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National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources of the Northern Arabian Peninsula, 2024

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean conventional resources of 5.1 billion barrels of oil and 19.5 trillion cubic feet of gas in the northern Arabian Peninsula.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional oil and gas resources within a composite total petroleum system (TPS) of the northern Arabian Peninsula (fig. 1). The formation of the composite TPS is related to the tectonic history of the northern and northeastern parts of the Arabian Peninsula (Beydoun and others, 1992; Al-Husseini, 2000; Brew and others, 2001; Fox and Ahlbrandt, 2002; Ruban and others, 2007; Soleimany and Sàbat, 2010; Mouthereau and others, 2012; Barrier and others, 2014; English and others, 2015; Saura and others, 2015; Abdulnaby and others, 2020). Ordovician glaciation covered much of Arabia and northern Africa, and as the glaciers melted, widespread channel systems formed that were subsequently filled with organic-rich Silurian marine source rocks. As Gondwana began to fragment in the late Permian to Late Triassic, rifting formed the northeast–southwest-trending Palmyride and Sinjar graben systems in which were deposited synrift Triassic organic-rich source rocks (Barrier and others, 2014). Passive margin subsidence along the eastern margin of Gondwana from Early Jurassic through Late Cretaceous resulted in extensive carbonate platforms and intraplatform basins in which several major source rocks were deposited, including organic-rich marls of the Jurassic Sargelu, Tuwaiq Mountain, Naokelekan, and Hanifa Formations, and the Cretaceous (Albian–Cenomanian) Kazhdumi Formation. Late Cretaceous transtension, possibly related to a mantle plume, formed the northwest–southeast-trending Euphrates graben system (Litak and others, 1998), which divided the once-continuous Palmyride and Sinjar grabens (fig. 1). Major source rocks in the Euphrates graben system are Upper Cretaceous synrift organic-rich shales (Litak and others, 1998).

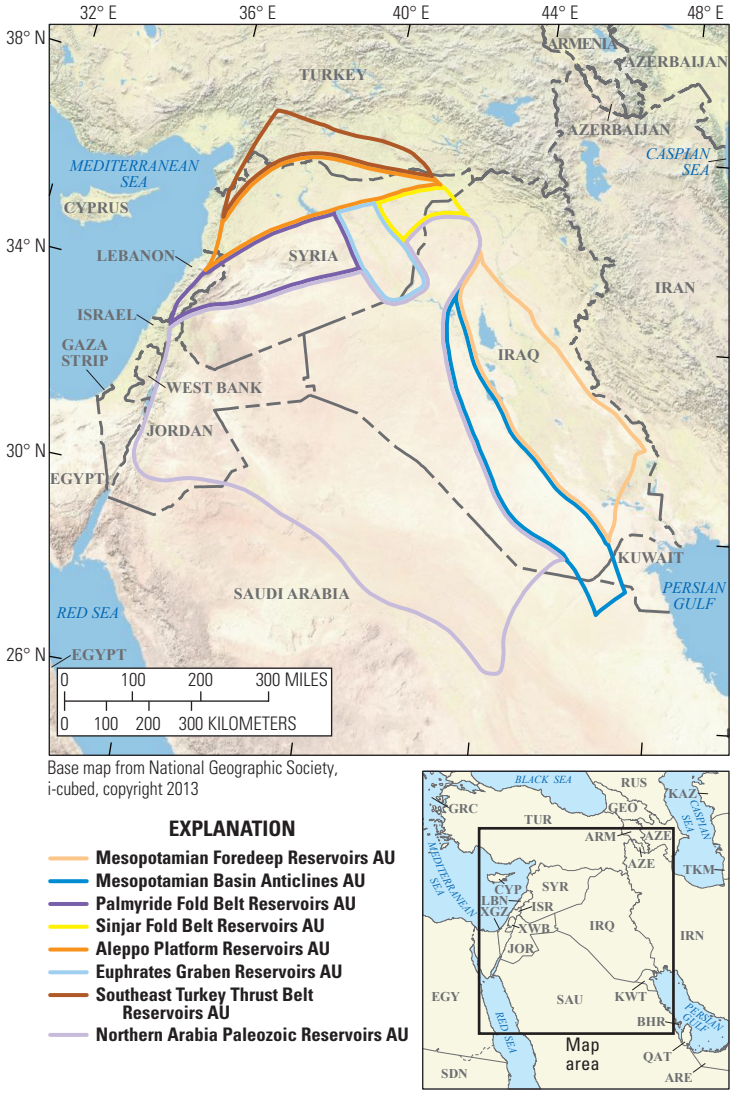

Figure 1. Maps showing the location of eight conventional assessment units (AUs) in the northern Arabian Peninsula.

