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Prepared in cooperation with the Afghanistan Geological Survey under the auspices of the U.S. Agency for International Development

Preliminary Assessment of Non-Fuel Mineral Resources of Afghanistan, 2007

The U.S. Geological Survey and Afghanistan Geological Survey estimated numbers of undiscovered deposits in Afghanistan by using geology-based assessment methodology. Estimates of known and undiscovered copper resources total nearly 60 million metric tons of copper. Resources of iron in known deposits are more than 2,200 million metric tons of iron ore. Twenty mineralized areas were identified that merit further study and may contain resources amenable to rapid development.

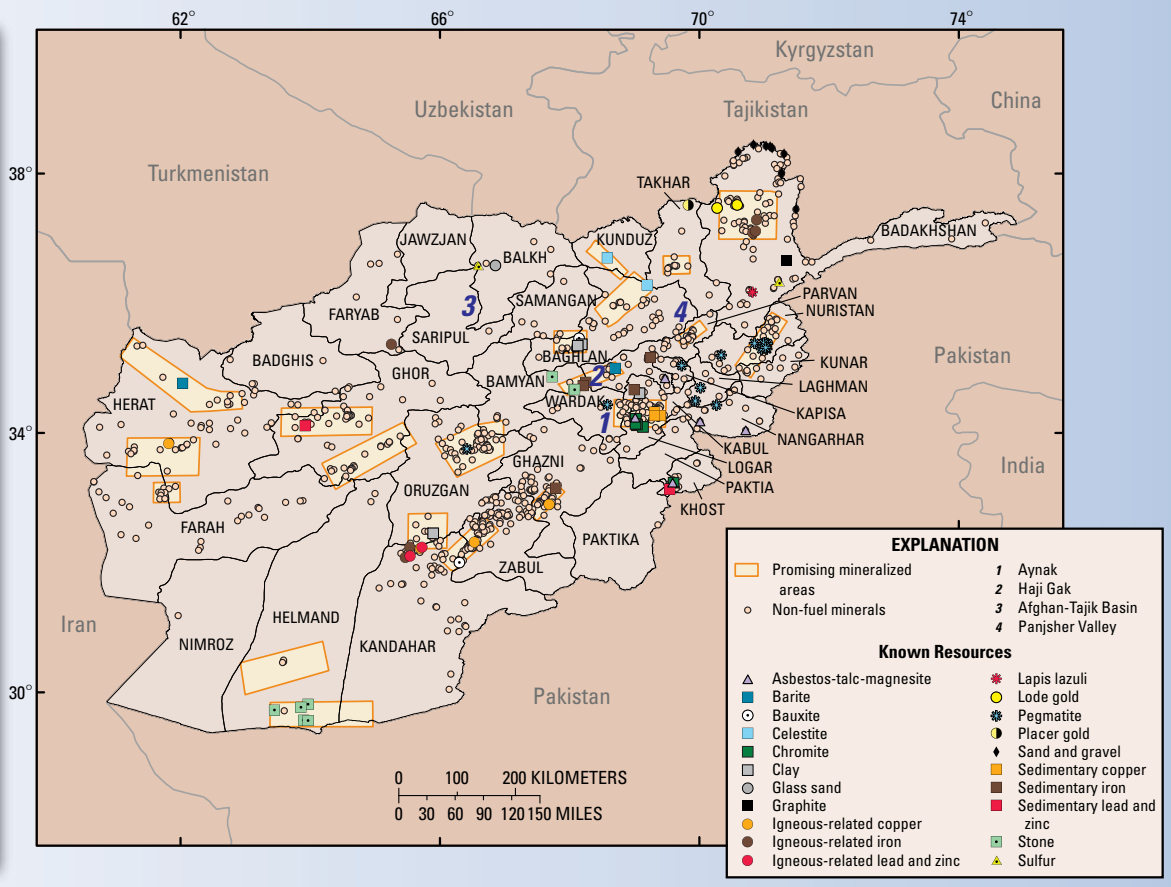

Figure 1. Map of Afghanistan showing mineralized areas recommended for further study (rectangular areas), known non-fuel mineral deposits and prospects (small dots), and selected mineral deposits for which resources have been published in the past (various symbols).

