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World Petroleum Resources Project Fact Sheet

Assessment of Undiscovered Oil and Gas Resources of the North Caspian Basin, Middle Caspian Basin, North Ustyurt Basin, and South Caspian Basin Provinces, Caspian Sea Area, 2010

The U.S. Geological Survey estimated mean volumes of technically recoverable, conventional, undiscovered petroleum resources at 19.6 billion barrels of crude oil, 243 trillion cubic feet of natural gas, and 9.3 billion barrels of natural gas liquids for the Caspian Sea area, using a geology-based assessment methodology.

Introduction

The U.S. Geological Survey (USGS) estimated technically recoverable, conventional, undiscovered oil and gas resources of the Caspian Sea area as part of a program to estimate these resources for priority basins around the world. Four petroliferous geologic provinces cover the Caspian Sea area, (1) the North Caspian Basin, (2) Middle Caspian Basin, (3) North Ustyurt Basin, and (4) South Caspian Basin (fig. 1). The provinces encompass approximately 1,315,000 square kilometers and were based on interpretations by Delia and others (2008) and Natal'in and Şengör (2005). This assessment was based on published geologic information and on commercial data from oil and gas wells and fields, and field production records. The USGS approach is to define total petroleum systems and assessment units, and assess the potential for undiscovered oil and gas resources.

Total Petroleum Systems and Assessment Units

One total petroleum system (TPS), Paleozoic Composite, was defined for the North Caspian Basin Province to include source rocks ranging in age from Late Devonian through Early Permian (table 1, Ulmishek, 2001b). Five assessment units (AU) were defined geologically within this TPS. Four of the AUs lie below Lower Permian (Kungarian) evaporites (fig. 2*A*) — North and West Margins Subsalt AU, East and Southeast Margins Subsalt AU, South Margin Subsalt AU, and Central Basin Subsalt AU (table 1). Most reservoirs and seals in these AUs are associated with carbonate shelves and reefs, although some shelf and basin-slope clastic reservoirs of poor quality exist. Because of the extreme depths, a greater uncertainty was assumed that the Central Basin Subsalt AU contains technically recoverable oil or gas exceeding the minimum accumulation size set for the assessment (0.5 million barrels of oil equivalent) and therefore it was assigned a probability of 0.63 (table 1). Carbonate reefs and features associated with carbonate shelves are important traps for the subsalt AUs. Structural traps and likely stratigraphic traps are known in the East and Southeast Margins Subsalt AU. The Suprasalt AU lies above the evaporites (fig. 2*A*). Reservoirs and seals in this AU include clastic rocks ranging in age from Late Permian through Cretaceous and traps are associated with salt tectonics.

