National and Global Petroleum Assessment

Assessment of Undiscovered Gas Resources of the Thrace Basin, Turkey, 2015

Using a geology-based assessment methodology, the U.S. Geological Survey assessed undiscovered, technically recoverable mean resources of 787 billion cubic feet of conventional gas and 1,630 billion cubic feet of unconventional gas in the Thrace Basin, Turkey.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional and unconventional (continuous) gas resources within the Thrace Basin, Turkey (fig. 1). The Thrace Basin, with as much as 9,000 meters of Eocene to Holocene sedimentary rock in the basin center, is interpreted as a supradetachment basin formed on an exhumed and extended Rhodope metamorphic complex that was subsequently modified by Neogene strike-slip deformation (Kilias and others, 2013). Shales of the Eocene Hamitabat Formation are the principal petroleum source rocks in the Thrace Basin (Hoşgörmez and Yalçin, 2005; Gürgey, 2009); other potential source rocks include shales of the Eocene Ceylan Formation, Oligocene Mezardere Formation, and Oligocene coals (for biogenic gas) of the Danişmen and Osmancik formations. The USGS defined a Paleogene Composite Total Petroleum System (TPS) that includes the (1) Paleogene Conventional Reservoirs Assessment Unit (AU); (2) Paleogene Tight Gas AU; and (3) Mezardere Shale Oil AU. The Oligocene Biogenic Gas AU was defined within the Biogenic Gas TPS.

Geologic Models for Assessment

The geologic model for the assessment of the Paleogene Conventional Reservoirs AU has gas generated within organic-bearing Paleogene shales migrating into sandstone reservoirs of the Hamitabat, Osmancik, and Danişmen Formations, and into carbonate reservoirs of the Soğucak Formation (fig. 2). Reservoirs are within complex traps that originated as Eocene extensional structures modified by Neogene deformation. This assessment model assumes that structures and reservoirs in the deeper part of the basin are underexplored when compared to shallower structures.

Figure 1. Location of the Thrace Basin in western Turkey and boundaries of the three assessment units defined in this study. AU, assessment unit.

The geologic model for the Paleogene Tight Gas AU has gas generated from shales of the Hamitabat Formation in the overpressured zone of the central part of the Thrace Basin migrating locally into tight (low-permeability) sandstones and siltstones of the Hamitabat Formation and into possibly tight sandstones of the Ceylan and Mezardere Formations. The geologic model for the Oligocene Biogenic Gas AU is for biogenic gas to be retained in the coals of the Danişmen and possibly the Osmancik Formation in the central, undeformed part of the basin.
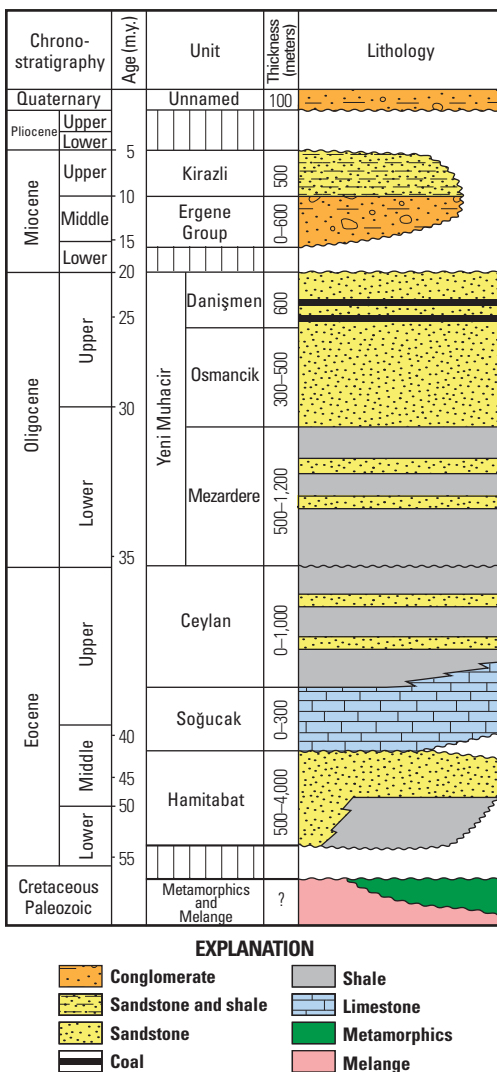
Key assessment input data for three AUs are summarized in table 1. Data for estimated ultimate recovery (EUR), well drainage area, and success ratio were based on U.S. analogs for tight-gas and biogenic-gas reservoirs (U.S. Geological Survey U.S. Continuous Resources Assessment Team, 2015).

Undiscovered Resource Summary

The USGS assessed potential undiscovered, technically recoverable conventional resources and unconventional (continuous) gas resources in the Thrace

Basin, Turkey. For conventional resources, the USGS assessed a mean of 787 billion cubic feet of gas (BCFG) and 3 million barrels of liquids (MMBNGL) (table 2). The ranges of resource estimates, F95–F5 (317 to 1,471 BCFG; 1 to 6 MMBNGL) reflect geologic uncertainty. For unconventional tight-gas resources, the mean is 1,261 BCFG with an F95–F5 range from 378 to 2,303 BCFG. For biogenic gas resources, the mean is 369 BCFG, with an F95–F5 range from 0 to 724 BCFG (table 2).

