

Assessment of Undiscovered Conventional Oil and Gas Resources of New Guinea, Papua Barat, Seram, and Timor-Leste, 2020

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered resource means of 1.8 billion barrels of oil and 129.5 trillion cubic feet of gas within New Guinea, Papua Barat, Seram, and Timor-Leste.

Introduction

The U.S. Geological Survey (USGS) quantitatively assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in eight assessment units (AUs) within New Guinea (comprised of both Papua and Papua New Guinea), Papua Barat, Seram, and Timor-Leste (fig. 1). Papua, Papua Barat, and Seram are part of Indonesia. The tectonic evolution of this region, described as one of the most complex in the world, includes relative movement of the Australia, Pacific, and Philippine plates; several phases of subduction with closure of ocean basins, arc-continent and microcontinent collision and accretion, and regional extension due to trench roll-back (Baldwin and others, 2012; Hall, 2012, 2014; Hall and others, 2017).

The focus of this assessment is the development of petroleum systems along the northern and northeastern passive margin of the Australian plate. From 90 to 45 million years ago (Ma), the Australian plate remained connected to Antarctica in their Gondwana configuration, and an extensive passive margin formed along the northern part of Gondwana. The Australian plate separated and began to move northeast from Antarctica about 45 Ma and in the latest Miocene and Pliocene began to collide with the Sepik, Weyland, and Melanesian arc terranes and microcontinents in the northeast and with the southern margin (present coordinates) of the Banda arc (Hall and others, 2009). Contractional deformation since the latest Miocene and Pliocene formed the Papua New Guinea Thrust Belt, the Papua-Lengguru Thrust Belt, and the adjacent foreland basins of the Papua Platform, Arafura Platform, and Bintuni Basin (Dolan and Hermany, 1988; Webb and Woyengu, 1999; Baillie and others, 2019; Gunarto and others, 2019). The Salawati Basin may have formed during transtensional deformation along regional wrench faults (Katili, 1991). Collision of the Australian margin with the Banda arc formed thrust belts and foreland basins on Timor-Leste and Seram (Charlton, 2004), though the Seram area's deformation history also includes regional extension during trench roll back (Pairault and others, 2003; Hall and others, 2009; Audley-Charles, 2011; Hall, 2012; Pownall and others, 2013; Hall and others, 2017). Several organic-rich source rocks were deposited during the Mesozoic along the northern passive margin of the Australian plate and these rocks were subsequently buried within stacked thrust sheets, resulting in thermal conditions necessary for the generation of oil and gas (Sapiie and others, 2012).

Total Petroleum System and Assessment Units

The USGS defined a Mesozoic–Cenozoic Composite Total Petroleum System (TPS) encompassing oil and gas that may have been generated from Triassic, Jurassic, and Cretaceous passive-margin source rocks and from Neogene foreland-basin source rocks for which orogenic burial was sufficient to thermally generate oil or gas. Triassic and Jurassic organic-rich shales are commonly cited as the most viable source rocks throughout the assessment area based largely

on oil geochemistry (Katili, 1991; Kemp and Mogg, 1992; Kaufman and others, 1997; Webb and Woyengu, 1999; Barber and others, 2003; Doust and Noble, 2008; Argakoesoemah and Hughes, 2017; Gunarto and others, 2019; Lie and others, 2018; Noku, 2020). The presence, quality, and thermal maturation of potential Cretaceous and Neogene source rocks are based on what little data exists at present, but these source rocks may be important locally (Kaufman and others, 1997; Webb and Woyengu, 1999; Barber and others, 2003; George and others, 2004; Aldha and Ho, 2008; Sapiie and others, 2012).

Within the Mesozoic–Cenozoic Composite TPS, the USGS defined the Papua New Guinea Thrust Belt Assessment Unit (AU); Papua Platform AU; Papua-Lengguru Thrust Belt AU; Arafura Platform AU; Bintuni Basin AU; Salawati Basin AU; Seram Thrust Structures AU; and the Timor Thrust Structures AU (fig. 1). The synoptic geologic model for these eight AUs is for oil and gas to have been generated from passive-margin, organic-rich marine source rocks, possibly as early as Late Cretaceous, with peak generation during late Miocene–Pliocene burial within the thrust belts and foreland basins. Oil and gas

