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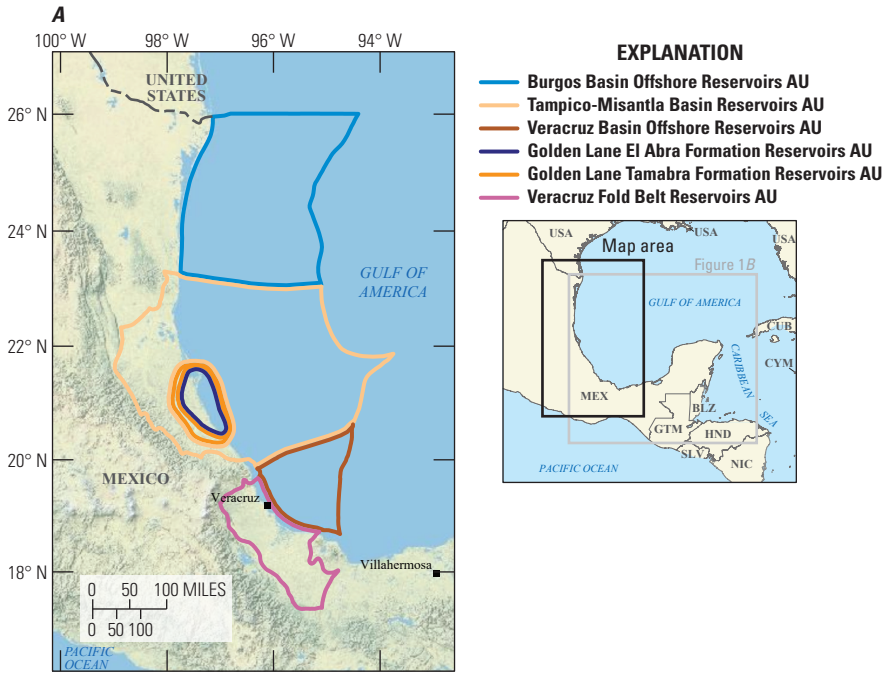
National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources in Mexico, Belize, and Guatemala, 2024

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean conventional resources of 14.6 billion barrels of oil and 83.7 trillion cubic feet of gas in Mexico, Belize, and Guatemala.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in 14 assessment units (AUs) (fig. 1*A*, *B*) within 9 geologically defined provinces of Mexico, Belize, and Guatemala. The geologic provinces assessed in this report are as follows: Burgos Basin, Tampico-Misantla Basin, Veracruz Basin, Campeche-Sigsbee Salt Basin, Saline-Comalcalco Basin, Villahermosa Uplift, Macuspana Basin, Yucatan Platform, and Sierra Madre de Chiapas-Petén Fold Belt. The geologic evolution of these provinces and the oil and gas resources within them resulted from a complex tectonic history (Lara, 1993; Bartok and others, 2015; Hudec and Norton, 2019; Davison, 2021; Graham and others, 2021; Hasan and Mann, 2021; Miranda-Madrigal and Chávez-Cabello, 2021; Pindell and others, 2021; Villagómez and others, 2022) that is briefly summarized for this report. Crustal extension in the Triassic to Early Jurassic between North America, the Yucatan Platform, and South America signaled the initial fragmentation of Pangaea and led to peripheral rift basins filled with synrift fluvial-alluvial and lacustrine sediments, possibly including viable petroleum source rocks, reservoir rocks, and traps. Intermittent access to the ocean during the Middle Jurassic (Bajocian) and possibly as late as the Callovian led to the deposition of as much as 2,000 meters of salt on extended continental crust. Rifting continued to extend the continental crust between North America, the Yucatan Platform, and South America up to the Oxfordian. As rifting waned and thermal subsidence occurred, transgressive organic-rich source rocks of Oxfordian, Kimmeridgian, and Tithonian age were deposited on the thick salt. Oxfordian sandstones and carbonates deposited along the western margin of the Yucatan Block may contain potential reservoirs like the Norphlet and Smackover Formations of the offshore eastern Gulf Coast margin of the United States (Snedden and others, 2021). Seafloor spreading began in the Oxfordian between North America and the Yucatan Platform as the Yucatan Platform rotated counterclockwise, resulting in the separation of the Bajocian salt basin into a northern salt basin along the U.S. Gulf of America margin (Louann salt basin) and a southern salt basin on the western margin of the Yucatan Block (Campeche salt basin). With burial, the salt began to deform into a spectrum of structures in the Campeche salt basin, forming numerous traps for oil and gas. By Valanginian time, the Yucatan Block ceased movement, ending seafloor spreading. Open marine conditions prevailed throughout the Gulf of America, and several transgressions and regressions led to the formation of extensive, stacked carbonate platforms along the passive margins of the Burgos Basin, Tampico-Misantla Basin, and Veracruz Basin Provinces, as well as the formation of carbonate platforms throughout the passive margins of the Yucatan Block. Carbonate platforms contain many potential reservoirs, such as karsts, dolomites, reefs, mounds, debris-flow conglomerates, and breccias. Subduction of the Farallon plate along the western margin of Mexico from the Late Cretaceous to Eocene led to deformation that formed the northwest–southeast-trending Sierra Madre de Chiapas Fold Belt, with potential fractured carbonate reservoirs within structural traps.



