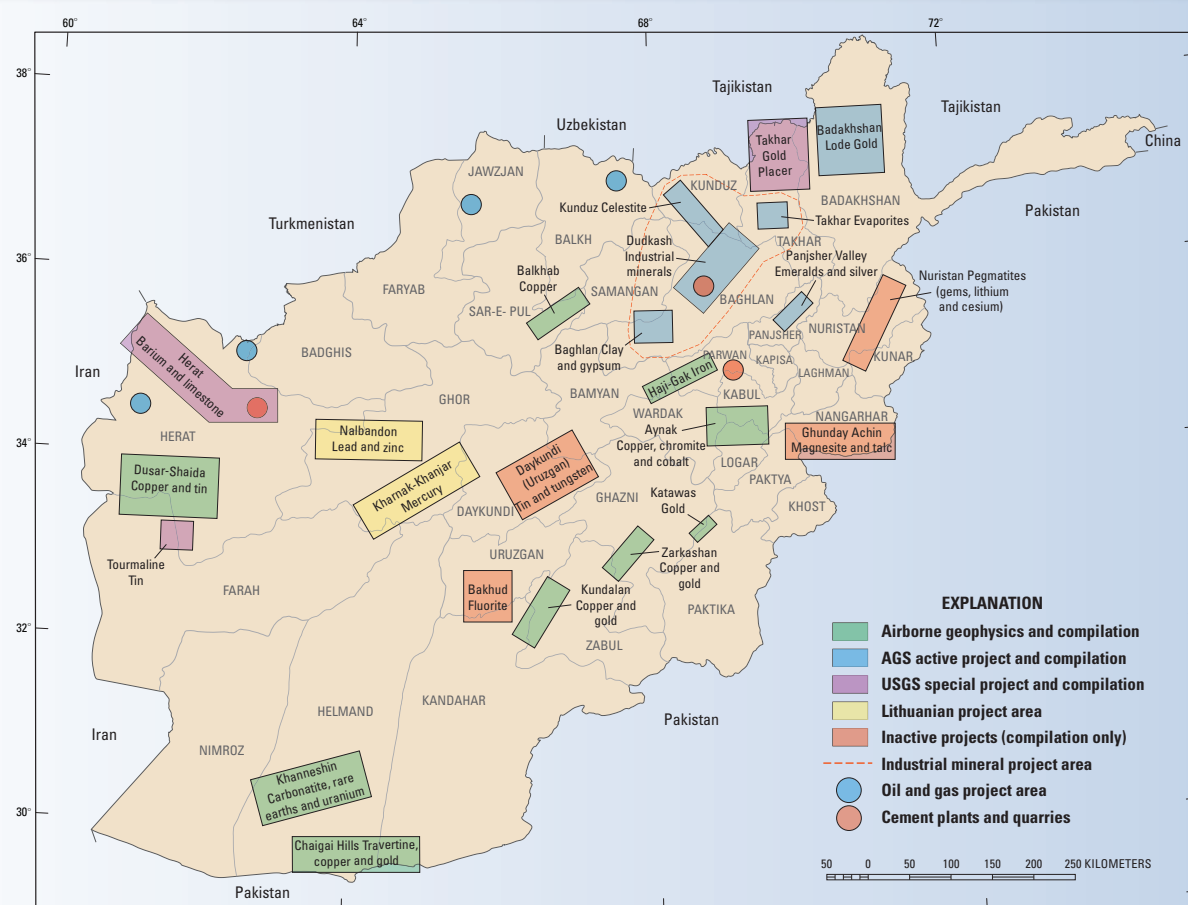


Prepared in cooperation with the U.S. Department of Defense Task Force for Business and Stability Operations, and the Afghanistan Geological Survey