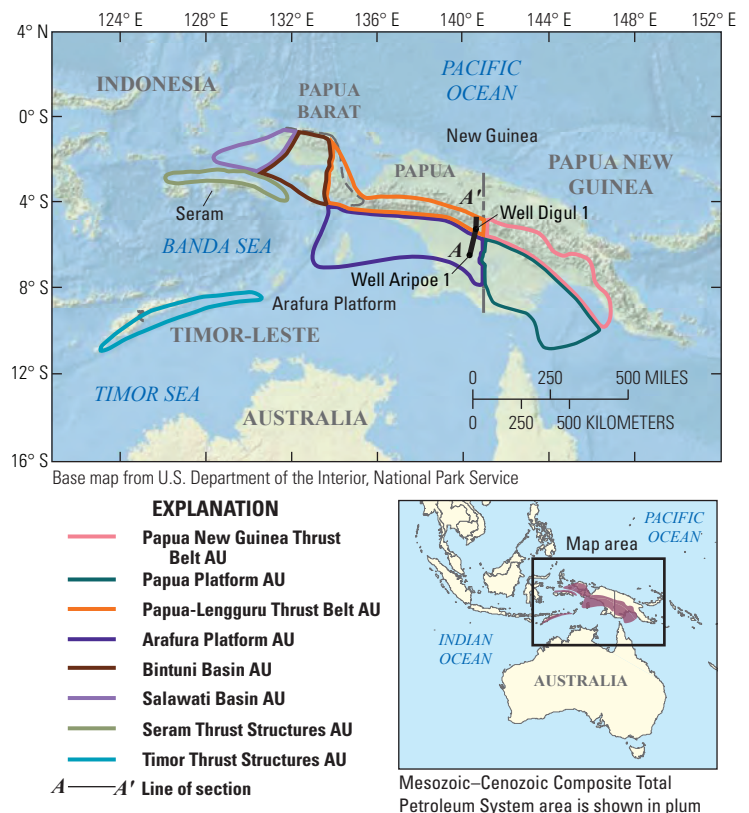


Figure 1. Map showing the location of eight conventional assessment units (AUs) in New Guinea, Papua Barat, Seram, and Timor-Leste.

migrated into structural traps within the Papua New Guinea Thrust Belt AU, Papua-Lengguru Thrust Belt AU, Seram Thrust Structures AU, and Timor Thrust Structures AU, or migrated into structural and stratigraphic traps within foreland basins of the Papua Platform AU, Arafura Platform AU, and the Bintuni Basin AU (figs. 1 and 2). Reservoirs consist of Jurassic to Cretaceous marine sandstones, Paleogene and Neogene carbonate platform-margin strata, and shallow- to deep-water

marine sandstones. Oil or gas generated prior to Neogene thrust loading and burial may be lost or remigrated due to contractional or extensional deformation (Lie and others, 2018; Gunarto and others, 2019). The presence of numerous oil and gas seeps attest to remigration or loss of oil and gas in this tectonically complex region (Price and others, 1987; Russell, 1990; Kaufman and others, 1997; Barber and others, 2003). Assessment input is summarized in table 1 and in Schenk (2022).

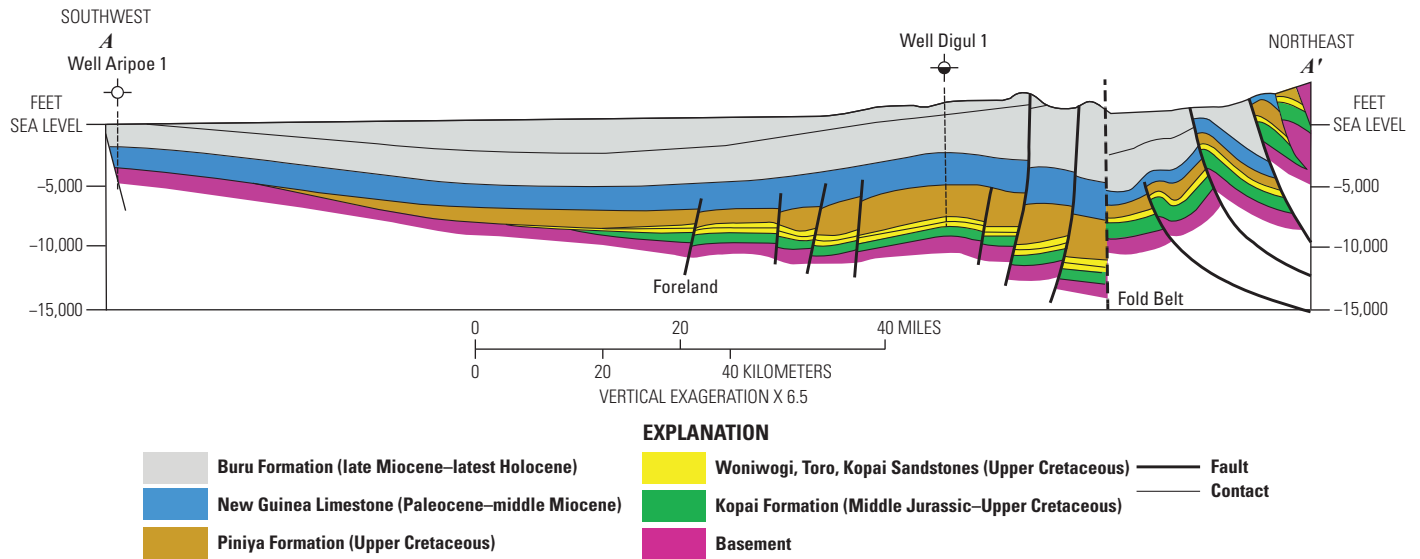


Figure 2. Generalized cross section illustrating a thrust belt and the adjacent foreland. Line of cross section shown on figure 1. Dashed black line is boundary between the thrust belt and foreland AUs. Modified from Argakoesoemah (2018).

