

Assessment of Continuous Oil and Gas Resources in the Perth Basin Province, Australia, 2017

Using a geology-based assessment methodology, the U.S. Geological Survey assessed undiscovered, technically recoverable mean resources of 223 million barrels of oil and 14.5 trillion cubic feet of gas in the Perth Basin Province, Australia.

Introduction

The U.S. Geological Survey (USGS) completed an assessment of undiscovered, technically recoverable continuous (unconventional) oil and gas resources within the Perth Basin Province of western Australia (fig. 1). The Perth Basin Province is a complex, 1,300-kilometer-long, multiphase extensional basin that formed from the Permian through Late Jurassic as Australia rifted and then separated from India (Cadman and others, 1994; Geoscience Australia, 2013). Permian through Jurassic rocks of the Perth Basin Province reflect multiple phases of rift and postrift subsidence and deposition that led to the development of several petroleum systems (Dargahi and Rezaee, 2013; Torghabeh and others, 2014; Ghori, 2015).

Total Petroleum Systems and Assessment Units

Within the Perth Basin Province, the USGS defined five total petroleum systems (TPSs) and seven contained assessment units (AUs) within these TPSs. The Permian Composite TPS was defined to include the potential for gas from several source rock intervals trapped in low-permeability rocks within the Permian Carynginia-Irwin River Tight Gas AU. The Triassic Kockatea TPS was defined to include the Triassic Kockatea Shale Oil AU and the Triassic Kockatea Shale Gas AU. The Triassic–Jurassic Composite TPS includes gas in low-permeability reservoirs within the Triassic–Jurassic Tight Gas AU. The Jurassic Cattamarra Coal TPS includes oil and condensate retained within coalbeds of the Jurassic Cattamarra Coal Oil AU (Warris, 2004; Geoscience Australia, 2013) and coalbed gas resources in the

Jurassic Cattamarra Coalbed Gas AU. The Permian Bunbury Sue Group Coal TPS was defined to include gas accumulations in low-permeability reservoirs within the Permian Bunbury Sue Group Tight Gas AU with gas generated from Sue Group coals and carbonaceous shales.

Assessment input data for each AU are shown in table 1. Well drainage areas, estimated ultimate recoveries, and success ratios were guided by U.S. shale-oil, shale-gas, tight-gas, and coalbed-gas analogs.

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered continuous oil and gas resources within the Perth Basin Province (table 2). For total undiscovered continuous oil and gas resources, the estimated means are 223 million barrels of oil (MMBO) with an F95–F5 range from 33 to 597 MMBO; 14,532 billion cubic feet of gas (BCFG), or 14.5 trillion cubic feet of gas, with an F95–F5 range from 3,351 to 31,207 BCFG; and 49 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 9 to 119 MMBNGL.

Of the estimated mean total gas resource of 14,532 BCFG, about 12,003 BCFG, or 83 percent, is estimated to be potential tight-gas resources in the Permian Carynginia-Irwin River Tight Gas AU (5,660 BCFG), the Triassic–Jurassic Tight Gas AU (3,341 BCFG), and the Permian Bunbury Sue Group Tight Gas AU (3,002 BCFG). Total mean potential shale-gas resources of 1,741 BCFG are collectively in the Triassic Kockatea Shale Gas AU and in the Triassic Kockatea Shale Oil AU (as associated gas), which accounts for about 12 percent of the mean total continuous gas resource. Mean gas

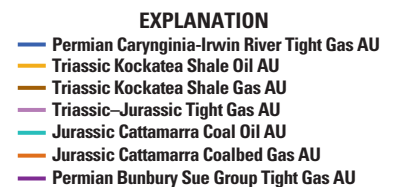
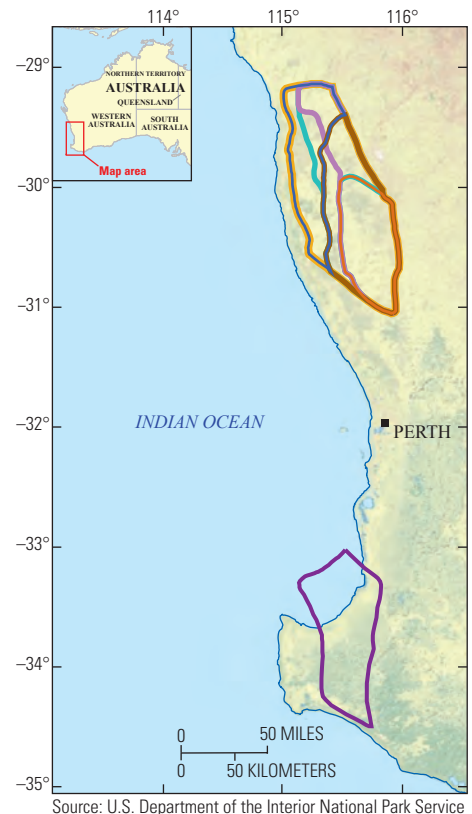