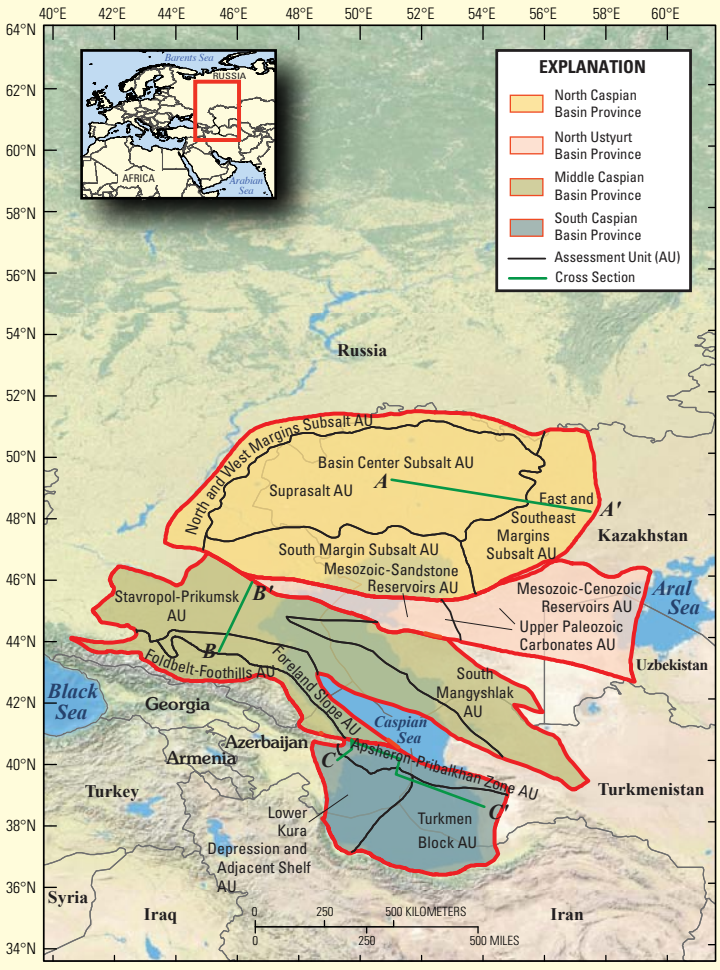

Figure 1. Location of 15 assessment units (AU) in the Caspian Sea area and approximate locations of cross sections shown in figure 2. (Map not definitive for political boundaries.)