Base map from U.S. Department of the Interior, National Park Service

Figure 1. Maps showing the locations of (*A*) six conventional oil and gas assessment units (AUs) within Mexico and (*B*) eight conventional oil and gas AUs within Mexico, Belize, and Guatemala.

Base map from U.S. Department of the Interior, National Park Service

Figure 1.—Continued

Uplift and erosion of the fold belts resulted in the eastward progradation of major offshore clastic sequences in the Burgos Basin, Tampico-Misantla Basin, and Veracruz Basin Provinces, providing numerous potential reservoirs and traps. Burial by these clastic sequences caused continuous movement and deformation of the underlying salt of the Campeche salt basin, with the potential for modifying the existing structures and possibly disrupting seal integrity. Northward dextral movement of the Greater Antilles arc system in the Paleogene caused the inversion of extensional structures along the once-passive southeastern Yucatan margin, with possible loss of oil and gas (Lara, 1993). Subduction of the Cocos-Nazca plate in the Miocene along the western Mexico margin formed the Sierra Madre de Chiapas Fold Belt and the foreland Petén Basin. Uplift in the Miocene and Pliocene resulted in eastward-prograding clastic sequences with numerous potential reservoirs and traps. In the Miocene, detachment surfaces along undercompacted and overpressured Eocene shales led to upslope extensional structures and downslope contractional structures, forming the Mexican Ridges Fold Belt offshore from the Burgos Basin, Tampico-Misantla Basin, and Veracruz Basin margins with potential for deep-water reservoirs, traps, and seals. Salt withdrawal in the southern Yucatan margin formed the Macuspana Basin and Saline-Comalcalco Basin that filled with Miocene to Pliocene clastics, providing potential reservoirs, traps, and seals.

Total Petroleum System and Assessment Units

The USGS defined a Mesozoic–Cenozoic Composite Total Petroleum System (TPS) that encompasses oil and gas generated from several Mesozoic and Cenozoic source rocks. Organic-rich shales of the Oxfordian Smackover Formation and Tithonian Pimienta Formation are cited as having generated most oil and gas in the nine defined provinces (Jacques and Clegg, 2002; Arzate and others, 2009; Kenning and Mann, 2021; Shann, 2021). Other sources of oil and gas in this composite TPS are Triassic lacustrine shales, Kimmeridgian marine shales, Early Cretaceous (Albian) marls, Cenomanian–Turonian marine shales, and Paleogene and Neogene marine and terrestrial shales (Guzmán-Vega and others, 2001; Prost and Aranda, 2001; Lourdes Clara Valdés and others, 2009; Petersen and others, 2012; Holland and others, 2024). Not all source rocks are present or have contributed oil and gas in all provinces.