Introduction

Afghanistan has abundant mineral resources, including known deposits of copper, iron, barite, sulfur, talc, chromium, magnesium, salt, mica, marble, rubies, emeralds, lapis lazuli, asbestos, nickel, mercury, gold and silver, lead, zinc, fluorspar, bauxite, beryllium, and lithium (fig. 1). Between 2005 and 2007, the U.S. Agency for International Development (USAID) funded a cooperative study by the U.S. Geological Survey (USGS) and the Afghanistan Geological Survey (AGS) to assess the non-fuel mineral resources of Afghanistan as part of the effort to aid in the reconstruction of that country.

An assessment is an estimation or evaluation, in this instance of undiscovered non-fuel mineral resources. Mineral resources are materials that are in such form that economic extraction of a commodity is currently or potentially feasible. In this assessment, teams of scientists from the USGS and the AGS compiled information about known mineral deposits and then evaluated the possible occurrence of undiscovered deposits of all types. Quantitative probabilistic estimates were made for undiscovered deposits of copper, mercury, rare-earth elements, sulfur, chromite, asbestos, potash, graphite, and sand and gravel. These estimates were made for undiscovered deposits at depths less than a kilometer. Other deposit types were considered and discussed in the assessment, but quantitative estimates of numbers of undiscovered deposits were not made. In addition, the assessment resulted in the delineation of 20 mineralized areas for further study, of which several may contain resources amenable to rapid development.

Resource Summary

Metals

Sediment-hosted copper deposits at Aynak contain known resources of more than 12.3 million metric tons of copper. Undiscovered sediment-hosted copper deposits similar to Aynak in nearby areas could contain a mean of 17 million metric tons of copper and 600,000 metric tons of cobalt. The total (known and undiscovered) amount of sediment-hosted copper of nearly 30 million metric tons would be the largest nonferrous metal resource in Afghanistan. Known resources in copper deposits related to plutonic rocks (chiefly skarn deposits) are about 70,000 metric tons of copper, along with auxiliary amounts of gold, lead, and zinc. Porphyry copper deposits also contain important copper resources. Twelve permissive tracts for porphyry copper deposits were delineated. They were estimated to contain a mean of 8 undiscovered porphyry copper deposits containing 28.5 million metric tons of copper, 724,000 metric tons of molybdenum, 682 metric tons of gold, and 9,100 metric tons of silver. Thus, the total copper resource in Afghanistan is estimated to be nearly 60 million metric tons of copper.

Known iron deposits are contained in both sedimentary and igneous rocks. Sedimentary iron deposits are abundant in central Afghanistan and the Haji Gak iron deposit (approximately 2,100 million metric tons of ore at between 63 and 69 weight percent iron) is of world-class size. This deposit is large enough to support a major mining operation. Additional resources in a number of sedimentary deposits near Haji Gak bring the total resource for Afghanistan to about 2,260 million metric tons of iron ore with grades higher than 62 weight percent iron. Additional resources in similar deposits are likely. Igneous-related deposits are known to contain 178 million metric tons of ore with grades between 47 and 68 weight percent iron with potential byproducts of sulfur, phosphorous, nickel, and manganese. Additional study is necessary to correctly classify Haji Gak and permit a more detailed assessment.

Undiscovered hot-spring mercury deposits in Afghanistan may contain about 32,000 metric tons of mercury, which is sufficient to support a local mercury industry. The areas containing mercury deposits could also contain epithermal precious-metal deposits.

Known resources of gold total about 1,780 kilograms (kg) in lode deposits and 918 kg in placer deposits. Additional deposits are probable, and exploitation of small- to medium-sized gold deposits could provide a source of local industry and employment.

Lead and zinc deposits in Afghanistan contain a known resource of about 244,000 metric tons of combined lead and zinc. Both igneous-related and sediment-hosted deposit types are present.

Tin and tungsten may be present in potentially important amounts. More knowledge about igneous rock compositions in Afghanistan could permit a more detailed assessment.

Known bauxite deposits in Afghanistan contain a resource of about 4.5 million metric tons of bauxite that contains about 50 percent alumina and 12 percent silica.

