

Assessment of Undiscovered Oil and Gas Resources of the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy, 2019

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 16.4 billion barrels of oil and 106.3 trillion cubic feet of gas in the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy (fig. 1). The Sirte and Pelagian Basin Provinces encompass a series of generally northwest–southeast trending horsts (or platforms) and grabens (or troughs) representing a polyphase history of rifting, subsidence, and postrift thermal sag beginning in the Triassic and continuing into the Neogene (Montgomery, 1994; Abadi and others, 2008; Badalini and others, 2009; Fiduk, 2009; Mriheel, 2015). The extent and orientation of rifts, magnitude of subsidence related to rifting events, and postrift deposition were the result of the diachronous opening of the Atlantic and Tethys Oceans, temporal variations in the movement of the African and Apulian Plates and Calabrian arc, and transpressional to transtensional motion along regional strike-slip faults in northernmost Africa (Fiduk, 2009; Hassan and Kendall, 2014).

Major petroleum source rocks deposited in the Sirte and Pelagian Basins reflect a complex tectonic and eustatic history and include the Lower Cretaceous Nubian Sandstone; the Upper Cretaceous Sirte, Rachmat, and Etel Shales in the Sirte Basin (and their Paleocene equivalents in the Pelagian Basin); and the Eocene Bou Dabbous Formation (or Bilal Shale) in the Pelagian Basin (Gumati and Schamel, 1988; Affouri and Montacer, 2014; Hassan and Kendall, 2014; Hrouda and Abdulhafied, 2019). Silurian source rocks have been reached by drilling in the Tunisian offshore part of the Pelagian Basin, and the Silurian source rocks are known to exist immediately to the south in the Ghadames Basin (Wang and others, 2019). Spatial variations in subsidence, thickness of synrift fill, heat flow, and Neogene uplift and erosion resulted in a complex pattern of source-rock thermal maturity across the study area (Montgomery, 1994). However, the extent of gas occurrence appears to be more extensive in the offshore compared to the onshore portions of the Sirte and Pelagian Basins (Futyan and Jawzi, 1996; Klett, 2001).

Total Petroleum Systems and Assessment Units

The USGS defined three total petroleum systems (TPS) and five assessment units (AU) within these systems: (1) Sirte Basin Mesozoic–Paleogene TPS with the Sirte Basin Mesozoic Onshore Conventional Oil and Gas AU and Sirte Basin Mesozoic Offshore Conventional Oil and Gas AU, (2) Pelagian Basin Mesozoic–Paleogene TPS with the Pelagian Basin Mesozoic Conventional Oil and Gas AU and Pelagian Basin Bou Dabbous Conventional Oil and Gas AU, and (3) Pelagian-Sirte Basins Silurian TPS with the Pelagian-Sirte Basins Silurian Offshore Conventional Gas AU. Assessment input data are summarized in table 1.

The geologic model for the Sirte Basin Mesozoic–Paleogene TPS and the Pelagian Basin Mesozoic–Paleogene TPS is for oil and gas to have been generated from organic-rich shales in the Paleogene with peak oil generation possibly in the late Paleogene to Neogene (Hassan and Kendall, 2014) and oil generation from the Eocene Bou Dabbous Formation in the Miocene to Pliocene. The geologic model for the Pelagian-Sirte Basins Silurian TPS is dependent on Silurian organic-rich marine shales to have been preserved in the continental margin offshore (Montgomery, 1994). If present, Silurian shales reached thermal

generation for oil and gas possibly in the Mesozoic, and Cenozoic burial resulted in the cracking of oil to gas. Oil and gas from all source rocks migrated into a spectrum of conventional structural and stratigraphic traps and reservoir types throughout the Sirte and Pelagian Basins (Klett, 2001; Fiduk, 2009; Whidden and others, 2011).

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil and gas resources in five assessment units (table 2). For undiscovered, technically recoverable conventional oil and gas resources, the mean totals are 16,357 million barrels of oil (MMBO), or 16.4 billion barrels of oil, with an F95–F5 fractile range from 8,445 to 27,027 MMBO; 106,311 billion cubic feet of gas (BCFG; associated), or 106.3 trillion cubic feet of gas, with an F95–F5 fractile range from 49,916 to 185,070 BCFG; and 1,614 million barrels of natural gas liquids (MMBNGL), or 1.6 billion barrels of natural gas liquids, with an F95–F5 fractile range from 763 to 2,830 MMBNGL. Of the mean total conventional oil resources of 16,357 MMBO, about 9,569 MMBO, or 59 percent, is estimated to be in the onshore portion of the Sirte Basin.

