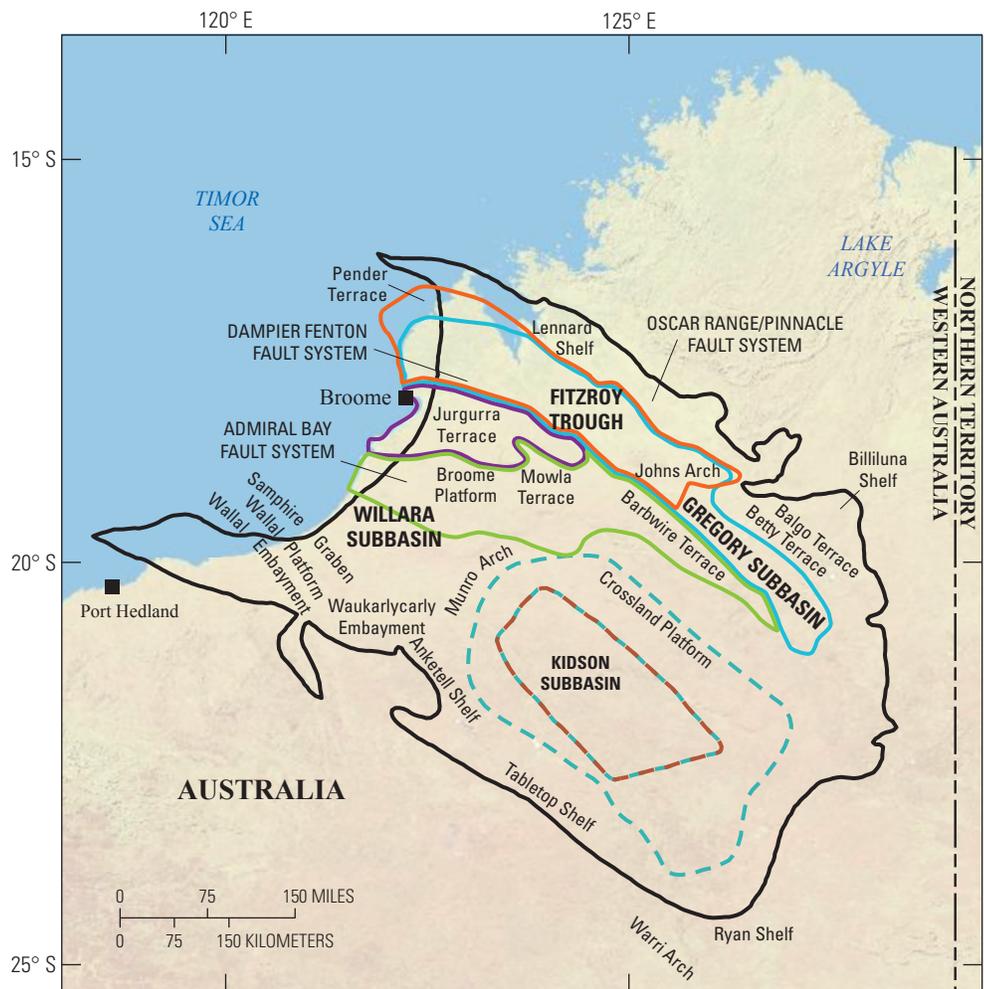


Assessment of Undiscovered Oil and Gas Resources in the Canning Basin Province, Australia, 2017

Using a geology-based assessment methodology, the U.S. Geological Survey estimated mean undiscovered, technically recoverable resources of 1.3 billion barrels of oil and 34.4 trillion cubic feet of gas in the Canning Basin Province of Australia.

Introduction

The U.S. Geological Survey (USGS) completed an assessment of undiscovered, technically recoverable continuous (unconventional) and conventional oil and gas resources in the Canning Basin Province, Australia (figs. 1 and 2). The Canning Basin is a mosaic of horsts and grabens initially formed by extension in the Early Ordovician to Silurian, the bounding faults of which have been reactivated through the Paleozoic and Mesozoic by alternating episodes of compressional and extensional deformation (Zhan and Mory, 2013). Initial extension and subsidence in the Ordovician to Silurian resulted in deposition of the Goldwyer Formation marine source rock, which is the most viable petroleum source rock in the province (Ghori, 2013; Triche and Bahar, 2013; Omotoye, 2014). Extension and subsidence in the Late Devonian and early Carboniferous led to the deposition of Laurel Formation marine source rock. Episodes of compressive deformation occurred in the late Silurian to Early Devonian, in the middle Carboniferous, and in the Triassic. As thermal maturation of petroleum source rocks in the Canning Basin is interpreted to have occurred prior to Triassic uplift and erosion, the Triassic event might have breached many structural traps, potentially leading to loss of oil and gas from conventional traps (Zhan and Mory, 2013) and self-sourced reservoirs such as shales. The potential loss of oil and gas resources resulting from the Triassic event is the major source of geologic uncertainty in this assessment of conventional and continuous resources.