Industrial Minerals

A number of industrial minerals were assessed in Afghanistan, and undiscovered deposits of several commodities are likely to be present in sufficient quantities to support local industries.

Undiscovered potash-bearing bedded halite deposits in northern Afghanistan may contain important amounts of potash. Estimation of undiscovered deposits resulted in a mean expected value of 27.5 million metric tons of potash.

Sulfur is present in two known deposits that contain about 450,000 metric tons of sulfur. Probabilistic estimates for undiscovered bedded sulfur deposits in rocks of the Afghan-Tajik Basin result in a mean expected value of 6 million metric tons of sulfur.

Rare-earth elements (REE) and uranium are present in Helmand Province, associated with a carbonatite body. Estimates of undiscovered deposits resulted in a mean expected value of 1.4 million metric tons of REE and 3.48 million metric tons of niobium. Important amounts of phosphorous, uranium, thorium, barite, fluorspar, and nepheline could also be associated with such deposits.

Chromite deposits are present in Logar and Khost Provinces, and known resources are approximately 200,000 metric tons of ore with a grade of about 43 weight percent chromium oxide. Estimation of undiscovered chromite deposits resulted in a mean expected value of 980,000 metric tons of chromium oxide.

Asbestos deposits related to mafic igneous rocks are also present in Logar and Khost Provinces. Estimation of undiscovered asbestos deposits resulted in a mean expected value of 13.4 million metric tons of asbestos.

Graphite is present in a number of small occurrences in northeastern Afghanistan. The known resource totals about 5,000 metric tons of graphite. Undiscovered graphite deposits may be present, and an expected mean value of 1 million metric tons of flake graphite was estimated.

Known resources of additional industrial mineral commodities are present, but estimation of undiscovered deposits will require further study (table 1). Barite, halite, gypsum, celestite, fluorite, talc and magnesite, and clays are abundant enough to support local industries. Pegmatite fields, principally in northeastern Afghanistan, contain a variety of commodities, such as lithium, beryllium, quartz, feldspars, mica, gemstones, tantalum, niobium, and cesium. Exploitation of these pegmatite deposits could support local glass, chemical, or artisanal industries.

Gemstones are present in many of the numerous pegmatite deposits and include tourmaline, kunzite, garnet, and ruby. Nonpegmatite gemstone deposits are present in northeastern Afghanistan. These include emerald deposits in the Panjsher Valley and other ruby, sapphire, spinel, and lapis lazuli occurrences in northeastern Afghanistan. Peridot is also known to be present along the Afghanistan-Pakistan border. Many areas contain sufficient amounts of gemstones to support local industries.

Building Materials

Building materials are present in quantities sufficient to support local construction industries. The mountains of Afghanistan contain abundant rock types suitable for use as building and decorative stone, such as granite, limestone, marble, sandstone, and travertine (table 1).

Limestone deposits suitable for cement production are widespread in Afghanistan, and deposits suitable for exploitation have been identified in Badakhshan, Herat, and Baghlan Provinces.

Afghanistan also has abundant sand and gravel resources. Material adequate for local industry is present adjacent to most existing population centers.

Table 1. Summary of known resources and estimated undiscovered resources for selected commodities in Afghanistan identified by the U.S. Geological Survey–Afghanistan Ministry of Mines Joint Mineral Resource Assessment Team.

[Values in metric tons unless otherwise indicated; kg, kilogram; m^3, cubic meter; wt. %, weight percent; approx., approximately]

