

World Petroleum Resources Project

Assessment of Undiscovered Conventional Oil and Gas Resources of the Arabian Peninsula and Zagros Fold Belt, 2012

Using a geology-based assessment methodology, the U.S. Geological Survey estimated means of 86 billion barrels of oil and 336 trillion cubic feet of undiscovered natural gas resources in the Arabian Peninsula and Zagros Fold Belt.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered conventional oil and gas accumulations within the Arabian Peninsula and Zagros Fold Belt as part of the USGS World Petroleum Resources Project. Twenty-three assessment units within seven petroleum systems were quantitatively assessed in this study, which represents a reassessment of this area last published in 2000 (U.S. Geological Survey World Energy Assessment Team, 2000) (fig. 1).

The methodology for the assessment included geologic definitions of total petroleum systems (TPS) and assessment units (AU) within these systems. Exploration and discovery history was a critical part of the methodology used to estimate sizes and numbers of undiscovered conventional accumulations. Each AU was assessed for undiscovered oil and non-associated gas accumulations, and coproduct ratios were used to calculate the volumes of associated gas (gas in oil fields) and volumes of natural gas liquids.

Total Petroleum Systems

The seven TPSs and the main geologic elements used to define them are as follows: (1) Huqf–Paleozoic TPS—petroleum generated from Precambrian–Cambrian shales of the Huqf Supergroup in three Oman basins; (2) Paleozoic Composite TPS—petroleum generated from Silurian (and possibly Ordovician) marine source rocks over much of the Arabian Peninsula; (3) Paleozoic–Mesozoic Composite TPS includes the Euphrates Graben of Syria in which petroleum from Triassic source rock is present in addition to that from Paleozoic source rocks;

(4) Mesozoic Composite TPS—petroleum generated from synrift Triassic and other Mesozoic source rocks in the Palmyra and Sinjar areas; (5) Madbi–Amran–Qishn TPS of Yemen—petroleum generated from Upper Jurassic marine source rocks; (6) Middle Cretaceous Natih TPS—petroleum from the Natih Formation trapped in the Fahud Salt Basin of Oman; and (7) Mesozoic–Cenozoic Composite TPS—petroleum generated from Middle and Upper Jurassic and Lower and Upper Cretaceous source marine rocks over a wide area of the eastern Arabian Peninsula and Zagros. The 23 AUs that were defined geologically and assessed within these TPS are listed in table 1.

Resource Summary

The USGS assessed undiscovered conventional oil and gas resources in 23 AUs within seven petroleum systems, with the following estimated mean totals: (1) for conventional oil resources, 85,856 million barrels of oil (MMBO), with a range from 34,006 to 161,651 MMBO; (2) for undiscovered conventional gas, 336,194 billion cubic feet of gas (BCFG), with a range from 131,488 to 657,939 BCFG; and (3) for natural gas liquids (NGL), 11,972 MMBNGL, with a range from 4,513 to 24,788 MMBNGL (table 1).

Of the mean undiscovered conventional oil resource of 85,856 MMBO, about 92 percent (78,747 MMBO) is estimated to be in six AUs within the Mesozoic–Cenozoic Composite Total Petroleum System (fig. 1B); most of this oil is estimated to be in the Zagros Fold Belt Structures AU (mean of 38,464 MMBO), the Mesopotamian Basin Anticlines AU (mean of 26,856 MMBO), the Arabian Platform



