A Petrographic Study of Jasperoids from Sepon Gold Deposits, Laos

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Introduction

The Sepon Cu-Au deposits are located in south central Laos and include a spectrum of mineral deposit types that range from porphyry and skarn to sediment-hosted gold with affinities to Carlin-type gold deposits. Like Carlin-type gold deposits, the main gold mineralization is hosted within calcareous shales and carbonates, and jasperoids are closely associated with gold mineralization. A petrographic-based study of jasperoids from different locations within the district was conducted to: 1) characterize mineralized jasperoids, 2) compare mineralized versus barren jasperoids, and 3) determine the origin of "chert-like" siliceous layers within the sedimentary units.

The Sepon district is located within the inverted Sepon Basin, situated within the southwest portion of the northwest-trending Truongson Fold Belt. The east-trending Sepon Basin is interpreted as a pull-apart basin formed during transpressional movement of the fold belt (Smith et al., 2005). The controlling northwest-trending faults associated with the Truongson fault system truncate the east-trending basin-related faults. Within the mining district, continental-derived Ordovician to Silurian siliciclastic rocks occur to the south and east and marine Silurian to Devonian carbonate rocks occur to the north and west. Locally, sills and dikes of Permian rhyodacite porphyry (RDP) cut the Paleozoic sedimentary rocks.

Gold occurs as inclusions within pyrite along formation contacts and steeply dipping faults. The continuity of mineralized zones between these two styles indicates that the ore bearing fluids were introduced either syn- or post-deformation, which is interpreted to reflect compression during basin inversion contemporaneous with RDP intrusion (Smith et al, 2005). The presence of dolomitization, decalcification, silicification, brecciation, veining and a variety of base-metal (Zn, Pb, Cu) and pathfinder (As, Sb, Ag) sulfide assemblages suggest that multiple mineralization and alteration stages occurred.

Methods and Results

Petrographic analysis was completed on twenty-seven polished thin sections using optical microscopy. Eighteen thin sections were further analyzed using scanning electron microscope (SEM) and qualitative energy dispersive spectroscopy (EDS). All analyses were completed in the Geology and Geological Engineering department labs at the Colorado School of Mines, Golden, Colorado.

Samples

Protolith, cherty and jasperoid samples were collected from the Discovery Trend area, the Houay Yeng deposit and other locations throughout the district. The Discovery Trend deposits (Namkok, Nalou, Daoleuk, Discovery Main, Discovery West, and Discovery Colluvium) are hosted in the calcareous shale and carbonate members of the Silurian to Devonian Nam Kian, Discovery and Nalou Formations. The Houay Yeng deposit is located approximately five kilometers southeast of the Discovery Trend. The host rock is the carbonate member of the Silurian Vang Ngang Formation, part of the older siliciclastic sequence described as a karst fill and collapse breccia. In addition, samples of barren jasperoid were collected from both stratigraphic sequences at the Ban Mai prospect, located on the western edge of the district, and the Phu Nga prospect, two kilometers south of the Discovery Trend.

Discovery Trend

Within the Discovery Trend, mineralized jasperoid developed in both calcareous shale and dolomite. Disseminated framboidal pyrite is found in the calcareous shale of the Discovery Formation, with clusters of pyrite displaying textural zoning of porous, inclusion-rich cores to solid rims with circular to incipient subhedral morphologies. No compositional zoning was discovered within the framboidal cores and overgrowth rims. The framboids contain minor galena and sphalerite inclusions. Locally, chalcopyrite replaces the surrounding carbonate-rich matrix.

Jasperoids within the Discovery Trend have a silicified mosaic texture with finer grain sizes found in organic rich areas. Relict textures of bioclasts, bedding, or dolomite crystals are defined by unaltered organic material, but other samples are intensely silicified with no relict textures. Sharp contacts between carbonate and silicified areas are found along stylolites, and microscopic gradational zones show finer grained dolomite crystals interfingered with a very fine-grained silicified matrix. Base metal mineralization (galena, sphalerite, chalcopyrite), stibnite, tennantite/tetrahedrite and silver sulfosalts are found within the fine-grained, silicified domains. Cromie et al (2006) interpreted this assemblage as an earlier stage of mineralization to the main gold mineralization. This paragenetic relationship is also found in brecciated mineralized clasts. Veining ranges from single thin quartz veinlets to thicker veins displaying multiple fluid inclusion growth horizons. Quartz veins appear transitional with the silicified matrix of breccias. Breccias contain jasperoid clasts as well as vein-quartz clasts suggesting multiple stages of silicification and quartz veining. Locally, euhedral quartz within veins displays feathery extinction similar to epithermal textures (Adams, 1920; Dong et al., 1995). Free gold was found at Discovery Colluvium and occurs within finer-grained vuggy quartz veins without zonal growth texture.

Houay Yeng

At the Houay Yeng deposit, mineralized jasperoid developed in a carbonate protolith containing minor fine-grained euhedral pyrite. The textures interpreted to reflect silicification within the mineralized jasperoids at this location are coarser grained and reticulated, defined by elongated quartz grains with a preferred orientation creating a cross hatched appearance. Preserved primary textures are minimal with the exception of stylolites and clay-rich areas. Mineralization within the reticulated silicified matrix is a combination of euhedral pyrite and arsenopyrite with inclusions of gold, electrum, and tennantite/tetrahedrite. Locally, larger euhedral pyrite displays arsenic zoning, but gold was not identified in these instances. Stibnite is

found locally filling vuggy quartz veins that have multiple growth zones and is interpreted to be part of a later stage of mineralization. Hematite coatings along fractures and vuggy quartz veins are interpreted to be supergene in origin.

Barren Jasperoids

The samples taken from unmineralized jasperoids are composed of fine-grained mosaic silicification texture similar to the Discovery Trend. One sample has relict bedding preserved by organic material. Only trace euhedral pyrite is found within the matrix, and no other sulfide minerals were observed. Zonal and feathery textures of the euhedral vuggy quartz veins are also found crosscutting the silicified matrix.

Cherty Samples

Both the Discovery Trend and Houay Yeng deposits have associated "cherty" beds proximal to mineralization. Mine geologists have interpreted these as primary chert or possibly secondary silicification related to surficial supergene processes. The silica matrix is microcrystalline to cryptocrystalline. Cherty layers with crude bedding of calcareous to shale components transition into adjoining lithologies. Spherical and tabular microfossils are concentrated parallel to bedding. Identifying these siliceous beds as either primary chert or later silicification is inconclusive.

Conclusions

A primary conclusion of this study is that the Sepon jasperoids are characterized by multiple stages of silicification including early pervasive jasperoid silicification and later quartz veins and vein-quartz breccias. Other conclusions include:

1. Base metal mineralization is associated with fine-grained mosaic silicification at the Discovery Trend deposits.
2. Precious metal mineralization is associated with medium-grained reticulated silicification as inclusions within pyrite and arsenopyrite at Houay Yeng deposit.
3. Rare visible gold is found within quartz veins at Discovery Colluvium deposit.
4. Later vuggy quartz veining displays epithermal-like feathery texture and is not mineralized.

References

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