

National and Global Petroleum Assessment

Assessment of Continuous Oil and Gas Resources in the Middle and Upper Magdalena Basins, Colombia, 2017

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean undiscovered, technically recoverable continuous resources of 0.45 billion barrels of oil and 1.0 trillion cubic feet of gas in the Middle and Upper Magdalena Basins, Colombia.

Introduction

The U.S. Geological Survey (USGS) completed an assessment of undiscovered, technically recoverable continuous (unconventional) oil and gas resources in the Middle and Upper Magdalena Basins of Colombia (fig. 1). These basins share a history of several tectonic events along the northwestern part of South America that largely shaped the development of petroleum systems and potential shale-oil and shale-gas resources (Cooper and others, 1995; Acosta and others, 2007).

Total Petroleum Systems and Assessment Units

For the Middle Magdalena Basin, the USGS defined the Middle Magdalena La Luna Total Petroleum System (TPS) based on the presence and thermal maturation of organicrich marine shales of the La Luna Formation. These shales are as much as 700 meters thick, and the organic matter is predominantly Type II and Type IIS. Total organic carbon content is as much as 18 weight percent (Rámon and others, 2001; Agencia Nacional de Hidrocarburos, 2009 a, b; Veiga and Dzelalija, 2014). For this assessment, the USGS defined a Middle Magdalena La Luna Shale Oil Assessment Unit (AU) and a Middle Magdalena La Luna Shale Gas AU within the TPS based on data from Spickert (2014). The geologic models for the Middle Magdalena La Luna Shale Oil AU and the Middle Magdalena La Luna Shale Gas AU have some portion of recoverable oil or gas retained within the La Luna Formation shales following migration into conventional traps.

For the Upper Magdalena Basin, the USGS defined the Upper Magdalena Villeta TPS and the Upper Magdalena Villeta Shale Oil AU within this TPS based on data from Sarmiento and Rangel (2004). The geologic model for this AU is for oil generated within organic-rich shales of the Villeta Group to have been partially retained following migration of oil out of the shales.

Assessment input data for the AUs are shown in table 1. Well drainage areas, estimated ultimate recoveries, and success ratios were guided by U.S. shale-oil and shale-gas assessment unit analogs.

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered, technically recoverable, continuous oil and gas resources in the Middle and Upper Magdalena Basins of Colombia (table 2). The estimated mean total continuous resources are 449 million barrels of oil (MMBO), or 0.45 billion barrels of oil, with an F95–F5 range from 98 to 1,004 MMBO; 1,022 billion cubic feet of gas (BCFG), or 1.0 trillion





cubic feet of gas, with an F95–F5 range from 213 to 2,377 BCFG; and 14 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 2 to 34 MMBNGL. For the Middle Magdalena La Luna Shale Oil AU, the estimated mean resources are 233 MMBO with an F95–F5 range from 51 to 521 MMBO, 232 BCFG with an F95–F5 range from 48 to 540 BCFG, and 2 MMBNGL with an F95–F5 range from 0 to 6 MMBNGL. For the Middle Magdalena La Luna Shale Gas AU, the estimated mean resources are 639 BCFG with an F95–F5 range from 134 to 1,490 BCFG and 10 MMBNGL with an F95 to F5 range from 2 to 24 MMBNGL. For the Upper Magdalena Villeta Shale Oil AU, the estimated mean resources are 216 MMBO with an F95–F5 range from 31 to 347 BCFG, and 2 MMBNGL with an F95–F5 range from 31 to 347 BCFG, and 2 MMBNGL with an F95–F5 range from 0 to 4 MMBNGL.

Table 1. Key assessment input data for three continuous assessment units in the Middle and Upper Magdalena Basins, Colombia.

[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	Mid	ldle Magdale	na La Luna Sh	ale Oil AU	Middle Magdalena La Luna Shale Gas AU						
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean			
Potential production area of AU (acres)	800	823,500	1,647,000	823,767	600	459,500	919,000	459,700			
Average drainage area of wells (acres)	40	120	200	120	80	120	160	120			
Success ratio (%)	10	50	90	50	10	50	90	50			
Average EUR (oil, MMBO; gas, BCFG)	0.03	0.06	0.15	0.065	0.1	0.3	1.0	0.337			
AU probability	1.0				1.0						

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Accessment input data	Upper Magdalena Villeta Shale Oil AU									
Continuous AUs	Minimum	Mode Maximu		Calculated mean						
Potential production area of AU (acres)	800	768,000	1,536,000	768,267						
Average drainage area of wells (acres)	40	120	200	120						
Success ratio (%)	10	50	90	50						
Average EUR (MMBO)	0.03	0.06	0.15	0.065						
AU probability	1.0									

Table 2. Assessment results for three continuous assessment units in the Middle and Upper Magdalena Basins, Colombia.

[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. For gas accumulations, all liquids are included in the NGL category. 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 astrology systems and	ALL	Accumulation type	Total undiscovered resources											
assessment units (AUs)	AU probability		Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Middle Magdalena La Luna Total Petroleum System														
Middle Magdalena La Luna Shale Oil AU	1.0	Oil	51	203	521	233	48	196	540	232	0	2	6	2
Middle Magdalena La Luna Shale Gas AU	1.0	Gas					134	537	1,490	639	2	8	24	10
Upper Magdalena Villeta Total Petroleum System														
Upper Magdalena Villeta Shale Oil AU	1.0	Oil	47	187	483	216	31	129	347	151	0	1	4	2
Total undiscovered continuous resources			98	390	1,004	449	213	862	2,377	1,022	2	11	34	14

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For More Information

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