Table 1. Key assessment input data for eight conventional AUs in New Guinea, Papua Barat, Seram, and Timor-Leste.

[Shading indicates not applicable. AU, assessment unit; MMBO, million barrels of oil; BCFG, billion cubic feet of gas]

Assessment input data— Conventional AUs	Mesozoic–Cenozoic Composite Total Petroleum System							
	Papua New Guinea Thrust Belt AU				Papua Platform AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	40	80	41.0	1	20	40	20.5
Number of gas fields	1	140	280	143.4	1	90	180	92.2
Size of oil fields (MMBO)	5	10	100	12.8	5	10	80	12.2
Size of gas fields (BCFG)	30	60	24,000	286.4	30	60	6,000	149.3
AU probability	1.0				1.0			
Assessment input data— Conventional AUs	Papua-Lengguru Thrust Belt AU				Arafura Platform AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
	Number of oil fields	1	10	30	10.6	1	20	60
Number of gas fields	1	50	150	53.2	1	90	270	95.7
Size of oil fields (MMBO)	5	8	200	12.2	5	10	200	14.8
Size of gas fields (BCFG)	30	48	4,000	105.4	30	60	4,000	127.9
AU probability	0.8				1.0			
Assessment input data— Conventional AUs	Bintuni Basin AU				Salawati Basin AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
	Number of oil fields	1	3	9	3.2	1	10	20
Number of gas fields	1	90	270	95.7	1	40	120	42.5
Size of oil fields (MMBO)	5	8	20	8.4	5	8	20	8.4
Size of gas fields (BCFG)	30	60	20,000	260.1	30	60	200	65.0
AU probability	1.0				1.0			
Assessment input data— Conventional AUs	Seram Thrust Structures AU				Timor Thrust Structures AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
	Number of oil fields	1	10	30	10.6	1	20	60
Number of gas fields	1	60	180	63.8	1	80	240	85.0
Size of oil fields (MMBO)	5	8	500	15.9	5	8	500	15.9
Size of gas fields (BCFG)	30	60	10,000	185.7	30	60	10,000	185.7
AU probability	1.0				1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered conventional oil, gas, and natural gas liquid (NGL) resources within New Guinea, Papua Barat, Seram, and Timor-Leste (table 2). The fully risked total means are: 1,815 million barrels of oil (MMBO) or 1.8 billion barrels

of oil, with an F95–F5 fractile range from 896 to 3,171 MMBO; 129,451 billion cubic feet of gas (BCFG), or 129.5 trillion cubic feet, with an F95–F5 range from 56,323 to 233,434 BCFG; and 1,841 million barrels of natural gas liquids (MMBNGL), or 1.8 billion barrels of natural gas liquids, with an F95–F5 range from 845 to 3,232 MMBNGL.

Table 2. Results for eight conventional AUs in New Guinea, Papua Barat, Seram, and Timor-Leste.

[Results shown are fully risked estimates. Shading indicates not applicable. F95 represents a 95-percent chance of at least the amount tabulated; other fractiles are defined similarly. MMBO, million barrels of oil; BCFG, billion cubic feet of gas; NGL, natural gas liquids; MMBNGL, million barrels of natural gas liquids]

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
Mesozoic-Cenozoic Composite Total Petroleum System														
Papua New Guinea Thrust Belt AU	1.0	Oil	336	509	762	524	401	611	918	629	8	12	18	13
		Gas					20,291	38,869	69,914	41,152	426	816	1,471	864
Papua Platform AU	1.0	Oil	158	245	369	252	189	294	444	302	3	4	7	4
		Gas					7,607	13,209	21,810	13,755	129	225	371	234
Papua-Lengguru Thrust Belt AU	0.8	Oil	0	99	241	103	0	119	289	124	0	2	4	2
		Gas					0	4,402	9,971	4,456	0	70	160	71
Arafura Platform AU	1.0	Oil	143	292	564	315	171	351	677	378	3	5	10	6
		Gas					5,675	11,409	21,496	12,213	96	194	365	208
Bintuni Basin AU	1.0	Oil	15	25	45	27	7	13	23	13	0	0	0	0
		Gas					9,225	22,523	48,721	24,912	23	56	123	62
Salawati Basin AU	1.0	Oil	58	84	123	86	34	50	75	52	1	1	2	1
		Gas					1,446	2,592	4,689	2,765	36	65	117	69
Seram Thrust Structures AU	1.0	Oil	57	141	385	170	114	281	770	340	3	9	23	10
		Gas					4,526	10,792	22,761	11,856	45	108	228	119
Timor Thrust Structures AU	1.0	Oil	129	299	682	338	258	598	1,364	677	8	18	41	20
		Gas					6,379	14,572	29,512	15,827	64	146	292	158
Total undiscovered conventional resources			896	1,694	3,171	1,815	56,323	120,685	233,434	129,451	845	1,731	3,232	1,841

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For More Information

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

Eastern Asia Assessment Team

Christopher J. Schenk, Tracey J. Mercier, Marilyn E. Tennyson, Geoffrey S. Ellis, Cheryl A. Woodall, Phuong A. Le, Heidi M. Leathers-Miller, and Ronald M. Drake II