# Summaries and Data Packages of Important Areas for Mineral Investment and Production Opportunities in Afghanistan

*The U.S. Geological Survey released new reports, interpretations, and extensive digital data for 24 mineral Areas of Interest in Afghanistan. These Areas of Interest contain known deposits and prospects of copper, iron, gold, rare earth elements, and other commodities. Many of the mineral deposits are of world-class size and tenor. These new U.S. Geological Survey data packages and reports constitute Information Packages that will help reduce the risk to investors and developers. The Information Packages are designed to be used by the Afghanistan Ministry of Mines in the bidding process and the procedures for the commercial development of these areas. The extraction of Afghanistan's abundant mineral resources is considered critical for creating economic growth, employment, and security.*



**Figure 1.** Map of Afghanistan showing the 24 Areas of Interest (AOIs) identified by the USGS and the locations where mineral data and information were compiled and activities were planned or implemented between 2009 and 2011 for public release.

The U.S. Geological Survey (USGS) of the Department of the Interior and the Task Force for Business and Stability Operations (TFBSO) of the Department of Defense entered into an agreement to study and assess the fuel and nonfuel mineral resources of Afghanistan from October 2009 through September 2011. The work resulted in a report that summarizes new results and interpretations on 24 important Areas of Interest (AOIs) of nonfuel mineral resources that were identified for mineral investment and production opportunities in Afghanistan (Peters and others, 2011). The report is supported by digital data in the form of geographic information system (GIS)

databases and by archival and non-USGS reports on each AOI. The data packages contain from 20 to 50 digital layers of data, such as geology, geophysics, and hyperspectral and remotely sensed imagery. Existing reports and maps are mainly from the Afghanistan Geological Survey (AGS) archive and are Soviet-era (1960s and 1970s) reports. These data are available from the AGS Data Center in Kabul (<http://mom.gov.af/en>; <http://www.bgs.ac.uk/afghanminerals/>) and also are available for viewing and download from the USGS public Web site (<http://afghanistan.cr.usgs.gov/>) and from a separate viewer at <http://mapdss2.er.usgs.gov>.

Afghanistan has abundant mineral resources, but modern technical data and information are necessary if they are to be developed successfully. Previous mineral-resource studies from the Union of Soviet Socialist Republics (USSR) and its Eastern European allies provided Afghanistan with large amounts of technical data. The USGS has added new interpretations of the mineral resources of Afghanistan and has provided quantitative classifications and new data that are designed to help in the development of the mineral resources of the country.

A wide variety of nonfuel mineral resources is known, including important deposits of copper, iron, gold, chromium, silver, barite, sulfur, talc, magnesium, salt, mica, marble, rubies, emeralds, and lapis lazuli. In addition, USGS-TFBSO surveys have also delineated potentially extractable deposits of asbestos, mercury, lead, zinc, fluor spar, bauxite, beryllium, clays, limestone, and lithium.

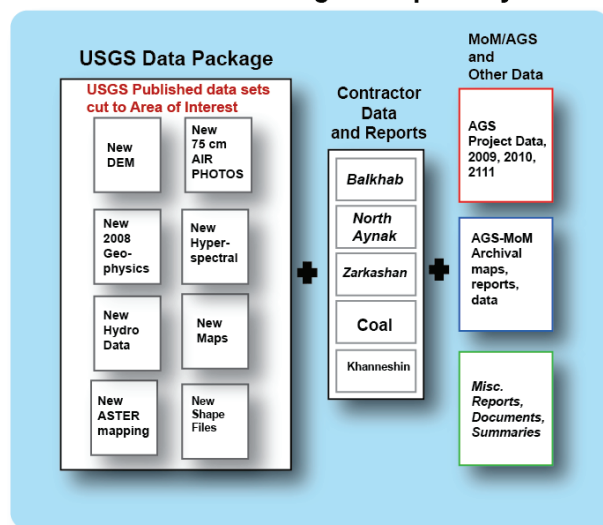
Newly created databases permit an assessment of the potential for near-term economic mining of different mineral, commodity, and mineral-deposit types. The AOIs were selected and identified in 2007 by the USGS (Peters, 2007) as areas where known deposits and resources were identified by Soviet and Afghanistan geologists (Abdullah and others, 1977). The areas include, among others, the giant Aynak copper-cobalt, Haji-Gak iron, Zarkashan copper-gold, and Khanneshin rare earth element deposits (fig. 1). Many other precious and base metal deposits as well as industrial mineral deposits also are highlighted in the newly released reports (table 1).

