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Mineral Exploration in the Al Madiq Prospect, Hijaz Terrane, Kingdom of Saudi Arabia

By Fares Almalki, Mohamad Hakami, Hisham Nyazi, Ibrahem Alzahrani, Abdullah Alsemiri, Fahad Alharbi, and Mostafa Rabee

The Saudi Geological Survey has initiated a phased exploration program to enhance our understanding of mineralization in the Al Madiq area. Copper-associated mineralization is observed in narrow bands, frequently linked to quartz veins and parallel-oriented alteration zones. Silver appears to be closely associated with copper mineralization. Additionally, gold has yielded promising results and appears to be hosted within the same country rocks that contain the copper- and silver-bearing quartz veins.

The Al Madiq project area covers approximately 7.3 km2 and is situated in the southeastern portion of the Hijaz Terrane, approximately 115 km south of Al-Madinah City.

Previous works, including regional geological studies conducted by the Directorate General of Mineral Resources (DGMR) and the French Geological Survey (BRGM) in 1969 and 1970, did not identify the project area as a mineral occurrence. The recent first-phase exploration work described in this report involves surface sampling, mapping, trenching, petrographical studies, and geophysics.

A sequence of metamorphosed Neoproterozoic volcano-sedimentary rock units of greenschist facies underlies the project area. The quartz veins, believed to be associated with orogenesis, are steeply dipping, narrow, milky, smoky quartz veins that generally strike east-west and extend for hundreds of meters. These veins primarily contain chalcocite and chalcopyrite, which have undergone varying degrees of alteration to covellite. Additionally, minor amounts of sphalerite, pyrite, and goethite are present. Notably, the quartz veins are restricted to the meta-volcanic pyroclastic rocks, as evidenced by field observations. Regional propylitic alteration is widespread and characterized by argillic, chloritic, oxidation, and silicic alterations occurring in close proximity to the quartz veins.

Surface sampling focused on the outcropping quartz veins, resulting in the collection of 118 samples. The mapping effort produced a detailed 1:3,000-scale geological map of the project area. Trenching involved excavating 30 trenches totaling 764 meters. These trenches, with an average length of 25 meters, were oriented approximately north-south, perpendicular to the general east-west strike of the quartz veins. A total of 365 samples were collected from the trenches. Petrographical and mineralogical study reports were compiled for 114 samples selected from surface and trenching sampling programs. Geophysical methods, including Electrical Resistivity Tomography (ERT), Induced Polarization (IP), Magnetics, and Gravity, were applied, and over ten selected profiles were surveyed. Most ground survey lines followed a north-south orientation, aligning with the general east-west orientation of the quartz veins. Other lines were oriented differently for structural and lithological identification

Example of a trench at the Al Madiq project area.

purposes, with each profile line spanning approximately 300 meters.

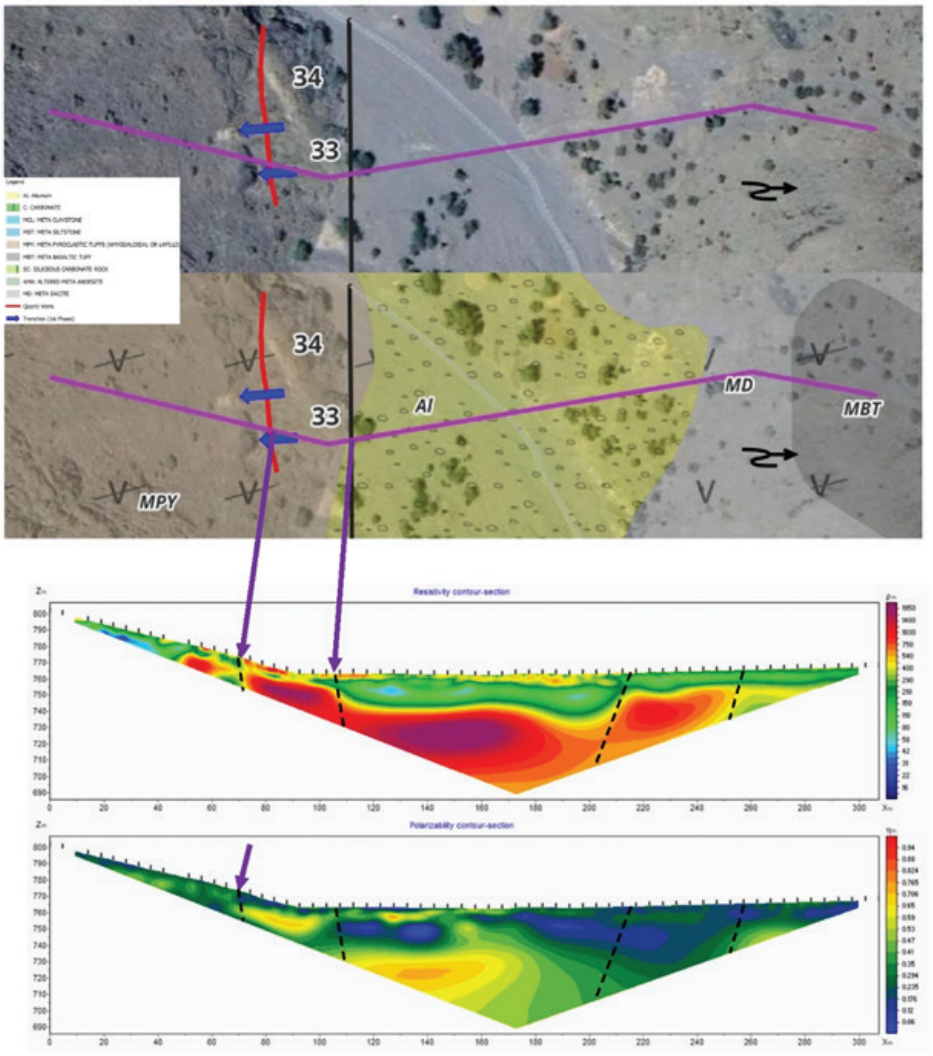
The initial promising results for copper, gold, and silver indicate the potential for a gold mineral deposit with copper and silver as valuable by-products (Au, Cu-Ag) in the Al Madiq project area.

