

INTRODUCTION

This map is a modified version of *Geological map of the area of Zarkashan-Anguri gold deposits*, scale 1:50,000 (Meshcheryakov and Sayapin, 1968a). The original map is one of several that accompany Soviet report no. R0657, which was prepared in cooperation with the Ministry of Mines and Industries of the Royal Government of Afghanistan in Kabul in 1967/68 under contract number 1378. This modified map, which illustrates the geologic setting of the Zarkashan-Anguri copper and gold deposits, includes a cross section and displays gold sampling locations that were originally shown on the *Heavy concentrate sampling map of Anguri-Zarkashan gold deposits area* (Meshcheryakov and Sayapin, 1968b).

This map reproduces the topology (contacts, faults, and so forth) of the original Soviet map and cross section and includes modifications based on our examination of that document and on observations made during a brief field visit in 2010. The description of map units, age designations, and unit colors have been modified to conform with Doehrich and Wahl (2006). Mineral symbols have been taken directly from Doehrich and Wahl (2006). Mineral prospect and deposit names have been added from Meshcheryakov and Sayapin (1968a) and Abdullah and others (1977). Elevations on the cross section are derived from the original Soviet topography and might not match the newer topography used on the current map. The map area was visited in April 2010 by the U.S. Geological Survey (USGS) on a brief reconnaissance mission during which grab samples were collected and photographs taken. The grab sampling areas are shown on the map and the photographs are shown in figures 1B, Table 1 contains sample descriptions and gold concentrations from one grab sampling area. Microscopic images of two of these samples are discussed in figures 5 and 6.

DESCRIPTION OF MAP UNITS

Q_{alac} Alluvium and colluvium fan deposits (Holocene and late Pleistocene)
N Fans of alluvium and colluvium; platy and detrital sediments, gravel, sand, clay

IGNEOUS ROCKS

P_{gd} Granodiorite (Oligocene)
N Granodiorite (Phase 1)
KP_{gmb} Gabbro and monzonite (Paleocene and Late Cretaceous)
N Gabbro, monzonite more abundant than diorite; granite, granosyenite, syenite porphyry, syenite
Ad Adamellite
G Gabbro, gabbrodiorite, and diorite

SEDIMENTARY ROCKS

K_{lss} Limestone and sandstone (Early Cretaceous (Aptian and Barremian))
N Limestone, marl, sandstone more abundant than conglomerate
T_{sdld} Limestone and dolomite (Late Triassic (Norian and Carnian))
N Limestone, dolomite
T_{ld} Limestone and dolomite (Middle Triassic)
N Limestone, dolomite. Pattern shown in cross section only
T_{pld} Limestone and dolomite (Middle and Early Triassic)
N Limestone, dolomite, marl
P_{ld} Limestone and dolomite (Late Permian)
N Limestone, dolomite more abundant than marl, conglomerate, sandstone, siltstone, shale, bauxite and bauxite-bearing rocks. Pattern shown in cross section only
Osl Limestone, sandstone, siltstone, shale (Ordovician-Silurian?)

ALTERATION

M Marble or partly dolomitized limestone
G Garnet alteration
C Contact-metamorphosed rock (hornfels)

EXPLANATION OF MAP SYMBOLS

Contact—Dotted where inferred
Regional fault or fracture zone—Dashed where inferred. In cross section, arrows indicate relative movement
Fault or fracture—Showing dip. Dashed where inferred. U, upthrown side; D, downthrown side. In cross section, arrows indicate relative movement
Strike and dip of bedding
Dike vein complex, granite apfites, granosyenites, apfites—Located in area of Zarkashan gold deposit
Fossil collecting site
Gold sampling site from Meshcheryakov and Sayapin (1968b)—Showing number of gold grains counted in a sample, color tint identifies sample collected in 1967; nc, no count
Outline of grab sampling area (USGS, 2010)
Regional synclinal axis—Showing direction of plunge
Ancient pit
Road
Town or village

METALLIC AND NONMETALLIC MINERALS

[Project name is shown next to symbol]

Vein gold, undivided
Skarn gold (± copper)
Placer gold
Unclassified gold
Mississippi Valley-type lead-zinc
Skarn tin
Unclassified tin
Marble



Figure 1.—Igneous breccias from the Zardak gold prospect area. This may be an isolated dike or pipe intruded into the hornfels country rock. Field of view is approximately 30 cm. Photograph by Stephen G. Peters, USGS.