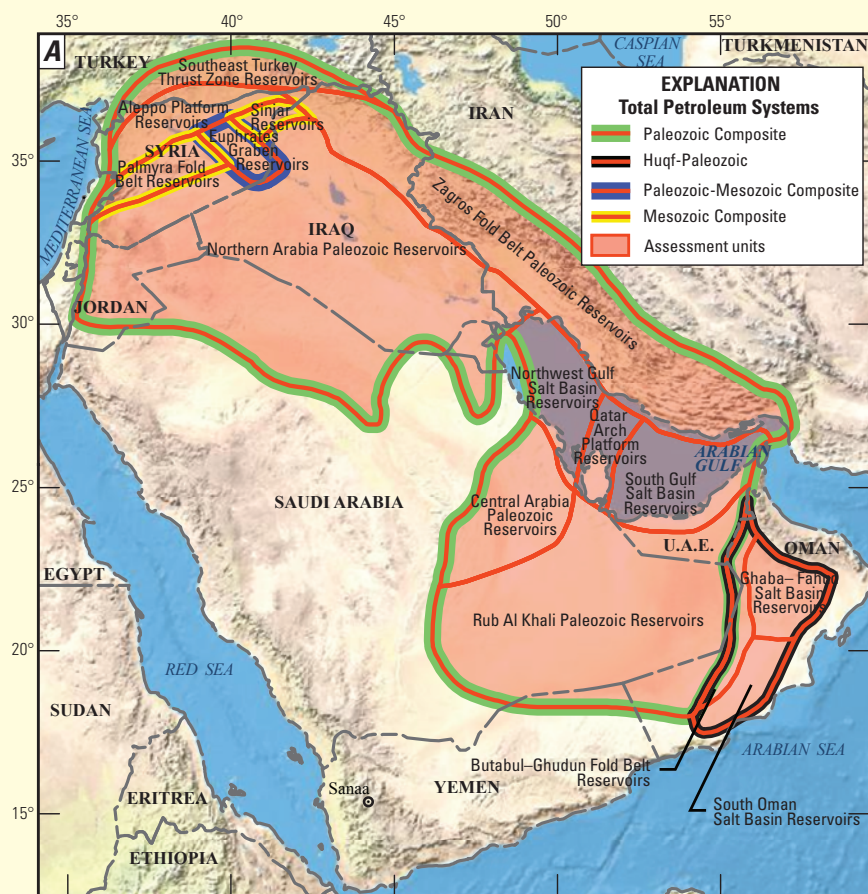


Figure 1. A. Locations of Huqf-Paleozoic Total Petroleum System (TPS), Paleozoic Composite TPS, Paleozoic-Mesozoic Composite TPS, and Mesozoic Composite TPS and associated assessment units (AU) of the Arabian Peninsula and Zagros Fold Belt. B. Locations of the Madbi-Amran-Qishn TPS, Middle Cretaceous Natih TPS, and Mesozoic-Cenozoic Composite TPS and associated AUs of the Arabian Peninsula and Zagros Fold Belt.

Table 1. Assessment results for undiscovered conventional oil and gas resources of the Arabian Peninsula and Zagros Fold Belt.

[Largest expected mean field size in million barrels of oil and billion cubic feet of gas. MMBO, million barrels of oil; BCFG, billion cubic feet of gas; MMBNGL, million barrels of natural gas liquids. Results shown are fully risked estimates. For gas accumulations, all liquids are included as NGL (natural gas liquids). Undiscovered gas resources are the sum of nonassociated (gas in gas fields) and associated gas (gas in oil fields). 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. AU, assessment unit; AU probability is the chance of at least one accumulation of minimum size within the AU. NGL, natural gas liquids. TPS, total petroleum system. Gray shading indicates not applicable]

