

Assessment of Undiscovered Oil and Gas Resources of Libya and Tunisia, 2010

Using a geology-based assessment methodology, the U.S. Geological Survey estimated means of 3.97 billion barrels of undiscovered oil, 38.5 trillion cubic feet of undiscovered natural gas, and 1.47 billion barrels of undiscovered natural gas liquids in two provinces of North Africa.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered conventional oil and gas fields within two geologic provinces of North Africa—Sirte Basin in Libya and Pelagian Basin in Tunisia and western Libya—as part of the USGS World Petroleum Resources Project (fig. 1). The Sirte Basin originated as a Cretaceous rift that evolved into a post-rift basin dominated by thermal subsidence; it is characterized by carbonate deposition on high blocks and fine-grained clastic deposition in troughs (Ahlbrandt, 2001; Hallett, 2002). The Pelagian Basin was dominated by Mesozoic and Cenozoic subsidence related to tectonism along the northern margin of the African plate (Klett, 2001).

One total petroleum system (TPS) was defined in the Sirte Basin Province, and two TPSs were defined in the Pelagian

Basin Province. The Sirte–Rachmat Composite TPS in the Sirte Basin Province contains the post-rift Coniacian–Campanian Sirte–Rachmat organic-rich shale/marl, which was deposited in troughs across the Sirte Basin during the early phase of thermal subsidence (Ahlbrandt, 2001; Hallett, 2002). Major reservoirs in the Sirte Basin Province include syn-rift continental sandstones and post-rift shallow-marine carbonates, with shales and evaporites acting as seals for hydrocarbon reservoirs (Ahlbrandt, 2001; Hallett, 2002). Two assessment units (AU) were defined within the Sirte–Rachmat Composite TPS: the Onshore Sirte Carbonate–Clastic AU and the Offshore Sirte Basin AU.

Within the Pelagian Basin, two TPSs as defined by Klett (2001) were retained for this assessment. The Jurassic–Cretaceous Composite TPS consists of fluids from Jurassic and Cretaceous deep-marine shales that migrated into Jurassic–Cretaceous shallow marine limestones and Upper Cretaceous fractured deep-water chinks. Seals include Jurassic and Cretaceous shales and evaporites. One AU was defined for this TPS, the Jurassic–Cretaceous Structural/Stratigraphic AU, based on Klett (2001). The Bou Dabbous Cenozoic TPS contains the Eocene Bou Dabbous organic-rich shale, with hydrocarbons that migrated into lower and middle Eocene shallow-water limestones that are sealed by

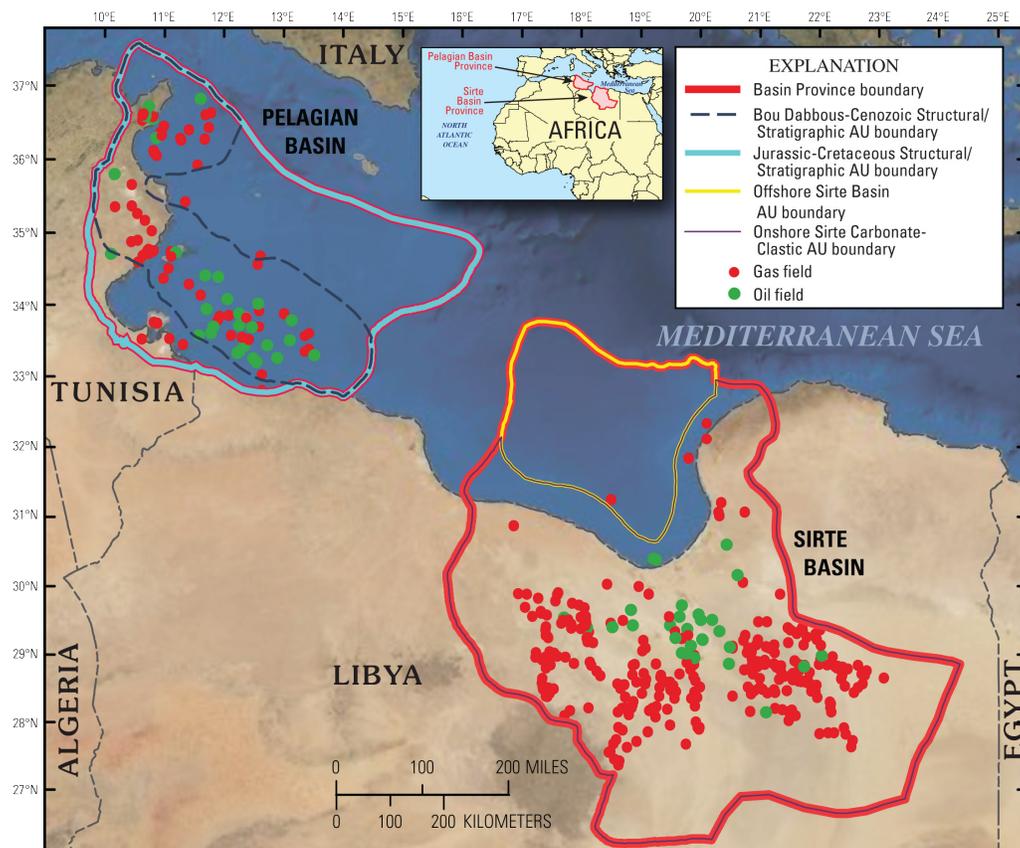


Figure 1. Locations of the Sirte and Pelagian Basin Provinces, North Africa. AU, assessment unit.

overlying shales and marls. This TPS contains the Bou Dabbous–Cenozoic Structural/Stratigraphic AU, as defined by Klett (2001).

