conventional field was added in 1984 (Tennyson and Isaacs, 2001).

The assessment is based upon the definition of a Miocene Composite Total Petroleum System (TPS) that formed through a multiphase tectonic evolution (Namson and Davis, 1990; Luyendyk, 1991; Wilson and others, 2005; Sweetkind and others, 2021). Miocene to Quaternary sediments overlie a complex basement assemblage composed of Jurassic Franciscan metamorphic rocks and ophiolites. In the early Miocene, the future site of the Santa Maria Basin was a westward-facing continental slope that was subjected to regional extension or transtension, possibly due to subduction trench rollback or backarc extension, which formed a horst and graben topography on the continental slope. Unconformably overlying the extended basement assemblage are nonmarine coarse clastics of the lower Miocene Lospe Formation, which are overlain by mudstones and turbidite sandstones of the marine Point Sal Formation. The Point Sal Formation transitions into the Miocene Monterey Formation, which is characterized by organic-rich mudstones, cherts, siliceous shales, phosphatic mudstones, dolomites, and sandstones that were deposited in bathyal conditions and collectively are more than 1,000 meters thick. The Monterey Formation drapes the extensional structures. By late Miocene to early Pliocene, clockwise rotation of the western Coast Ranges block initiated regional deformation, forming the

northwest–southeast-trending contractional structures in the Santa Maria Basin, as the continental margin changed from transtension to transpression deformation. Uplift and erosion during this phase of deformation resulted in the progradation of mudstones and sandstones of the Miocene to Pliocene Sisquoc Formation, the upper Pliocene Foxen Mudstone, and the Careaga Sandstone into the basin. Deposition of as much as 5 kilometers of Pliocene to Quaternary sediments placed the Monterey Formation organic-rich source rocks and possibly other source rocks into the thermal window for oil generation.

Total Petroleum System and Assessment Units

The USGS defined the Miocene Composite TPS to encompass oil potentially sourced from several organic-rich shales and marls. Organic-rich lithologies of the Monterey Formation in the Santa Maria Basin Province have the highest volumes of oil generated, migrated, and trapped (Isaacs, 1989; Tennyson and Isaacs, 2001). Monterey Formation source rocks are dominated by Type IIS organic matter and have total organic carbon (TOC) values as much as 14 weight percent (wt. pct.), hydrogen index values greater than 600 milligrams of hydrocarbon per gram of TOC, and sulfur content as much as 5.9 wt. pct. The level of thermal maturation is problematic to assess in the Monterey Formation because standard thermal maturation indices are difficult to apply to these rocks (Isaacs and Tomson, 1990). Other source rocks may include organic-rich mudstones of the Point Sal Formation with TOC values as much as 3.5 wt. pct. (Bennett and others, 2022), the lower Miocene Rincon Shale with an average TOC of 3.5 wt. pct., and mudstones of the Sisquoc Formation with TOC values as much as 6 wt. pct. and an average of 2.3 wt. pct. (Baskin and Peters, 1992; Bohacs, 1993; Tennyson and Isaacs, 2001).

Two assessment units (AUs) were defined within the Miocene Composite TPS: the Santa Maria Basin Conventional Reservoirs AU and the Santa Maria Basin Continuous Oil AU. The geologic model for the Santa Maria Basin Conventional Reservoirs AU is for high-sulfur oil generated from Monterey Formation organic-rich lithologies to have migrated updip into fractured Monterey Formation reservoirs on structural highs. Low seal integrity in this AU may have caused numerous oil seeps and tar accumulations on the surface.

The geologic model for the assessment of the Santa Maria Basin Continuous Oil AU is for oil generated from Monterey Formation organic-rich source rocks to have been partly retained within the matrix of the reservoirs after migration of oil updip into conventional fractured reservoirs. Because there are no production data from the Monterey Formation in this AU, the input to the assessment of continuous resources was guided by the input for the assessment of continuous oil resources from the Monterey Formation in the nearby San Joaquin Basin Province (Tennyson and others, 2015). The assessment input data for the two AUs are summarized in [table 1](#) and Schenk (2025).