The AOIs were selected by the USGS on the basis of a preliminary assessment of quantitative estimates of undiscovered nonfuel minerals in Afghanistan (Peters and others, 2007). Many of the most important AOIs were field checked by USGS and TFBSO geologists between 2009 and 2011, and many of the previous Soviet geologic studies were confirmed. Significant quantitative potential of the AOIs is based on USGS estimates that resulted from classification of the

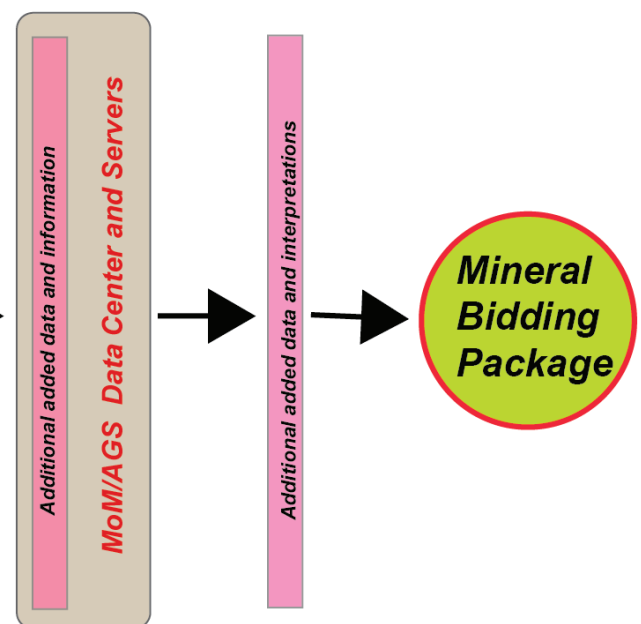
deposits into mineral-deposits models that contain known grade and tonnage characteristics derived from worldwide studies. The economic geology in the AOIs and elsewhere in Afghanistan is documented by archival reports and maps (Eppinger and Sipeki, 2006), and in most cases the areas contain known measured mineral reserves or resources that were generated from previous sampling in trenches, drill holes, and (or) underground workings. Road access is common in most of the AOIs. Therefore, these AOIs contain low-risk assets from an access perspective. USGS data and information may make bidding and operating in these areas easier and may further reduce investment risk. The USGS-compiled digital GIS data for each of the 24 AOIs, and data for an additional 33 subareas within these AOIs, include both previously published USGS and other published data and newly generated data from the joint USGS-TFBSO activities. The aggregate of these data within each AOI constitutes a *Data Package* (fig. 2). These digital data packages have been combined with other existing reports and data generated by the USGS. Data and reports in each AOI are interpreted and summarized in the individual chapters in the report, and these summaries, combined with the archival reports and other information, form technical *Information Packages* for each AOI. The information packages are intended to be used to assemble *Bidding Packages* that would be prepared by the Afghan Ministry of Mines and distributed to potential bidders (fig. 2), in accordance with the Afghan Mining Law and to encourage investors and mining firms to develop the mineral wealth of the country.

Each chapter in the main report (Peters and others, 2011) summarizes mineral-resource studies in the individual AOIs and their subareas. Three chapter types are included: “A” chapters summarize the economic geology, “B” chapters summarize the hyperspectral data and hyperspectral data anomalies that may indicate mineralized areas, and “C” chapters summarize the geohydrology of each AOI. An additional chapter “D” is included for the Haji-Gak Iron AOI, and this chapter discusses the ore reserve calculations.

## Total Information Package Compiled by USGS



**Data packages + contractor data + other reports and data = Information Packages**



**Processing of Data Packages and Information Packages to produce Bidding Packages**

**Figure 2.** Flow chart and classification of data and information packages for each mineral Area of Interest leading to a bidding package. The area in blue is the information package, a combination of U.S. Geological Survey and other data (Peters and others, 2011). Each data and information package complements the chapters in this report and is available on the Web at <http://afghanistan.cr.usgs.gov/>. MoM/AGS is the Ministry of Mines, Afghanistan Geological Survey.