Other unconventional oil and gas accumulations may be present in the Thrace Basin, including shale oil within source rocks of the Mezardere Formation (Gürgey, 2015). However, available data for total organic carbon content indicate that most of the Mezardere Formation does not pass the threshold for the USGS definition of a potential shale-oil reservoir (greater than 2 weight percent total organic carbon), and therefore the Mezardere Formation was not quantitatively assessed in this study.

Table 1. Key assessment input data for two continuous assessment units and one conventional assessment unit in the Thrace Basin, Turkey.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; MMBO, million barrels of oil; BCFG, billion cubic feet of gas. The average EUR input is the minimum, median, maximum, and calculated mean. Shading indicates not applicable]

Assessment input data—Continuous AUs				
Paleogene Tight Gas AU	**Minimum**	**Mode**	**Maximum**	**Calculated mean**
Potential production area of AU (acres)	1,000	226,000	452,000	226,333
Average drainage area of wells (acres)	40	80	120	80
Success ratio (%)	60	70	80	70
Average EUR (MMBO)	0.4	0.6	1.0	0.619
AU probability	1.0			
Oligocene Biogenic Gas AU	**Minimum**	**Mode**	**Maximum**	**Calculated mean**
Potential production area of AU (acres)	1,000	406,000	609,000	338,667
Average drainage area of wells (acres)	40	60	80	60
Success ratio (%)	50	60	70	60
Average EUR (MMBO)	0.09	0.15	0.3	0.157
AU probability	0.9			
Assessment input data—Conventional AU				
Paleogene Conventional Reservoirs AU	**Minimum**	**Mode**	**Maximum**	**Calculated mean**
Number of undiscovered fields	1	30	90	31
Sizes of undiscovered fields (BCFG)	3	12	600	23
AU probability	1.0			

Table 2. Assessment results for undiscovered continuous and conventional resources of the Thrace Basin, Turkey.

[AU, assessment unit; 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 under the NGL (natural gas liquids) category. F95 represents a 95 percent chance of at least the amount tabulated. Other fractiles are defined similarly. Fractiles are additive under assumption of perfect positive correlation. Shading indicates not applicable]

Total petroleum system and AU	AU probability	Accumulation type	Total undiscovered resources							
			Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean
Paleogene Composite Total Petroleum System										
Paleogene Tight Gas AU	1.0	Gas	378	1,211	2,303	1,261	1	5	10	5
Mezardere Shale Oil AU	0.1	Oil	Not quantitatively assessed							
Biogenic Gas Total Petroleum System										
Oligocene Biogenic Gas AU	0.9	Gas	0	372	724	369	0	0	0	0
Total continuous resources			**378**	**1,583**	**3,027**	**1,630**	**1**	**5**	**10**	**5**
Paleogene Composite Total Petroleum System										
Paleogene Conventional Reservoirs AU	1.0	Gas	317	722	1,471	787	1	3	6	3
Total conventional resources			**317**	**722**	**1,471**	**787**	**1**	**3**	**6**	**3**
Total undiscovered resources			**695**	**2,305**	**4,498**	**2,417**	**2**	**8**	**16**	**8**

References Cited

Gürgey, Kadir, 2009, Geochemical overview and undiscovered gas resources generated from Hamitabat petroleum system in the Thrace Basin, Turkey: Marine and Petroleum Geology, v. 26, no. 7, p. 1240–1254.

Gürgey, Kadir, 2015, Estimation of oil in-place resources in the lower Oligocene Mezardere Shale, Thrace Basin, Turkey: Journal of Petroleum Science and Engineering, v. 133, p. 543–565.

Hoşgörmez, Hakan, and Yalçin, M.N., 2005, Gas–source rock correlation in Thrace Basin, Turkey: Marine and Petroleum Geology, v. 22, no. 8, p. 901–916.

Kilias, Adamantios, Falalakis, George, Sfeikos, Aristides, Papadimitriou, Eleftheria, Vamvaka, Agni, and Gkarlaouni, Chara, 2013, The Thrace Basin in the Rhodope province of NE Greece—A tertiary supradetachment basin and its geodynamic implications: Tectonophysics, v. 595–596, p. 90–105.

U.S. Geological Survey U.S. Continuous Resources Assessment Team, 2015, U.S. Geological Survey assessments of continuous (unconventional) oil and gas resources, 2000 to 2011: U.S. Geological Survey Digital Data Series DDS–69–MM, 46 p.

Figure 2. Generalized stratigraphic column for the Thrace Basin, Turkey. Modified from Gürgey (2015).

Thrace Basin Assessment Team

Christopher J. Schenk, Timothy R. Klett, Marilyn E. Tennyson, Janet K. Pitman, Stephanie B. Gaswirth, Phuong A. Le, Heidi M. Leathers-Miller, Tracey J. Mercier, Kristen R. Marra, Sarah J. Hawkins, and Michael E. Brownfield.

For Further Information

Assessment results also are available at the USGS Energy Resources Program Web site at http://energy.usgs.gov.