USGS
science for a changing world

National and Global Petroleum Assessment

Assessment of Undiscovered Conventional Oil and Gas Resources in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran, 2026

Using a geology-based assessment methodology, the U.S. Geological Survey estimated undiscovered, technically recoverable mean conventional resources of 442 million barrels of oil and 218 trillion cubic feet of gas in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran.

Introduction

The U.S. Geological Survey (USGS) assessed the potential for undiscovered, technically recoverable conventional oil and gas resources in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran (fig. 1). The tectonic history of the Amu Darya Basin and Afghan-Tajik Basin is complex (Brunet and others, 2017) and is briefly summarized for this report. The Amu Darya Basin and Afghan-Tajik Basin were a single geologic entity until compressional deformation in the Miocene related to the Pamir block collision. The Amu Darya Basin and Afghan-Tajik Basin consist of Early to Middle Jurassic horsts and grabens formed in an extensional, backarc realm associated with north-directed subduction and an associated volcanic arc that formed during the latest Triassic to Early Jurassic (Otto, 1997; Ulmishek, 2004; Smit and others, 2013; Brunet and others, 2017; Yang and others, 2017). The grabens were sites of thick successions of Lower to Middle Jurassic nonmarine sandstones, mudstones, coal beds, and carbonaceous shales. As the rate of extension decreased, subsidence led to marine transgression and the formation of widespread Callovian to Oxfordian carbonate platforms, and thick sequences of organic-rich calcareous shales were deposited in basins adjacent to the platforms (Xu and others, 2018). The Lower to Middle Jurassic coal beds, carbonaceous shales, and organic-rich marine shales form the major source rocks in the Amu Darya Basin and Afghan-Tajik Basin.



Figure 1. Map showing the location of two conventional oil and gas assessment units (AUs) in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran.

In the Kimmeridgian to Tithonian, minor uplift led to restricted marine conditions and the formation of as much as 900 meters of salt and anhydrite of the Gaurdak Formation (Ulmishek, 2004). Fully marine conditions were reestablished in the Early Cretaceous, and the deposition from the Early Cretaceous to the Oligocene was dominated by several transgressive-regressive sequences, resulting in as much as 7 kilometers of sandstones, mudstones, and minor carbonates being deposited in the deeper grabens. In the Miocene, collision of the Pamir block with the passive margin resulted in the formation of thrusts, folds, and anticlines in the Afghan-Tajik Basin, which effectively separates the Afghan-Tajik Basin from the Amu Darya Basin (Brookfield and Hashmat, 2001; Ulmishek, 2004; Smit and others, 2013; Fürsich and others, 2017). Miocene contraction in the Amu Darya Basin resulted in the formation of broad folds and anticlines that host many of the oil and gas reservoirs. Additional burial related to this phase of structural deformation may have resulted in the thermal maturation of potential Paleogene source rocks in the Afghan-Tajik Basin compared to the thermally immature Paleogene rocks in the Amu Darya Basin.

Total Petroleum Systems and Assessment Units

The USGS defined the Mesozoic Composite Total Petroleum System (TPS) in the Amu Darya Basin Province. The two major petroleum source rocks in this TPS are within the presalt stratigraphic section. Lower to Middle Jurassic coal beds, carbonaceous shales, and lacustrine shales are the first of these source rocks (Brunet and others, 2017; Mordvintsev and others, 2017). Coal beds are the major gas source in the Amu Darya Basin (Yu and others, 2015; Li and others, 2017; Chai and others, 2024). Callovian to Oxfordian calcareous, organic-rich, basinal, bituminous marls and shales are the second major source rocks (Ulmishek, 2004; Brunet and others, 2017; Nie and others, 2022). Callovian to Oxfordian organic-rich marine shales have total organic carbon values as much as 15 weight-percent, are as much as 250 meters thick, and are mainly type-IIS kerogen (Ulmishek, 2004). These presalt source rocks are modeled to be mainly in the thermal generation window for gas throughout the Amu Darya Basin, except in a narrow zone along the basin margins (Chai and others, 2024).