Base map from U.S. Department of the Interior National Park Service

EXPLANATION

- Fitzroy Trough Carboniferous–Permian Tight Gas AU
- Fitzroy Trough Goldwyer Shale Gas AU
- Broome Platform–Jurgurra Terrace Goldwyer Shale Oil AU
- Broome Platform–Barbwire Terrace Goldwyer Shale Gas AU
- Kidson Subbasin Goldwyer Shale Oil AU
- Kidson Subbasin Goldwyer Shale Gas AU
- Canning Basin Province boundary



Figure 1. Location of the Canning Basin Province and six continuous assessment units (AUs) in Australia. Basin and shelf areas are from Ghori (2013); province boundary is from Klett and others (1997).

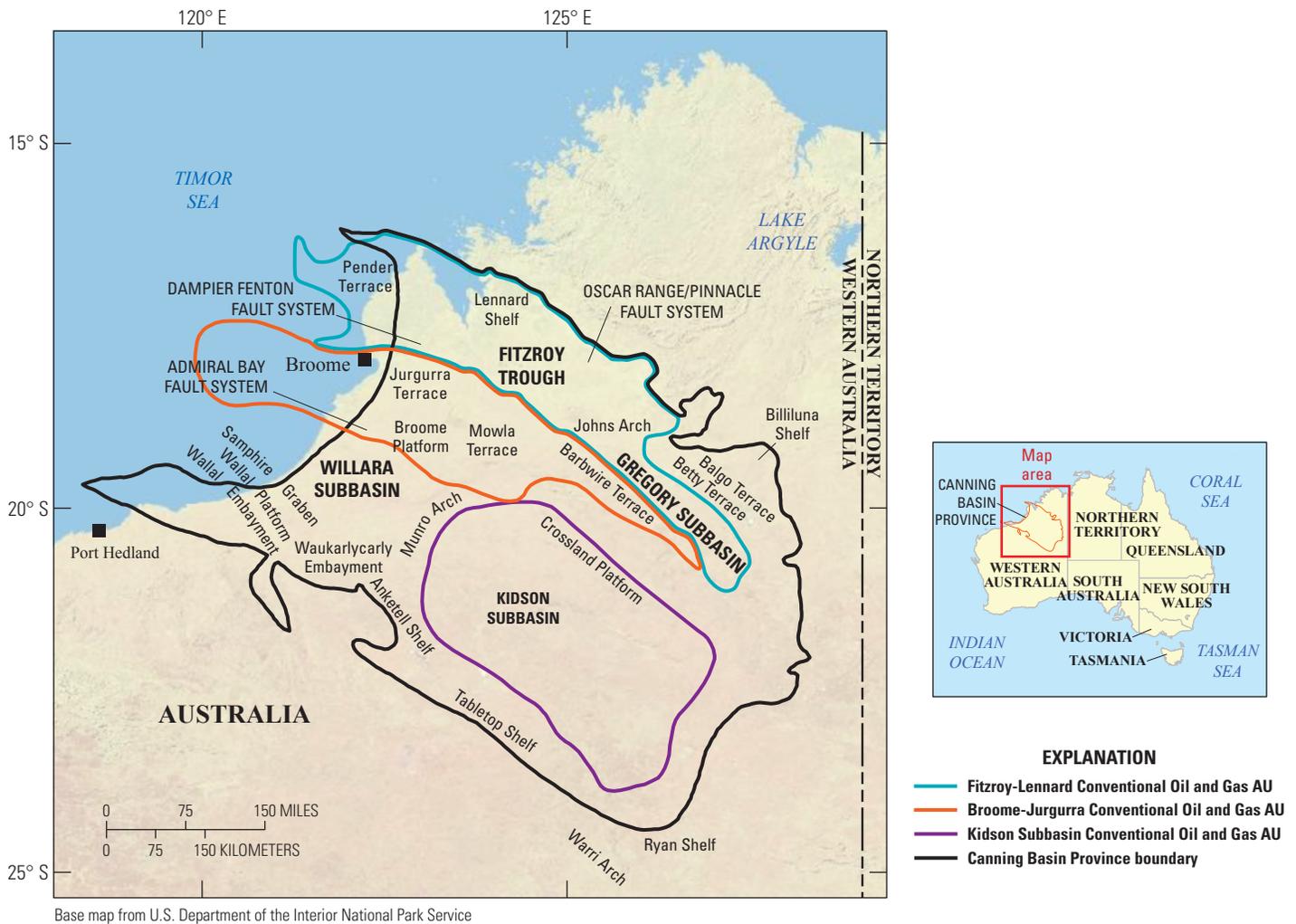


Figure 2. Location of the Canning Basin Province and three conventional assessment units (AUs) in Australia. Basin and shelf areas are from Ghori (2013); province boundary is from Klett and others (1997).

Total Petroleum Systems and Assessment Units

In the Canning Basin Province, the Carboniferous–Permian Total Petroleum System (TPS) in the Fitzroy Trough is defined by gas sourced mainly from marine shales of the Carboniferous Laurel Formation (Kingsley and Streitberg, 2013). The geologic model for the Fitzroy Trough Carboniferous–Permian Tight Gas Assessment Unit (AU) is for gas, generated from organic matter in Laurel Formation shales (and possibly from the Goldwyer Formation), to have migrated locally and been trapped within low-permeability, nonmarine to shallow marine sandstones and siltstones of the Laurel Formation, Yellow Drum Sandstone, Anderson Formation, and Reeves Formation.