Figure 1. Location of the Perth Basin Province and the seven assessment units (AUs) defined in this study.

resources of 788 BCFG, or 5 percent of the mean total, are estimated to be in the Jurassic Cattamarra Coalbed Gas AU and the Jurassic Cattamarra Coal Oil AU (as associated gas). Values of zero at F95 reflect the chance that continuous gas might not be present in the AU, and the geologic AU probability was estimated to be less than one.

Table 1. Key assessment input data for seven continuous assessment units in the Perth Basin Province, Australia.

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

Assessment input data	Permian Carynginia-Irwin River Tight Gas AU				Triassic Kockatea Shale Oil AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	800	1,424,000	2,848,000	1,424,267	800	537,000	1,074,000	537,267
Average drainage area of wells (acres)	40	80	120	80	80	160	240	160
Success ratios (%)	10	50	90	50	10	50	90	50
Average EUR (BCFG, gas; MMBO, oil)	0.4	0.6	1.0	0.619	0.04	0.08	0.2	0.086
AU probability	1.0				1.0			
Assessment input data	Triassic Kockatea Shale Gas AU				Triassic–Jurassic Tight Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,200	887,000	1,774,000	887,400	800	839,000	1,678,000	839,267
Average drainage area of wells (acres)	80	120	160	120	40	80	120	80
Success ratios (%)	10	50	90	50	10	50	90	50
Average EUR (BCFG, gas)	0.2	0.4	1.0	0.431	0.4	0.6	1.0	0.619
AU probability	1.0				1.0			
Assessment input data	Jurassic Cattamarra Coal Oil AU				Jurassic Cattamarra Coalbed Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	800	553,000	1,107,000	553,600	800	548,500	1,097,000	548,767
Average drainage area of wells (acres)	80	160	240	160	40	80	160	93.3
Success ratios (%)	10	50	90	50	10	50	90	50
Average EUR (MMBO, oil; BCFG, gas)	0.04	0.08	0.2	0.086	0.03	0.2	1.0	0.244
AU probability	0.5				1.0			
Assessment input data	Permian Bunbury Sue Group Tight Gas AU							
	Minimum	Mode	Maximum	Calculated mean				
Potential production area of AU (acres)	800	725,500	1,505,000	752,767				
Average drainage area of wells (acres)	40	80	120	80				
Success ratios (%)	10	50	90	50				
Average EUR (BCFG, gas)	0.4	0.6	1.0	0.619				
AU probability	1.0							

Table 2. Assessment results for seven continuous assessment units in the Perth Basin Province, Australia.

[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 petroleum systems 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
Permian Composite Total Petroleum System														
Permian Carynginia-Irwin River Tight Gas AU	1.0	Gas					1,329	5,109	11,917	5,660	4	16	44	19
Triassic Kockatea Total Petroleum System														
Triassic Kockatea Shale Oil AU	1.0	Oil	33	130	321	147	31	127	335	147	0	1	3	1
Triassic Kockatea Shale Gas AU	1.0	Gas					367	1,408	3,465	1,594	1	4	13	5
Triassic–Jurassic Composite Total Petroleum System														
Triassic–Jurassic Tight Gas AU	1.0	Gas					789	3,021	7,026	3,341	2	9	26	11
Jurassic Cattamarra Coal Total Petroleum System														
Jurassic Cattamarra Coal Oil AU	0.5	Oil	0	0	276	76	0	0	282	75	0	0	1	0
Jurassic Cattamarra Coalbed Gas AU	1.0	Gas					123	550	1,864	713	0	2	9	3
Permian Bunbury Sue Group Coal Total Petroleum System														
Permian Bunbury Sue Group Tight Gas AU	1.0	Gas					712	2,712	6,318	3,002	2	9	23	10
Total undiscovered continuous resources			33	130	597	223	3,351	12,927	31,207	14,532	9	41	119	49

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For More Information

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

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