Figure 2.—View of the Zarkashan gold deposit area looking northeast, showing pluton in the background (dark knobby rocks) and hornfels and skarn in the foreground. Red color coincides with mapped alteration zones and hyperspectral anomalies for goethite and sericite. Photograph by Stephen G. Peters, USGS.



Figure 3.—View of the Zarkashan gold deposit area looking southeast, showing trenches above the road and two major faults. Location is within the area of the red box shown on the map. Photograph by Stephen G. Peters, USGS.



Figure 4.—Iron-stained outcrop at the Below gold prospect area looking west into the village in the valley. Photograph by Stephen G. Peters, USGS.

Table 1.—Gold concentrations in grab samples collected from the Zarkashan gold deposit area by the USGS in April 2010. Collection area is outlined by the red box on the map. ppb, parts per billion.

Field No.	Sample Description	Gold (ppb)
ZR10001	Pyrrhotite sericite in hornfels	11,000
ZR10002	Malachite-stained skarn	9,460
ZR10003	Slate and malachite and chalcopryite	1,770
ZR10004	Malachite-stained skarn and greisen	23,000
ZR10005	Malachite and skarn/slate	182,000
ZR10006	Black malachite-stained skarn	18,000
ZR10007	Pyrite-rich sericite hornfels	6,800
ZR10008	Sericite hornfels	6,400
ZR10009	Pyrite-rich skarn	70,000
ZR10010C	Oxidized ore and pyrite	8,490
ZR10011	Oxide ore	13,000
ZR10012	Malachite-stained hornfels	35,000
ZR10013	Malachite-stained hornfels	88,000
ZR10014	Fibrous hematite	633
ZR10015B	Hornfels (representative of background)	19,000
ZR10016	Malachite-stained hornfels	1,290
ZR10017	Pyrite-rich hornfels/skarn	11,000
ZR10018	Malachite-stained hornfels	6,240