The Amu Darya Mesozoic–Cenozoic Reservoirs Assessment Unit (AU) was defined within the Mesozoic Composite TPS. The geologic model for the presalt reservoirs within this AU is for oil and gas generated from the two source rocks to have migrated into a spectrum of presalt carbonate reservoirs, such as platform-margin reefs, patch reefs, dolomites, karsts, ooid shoals, and carbonate debris flows; these reservoirs were partly sealed by salt and anhydrite of the Gaurdak Formation (Li and others, 2017; Xu and others, 2018; Wang, 2023; Chai and others, 2024; Yuzhe and others, 2024). The deepest reservoirs in this AU may be highly overpressured (Xing and others, 2020) and naturally fractured (Xing and others, 2022; Li and others, 2024). The condensate component of the generated petroleum has been interpreted as being sourced by coal beds (Shan and others, 2022). The geologic model for the postsalt reservoirs within this AU is for oil and gas generated from thermally mature presalt source rocks to have migrated into postsalt sandstone reservoirs, such as Cretaceous to Oligocene fluvial, deltaic, nearshore-marine, shelf, and deepwater turbidite sandstones. Fluvial-deltaic to nearshore-marine sandstones of the Lower Cretaceous Shatlyk Formation are the most important postsalt reservoirs (Ulmishek, 2004; Hosseinyar and others, 2018). Platform-margin carbonates are minor postsalt reservoirs. Oil and gas generated from presalt sources migrated into postsalt reservoirs, possibly due to the spatial variation in seal integrity and the presence of numerous faults in the section. Neogene contraction formed broad folds that contain most of the oil and gas resources in this AU.

In the Afghan-Tajik Basin Province, the USGS defined the Mesozoic–Cenozoic Composite TPS. This TPS not only has source rocks as in the Mesozoic Composite TPS but also may have Paleogene organic-rich marine shales as an additional source rock. Thermal maturity in these shales may have been achieved for generation of oil and gas in the Neogene (Fürsich and others, 2017). The Afghan-Tajik Mesozoic–Cenozoic Reservoirs AU was defined within the Mesozoic–Cenozoic Composite TPS. The geologic model for this AU is for oil and gas generated from several source rocks to have migrated into similar platform-margin carbonate reservoirs, such as reefs, patch reefs, dolomites, debris flows, and karst zones, as well as Paleogene fluvial-deltaic, marginal-marine to deep-marine turbidite sandstones. The collision of the Pamir block with the passive margin in the Neogene may have caused remigration and possible loss of oil and gas from earlier traps in the Afghan-Tajik Basin. Key assessment data for the two defined AUs are summarized in table 1 and Schenk (2026).

Table 1. Key input data for two conventional oil and gas assessment units in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran.

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

Assessment input data—Conventional AUs	Amu Darya Mesozoic–Cenozoic Reservoirs AU				Afghan-Tajik Mesozoic–Cenozoic Reservoirs AU			
	Minimum	Median	Maximum	Calculated mean	Minimum	Median	Maximum	Calculated mean
Number of oil fields	1	75	150	76.8	1	10	20	10.3
Number of gas fields	1	700	1,400	717.1	1	60	120	61.5
Size of oil fields (MMBO)	1	4	40	5.2	1	4	10	4.2
Size of gas fields (BCFG)	6	24	40,000	298.6	6	24	2,000	60.1
AU probability	1.0				1.0			

Undiscovered Resources Summary

The USGS quantitatively assessed undiscovered, technically recoverable conventional oil and gas resources in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran (table 2). The estimated mean resources are 442 million barrels of oil (MMBO), or 0.44 billion barrels of oil, with an F95–F5 range from 288 to 634 MMBO; 217,970 billion cubic feet of gas (BCFG), or 218 trillion cubic feet of gas, with an F95–F5 range from 125,527 to 333,944 BCFG; and 3,048 million barrels of natural gas liquids (MMBNGL), or 3 billion barrels of natural gas liquids, with an F95–F5 range from 1,753 to 4,682 MMBNGL.

Table 2. Results for two conventional oil and gas assessment units in the Amu Darya Basin and Afghan-Tajik Basin Provinces of Turkmenistan, Uzbekistan, Tajikistan, Afghanistan, and Iran.

[Gray shading indicates not applicable. Results shown are fully risked estimates. 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 systems (TPSs) 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 Composite TPS														
Amu Darya Mesozoic–Cenozoic Reservoirs AU	1.0	Oil	260	389	573	399	103	156	231	160	5	7	10	7
		Gas					123,438	207,353	327,655	214,078	1,725	2,901	4,599	2,997
Mesozoic–Cenozoic Composite TPS														
Afghan-Tajik Mesozoic–Cenozoic Reservoirs AU	1.0	Oil	28	42	61	43	31	46	68	47	0	0	1	0
		Gas					1,955	3,517	5,990	3,685	23	42	72	44
Total undiscovered conventional oil and gas resources			**288**	**431**	**634**	**442**	**125,527**	**211,072**	**333,944**	**217,970**	**1,753**	**2,950**	**4,682**	**3,048**

References Cited

Brookfield, M.E., and Hashmat, A., 2001, The geology and petroleum potential of the North Afghan platform and adjacent areas (northern Afghanistan, with parts of southern Turkmenistan, Uzbekistan and Tajikistan): Earth-Science Reviews, v. 55, nos. 1–2, p. 41–71, accessed March 16, 2026, at https://doi.org/10.1016/S0012-8252(01)00036-8.