Fourteen AUs were defined within the composite TPS based on the predominant types of hydrocarbon reservoirs and traps. The Burgos Basin Offshore Reservoirs AU, Tampico-Misantla Basin Reservoirs AU, and Veracruz Basin Offshore Reservoirs AU were defined on the presence of deep-water slope and basin-floor fan sandstone reservoirs within structural traps, including the Mexican Ridges Fold Belt offshore. The Golden Lane El Abra Formation Reservoirs AU and the Golden Lane Tamabra Formation Reservoirs AU are dominated by reef and reef-margin debris-flow reservoirs, respectively. The Veracruz Fold Belt Reservoirs AU contains fractured carbonate reservoirs within stacked thrust sheets. The Saline-Comalcalco Basin Reservoirs AU and Macuspana Basin Reservoirs AU are dominated by shallow- to deep-marine sandstone reservoirs within stratigraphic traps. The Villahermosa-Reforma Trend Reservoirs AU has extensive Tamabra-like debris-flow reservoirs in salt-related structural and combination traps. The Campeche-Yucatan Basin Postsalt Reservoirs AU is defined by carbonate reservoirs within salt-related structural traps. The Campeche-Yucatan Basin Presalt Reservoirs AU contains potential Triassic fluvial-deltaic to deep-lacustrine sandstone reservoirs within stratigraphic traps. The Yucatan Platform NW Margin Reservoirs AU is defined by a spectrum of carbonate reservoirs within stratigraphic traps. The Yucatan Platform SE Margin Reservoirs AU has fluvial-deltaic to shallow-marine sandstone reservoirs within complex, inverted structural traps. The Sierra Madre de Chiapas-Petén Fold Belt and Basin Reservoirs AU is defined by sandstone reservoirs within structural traps in the fold belt and adjacent foreland basin. The assessment input data for 14 conventional AUs are summarized in table 1 and in Schenk (2025).

Table 1. Key input data for 14 conventional oil and gas assessment units in Mexico, Belize, and Guatemala.

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

Assessment input data—Conventional AUs	Burgos Basin Offshore Reservoirs AU				Tampico-Misantla Basin Reservoirs AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	80	240	85.1	1	40	80	41.0
Number of gas fields	1	30	90	31.9	1	40	120	42.5
Size of oil fields (MMBO)	5	8	5,000	45.4	0.5	0.8	2,000	10.9
Size of gas fields (BCFG)	30	48	12,000	168.0	3	24	8,000	120.3
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Veracruz Basin Offshore Reservoirs AU**				**Golden Lane El Abra Formation Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	15	45	16.0	1	3	6	3.1
Number of gas fields	1	60	180	63.8				
Size of oil fields (MMBO)	1	4	500	11.9	0.5	0.8	20	1.2
Size of gas fields (BCFG)	6	24	8,000	115.5				
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Golden Lane Tamabra Formation Reservoirs AU**				**Veracruz Fold Belt Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	8	40	9.1	1	15	30	15.4
Number of gas fields	1	2	8	2.2	1	30	100	51.2
Size of oil fields (MMBO)	0.5	0.8	800	6.0	0.5	1.0	500	5.4
Size of gas fields (BCFG)	3	24	300	33.0	3	24	12,000	150.4
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Saline-Comalcalco Basin Reservoirs AU**				**Macuspana Basin Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	100	200	102.4	1	5	15	5.3
Number of gas fields	1	40	80	41.0	1	60	120	61.5
Size of oil fields (MMBO)	0.5	0.8	4,000	17.6	0.5	0.8	60	1.7
Size of gas fields (BCFG)	3	24	12,000	150.4	3	24	10,000	135.8
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Villahermosa-Reforma Trend Reservoirs AU**				**Campeche-Yucatan Basin Postsalt Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	60	120	61.5	1	80	240	85.1
Number of gas fields	1	30	90	31.9	1	40	120	42.5
Size of oil fields (MMBO)	0.5	1	5,000	23.6	5	10	8,000	70.7
Size of gas fields (BCFG)	3	24	8,000	120.3	30	60	14,000	217.4
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Campeche-Yucatan Basin Presalt Reservoirs AU**				**Yucatan Platform NW Margin Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	10	40	11.0	1	40	120	42.5
Number of gas fields	1	40	160	44.1	1	20	60	21.3
Size of oil fields (MMBO)	5	8	500	15.9	0.5	0.8	250	3.1
Size of gas fields (BCFG)	30	48	4,000	105.4	3	24	2,000	62.0
AU probability	0.144				1.0			

Table 1. Key input data for 14 conventional oil and gas assessment units in Mexico, Belize, and Guatemala.—Continued