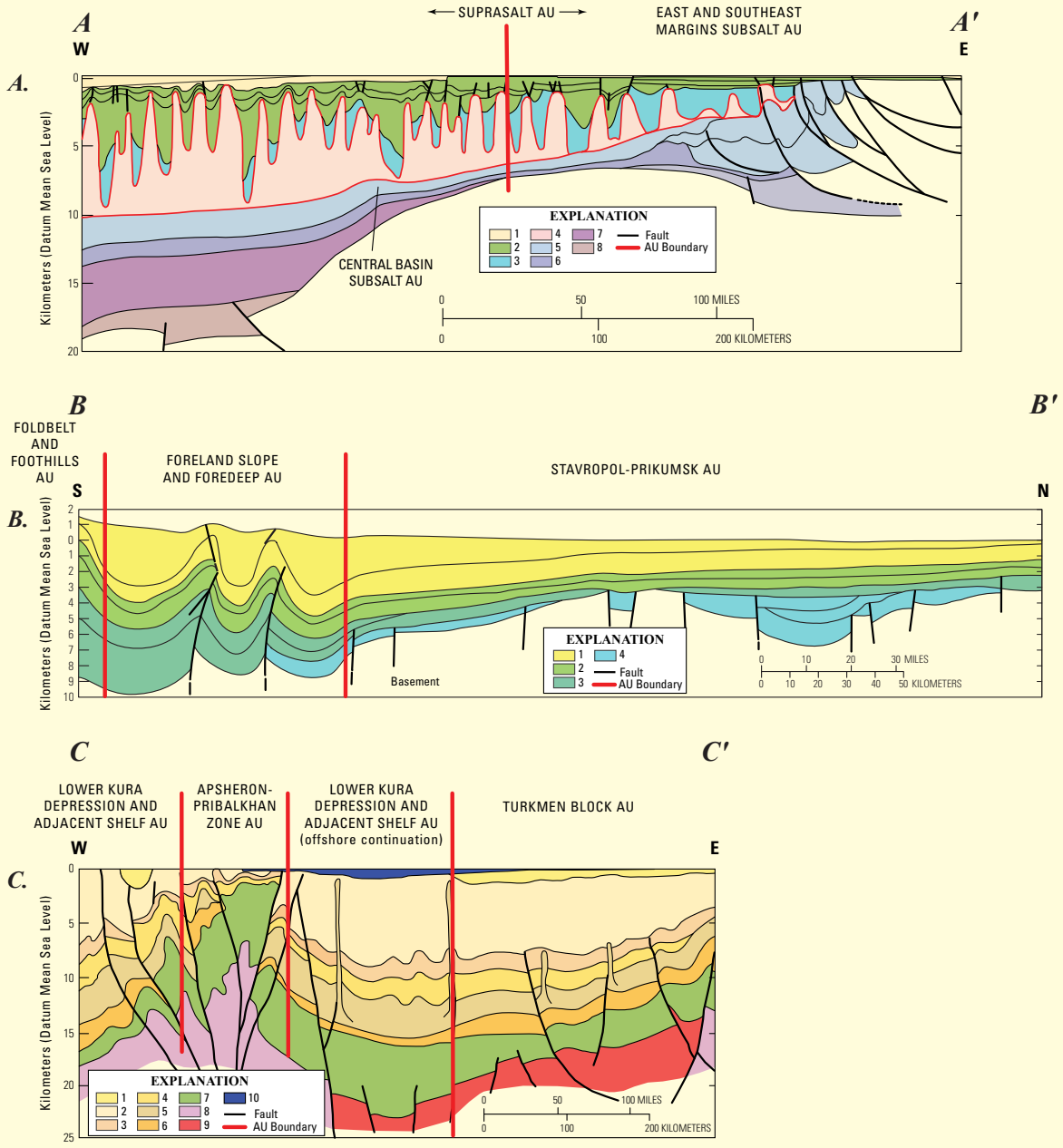

Figure 2. Schematic geologic cross sections of the Caspian Sea basins illustrating the geologic delineations of several assessment units (AU) in this study. Locations of cross sections shown in figure 1. *A*. North Caspian Basin Province, modified from Volozh and others (2003). Rock units: 1, Cenozoic; 2, Mesozoic; 3, Upper Permian; 4, Kungarian salt; 5, Carboniferous to Permian; 6, Devonian to Carboniferous; 7, Lower Paleozoic; 8, Proterozoic. *B*. Middle Caspian Basin Province, modified from Ulmishek (2001a). Rock units: 1, Cenozoic; 2, Cretaceous; 3, Jurassic; 4, Upper Permian to Triassic. *C*. South Caspian Basin Province, modified from Abrams and Narimanov (1997). Rock units: 1, Quaternary; 2, middle to upper Pliocene; 3, lower Pliocene; 4, Miocene; 5, Oligocene to Miocene (Maykop Formation); 6, Paleocene to Eocene; 7, Mesozoic; 8, basement, continental crust; 9, basement, oceanic crust; 10, water of the Caspian Sea.

Three TPSs were identified in the North Ustyurt Basin Province — Buzachi Arch and Surrounding Areas Composite TPS, Mesozoic-Cenozoic Composite TPS, and Paleozoic Composite TPS (table 1, Ulmishek, 2001c). The Buzachi Arch and Surrounding Areas Composite TPS was defined to include source rocks within the Buzachi Arch and possible contributions of oil and gas from the neighboring North and Middle Caspian Basins. One AU was defined for each TPS — Mesozoic Sandstone Reservoirs AU, Mesozoic-Cenozoic Reservoirs AU, and Upper Paleozoic Carbonates AU, respectively. Reservoirs and seals are indicated in the AU names. Most known traps are structural, although some pinchout traps are inferred.

The Terek-Caspian, South Mangyshlak, and Stavropol-Prikumsk TPSs were identified in the Middle Caspian Basin Province (table 1, Ulmishek, 2001a). Source rocks in the Terek-Caspian TPS include Oligocene to Lower Miocene Maykop Formation, Eocene Kuma Formation, and possibly some Middle to Upper Jurassic subsalt mudstones. The South Mangyshlak TPS includes Triassic and possibly Jurassic source rocks. Lower Triassic, Middle Jurassic, and the Oligocene to lower Miocene

Table 1. Caspian Sea area assessment results (technically recoverable, conventional undiscovered resources).

[MMB, million barrels; BCF, billion cubic feet. Results shown are fully risked estimates. For gas fields, all liquids are included under the natural gas liquids (NGL) category. F95 denotes 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. TPS, total petroleum system; AU, assessment unit. Gray shading indicates not applicable]