Total petroleum systems (TPS) and assessment units (AU)	AU probability	Field type	Expected largest field size	Total undiscovered resources											
				Oil (MMBO)				Gas (BCFG)				NGL (MMBNGL)			
				F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
Huqf-Paleozoic TPS (in 2 provinces)															
South Oman Salt Basin Reservoirs AU	1.0	Oil	54	212	360	578	373	159	280	475	294	20	34	59	36
		Gas	200					48	195	996	315	1	6	31	10
Ghaba-Fahud Salt Basin Reservoirs AU	1.0	Oil	16	156	233	344	240	84	129	193	132	3	5	9	6
		Gas	760					2,711	4,743	7,788	4,927	117	213	383	227
Butabul-Ghudun Fold Belt Reservoirs AU	1.0	Oil	11	124	185	271	189	520	790	1,172	810	6	9	14	9
		Gas	220					119	348	1,191	458	4	11	37	14
Paleozoic Composite TPS (in 6 provinces)															
Rub al Khali Paleozoic Reservoirs AU	1.0	Oil	144	104	293	826	355	133	380	1,081	464	7	20	58	24
		Gas	2,443					9,445	19,030	35,836	20,361	592	1,213	2,301	1,300
South Gulf Salt Basin Reservoirs AU	1.0	Oil	145	105	297	830	359	327	962	2,828	1,189	13	40	123	51
		Gas	2,295					7,828	16,050	30,390	17,171	319	659	1,248	705
Central Arabia Paleozoic Reservoirs AU	1.0	Oil	189	225	528	1,218	599	290	686	1,610	783	15	36	86	41
		Gas	988					1,309	2,976	6,599	3,336	81	188	432	213
Northwest Gulf Salt Basin Reservoirs AU	1.0	Oil	145	105	297	830	359	326	965	2,825	1,191	13	40	123	51
		Gas	1,904					4,525	9,971	19,626	10,733	184	408	809	441
Qatar Arch Paleozoic Reservoirs AU	1.0	Oil		0	0	0	0	0	0	0	0	0	0	0	0
		Gas	427					47	232	1,963	536	1	7	62	17
Northern Arabia Paleozoic Reservoirs AU	1.0	Oil	252	413	975	2,064	1,072	533	1,268	2,720	1,400	28	66	146	74
		Gas	2,669					12,239	24,165	44,995	25,769	774	1,541	2,893	1,645
Zagros Fold Belt Reservoirs AU	1.0	Oil	102	469	909	1,672	968	1,105	2,245	4,265	2,408	16	33	63	35
		Gas	19,766					40,736	95,892	194,610	103,772	686	1,626	3,382	1,776
Southeast Turkey Thrust Zone Reservoirs AU	1.0	Oil	17	289	427	624	438	16	24	36	25	1	2	3	2
		Gas	38					72	125	236	135	4	6	13	7
Paleozoic-Mesozoic Composite TPS (in 1 province)															
Euphrates Graben Reservoirs AU	1.0	Oil	22	96	157	246	162	79	131	208	135	8	13	21	14
		Gas	54					113	199	345	210	5	9	16	10
Mesozoic Composite TPS (in 3 provinces)															
Sinjar Reservoirs AU	1.0	Oil	16	83	131	201	135	300	485	756	501	15	25	39	26
		Gas	48					257	374	531	381	6	10	14	10
Aleppo Platform Reservoirs AU	1.0	Oil	10	102	153	226	157	221	338	504	347	5	7	11	8
		Gas						0	0	0	0	0	0	0	0
Palmyra Fold Belt Reservoirs AU	1.0	Oil	29	222	342	511	351	12	19	30	20	1	1	2	1
		Gas	387					1,674	2,804	4,464	2,903	87	147	236	152
Madbi-Amran-Qishn TPS (in 1 province)															
Ma ‘Rib-Al Jawf/Shabwah/ Masila Grabens AU	1.0	Oil	121	595	1,049	1,773	1,098	95	246	644	293	3	7	18	8
		Gas	282					1,052	1,858	3,168	1,949	25	46	80	48
Middle Cretaceous Natih TPS (in 1 province)															
Natih-Wasia Structural/ Stratigraphic AU	1.0	Oil	10	132	239	429	254	180	348	638	370	3	7	13	7
		Gas						0	0	0	0	0	0	0	0
Mesozoic-Cenozoic Composite TPS (in 5 provinces)															
South Gulf Suprasalt Structures and Desert Anticlines AU	1.0	Oil	116	553	986	1,682	1,034	634	1,241	2,324	1,328	20	41	82	45
		Gas	878					1,953	4,570	9,863	5,063	126	302	662	336
South Gulf Basin and Oman Foreland Structures AU	1.0	Oil	46	262	446	744	467	181	359	708	391	12	24	48	26
		Gas	245					1,536	2,589	4,284	2,709	94	161	268	168
Horst Block and Suprasalt Structural Oil AU	1.0	Oil	643	2,529	4,985	9,163	5,300	1,792	3,580	6,662	3,820	48	97	183	104
		Gas						0	0	0	0	0	0	0	0
Arabian Platform Structures AU	1.0	Oil	524	3,228	6,220	11,430	6,626	1,630	3,141	5,774	3,347	55	107	199	115
		Gas						0	0	0	0	0	0	0	0
Mesopotamian Basin Anticlines AU	1.0	Oil	5,715	9,985	24,737	51,257	26,856	8,359	22,679	57,504	26,467	274	759	2,016	905
		Gas	3,203					208	1,493	16,751	4,141	31	226	2,542	629
Zagros Fold Belt Structures AU	1.0	Oil	10,297	14,017	34,944	74,732	38,464	17,734	48,072	128,317	57,608	545	1,484	4,054	1,791
		Gas	6,130					10,906	25,681	53,029	28,002	265	725	2,009	885
Total conventional resources				34,006	78,893	161,651	85,856	131,488	301,663	657,939	336,194	4,513	10,361	24,788	11,972

Structures AU (mean of 6,626 MMBO), and the Horst Block and Suprasalt Structural Oil AU (mean of 5,300 MMBO).

For the undiscovered conventional gas resource mean of 336,194 BCFG, 96 percent is in two total petroleum systems: Paleozoic Composite TPS (mean of 189,273 BCFG) and the Mesozoic–Cenozoic Composite TPS (mean of 132,876 BCFG). In the Paleozoic Composite TPS, 56 percent (106,180 BCFG) of the undiscovered gas is estimated to be in the Zagros Fold Belt Reservoirs AU (table 1).

Similarly, 64 percent (85,610 BCFG) of the undiscovered gas in the Mesozoic–Cenozoic Composite TPS is in the Zagros Fold Belt Structures AU.

Reference Cited

U.S. Geological Survey World Energy Assessment Team, 2000, U.S. Geological Survey World Petroleum Assessment 2000—Description and results: U.S. Geological Survey Digital Data Series DDS-60, 4 CD-ROMs.

For Further Information

Supporting studies of the geologic models and the methodology used in the assessment of Arabian Peninsula and Zagros Fold Belt provinces are in progress. Assessment results are available at the USGS Energy Program website, <http://energy.usgs.gov/>.

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