The Goldwyer TPS was defined to encompass oil or gas retained within potential Goldwyer Formation self-sourced reservoirs in the Fitzroy Trough Goldwyer Shale Gas AU (includes the Gregory Subbasin), the Broome Platform–Jurgurra Terrace Goldwyer Shale Oil AU, the Broome

Platform–Barbwire Terrace Goldwyer Shale Gas AU (includes the Willara Subbasin), the Kidson Subbasin Goldwyer Shale Oil AU, and the Kidson Subbasin Goldwyer Shale Gas AU. The geologic model for potential shale-oil and shale-gas resources in the Goldwyer TPS is for some portion of the oil or gas to have been retained within Goldwyer shales following Triassic compression, uplift, and erosion.

The Paleozoic Composite TPS was defined to account for oil and gas from multiple sources that are potentially trapped in conventional fields (Feiner and others, 2017), which retained hydrocarbons following compressive deformation in the Triassic, in the Fitzroy-Lennard Conventional Oil and Gas AU, the Broome-Jurgurra Conventional Oil and Gas AU, and the Kidson Subbasin Conventional Oil and Gas AU.

Assessment input data for nine assessment units are shown in table 1. For continuous assessment units, well drainage areas, success ratios, and estimated ultimate recoveries are guided by geologic analogs from the United States.

Table 1. Key input data for six continuous and three conventional assessment units in the Canning Basin Province, Australia.

