

Contemporaneous volcanism and hydrothermal mineralization: An example from the Northwest Quartz-Pyrite-Gold (QPG) veins, Lepanto, Mankayan District, Philippines

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We present the characteristics of mineralization at the Northwest Quartz-Pyrite-Gold (NW QPG) veins that have been recently delineated in the Lepanto Mine, Mankayan Mineral District, northern Luzon, Philippines. The NW QPG deposit is an older high-sulfidation epithermal copper-gold deposit occurring deeper than the younger Lepanto enargite-gold orebody. Underground exposures and drill hole intercepts show that the NW QPG ores occur as veins and vein breccias that are associated with sericitic and advanced argillic alteration haloes. Two main episodes of mineralization have been determined through paragenetic studies. The first stage is composed mainly of quartz veins and breccias that are associated with abundant luzonite, enargite and pyrite. The later mineralization stage is composed mainly of pyrite-rich quartz veins associated with sphalerite, galena, tennantite-tetrahedrite solid solution and chalcopyrite. Gold and silver occur as tellurides and sulfides that are included in pyrite, luzonite and enargite crystals. Microthermometry on fluid inclusions in quartz indicates that the temperatures of ore formation of late-stage mineralization were higher. Analysis of volatile components in fluid inclusions in quartz shows that the early-stage mineralization is dominated by boiling fluids with significant magmatic component, while the late-stage mineralization was formed by mixing with meteoric water. The higher temperature of late-stage ore-formation is consistent with the presence of coarse-grained muscovite and pyrophyllite in the enveloping sericitic and advanced argillic alteration zones. These conditions indicate that the late-stage mineralization was formed at greater depths, which could be due to the deposition of pyroclastics materials above the hydrothermal system. The Ar-Ar age of the NW QPG mineralization determined in this study indicates that the mineralization was contemporaneous with the volcanism that produced the Imbanguila Dacite, which subsequently covered this older epithermal deposit prior to the mineralization of the Lepanto enargite-gold orebody along the unconformity. The presence of similarly-aged Teresa intermediate sulfidation epithermal vein-type and Fatima porphyry-type mineralizations indicates that there are more than one hydrothermal systems preserved in the Mankayan District.

Keywords: Lepanto Mine, Mankayan District, Geochronology, Fluid inclusions Analysis