Brunet, M.-F., Ershov, A.V., Korotaev, M.V., Melikhov, V.N., Barrier, E., Mordvintsev, D.O., and Sidorova, I.P., 2017, Late Paleozoic and Mesozoic evolution of the Amu Darya Basin (Turkmenistan, Uzbekistan), *in* Brunet, M.-F., McCann, T., and Sobel, E.R., eds., Geological evolution of central Asian basins and the western Tien Shan Range: Geological Society of London Special Publication 427, p. 89–144, accessed March 16, 2026, at https://doi.org/10.1144/SP427.18.

Chai, H., Wang, H., Guo, C., Zhang, L., Chen, P., Xing, Y., Cheng, M., and Zhang, T., 2024, Geological characteristics and developmental achievements of the large presalt carbonate gas fields in the Amu Darya Basin: Unconventional Resources, v. 4, article 100089, 13 p., accessed February 9, 2026, at https://doi.org/10.1016/j.uncres.2024.100089.

Fürsich, F.T., Brunet, M.-F., Auxiètre, J.-L., and Munsh, H., 2017, Lower–Middle Jurassic facies patterns in the NW Afghan-Tajik Basin of southern Uzbekistan and their geodynamic context, *in* Brunet, M.-F., McCann, T., and Sobel, E.R., eds., Geological evolution of central Asian basins and the western Tien Shan Range: Geological Society of London Special Publication 427, p. 357–409, accessed March 16, 2026, at https://doi.org/10.1144/SP427.9.

Hosseinyar, G., Moussavi-Harami, R., Fard, I.A., Mahboubi, A., Rad, R.N., and Ebrahimi, M.-H., 2018, Facies analyses and depositional setting of the Lower Cretaceous Shurijeh-Shatlyk formations in the Kopeh Dagh-Amu Darya Basin (Iran and Turkmenistan): Geological Journal, v. 54, no. 3, p. 1715–1729, accessed March 16, 2026, at https://doi.org/10.1002/gj.3264.

Li, Y., Cheng, X., Fan, L., Sun, L., Wu, J., and Wei, J., 2024, Evaluation of fractured carbonate reservoir and prediction of favorable areas in the eastern area of Amu Darya right bank: Frontiers in Earth Science, v. 12, article 1495245, 15 p., accessed February 13, 2026, at https://doi.org/10.3389/feart.2024.1495245.

Li, F., Jing, X., Zou, C., Zhang, H., and Xiang, F., 2017, Facies analysis of the Callovian–Oxfordian carbonates in the northeastern Amu Darya Basin, southeastern Turkmenistan: Marine and Petroleum Geology, v. 88, p. 359–380, accessed February 9, 2026, at https://doi.org/10.1016/j.marpetgeo.2017.08.038.

Mordvintsev, D., Barrier, E., Brunet, M.-F., Blaniped, C., and Sidorova, I., 2017, Structure and evolution of the Bukhara-Khiva region during the Mesozoic—The northern margin of the Amu-Darya Basin (southern Uzbekistan), *in* Brunet, M.-F., McCann, T., and Sobel, E.R., eds., Geological evolution of central Asian basins and the western Tien Shan Range: Geological Society of London Special Publication 427, p. 145–174, accessed March 16, 2026, at https://doi.org/10.1144/SP427.16.

Nie, M., Zhao, W., He, D., Xu, S., and Fang, J., 2022, Hydrocarbon migration and accumulation in the large Samandepe gas field in the Chardzhou step-fault zone, Amu Darya Basin, northeastern Turkmenistan—A response to the tectonic evolution of the northern margin of the Tethys: Marine and Petroleum Geology, v. 145, article 105874, 15 p., accessed March 16, 2026, at https://doi.org/10.1016/j.marpetgeo.2022.105874.

Otto, S.C., 1997, Mesozoic–Cenozoic history of deformation and petroleum systems in sedimentary basins of central Asia; implications of collisions on the Eurasian margin: Petroleum Geoscience, v. 3, no. 4, p. 327–341, accessed March 16, 2026, at https://doi.org/10.1144/petgeo.3.4.327.

Schenk, C.J., 2026, USGS National and Global Oil and Gas Assessment Project—Amu Darya Basin and Afghan-Tajik Basin Provinces conventional resources—Assessment unit boundaries, assessment input data, and fact sheet data tables: U.S. Geological Survey data release, https://doi.org/10.5066/P13CCYEB.