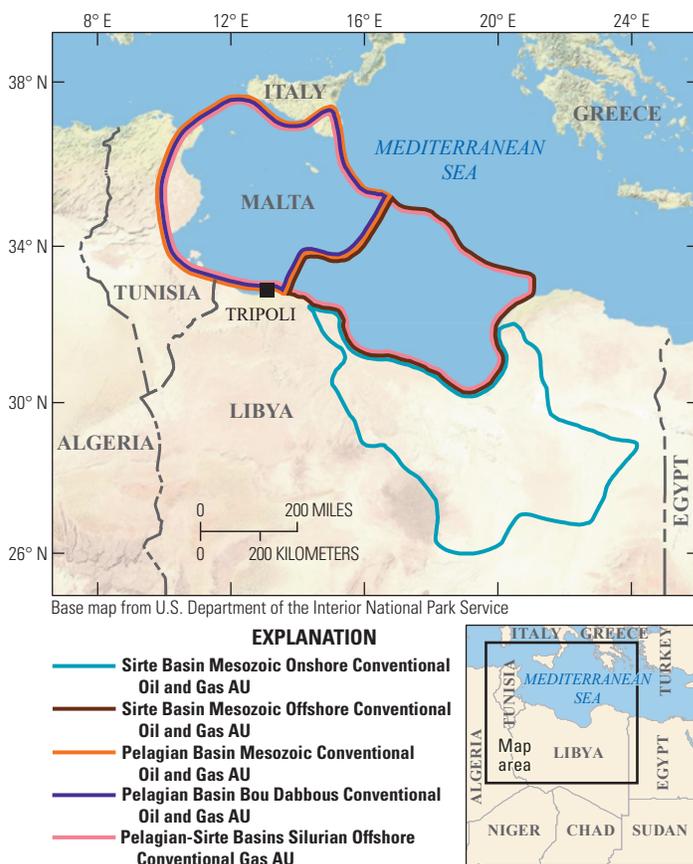


Figure 1. Map showing five conventional assessment units (AUs) in the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy.

Table 1. Key input data for five conventional assessment units in the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy.

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

Assessment input data— Conventional AUs	Sirte Basin Mesozoic Onshore Conventional Oil and Gas AU				Sirte Basin Mesozoic Offshore Conventional Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	400	900	413.5	1	120	360	127.6
Number of gas fields	1	100	300	106.3	1	240	480	245.9
Size of oil fields (MMBO)	1	5	1,500	23.1	5	10	2,500	37.5
Size of gas fields (BCFG)	6	30	2,000	69.6	30	60	9,000	177.1
AU probability	1.0				1.0			
Assessment input data— Conventional AUs	Pelagian Basin Mesozoic Conventional Oil and Gas AU				Pelagian Basin Bou Dabbous Conventional Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	60	180	63.8	1	60	120	61.5
Number of gas fields	1	100	300	106.3	1	80	160	82.0
Size of oil fields (MMBO)	5	10	500	19.3	5	10	100	12.8
Size of gas fields (BCFG)	30	60	5,000	139.0	30	60	2,500	109.2
AU probability	1.0				1.0			
Assessment input data— Conventional AU	Pelagian-Sirte Basins Silurian Offshore Conventional Gas AU							
	Minimum	Median	Maximum	Calculated mean				
Number of gas fields	1	120	480	132.3				
Size of gas fields (BCFG)	30	60	6,000	149.3				
AU probability	0.7							

Table 2. Results for five conventional assessment units in the Sirte and Pelagian Basin Provinces of Libya, Tunisia, Malta, and Italy.

[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. 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 systems 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
Sirte Basin Mesozoic–Paleogene Total Petroleum System														
Sirte Basin Mesozoic Onshore Conventional Oil and Gas AU	1.0	Oil	5,414	9,235	14,891	9,569	4,738	9,045	16,191	9,562	68	134	251	143
		Gas					3,438	6,930	13,007	7,404	25	54	111	59
Sirte Basin Mesozoic Offshore Conventional Oil and Gas AU	1.0	Oil	1,957	4,405	8,829	4,772	2,131	5,181	11,224	5,728	31	77	172	86
		Gas					26,105	42,193	65,295	43,514	238	417	696	436
Pelagian Basin Mesozoic–Paleogene Total Petroleum System														
Pelagian Basin Mesozoic Conventional Oil and Gas AU	1.0	Oil	563	1,149	2,179	1,231	403	899	1,859	984	4	11	23	12
		Gas					6,722	13,764	26,138	14,772	194	410	808	443
Pelagian Basin Bou Dabbous Conventional Oil and Gas AU	1.0	Oil	511	765	1,128	785	983	1,523	2,318	1,570	17	30	51	31
		Gas					5,396	8,677	13,412	8,941	186	341	588	358
Pelagian-Sirte Basins Silurian Total Petroleum System														
Pelagian-Sirte Basins Silurian Offshore Conventional Gas AU	0.7	Gas					0	13,413	35,626	13,836	0	40	130	46
Total undiscovered conventional resources			8,445	15,554	27,027	16,357	49,916	101,625	185,070	106,311	763	1,514	2,830	1,614

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Differences in the spelling of the Sirte (Sirt) Basin reflect the individual author's usage.

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For More Information

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