The Al Madiq exploration area covers approximately 7.3 km² and is situated on the western side of the Hijaz Province, approximately 115 km south of the Al-Madinah City. It falls within the Al Madinah Province. Access to the area is by a paved road connecting Al Ased hamlet to the highway that links Al Faqirah and Rabigh.

The Al Madiq project area is underlain by a sequence of Neoproterozoic volcano-sedimentary rock units, which underwent low-grade metamorphism during the early-middle Cryogenian period (approximately 850-740 million years ago). These rocks belong to the Qidirah formation within the Furayh Group and exhibit green-schist facies (Camp, 1986). The Furayh Group is situated in the southern part of the Hijaz Terrane, specifically within the Birak. It is separated from the Mahd adh Dhahab-Samran arc by the Bi'r Umq suture zone (Johnson and Kattan, 2012).

Regionally, propyllitic alteration is widespread, characterized by argillic, chloritic, oxidation, and silicic alterations that are narrowly proximal to quartz veins, alteration, and shear zones.

The meta-volcanic rocks predominantly consist of finely porphyritic to dense, dark green, gray, low-K calc-alkaline



Ground Geophysical Models (ERT and IP) for Profile-2V.

series of meta-andesite-dacite. These rocks exhibit general propyllitic alteration, characterized by the dominance of epidote and chlorite. Occasionally, these minerals are localized along quartz veins, alteration zones, and shear zones. In certain areas, bleaching and silicification have occurred, resulting in numerous quartz seams and pods within sheared and brecciated zones within the meta-volcanic rocks.

In the western part of the Al Madiq area, the meta-volcanic rock unit primarily comprises green to dark green, massive to poorly layered meta-andesite-dacite, and meta-basalt. These rocks are locally interlayered with reddish-pink to light brown rhyolite and rhyolitic tuffs. Within the lava flows, andesitic-dacitic meta-tuff displays poor layering.

The project area is underlain by meta-sedimentary rocks that disconformably overlie the meta-volcanic units. These meta-sedimentary rocks primarily consist of siltstone, mudstone, and marl, arranged in successive layers. In specific areas within the NW and SW, these rocks are overlain by dark gray altered marble beds.

The quartz veins, believed to be associated with orogenesis, are restricted to the meta-volcanic and meta-pyroclastic rocks. These veins are steeply dipping and narrow and exhibit milky and smoky quartz veins. Notably, visible copper mineralization occurs along narrow bands within the parallel-oriented alteration zones. The veins strike generally E-W and extend for hundreds of meters.

Regionally, the dominant major structures affecting the project area include NNW- and EW-trending faults. Detailed geological investigations reveal that the prevailing structural trends within the project area are E-W, NW-SE, and N-S, exhibiting both dextral and sinistral strike-slip movement. Further detailed structural investigations may be necessary for verification.

The majority of the mineralized quartz veins exhibit an E-W trend, while the minority follow the NW-SE trend. The overall schistosity trend within the meta-volcanics and meta-pyroclastics is approximately E-W, with a general dip toward the NE direction. The dip angles vary between 8° and 40°.

CONCLUSIONS

- The Al Madiq project area is comprised of a sequence of meta-volcanic and meta-sedimentary rock units of low-grade greenschist metamorphism. Within the meta-volcanic rock units, orogenic mineralization of quartz veins and alteration zones is constrained.
- Copper and silver mineralization concentrate in quartz veins and alteration zones, whereas gold concentrates in the country rock. The highest values are for surface samples taken from the quartz veins.
- The presence of varying gold and silver values across different trenches and surface samples added another insight into the project area's value.
- The results from both surface and trench samples indicate interesting gold values, with some exceeding 13.7 g/t Au and 23 g/t Au, respectively. However, the specific style of gold mineralization within quartz veins and the host country rocks remains unclear. Additionally, silver exhibited interesting high values, reaching a maximum of 924.7 ppm Ag. Unfortunately, silver testing was limited to surface samples.
- Based on the findings from comprehensive geophysical investigations in the study area, with particular emphasis on electrical resistivity tomography (ERT) and induced polarization (IP) analysis, it has been determined that the upper 80 meters of the subsurface consists of four primary geological units. However, the nature of the fourth unit remains unknown. Additionally, the study has revealed the presence of numerous faults intersecting the area, exhibiting diverse orientations, along with some anomalous IP zones. (SGS-OF-2024-1)