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## Mineralogical Characterization and Location of Critical Metals in the VHMS: Reevaluating the Potential of the Tharsis Mine

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The Iberian Pyrite Belt hosts some of the largest resources of base metals in Europe, hosted by what is considered the largest VHMS district worldwide. However, these deposits also have a significant anomaly in critical metals such as Co, Bi, Te, In, Ga, or Ge.

The Tharsis deposit is one of the most important VHMS deposits in the Iberian Pyrite Belt with original reserves of over 130 Mt. This shale-hosted deposit contains at least six massive sulfide orebodies and an underlying stockwork developed on chloritized dark shale. The ore exhibits various types of mineralization, mainly composed of pyrite with minor amounts of chalcopyrite, sphalerite, and galena. However, a facies enriched in siderite (carbonate ore) and the stockwork include a more complex mineral assemblage with significant contents of Co, Bi, Te, and Au.

This study aims to detail the mineral assemblage hosting these critical metals, their genesis, and to delineate the ore-rich zones within the stockwork. The stockwork consists of irregular veins composed of pyrite, minor quartz, Co–As–Fe–S minerals, and traces of Bi–Pb–Cu–(Sb) sulfosalts, tellurides, and native gold. LA-ICPMS shows that the pyrite is also variably enriched in these critical metals. Preliminary results show that there is a positive correlation between Bi–Au ( $r = 0.94$ ) and Co–Au ( $r = 0.74$ ). The data are consistent with the presence in the assemblage of cobalt-bearing minerals (e.g., cobaltite, allosclausite, and/or glaucodot) and Bi minerals (kobellite and/or bismuthinite) and strongly suggest that Co, Bi, and Au occur as solid solution or nanoinclusions. Spongiform and colloform pyrite is enriched in As and Au, likely formed in a high-temperature environment from a low  $fS_2$ – $fO_2$  fluid.