**Table 1.** List of mineral Areas of Interest (AOIs) and their commodities.

[ASTER, Advanced Spaceborne Thermal Emission and Reflection Radiometer; REE, rare earth element]

Area of Interest	Subareas	Deposit models	Main commodities	Minor or possible commodities	Comments
Aynak Copper-Cobalt (Logar Chromite)	Yes	Sediment-hosted copper, podiform chromite	Copper, cobalt, silver	Marble, chromite, asbestos, talc	Reserves at Aynak, Jawhar, and Darband deposits
Badakhshan Gold	Yes	Gold-quartz veins, gold and iron skarn	Gold, iron	Silver, copper, uranium	Weka Dur deposit contains 958 kilograms gold
Baghlan Clay-Gypsum	No	Bauxite, clay, gypsum	Bauxite, clay (kaolin), gypsum	—	Resources contained in Tala Barfak bauxite deposit, extensive clay deposits
Bakhud Fluorite	No	Sediment-hosted fluorite, fluorite vein, polymetallic skarn	Fluorite	Zinc, lead, silver, antimony, barium	Main fluorite district in Afghanistan
Balkhab Copper	Yes	Volcanogenic massive sulfide	Copper	Lead, zinc, coal	Balkhab copper prospect; over 3-kilometer strike length
Chaigai Hills Travertine	No	Travertine, porphyry copper-gold	Travertine (onyx)	Copper, gold, molybdenum	Travertine production, porphyry copper-gold deposits in adjacent Pakistan
Daykundi Tin-Tungsten-Lithium	No	Greisen tin-tungsten, tin-tungsten skarn, lithium pegmatite	Tin, tungsten, lithium	Copper, lead-zinc	Taghawlor lithium pegmatite field, also contains tin and base metals
Dudkash Industrial Minerals	No	Limestone cement, dolomite, bedded celestite, gypsum clay	Limestone cement, dolomite, celestite, gypsum clay	Coal	Located in Pul-e-Khumri area and in Tangi-Murch celestite deposit
Dusar-Shaida Copper-Tin	Yes	Porphyry copper, volcanogenic massive sulfide, tin-copper skarn	Copper, tin	Lead, zinc, tungsten	Shaida porphyry copper prospect
Ghunday-Achin Magnesite-Talc	Yes	Metasomatic magnesite-talc, ultramafic-hosted asbestos	Magnesite, talc, asbestos	Graphite, coal, marble	Achin and Ghunday magnesite-talc deposits near Tora Bora
Haji-Gak Iron	Yes	Volcanogenic iron (?)	Iron	Barium, marble, sandstone, uranium, copper	1.7 billion tonnes + iron ore
Kharnak-Khanjar Mercury	Yes	Epithermal mercury, base-metal skarn	Mercury	Antimony, arsenic, gold, silver (?)	Mercury belt
Katawas Gold	Yes	Epithermal gold-silver	Gold, silver (?)	Mercury, tungsten (?)	ASTER anomaly
Khanneshin Carbonatite	Yes	Carbonatite	REE, uranium, phosphorus	Thorium, barium, strontium, limestone	Significant REE prospect and uranium resources
Kundalan Copper-Gold	Yes	Porphyry copper-gold and skarn	Copper, gold, molybdenum	Silver, lead	Copper and gold resource; multiple occurrences
Kunduz Celestite	No	Bedded celestite, oil and gas, bedded phosphate deposits	celestite (SrSO <sub>4</sub> )	Oil and gas	About 1 million tonnes of celestite in speculative resource and Katar oil occurrence
Nalbandon Lead-Zinc	Yes	Sediment-hosted lead-zinc	Lead, zinc	Silver (?)	Extensive mineral field
North Herat Barium-Limestone	No	Bedded barite, vein barite, chemical limestone, marble, clay, iron skarn	Barium, limestone, marble, clay, iron	—	Major barite field, marble factory, industrial center
North Takhar Gold Placer	No	Gold placer	Gold	—	Past production, gold resources
Nuristan Pegmatite	No	Pegmatites	REE, lithium, tin, and mica	Tantalum, niobium	Paron (Jamanak-Pasgushta) and Pachigram pegmatite fields; lithium resources
Panjsher Valley Emerald-Iron-Silver	No	Emerald, sedimentary iron and silver	Emerald, iron, silver	—	Major emerald mining area
Takhar Evaporite	No	Salt dome, clay, sandstone	Salt, clay silica	Coal, oil and gas	Rock salt deposit at Namakab; porcelain and pottery clay
Tourmaline Tin	No	Tin-tungsten vein, placer tin	Tin (tungsten)	Copper (?)	Previous mining for placer tin
Zarkashan Copper-Gold	Yes	Porphyry copper-gold and skarn	Copper, gold	Silver, lead	Copper and gold resource; multiple occurrences, gold placers