Total Petroleum Systems (TPS) and Assessment Units (AU)	Field type	Mean (expected) largest field size (MMB or BCF)	Total undiscovered resources											
			Oil (MMB)				Gas (BCF)				NGL (MMB)			
			F95	F50	F5	Mean	F95	F50	F5	Mean	F95	F50	F5	Mean
North Caspian Basin Province, Paleozoic Composite TPS														
North and West Margins Subsalt AU	Oil	17	16	48	127	56	37	111	296	131	1	2	6	3
	Gas	199					250	736	1,877	859	8	24	62	28
East and Southeast Margins Subsalt AU	Oil	160	88	331	1,031	414	155	593	1,907	755	3	12	40	16
	Gas	633					196	879	3,606	1,242	6	28	118	41
South Margin Subsalt AU	Oil	993	663	2,173	6,246	2,646	1,544	5,051	14,550	6,160	32	104	311	129
	Gas	5,954					3,975	13,070	37,194	15,858	129	424	1,227	518
Central Basin Subsalt AU (AU probability = 0.63)	Oil		0	0	0	0	0	0	0	0	0	0	0	0
	Gas	3,581					0	1,515	14,574	3,592	0	49	475	117
Suprasalt AU	Oil	309	511	1,388	3,161	1,555	1,291	3,750	9,200	4,307	1,112	3,404	8,897	4,004
	Gas	48					63	169	419	195	3	7	17	8
Total Undiscovered Resources, North Caspian Basin			1,278	3,940	10,565	4,671	7,511	25,874	83,623	33,099	1,294	4,054	11,153	4,864
Middle Caspian Basin Province, Terek-Caspian TPS														
Foldbelt-Foothills AU	Oil	28	66	129	238	138	147	309	620	336	3	6	13	7
	Gas	154					300	616	1,187	662	8	16	32	17
Foreland Slope and Foredeep AU	Oil	90	66	219	618	264	144	512	1,586	642	3	11	33	13
	Gas	369					153	599	2,133	795	4	16	57	21
Middle Caspian Basin Province, South Mangyshlak TPS														
South Mangyshlak AU	Oil	116	145	374	855	422	324	879	2,223	1,023	21	57	152	68
	Gas	293					315	824	1,972	940	13	35	86	40
Middle Caspian Basin Province, Stavropol-Prikumsk TPS														
Stavropol-Prikumsk AU	Oil	399	292	903	2,489	1,084	629	1,994	5,930	2,468	28	91	294	117
	Gas	803					396	1,365	4,711	1,789	14	51	183	69
Total Undiscovered Resources, Middle Caspian Basin			569	1,625	4,200	1,908	2,408	7,098	20,362	8,655	94	283	850	352
North Ustyurt Basin Province, Buzachi Arch and Surrounding Areas Composite TPS														
Mesozoic Sandstone Reservoirs AU	Oil	68	97	250	592	285	35	92	228	107	1	2	6	3
	Gas	261					76	300	1,270	438	2	6	29	10
North Ustyurt Basin Province, Mesozoic-Cenozoic Composite TPS														
Mesozoic-Cenozoic Reservoirs AU	Oil	95	21	51	115	57	7	19	45	22	<1	1	1	1
	Gas	373					370	953	2,282	1,091	8	20	52	24
North Ustyurt Basin Province, Paleozoic Composite TPS														
Upper Paleozoic Carbonates AU	Oil	21	0	0	0	0	0	0	0	0	0	0	0	0
	Gas	425					851	2,524	6,762	2,993	6	19	52	23
Total Undiscovered Resources, North Ustyurt Basin			118	301	707	342	1,339	3,888	10,587	4,651	17	48	140	61
South Caspian Basin Province, Cenozoic Composite TPS														
Apsheron-Pribalkhan Zone AU	Oil	259	349	897	1,997	1,001	981	2,608	6,312	2,997	12	32	80	38
	Gas	1,149					319	1,382	6,226	2,065	12	51	235	78
Lower Kura Depression and Adjacent Shelf AU	Oil	1,731	634	2,938	10,744	3,947	1,743	8,377	33,632	11,833	21	104	427	149
	Gas	10,354					3,859	17,659	64,260	23,632	141	654	2,469	889
Turkmen Block AU	Oil	3,101	1,375	6,025	19,802	7,723	13,929	61,698	205,402	79,223	211	936	3,140	1,207
	Gas	24,901					17,499	64,405	178,526	77,085	363	1,354	3,898	1,641
Total Undiscovered Resources, South Caspian Basin			2,358	9,860	32,543	12,671	38,330	156,129	494,358	196,835	760	3,131	10,249	4,002
Total Undiscovered Petroleum Resources, Caspian Sea Area						19,592				243,240				9,279

