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National and Global Petroleum Assessment

Assessment of Continuous Oil and Gas Resources in Jurassic Posidonia Shales of Greece and Albania, 2019

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean resources of 118 million barrels of continuous oil and 170 billion cubic feet of continuous gas in the Jurassic Posidonia Shale Total Petroleum System of western Greece and southern Albania.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable continuous oil and gas resources in the Jurassic Posidonia Shale Total Petroleum System (TPS) of western Greece and southern Albania (fig. 1). From the Late Triassic to Early Jurassic, this area of western Greece and southern Albania was part of a regionally extensive carbonate platform that developed on and around the Apulian Plate (Karakitsios, 1995; 2013). Deposited along the passive margin during this time were as much as 1,000 meters of platform carbonates of the Pantokrator Limestone. Jurassic extension and rifting associated with the opening of the neo-Tethys Ocean led to the formation of numerous grabens and half-grabens along the margin of the Apulian Plate (Karakitsios, 1995; Karakitsios and Rigakis, 2007). The bottom waters of the deeper grabens and half-grabens were anoxic, resulting in the deposition and preservation of organic-rich petroleum source rocks of the Jurassic Posidonia Shale. These extensional structures persisted through the Jurassic and eventually were buried by the regionally extensive, postrift Cretaceous Vigla Limestone. From the Cretaceous through the Paleogene, the Apulian Plate was relatively undeformed and buried by perhaps hundreds of meters of carbonate deposits. Beginning in the Eocene and ending in the Miocene, the Apulian Plate collided with the Eurasian Plate, forming the Dinaride and Hellenide fold and thrust belts, resulting in compressional deformation of Mesozoic rocks. Associated with the collision of Apulia was the progradation of orogenic clastic wedges up to several kilometers thick (Gonzalez-Bonorino, 1996; Karakitsios, 2013). Neogene burial by these orogenic clastics resulted in the thermal maturation into the oil- and gas-generation windows of the Jurassic Posidonia source rocks (Rigakis and Karakitsios, 1998; Karakitsios and Rigakis, 2007).

Total Petroleum System and Assessment Units

The USGS defined the Jurassic Posidonia Shale TPS and two continuous assessment units (AUs) within the TPS (fig. 1). The Jurassic Posidonia Shale Oil AU and the Jurassic Posidonia Shale Gas AU were defined based on thickness of organic-rich shale, total organic carbon content, and levels of thermal maturation for oil and gas.

Jurassic Posidonia organic-rich shales form some of the most prolific petroleum source rocks in Europe and have been studied extensively (van Bergen and others, 2013; Song and others, 2017; Stock and Littke, 2018). Jurassic Posidonia Shales in Greece and Albania contain Type II and Type I organic matter, have as much as 20 weight percent total organic carbon, have hydrogen indices as much as 565 milligrams of hydrocarbon per gram of total organic carbon, are up to 80 meters thick, and are interpreted to be thermally mature both for oil and gas (Rigakis and Karakitsios, 1998; Zelilidis and others, 2003; Karakitsios and Rigakis, 2007; Barbullushi, 2013; Karakitsios, 2013; Spathopoulos and Sephton, 2013; Zelilidis and others, 2013).

The Jurassic Posidonia Shale source rocks have been studied in detail with respect to geochemical data such as organic carbon content, hydrogen index, and kerogen composition. However, the geologic uncertainty in this assessment revolves around the extent and level of thermal maturation of organic matter in the shales and the extent of retention of oil and gas within the shales following deformation, expulsion, and mainly Neogene migration.

The geologic model underlying the assessment of the Jurassic Posidonia Shale Oil AU and Jurassic Posidonia Shale Gas AU is for oil and gas to have been generated within these organic-rich shales during burial by Eocene-to-Neogene orogenic clastic wedges. Thermal maturation coincided with Neogene compression and deformation, and the model requires that some portion of the oil and gas was retained within the shales following expulsion and migration.

The assessment input data are summarized in table 1.