The USGS participated in the planning and execution of USGS-TFBSO scoping missions to the AOIs during 2009, 2010, and 2011. The AOIs visited were the Khanneshin Carbonatite, Chaigai Hills Travertine, Balkhab Copper, Haji-Gak Iron, Northern Aynak Copper-Cobalt, Kundalan Copper-Gold, Zarkashan Copper-Gold, and Dusha-Shaida Copper-Tin AOIs (fig. 1). Data and information gathered on these scoping missions are incorporated in the summaries of each AOI or are part of the data or information packages. In each case, new and unique geologic observations were acquired that allowed evaluation and interpretation of the previous Soviet studies, which in many cases were confirmed.

Previous USGS work on nonfuel minerals was conducted jointly by the USGS and the AGS from October 1, 2007, to the present. The main AGS focus in Afghanistan during 2009 and 2010 was in the Badakhshan Gold, Balkhab Copper, and Panjsher Valley Emerald-Iron-Silver AOIs (fig. 1). Separate reports of this work by the AGS are included within the information packages for each AOI and are also available through the AGS.

All the AOIs were selected as areas that could potentially support mineral production in the near future. As part of the project prioritization process, a number of AOIs or subareas were identified as more important because new information gathered and compiled in 2009 and 2011 confirmed and augmented the geologic concepts or mineral potential resulting from previous Soviet fieldwork and USGS assessments. These important, higher priority AOIs are Badakhshan Gold, Balkhab Copper, Haji-Gak Iron, Aynak Copper-Cobalt, Zarkashan Copper-Gold, Kundalan Copper-Gold, Khanneshin Carbonatite, and Dusha-Shaida Copper-Tin (fig. 1). These AOIs display outcropping mineralization with favorable geometries and simple metallurgical ore types; these characteristics may translate into lower capital costs, shorter lead times, and shorter payback periods. Many of the AOIs may contain ore deposits that could be medium to world class in size and tenor.

Industrial mineral activities by the USGS in Afghanistan between 2009 and 2011 were designed to assess the deposits and use of the industrial mineral resources by Afghanistan indigenous industries. This focus was on cement and marble production. Two cement plants, Jabal-e-Saraj and Pul-e-Khumri, were assessed, and planning for marble and phosphorite development was initiated. Studies of cement are summarized in Peters and others (2011). Additional report chapters summarize information on other industrial minerals, such as clays, gypsum, salt, sulfur, sand and gravel, limestone, and other materials. Geohydrologic activities in support of mineral development involved a number of activities including the completion of the analysis of historical streamflows for Afghanistan.

## Further Information

Supporting geologic studies of mineralized systems and areas of interest are available from the Afghanistan Geological Survey Data Center in Kabul (<http://mom.gov.af/en>; <http://www.bgs.ac.uk/afghanminerals/>) and also are available for viewing and download on the USGS public Web site (<http://afghanistan.cr.usgs.gov/>) and in a separate viewer at <http://mapdss2.er.usgs.gov>.

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