Maykop Formation are source rocks in the Stavropol-Prikumsk TPS. Two AUs were defined for the Terek-Caspian TPS — Foldbelt-Foothills AU and Foreland Slope and Foredeep AU (fig. 2*B*). Reservoirs and seals in these AUs are mainly Upper Cretaceous to Eocene carbonate rocks and Lower to Upper Cretaceous and Miocene clastic rocks. One AU was defined for each of the other TPSs, having the same names as the TPS — South Mangyshlak AU and Stavropol-Prikumsk AU (fig. 2*B*, table 1). In the South Mangyshlak AU, reservoirs and seals exist in Lower to Middle Jurassic and Cretaceous clastic rocks, Triassic carbonates, and in fractured and weathered basement granite. Triassic carbonate rocks; Jurassic, Cretaceous, and Oligocene clastic rocks; and fractured Maykop mudstone provide reservoirs and seals in the Stavropol-Prikumsk AU. Known traps in all of the AUs are mostly structural, with some pinchout and stratigraphic traps.

The Cenozoic Composite TPS was defined for the South Caspian Basin Province (table 1) to include Oligocene to lower Miocene Maykop Formation and overlying Diatom Formation marine source rocks, and possibly also Eocene marine source rocks. The Apsheron-Pribalkhan Zone, Lower Kura Depression and Adjacent Shelf, and Turkmen Block AUs were defined in the TPS (fig. 2*C*). Reservoir and seal rocks are predominantly Pliocene to Pleistocene clastic rocks. Known traps include both structural and stratigraphic.

Assessment Results

Estimates of volumes of technically recoverable, conventional, undiscovered oil and gas resources are shown in table 1. No attempt was made to estimate economically recoverable resources because it is beyond the scope of this study. The combined mean undiscovered petroleum resources in the Caspian Sea area are 19.6 billion barrels of recoverable crude oil, 243 trillion cubic feet of recoverable natural gas, and 9.3 billion barrels of recoverable natural gas liquids.

In the North Caspian Basin Province, the mean volumes and probability ranges (F_{95} to F_{05}) of undiscovered petroleum are approximately 4,671 million barrels (MMB) of crude oil, with a range of 1,278 to 10,565 MMB; 33,099 BCF of natural gas (both associated and dissolved, and nonassociated), with a range of 7,511 to 83,623 billion cubic feet (BCF); and 4,864 MMB of natural gas liquids, with a range of 1,294 to 11,153 MMB.

In the North Ustyurt Basin Province, the mean volumes and probability ranges (F_{95} to F_{05}) of undiscovered oil are approximately 342 MMB of crude oil, with a range of 118 to 707 MMB; 4,651 BCF of natural gas (both associated and dissolved, and nonassociated), with a range of 1,339 to 10,587 BCF; and 61 MMB of natural gas liquids, with a range of 17 to 140 MMB.

In the Middle Caspian Basin Province, the mean volumes and probability ranges (F_{95} to F_{05}) of undiscovered oil are approximately 1,908 MMB of crude oil, with a range of 569 to 4,200 MMB; 8,655 BCF of natural gas (both associated and dissolved, and nonassociated), with a range of 2,408 to 20,362 BCF; and 352 MMB of natural gas liquids, with a range of 94 to 850 MMB.

In the South Caspian Basin Province, the mean volumes and probability ranges (F_{95} to F_{05}) of undiscovered oil are approximately 12,671 MMB of crude oil, with a range of 2,358 to 32,543 MMB; 196,835 BCF of natural gas (both associated and dissolved, and nonassociated), with a range of 38,330 to 494,358 BCF; and 4,002 MMB of natural gas liquids, with a range of 760 to 10,249 MMB.

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For Further Information

Publications detailing the geology and the methodology for the Caspian Sea area and assessment results are available at the USGS Energy Program Web site, *http://energy.cr.usgs.gov/oilgas/*.

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