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

Assessment input data—Conventional AUs	Yucatan Platform SE Margin Reservoirs AU				Sierra Madre de Chiapas-Petén Fold Belt and Basin Reservoirs AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	10	30	10.6	1	60	180	63.8
Number of gas fields					1	40	120	42.5
Size of oil fields (MMBO)	0.5	0.8	20	1.2	0.5	0.8	1,200	7.7
Size of gas fields (BCFG)					3	24	8,000	120.3
AU probability	1.0				1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil and gas resources in 14 AUs in geologic provinces of Mexico, Belize, and Guatemala (table 2). The estimated mean undiscovered resources are 14,612 million barrels of oil (MMBO), or 14.6 billion barrels of oil, with an F95–F5 range from 3,957 to 34,303 MMBO; 83,711 billion cubic feet of gas (BCFG), or 83.7 trillion cubic feet of gas, with an F95–F5 range from 25,835 to 187,036 BCFG; and 4,849 million barrels of natural gas liquids (MMBNGL), with an F95–F5 range from 1,493 to 10,685 MMBNGL.

Table 2. Results for 14 conventional oil and gas assessment units in Mexico, Belize, and Guatemala.

[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
Mesozoic–Cenozoic Composite Total Petroleum System														
Burgos Basin Offshore Reservoirs AU	1.0	Oil	1,183	3,333	8,257	3,852	2,955	8,325	20,678	9,628	251	708	1,756	818
		Gas					1,563	4,396	12,617	5,366	111	312	896	381
Tampico-Misantla Basin Reservoirs AU	1.0	Oil	79	290	1,395	443	127	464	2,230	709	2	9	42	13
		Gas					1,470	4,405	11,243	5,120	37	110	281	128
Veracruz Basin Offshore Reservoirs AU	1.0	Oil	51	156	449	190	81	250	719	304	2	5	14	6
		Gas					2,468	6,522	14,993	7,346	30	78	180	88
Golden Lane El Abra Formation Reservoirs AU	1.0	Oil	2	3	8	4	1	2	7	3	0	0	0	0
		Gas												
Golden Lane Tamabra Formation Reservoirs AU	1.0	Oil	4	23	211	54	5	31	284	74	0	1	9	2
		Gas					17	60	177	74	0	1	4	2
Veracruz Fold Belt Reservoirs AU	1.0	Oil	17	55	250	83	22	71	325	107	0	1	7	2
		Gas					2,743	6,710	15,929	7,688	170	416	989	477
Saline-Comalcalco Basin Reservoirs AU	1.0	Oil	430	1,414	4,528	1,813	515	1,696	5,455	2,175	36	119	381	152
		Gas					1,982	5,215	13,622	6,161	192	506	1,322	598
Macuspana Basin Reservoirs AU	1.0	Oil	3	7	24	9	5	14	50	19	0	0	1	0
		Gas					3,267	7,528	16,186	8,342	56	128	275	142

Table 2. Results for 14 conventional oil and gas assessment units in Mexico, Belize, and Guatemala.—Continued

[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
Villahermosa-Reforma Trend Reservoirs AU	1.0	Oil	268	1,008	4,276	1,457	454	1,711	7,262	2,477	11	41	174	59
		Gas					993	3,177	8,918	3,825	86	276	776	333
Campeche-Yucatan Basin Postsalt Reservoirs AU	1.0	Oil	1,769	5,187	13,109	6,042	2,121	6,219	15,771	7,249	148	435	1,104	507
		Gas					2,970	8,044	19,757	9,273	288	780	1,916	899
Campeche-Yucatan Basin Presalt Reservoirs AU	0.14	Oil	0	0	186	25	0	0	130	18	0	0	1	0
		Gas					0	0	5,103	672	0	0	51	7
Yucatan Platform NW Margin Reservoirs AU	1.0	Oil	40	111	302	133	67	189	513	226	2	5	12	5
		Gas					427	1,154	2,754	1,318	37	100	240	115
Yucatan Platform SE Margin Reservoirs AU	1.0	Oil	5	12	25	13	3	7	15	8	0	0	0	0
		Gas												
Sierra Madre de Chiapas-Petén Fold Belt and Basin Reservoirs AU	1.0	Oil	106	379	1,283	494	85	302	1,029	395	1	2	6	2
		Gas					1,494	4401	11,269	5,134	33	97	248	113
Total undiscovered conventional oil and gas resources			**3,957**	**11,978**	**34,303**	**14,612**	**25,835**	**70,893**	**187,036**	**83,711**	**1,493**	**4,130**	**10,685**	**4,849**

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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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