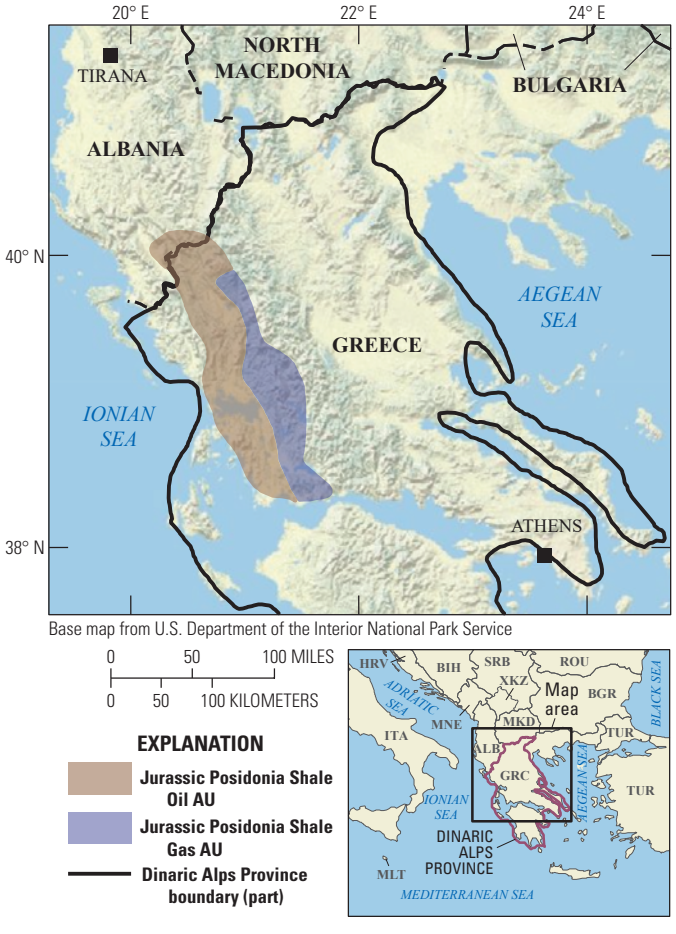

Figure 1. Map showing the location of two continuous assessment units in the Jurassic Posidonia Shale Total Petroleum System of western Greece and southern Albania and the Dinaric Alps Province boundary.

Table 1. Key input data for two continuous assessment units in the Jurassic Posidonia Shale Total Petroleum System of western Greece and southern Albania.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; MMBO, million barrels of oil; BCFG, billion cubic feet of gas. Well drainage area, success ratio, and EUR are defined partly using U.S. shale-oil and shale-gas analogs. The average EUR input is the minimum, median, maximum, and calculated mean. Shading indicates not applicable]

Assessment input data—Continuous AUs	Jurassic Posidonia Shale Oil AU				Jurassic Posidonia Shale Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,000	849,000	1,698,000	849,333	1,000	491,000	982,000	491,333
Average drainage area of wells (acres)	60	100	140	100	80	120	160	120
Area untested in AU (%)	100	100	100	100	100	100	100	100
Success ratio (%)	10	40	80	43.3	10	40	80	43.3
Average EUR (MMBO, oil; BCFG, gas)	0.01	0.04	0.15	0.046	0.04	0.07	0.1	0.071
AU probability	0.7				0.6			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered, technically recoverable continuous oil and gas resources within the Jurassic Posidonia Shale TPS of western Greece and southern Albania (table 2). The estimated mean totals for continuous resources are 118 million barrels of oil (MMBO) with an F95–F5 range from 0 to 368 MMBO, 170 billion cubic feet of gas (BCFG) with a F95–F5 range from 0 to 539 BCFG, and 1 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 0 to 5 MMBNGL. The zeros at the F95 fractiles reflect uncertainty in the geologic model, particularly with respect to the retention of oil or gas within Posidonia Shales.

Table 2. Results for two continuous assessment units in the Jurassic Posidonia Shale Total Petroleum System of western Greece and southern Albania.

[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 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
Jurassic Posidonia Shale Total Petroleum System														
Jurassic Posidonia Shale Oil AU	0.7	Oil	0	90	368	118	0	68	302	94	0	1	4	1
Jurassic Posidonia Shale Gas AU	0.6	Gas					0	58	237	76	0	0	1	0
Total undiscovered continuous resources			**0**	**90**	**368**	**118**	**0**	**126**	**539**	**170**	**0**	**1**	**5**	**1**

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For More Information

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

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ISSN 2327-6916 (print) ISSN 2327-6932 (online) https://doi.org/10.3133/fs20193075