[AU, assessment unit; %, percent; EUR, estimated ultimate recovery per well; BCFG, billion cubic feet of gas; MMBO, million barrels of oil. 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	Fitzroy Trough Carboniferous–Permian Tight Gas AU				Fitzroy Trough Goldwyer Shale Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	1,100	2,817,000	11,786,000	4,868,033	500	2,500,000	13,797,000	5,432,500
Average drainage area of wells (acres)	40	110	180	110	100	160	220	160
Success ratio (%)	10	50	90	50	10	50	90	50
Average EUR (BCFG)	0.25	0.6	1.5	0.645	0.1	0.4	1.3	0.447
AU probability	1.0				1.0			
Assessment input data— Continuous AUs	Broome Platform–Jurgurra Terrace Goldwyer Shale Oil AU				Broome Platform–Barbwire Terrace Goldwyer Shale Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	500	2,158,500	4,317,000	2,158,667	500	5,610,000	11,222,000	5,610,833
Average drainage area of wells (acres)	100	160	220	160	100	160	220	160
Success ratio (%)	10	50	90	50	10	50	90	50
Average EUR (MMBO, oil; BCFG, gas)	0.01	0.04	0.2	0.049	0.1	0.3	1.2	0.350
AU probability	0.9				0.9			
Assessment input data— Continuous AUs	Kidson Subbasin Goldwyer Shale Oil AU				Kidson Subbasin Goldwyer Shale Gas AU			
	Minimum	Mode	Maximum	Calculated mean	Minimum	Mode	Maximum	Calculated mean
Potential production area of AU (acres)	500	8,281,500	16,563,000	8,281,667	500	4,469,000	9,298,000	4,589,167
Average drainage area of wells (acres)	100	160	220	160	100	160	220	160
Success ratio (%)	10	50	90	50	10	50	90	50
Average EUR (MMBO, oil; BCFG, gas)	0.01	0.04	0.2	0.049	0.1	0.3	1.2	0.350
AU probability	0.5				0.5			
Assessment input data— Conventional AUs	Fitzroy–Lennard Conventional Oil and Gas AU				Broome–Jurgurra Conventional Oil and Gas AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	3	18	3.5	1	8	50	9.5
Number of gas fields	1	10	60	11.8	1	8	50	9.5
Size of oil fields (MMBO)	5	10	1,000	24.9	5	10	500	19.3
Size of gas fields (BCFG)	30	60	6,000	149.3	30	60	3,000	115.8
AU probability	0.5				0.5			
Assessment input data— Conventional AU	Kidson Subbasin Conventional Oil and Gas AU							
	Minimum	Median	Maximum	Calculated mean				
Number of oil fields	1	15	90	17.7				
Number of gas fields	1	15	90	17.7				
Size of oil fields (MMBO)	5	10	1,000	24.9				
Size of gas fields (BCFG)	30	60	6,000	149.3				
AU probability	0.5							

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered continuous and conventional oil and gas resources within the Canning Basin Province, Australia (table 2). For undiscovered resources, the estimated mean totals are 1,275 million barrels of oil (MMBO), or 1.3 billion barrels of oil, with an F95–F5 range from 0 to 4,819 MMBO; 34,449 billion cubic feet of gas (BCFG), or

34.4 trillion cubic feet of gas, with an F95–F5 range from 3,903 to 96,210 BCFG; and 796 million barrels of natural gas liquids (MMBNGL) with an F95–F5 range from 88 to 2,257 MMBNGL. Of the total mean oil resources of 1,275 MMBO, about 72 percent, or 919 MMBO, is continuous oil, and of the mean total gas resources of 34,449 BCFG, about 91 percent, or 31,270 BCFG, is continuous gas. For continuous gas resources, about 47 percent, or 14,741 BCFG, is potential tight-gas resources.

Table 2. Results for six continuous and three conventional assessment units in the Canning 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
Carboniferous–Permian Total Petroleum System														
Fitzroy Trough Carboniferous–Permian Tight Gas AU	1.0	Gas					2,712	12,072	35,885	14,741	61	282	887	353
Goldwyer Total Petroleum System														
Fitzroy Trough Goldwyer Shale Gas AU	1.0	Gas					1,191	5,774	19,444	7,491	27	135	482	179
Broome Platform–Jurgurra Terrace Goldwyer Shale Oil AU	0.9	Oil	0	225	812	291	0	262	999	350	0	1	5	2
Broome Platform–Barbwire Terrace Goldwyer Shale Gas AU	0.9	Gas					0	4,489	14,262	5,465	0	105	352	131
Kidson Subbasin Goldwyer Shale Oil AU	0.5	Oil	0	57	2,541	628	0	68	3,064	753	0	0	16	4
Kidson Subbasin Goldwyer Shale Gas AU	0.5	Gas					0	231	9,468	2,470	0	5	232	59
Total undiscovered continuous resources			0	282	3,353	919	3,903	22,896	83,122	31,270	88	528	1,974	728
Paleozoic Composite Total Petroleum System														
Fitzroy–Lennard Conventional Oil and Gas AU	0.5	Oil	0	8	197	45	0	9	238	54	0	0	1	0
		Gas					0	172	3,713	884	0	0	90	21
Broome–Jurgurra Conventional Oil and Gas AU	0.5	Oil	0	0	371	91	0	0	447	109	0	0	2	1
		Gas					0	0	2,215	543	0	0	53	13
Kidson Subbasin Conventional Oil and Gas AU	0.5	Oil	0	37	898	220	0	41	1,087	264	0	0	6	1
		Gas					0	228	5,388	1,325	0	5	131	32
Total undiscovered conventional resources			0	45	1,466	356	0	450	13,088	3,179	0	5	283	68
Total undiscovered resources			0	327	4,819	1,275	3,903	23,346	96,210	34,449	88	533	2,257	796

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For More Information

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