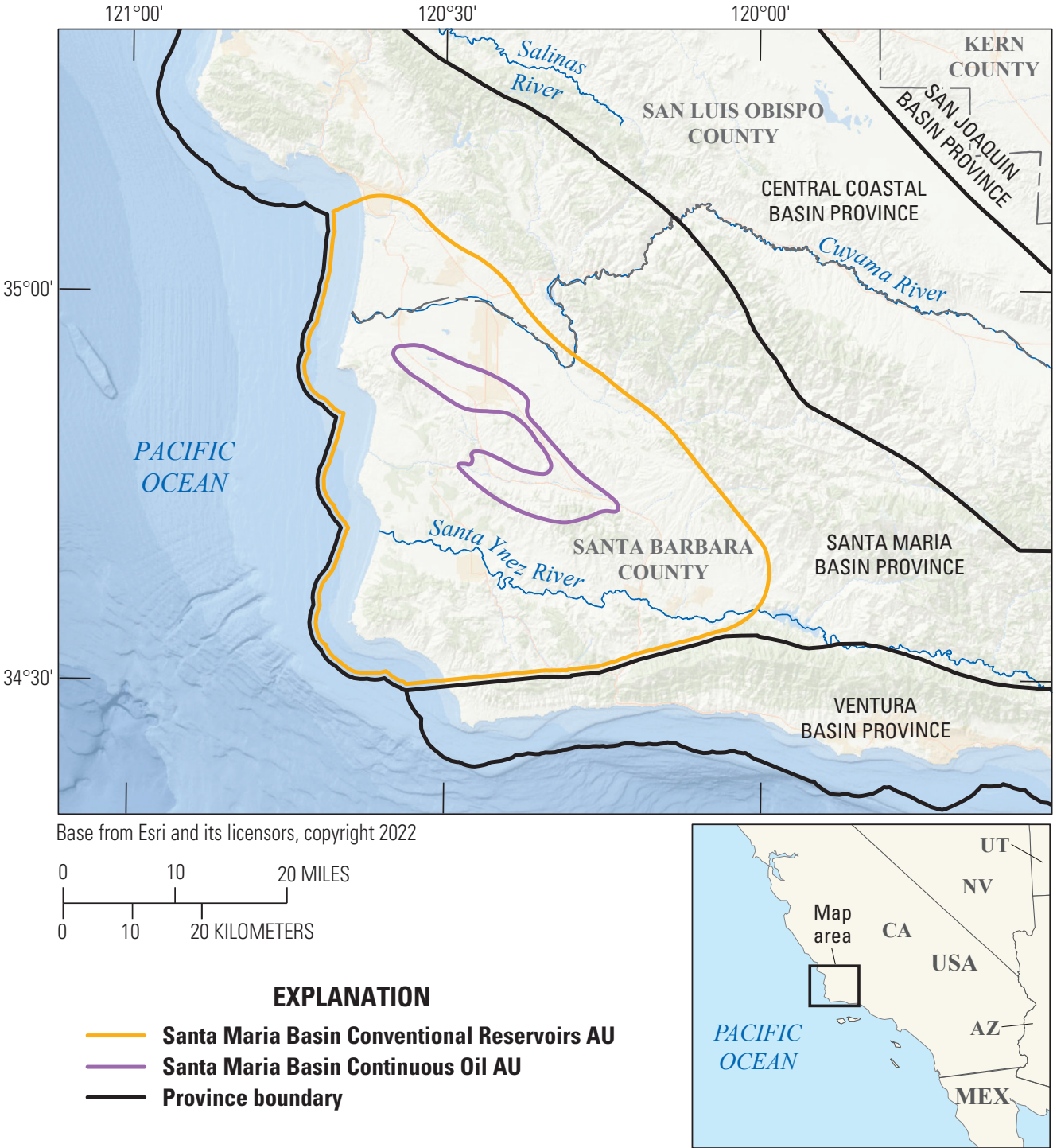


Figure 1. Maps showing the location of two assessment units (AUs) in the Santa Maria Basin Province, California.

Table 1. Key input data for one conventional and one continuous assessment unit in the Santa Maria Basin Province, California.

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

Assessment input data—Conventional AUs	Santa Maria Basin Conventional Reservoirs AU			
	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	16	32	16.4
Number of gas fields				
Size of oil fields (MMBO)	0.5	0.7	500	4.0
Size of gas fields (BCFG)				
AU probability	1.0			
Assessment input data—Continuous AUs	Santa Maria Basin Continuous Oil AU			
	Minimum	Mode	Maximum	Calculated mean
Potential production area (acres)	50	28,600	57,200	28,617
Average drainage area (acres)	5	10	40	18.3
Success ratio (%)	5	10	40	18.3
Untested area (%)	100	100	100	100
Average EUR (MMBO, oil; BCFG, gas)	0.003	0.005	0.02	0.006
AU probability	0.9			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional and continuous oil and gas resources in two AUs in the Santa Maria Basin Province ([table 2](#)). The estimated mean undiscovered resources are

67 million barrels of oil (MMBO), with an F95–F5 range from 13 to 218 MMBO; 56 billion cubic feet of gas (BCFG), with an F95–F5 range from 11 to 183 BCFG; and 4 million barrels of natural gas liquids (MMBNGL), with an F95–F5 range from 1 to 14 MMBNGL.

Table 2. Results for one conventional and one continuous assessment unit in the Santa Maria Basin Province, California.

[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 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
Miocene Composite Total Petroleum System														
Santa Maria Basin Conventional Reservoirs AU	1.0	Oil	13	39	213	65	11	33	179	55	1	3	14	4
		Gas												
Total undiscovered conventional oil and gas resources			13	39	213	65	11	33	179	55	1	3	14	4
Santa Maria Basin Continuous Oil AU	0.9	Oil	0	1	5	2	0	1	4	1	0	0	0	0
		Gas												
Total undiscovered continuous oil and gas resources			0	1	5	2	0	1	4	1	0	0	0	0
Total undiscovered oil and gas resources			13	40	218	67	11	34	183	56	1	3	14	4

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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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