The methodology for the assessment included a complete geologic framework description for each province, based mainly on published literature and the definition of petroleum systems and assessment units within these systems. Exploration and discovery history was a critical part of the methodology used to estimate sizes and numbers of undiscovered accumulations. In areas where there are few or no discoveries (for example, offshore Sirte Basin), geologic analogs were used as a basis for estimating volumes of undiscovered oil and gas resources. Each assessment unit was assessed for undiscovered oil and nonassociated gas accumulations, and coproduct ratios were used to calculate the volumes of associated gas (gas in oil fields) and natural gas liquids.

Resource Summary

The USGS assessed undiscovered conventional oil and gas resources within the three TPSs in the Sirte and Pelagian Basin Provinces (table 1). The mean total of undiscovered oil in these two provinces is 3,974 million barrels of oil (MMBO), with a range from 1,119 MMBO (95 percent probability) to 9,044 MMBO (5 percent probability); for undiscovered gas the mean total is 38,509 billion cubic feet of gas (BCFG), with a range from 11,520 to 84,347 BCFG; and the mean total for natural gas is 1,466 million barrels of natural gas liquids (MMBNGL), with a range from 405 to 3,384 MMBNGL.

About 90 percent of the mean total of undiscovered oil (3,545 MMBO), 85 percent of the mean total of undiscovered gas (32,451 BCFG), and 89 percent of the mean total of undiscovered natural gas liquids (1,298 MMBNGL) are estimated to be in the Sirte Basin Province. Of these volumes, 64 percent of the undiscovered oil (2,267 MMBO), 80 percent of the undiscovered gas (25,609 BCFG), and 78 percent of the undiscovered natural gas liquids (1,010 MMBNGL) are in the Offshore Sirte Basin AU, with the remaining percentages in the Onshore Sirte Carbonate–Clastic AU. The higher percentage of undiscovered oil and gas resources assessed in the Offshore Sirte Basin AU reflects

the relatively underexplored history of this part of the Sirte Basin Province.

Overall, the assessment indicates that (1) 80–90 percent of the undiscovered oil and gas resources are in the Sirte Basin Province, (2) there is significantly more total undiscovered gas resource in both provinces (38,509 BCFG or 6,640 MMBOE) than total undiscovered oil resource (3,974 MMBO), and (3) there is almost twice as much undiscovered gas (25,609 BCFG or 4,415 MMBOE) in the Offshore Sirte Basin AU as there is undiscovered oil (2,267 MMBO).

References Cited

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- Klett, T.R., 2001, Total petroleum systems of the Pelagian Province, Tunisia, Libya, Italy, and Malta—The Bou Dabbous–Tertiary and Jurassic–Cretaceous Composite: U.S. Geological Survey Bulletin 2202-D, 27 p., <http://geology.cr.usgs.gov/pub/bulletins/b2202-d/>.

For Further Information

Supporting studies of the geologic models and the methodology used in the assessment of North Africa basins are in progress. Assessment results are available at the USGS Central Energy Resources Science Center website, <http://energy.cr.usgs.gov/oilgas/>.

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Table 1. Libya and Tunisia assessment results.

[MMBO, million barrels of oil. BCFG, billion cubic feet of gas. MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas accumulations, all liquids are included as NGL (natural gas liquids). Undiscovered gas resources are the sum of nonassociated and associated gas. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. Largest expected oil field in MMBO; largest expected gas field in BCFG. TPS, total petroleum system; AU, assessment unit. Gray shading indicates not applicable]

Total petroleum systems (TPS) and assessment units (AU)	Field type	Largest expected mean field size	Total undiscovered resources															
			Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)							
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean				
Sirte-Rachmat Composite TPS																		
Onshore Sirte Carbonate-Clastic AU	Oil	432	364	1,087	2,823	1,278	418	1,338	4,035	1,673	22	74	240	96				
	Gas	2,042					1,267	4,179	12,569	5,169	44	151	478	192				
Offshore Sirte Basin AU	Oil	857	563	1,838	5,457	2,267	633	2,250	7,677	2,972	34	124	454	170				
	Gas	6,843					6,591	19,540	49,077	22,637	233	709	1,903	840				
Bou Dabbous-Cenozoic TPS																		
Bou Dabbous-Cenozoic Structural/Stratigraphic AU	Oil	60	130	283	552	305	45	113	274	131	1	3	8	4				
	Gas	616					1,443	2,933	5,405	3,119	37	75	140	80				
Jurassic-Cretaceous Composite TPS																		
Jurassic-Cretaceous Structural/Stratigraphic AU	Oil	13	62	116	212	124	79	154	287	165	2	4	7	4				
	Gas	569					1,044	2,409	5,023	2,643	32	73	154	80				
Total conventional resources							1,119	3,324	9,044	3,974	11,520	32,916	84,347	38,509	405	1,213	3,384	1,466