Shan, Y., Chai, H., Wang, H., Zhang, L., Su, P., Kong, X., Bai, Z., Cheng, M., and Zhang, H., 2022, Origin and characteristics of the crude oils and condensates in the Callovian–Oxfordian carbonate reservoirs of the Amu Darya right bank block, Turkmenistan: Lithosphere, v. 2022, article 5446117, 28 p., accessed February 9, 2026, at https://doi.org/10.2113/2022/5446117.

Smit, J.H.W., Cloetingh, S.A.P.L., Burov, E., Tesauro, M., Sokoutis, D., and Kaban, M., 2013, Interference of lithospheric folding in western central Asia by simultaneous Indian and Arabian plate indentation: Tectonophysics, v. 602, p. 176–193, accessed March 16, 2026, at https://doi.org/10.1016/j.tecto.2012.10.032.

Ulmishek, G.F., 2004, Petroleum geology and resources of the Amu-Darya Basin, Turkmenistan, Uzbekistan, Afghanistan, and Iran: U.S. Geological Survey Bulletin 2201–H, 32 p., accessed March 16, 2026, at https://pubs.usgs.gov/bul/2201/H/.

Wang, Q., 2023, Types and distribution characteristics of Callovian–Oxfordian reservoir on the right bank of Amu Darya River in Turkmenistan: Geofluids, v. 2023, article 6754915, 13 p., accessed February 9, 2026, at https://doi.org/10.1155/2023/6754915.

Xing, Y., Guo, C., Cheng, M., Yang, H., Shi, H., and Chen, P., 2020, Flow unit classification and characterization of Callovian–Oxfordian carbonate reservoir—Bereketli-Pirgui Gas Field, the right bank of Amu Darya, *in* Lin, J., ed., Proceedings of the International Field Exploration and Development Conference 2019, Xi'an, China, October 16–18, 2019: Singapore, Springer, p. 2328–2337, accessed February 13, 2026, at https://doi.org/10.1007/978-981-15-2485-1_211.

Xing, Y., Wang, H., Zhang, L., Chen, P., Yu, W., Guo, C., and Shi, H., 2022, Fracture properties and their impacts on performance in carbonate reservoir, central Block B on the right bank of Amu Darya: Lithosphere, v. 2022, article 5335113, 15 p., accessed February 9, 2026, at https://doi.org/10.2113/2022/5335113.

Xu, W., Wen, H., Zheng, R., Li, F., Huo, F., Hou, M., and Zhou, G., 2018, The carbonate platform model and reservoirs' origins of the Callovian–Oxfordian Stage in the Amu Darya Basin, Turkmenistan: Crystals, v. 8, no. 2, 22 p., accessed February 13, 2026, at https://doi.org/10.3390/cryst8020084.

Yang, Y.-T., Guo, Z.-X., and Luo, Y.-J., 2017, Middle–Late Jurassic tectonostratigraphic evolution of central Asia, implications for the collision of the Karakoram-Lhasa Block with Asia: Earth-Science Reviews, v. 166, p. 83–110, accessed February 13, 2026, at https://doi.org/10.1016/j.earscirev.2017.01.005.

Yu, Y., Yin, J., Zheng, J., Li, F., Tao, C., Xu, X., and Wu, H., 2015, Division and resources evaluation of hydrocarbon plays in the Amu Darya Basin, central Asia: Petroleum Exploration and Development, v. 42, no. 6, p. 819–826, accessed February 13, 2026, at https://doi.org/10.1016/S1876-3804(15)30078-1.

Yuzhe, T., Hongjun, W., Liangjie, Z., Pengyu, C., Xingming, P., Wenqi, Z., Lingzhi, J., Yuzhong, X., Chen, W., and Yunpeng, S., 2024, Seismic lithology and geological implications of pre-salt Jurassic carbonate rocks in the Amu Darya Right Bank: Marine and Petroleum Geology, v. 165, article 106865, 15 p., accessed March 16, 2026, at https://doi.org/10.1016/j.marpetgeo.2024.106865.

For More Information

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

Amu Darya Basin and Afghan-Tajik Basin Provinces Assessment Team

Christopher J. Schenk, Tracey J. Mercier, Phuong A. Le, Andrea D. Cicero, Sarah E. Gelman, Jane S. Hearon, Benjamin G. Johnson, Jenny H. Lagesse, and Heidi M. Leathers-Miller

ISSN 2327-6932 (online) https://doi.org/10.3133/fs20263024