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National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources of the Senegal Basin Province of Northwest Africa, 2021

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 13,929 million (13.9 billion) barrels of oil and 193,721 billion (193.7 trillion) cubic feet of gas within the Senegal Basin Province of northwest Africa.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable conventional oil and gas resources within the Senegal Basin Province of northwest Africa (fig. 1). The Senegal Basin Province is one segment of the rifted passive margin that developed along the northwestern margin of Africa as North and South America separated in the Late Triassic. The complex tectonic and stratigraphic evolution of the rifted passive margin from the Triassic to Neogene is reflected in the spectrum of hydrocarbon reservoirs, traps, and source rocks present in the Senegal Basin Province (Brownfield and Charpentier, 2003; Davison, 2005; Ndiaye and others, 2016; Casson and others, 2021).

Total Petroleum System and Assessment Unit

The USGS defined a Mesozoic Composite Total Petroleum System (TPS) that includes organic-rich shales of Triassic to Cretaceous age. Organic-rich Cenomanian–Turonian shales are interpreted as the highest quality source rocks in the basin. They are up to 60 meters thick and have total organic carbon (TOC) values up to 20 weight percent and hydrogen index (HI) values up to 600 milligrams of hydrocarbon per gram of TOC (mg HC/g TOC; Herbin and others, 1986; Nzoussi-Mbassani and others, 2003; Davison, 2005; Wagner and others, 2013; Van Helmond and others, 2014). Organic-rich shales of Aptian–Albian age are up to 100 meters thick and have TOC contents as much as 34 weight percent and HI values that range from 450 to 650 mg HC/g TOC (Hathon, 2018). Geochemical data are not available to characterize neither Triassic synrift lacustrine shales nor Jurassic off-platform, deep-water organic-rich shales.

The Senegal Basin Reservoirs Assessment Unit (AU) was defined to encompass oil and gas that was generated from Triassic to Cretaceous source rocks and migrated into reservoirs within structural and stratigraphic traps. Triassic reservoir rocks may include alluvial, fluvial, deltaic, and lacustrine sandstones within structural and stratigraphic traps, possibly sealed by salt. The margins of salt diapirs and other structures may be sites for sandstone reservoirs sealed by salt. Lower Jurassic to Lower Cretaceous reservoirs may include carbonate platform-margin reefs, karst zones, off-platform sediment gravity flows, and slope-channel and basin-floor sandstones in which clastics have bypassed the carbonate shelf margin (Clayburn, 2018).

Upper Cretaceous to Eocene sandstones presently form the most important reservoirs, ranging from fluvial-deltaic to basin-floor fan deposits (Casson and others, 2021). Of these reservoirs, extensive, stacked basin-floor fan sandstones may be the most important reservoir systems for undiscovered resources (Hand and others, 2015; Clayburn, 2018). Key assessment input data are summarized in table 1 and in Schenk (2022).

Figure 1. Map showing the location of one conventional assessment unit (AU) in the Senegal Basin Province, northwest Africa. The Sengal Basin Province boundary coincides with the Senegal Basin Reservoirs AU boundary.

Table 1. Key input data for one conventional assessment unit in the Senegal Basin Province, northwest Africa.

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

Assessment input data—Conventional AUs	Senegal Basin Reservoirs AU			
	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	150	300	153.7
Number of gas fields	1	210	420	215.1
Size of oil fields (MMBO)	5	10	12,000	90.5
Size of gas fields (BCFG)	30	72	80,000	647.2
AU probability	1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil, gas, and natural gas liquid (NGL) resources within the Senegal Basin Province of northwest Africa (table 2). For the Senegal Basin Reservoirs AU, the fully risked mean totals are 13,929 million barrels of oil (MMBO) or 13.9 billion barrels, with an F95–F5 fractile range from 5,749 to 26,079 MMBO; 193,721 billion cubic feet of gas (BCFG), or 193.7 trillion cubic feet, with an F95–F5 range from 87,592 to 342,358 BCFG; and 3,123 million barrels of natural gas liquids (MMBNGL), or 3.1 billion barrels, with an F95–F5 range from 1,401 to 5,554 MMBNGL.

Table 2. Results for one conventional AU in the Senegal Basin Province, northwest Africa.

[Results shown are fully risked estimates. F95 represents a 95 percent chance of at least the amount tabulated; other fractiles are defined similarly. Shading indicates not applicable. 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 Composite Total Petroleum System														
Senegal Basin Reservoirs AU	1.0	Oil	5,749	12,748	26,079	13,929	22,433	49,703	101,675	54,324	426	944	1,934	1,032
		Gas					65,159	131,122	240,683	139,397	975	1,965	3,620	2,091
Total undiscovered conventional resources			**5,749**	**12,748**	**26,079**	**13,929**	**87,592**	**180,825**	**342,358**	**193,721**	**1,401**	**2,909**	**5,554**	**3,123**

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For More Information

Assessment results are also available at the USGS Energy Resources Program website at https://www.usgs.gov/programs/energy-resources-program.

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