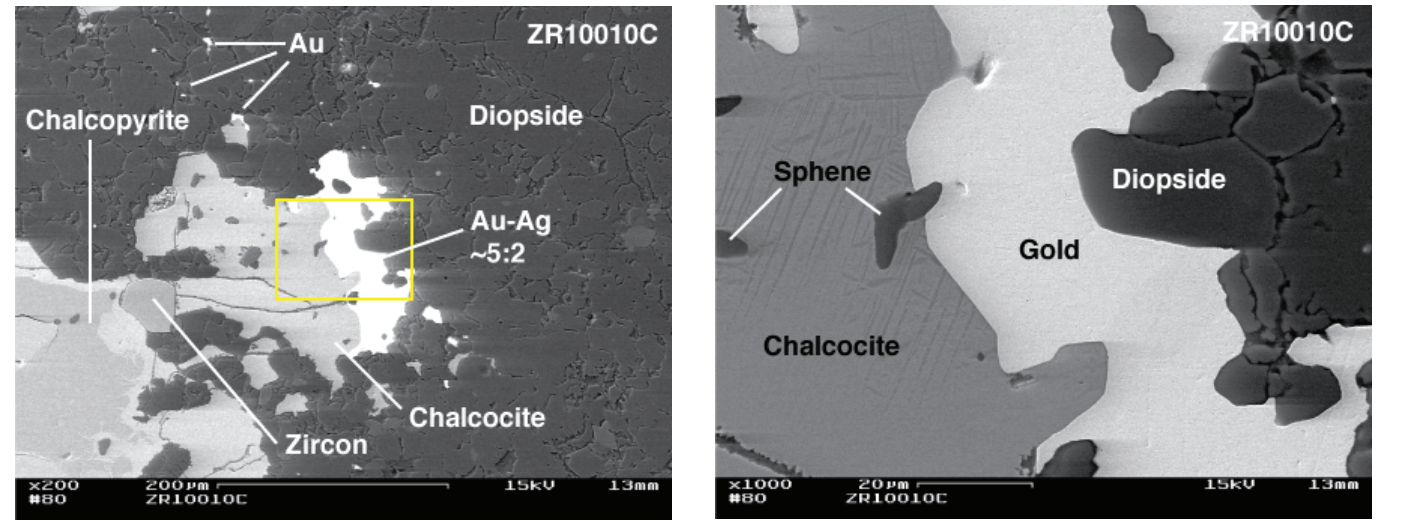


Figure 5.—Scanning electron microscope backscattered images of sample ZR10010C, which is a chalcopryite-bearing diopside hornfels or skarn containing fairly widespread concentrations of the scapolite-group mineral melonite (not shown in images). This sample contains a large (about 200 µm wide), irregularly shaped bleb of free gold (see image A). Additionally, diopside and melonite appear cognetic and stable with each other, and this particular diopside hornfels or skarn also contains minor amounts of quartz. The Au:Ag ratio in the gold bleb is about 5:2 on the basis of peak heights for each of the two elements. **A**, Free gold in the sample also is present as a number of small blebs in open spaces among diopside crystals. The textural relations also suggest that gold, chalcopryite, sphene, and diopside, as well as melonite, may have been coexisting stably at one time prior to secondary alteration of much of the chalcopryite to chalcocite. Though not much melonite is in the rock, where present it is in close textural association with unaltered chalcopryite. **B**, Enlargement of the area of image A outlined by yellow box, showing that free gold must have been coexisting with chalcopryite, rather than being a product of oxidation. Scale shown at bottom of images. Abbreviations used: Au, gold; Ag, silver. Images from Ted Theodore, USGS, August 2010, written commun.