Commodity	Province	Deposit type	Known resource estimates from Abdullah and others (1977)	USGS-AGS assessment of undiscovered deposits (mean expected values)
Metals				
Aluminum	Zabul, Baghlan	bauxite	4,535,000 (bauxite at 50.5 wt. % alumina and 12 wt. % silica)	Further study recommended
Copper	Kabul, Logar	sediment-hosted copper	12,340,600	16,880,000 (copper); 600,000 (cobalt)
	Kandahar, Zabul, Herat	igneous-related copper	68,500	28,469,200 (copper); 724,010 (molybdenum); 682 (gold); 9,067 (silver)
Gold	Takhar, Ghazni	placer gold	918 kg	Further study recommended
	Badakhshan, Ghazni, Zabul	lode gold	approx. 1,780 kg	Further study recommended
Iron	Bamyan, Baghlan	sediment-hosted iron	2.26 billion (>62 wt. % iron)	Further study recommended
	Badakhshan, Kandahar	igneous-related iron	178,000,000 (at between 47 and 68 wt. % iron)	Further study recommended
Lead and zinc	Kandahar, Herat, Paktia	igneous-related lead and zinc	90,000 (combined lead and zinc)	Further study recommended
	Ghor	sediment-hosted lead and zinc	153,900 (combined lead and zinc)	Further study recommended
Mercury	Farah, Ghor	hot-spring mercury	May contain gold and silver	32,000
Tin and tungsten	Herat, Farah, Oruzgan	tin veins, tin and tungsten skarns and greisen	No previous estimate	Further study recommended
Industrial Minerals				
Barite	Parvan, Herat	bedded and vein barite	151,500,000	Further study recommended
Brick clay	Kabul	clay	2,200,000 m^3	Further study recommended
Celestite	Baghlan, Kunduz	celestite	>1,000,000 (at 75 wt. %)	Further study recommended
Chromite	Logar, Paktia	chromium oxide	approx. 200,000 (at about 43 wt. %)	980,000 (chromium oxide)
Fluorite	Oruzgan	fluorspar	8,791,000 (ore averaging 46.69 wt. %)	Further study recommended
Graphite	Badakhshan	disseminated flake graphite	5,000	1,050,000 (flake graphite)
Halite	North Afghanistan	evaporite	No previous estimate	Further study recommended
Kaolin	Baghlan	residual kaolin	100,000 to 150,000 (clay)	Further study recommended
	Baghlan	sedimentary kaolin	385,000 (clay)	Further study recommended
Lazurite	Badakhshan	skarn lazurite	1,300	Further study recommended
Potash	Balkh, Samangan, Kunduz	evaporite	No previous estimate	27,514,000
Rare-earth elements (REE)	Helmand	carbonatite	No previous estimate	1,405,000 (REE), 3,480,000 (niobium and phosphorous, uranium and thorium)
Sulfur	Balkh, Badakhshan	bedded and fumerolic	450,000	6,000,000
Talc, asbestos, and magnesite	Nangarhar	metasomatic/ metamorphic replacement magnesite	1,250,000 (talc); 31,200 (magnesite)	Further study recommended
	Nangarhar	ultramafic-hosted talc magnesite	50,000 (mined previously)	13,400,000 (asbestos)

Table 1. Summary of known resources and estimated undiscovered resources for selected commodities in Afghanistan identified by the U.S. Geological Survey–Afghanistan Ministry of Mines Joint Mineral Resource Assessment Team. — Continued

[Values in metric tons unless otherwise indicated; kg, kilogram; m^3, cubic meter; wt. %, weight percent; approx., approximately]

Commodity	Province	Deposit type	Known resource estimates from Abdullah and others (1977)	USGS-AGS assessment of undiscovered deposits (mean expected values)
Building Materials				
Aragonite	Helmand	dimension stone	770,000	Further study recommended
Dolomite	Bamyan	building stone	1,040,000	Further study recommended
Glass sand	Balkh	sand	110,000 (siliceous sand); 10,900,000 (sandstone)	Further study recommended
Limestone	Bamyan	building stone	3,500,000	Further study recommended
	Badakhshan, Herat, and Baghlan	cement and flux	> 500,000,000	Further study recommended
Marble	Various	building stone	1.3 billion (coarsely crystalline marble)	Further study recommended
Sand and gravel	Badakhshan	aggregate	136,000,000 m^3	Further study recommended
Sandstone	Bamyan	building stone	650,000 (siliceous sandstone)	Further study recommended

Further Information

Supporting geologic studies of mineralized systems and assessment areas and reports on the methodology used in this study are in progress. Assessment results are available at the USGS Afghanistan website *(http://afghanistan.cr.usgs.gov)* and at the Afghanistan Geological Survey website *(http://www.bgs.ac.uk/afghanminerals)*.

U.S. Geological Survey–Afghanistan Ministry of Mines Joint Mineral Resource Assessment Team

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The USGS Afghanistan Project

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