Total Petroleum System and Assessment Units

The USGS defined a Paleozoic–Mesozoic Composite TPS encompassing petroleum generated from several source rocks deposited on the northern and eastern passive margins of Gondwana. The Silurian Qusaiba Formation has generated most of the oil and gas in the northern part of the Arabian Peninsula (Lüning and others, 2000; Konert and others, 2001; Barrier and others, 2014; Cantrell and others, 2014; İnan and others, 2017; Varol and Demirel, 2020). Along the eastern margin of the Arabian Peninsula, source rocks are organic-rich basinal carbonate platform marls of the Sargelu and Tuwaiq Mountain Formations, Naokelekan and Hanifa Formations, and Kazhdumi Formation (Beydoun and others, 1992; Opera and others, 2013; Barrier and others, 2014; Baniasad and others, 2017). Jurassic and Cretaceous marls are the most important source rocks in the eastern part of the Arabian Peninsula (Beydoun and others, 1992; Ziegler, 2001; Damoulianou and others, 2020; Alipour, 2022). Eight assessment units (AUs) were defined within the composite TPS and reflect the tectonic history and formation of source rocks, reservoir rocks, traps, and generation of oil and gas (fig. 1). The Mesopotamian Foredeep Reservoirs AU and Mesopotamian Basin Anticlines AU have basement-related structural traps related to the formation of the Zagros Fold Belt, with clastic and carbonate reservoirs, and major Jurassic and Cretaceous source rocks. The Palmyride Fold Belt Reservoirs AU and Sinjar Fold Belt Reservoirs AU have Triassic synrift source rocks and reservoirs within structural traps. The Euphrates Graben Reservoirs AU has Upper Cretaceous synrift source rocks and clastic reservoirs in structural traps. The Aleppo Platform Reservoirs AU, Southeast Turkey Thrust Belt Reservoirs AU, and Northern Arabia Paleozoic Reservoirs AU have Silurian Qusaiba source rocks that reached thermal maturity for gas generation. Each of the eight AUs was assessed for undiscovered conventional oil and gas resources. The assessment input data are summarized in table 1 and in Schenk (2025).

Table 1. Key input data for eight conventional assessment units in the northern Arabian Peninsula.

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

Assessment input data—Conventional AUs	Mesopotamian Foredeep Reservoirs AU				Mesopotamian Basin Anticlines AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	50	150	53.2	1	40	120	42.5
Number of gas fields	1	20	60	21.3	1	15	45	16.0
Size of oil fields (MMBO)	5	8	5,000	45.4	5	8	4,000	40.1
Size of gas fields (BCFG)	30	48	12,000	168.0	30	48	1,500	77.3
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Palmyride Fold Belt Reservoirs AU**				**Sinjar Fold Belt Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	20	40	20.5	1	15	30	15.4
Number of gas fields	1	40	80	41.0	1	5	15	5.3
Size of oil fields (MMBO)	1	4	30	4.9	1	4	100	6.6
Size of gas fields (BCFG)	6	24	1,000	46.3	6	24	700	41.2
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Aleppo Platform Reservoirs AU**				**Euphrates Graben Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	10	30	10.6	1	30	60	30.7
Number of gas fields	1	6	18	6.4	1	5	15	5.3
Size of oil fields (MMBO)	0.5	1.5	300	5.4	1	4	1,200	18.2
Size of gas fields (BCFG)	3	12	1,000	30.1	6	24	2,000	60.1
AU probability	1.0				1.0			
Assessment input data—Conventional AUs	**Southeast Turkey Thrust Belt Reservoirs AU**				**Northern Arabia Paleozoic Reservoirs AU**			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	7	14	7.2	1	10	30	10.6
Number of gas fields					1	60	180	63.8
Size of oil fields (MMBO)	0.5	1	30	1.7	5	8	200	12.2
Size of gas fields (BCFG)					30	48	8,000	139.3
AU probability	1.0				1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil and gas resources in eight AUs in the northern Arabian Peninsula (table 2). The estimated mean resources are 5,086 million barrels of oil (MMBO), or 5.1 billion barrels of oil, with an F95–F5 range from 1,438 to 12,016 MMBO; 19,546 billion cubic feet of gas (BCFG), or 19.5 trillion cubic feet of gas, with an F95–F5 range from 6,941 to 41,349 BCFG; and 735 million barrels of natural gas liquids (MMBNGL), or 0.7 billion barrels, with an F95–F5 range from 281 to 1,460 MMBNGL.

Table 2. Results for eight conventional assessment units in the northern Arabian Peninsula.

[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
Paleozoic–Mesozoic Composite Total Petroleum System														
Mesopotamian Foredeep Reservoirs AU	1.0	Oil	630	1,958	5,816	2,420	378	1,174	3,509	1,452	3	11	32	13
		Gas					920	2,735	9,244	3,564	14	41	139	53
Mesopotamian Basin Anticlines AU	1.0	Oil	441	1,362	4,195	1,707	220	681	2,099	854	2	6	19	8
		Gas					519	1,121	2,349	1,236	8	17	35	19
Palmyride Fold Belt Reservoirs AU	1.0	Oil	62	98	148	100	21	34	52	35	0	1	1	1
		Gas					1,035	1,818	3,036	1,898	52	91	152	95
Sinjar Fold Belt Reservoirs AU	1.0	Oil	50	95	172	101	28	52	95	55	0	0	1	0
		Gas					64	182	506	220	0	1	3	1
Aleppo Platform Reservoirs AU	1.0	Oil	11	41	163	57	6	21	82	29	0	0	2	1
		Gas					41	142	519	192	1	2	8	3
Euphrates Graben Reservoirs AU	1.0	Oil	185	473	1,246	559	249	639	1,684	755	8	20	54	24
		Gas					62	228	911	320	3	12	49	17
Southeast Turkey Thrust Belt Reservoirs AU	1.0	Oil	5	10	24	12	1	1	2	1	0	0	0	0
		Gas												
Northern Arabia Paleozoic Reservoirs AU	1.0	Oil	54	117	252	130	27	58	126	65	1	3	5	3
		Gas					3,370	8,015	17,135	8,870	189	449	960	497
Total undiscovered conventional oil and gas resources			**1,438**	**4,154**	**12,016**	**5,086**	**6,941**	**16,901**	**41,349**	**19,546**	**281**	**654**	**1,460**	**735**

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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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