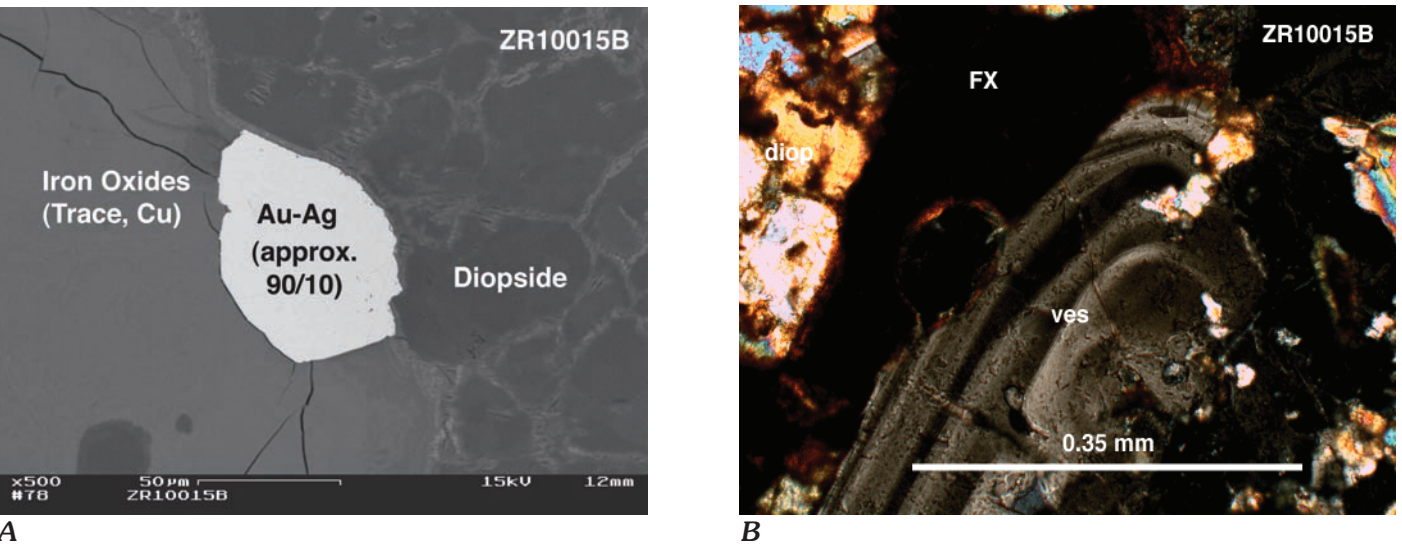
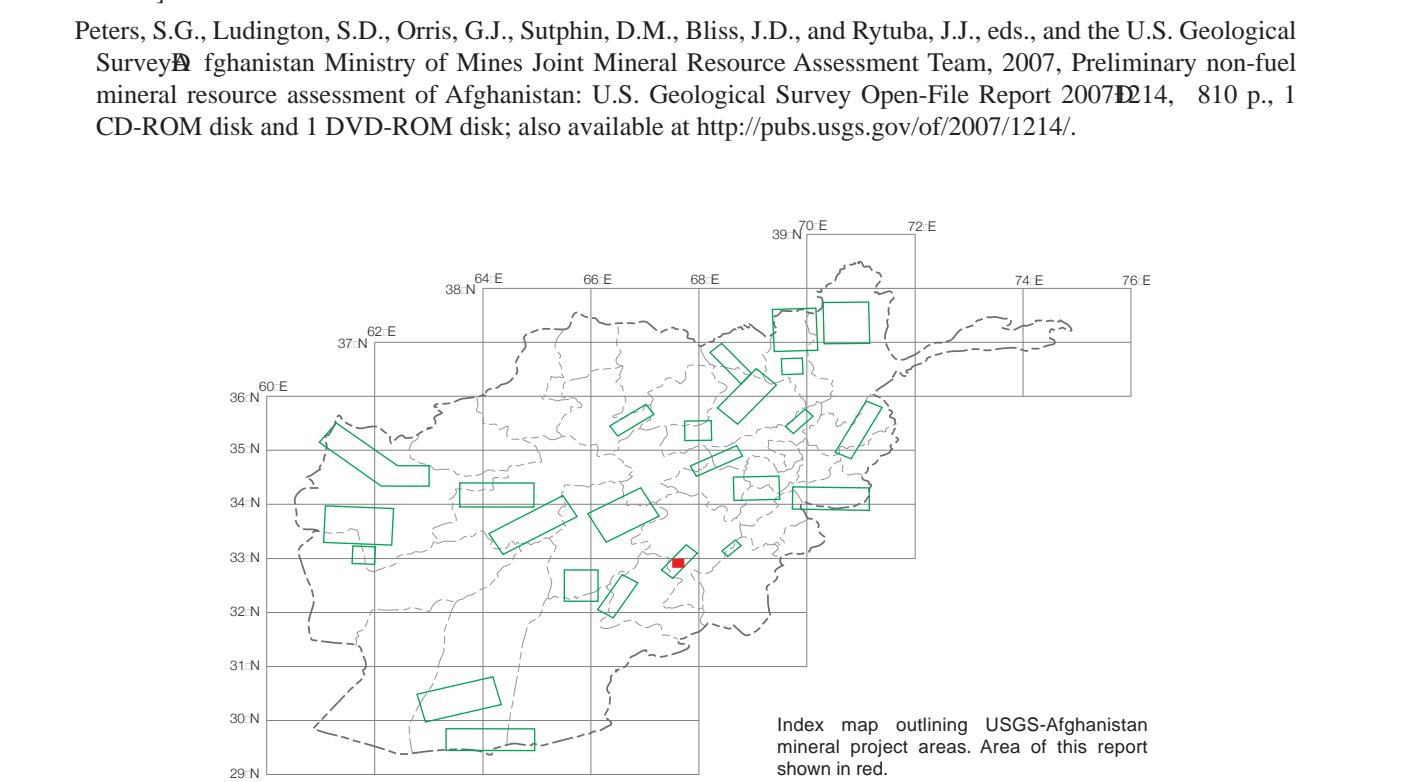


Figure 6.—Scanning electron microscope backscattered images (A, C) and photomicrographs (B, D) of sample ZR10015B, which is a gold-bearing grossularite-diopside copper (chalcopryite) gold skarn. **A**, Gold grain between iron oxides and diopside. **B**, Growth zones of almost isotropic and low birefringent vesuvianite indicate a fluctuation of major-element ratios in fluids associated with its crystallization just prior to cessation of its growth. **C**, Gold grains inside chlorite-iron oxide matrix, which is enclosed in skarn minerals, garnet, apatite, and diopside. **D**, Wider field of view of area shown in A in reflected-light polished section, in which gold grains are located with iron-oxide minerals between garnet and diopside grains. Scales in A and C shown at bottom of image. Abbreviations used: FX, iron oxide (mostly including silica and traces of copper); Cu, copper; Au, gold; Ag, silver; gar, garnet; diop, diopside; ves, vesuvianite. Images from Ted Theodore, USGS, August 2010, written commun.

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Geologic Map of the Zarkashan-Anguri Copper and Gold Deposits, Ghazni Province, Afghanistan, Modified From the 1968 Original Map Compilation of E.P. Meshcheryakov and V.P. Sayapin

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