

Use of mining wastes for high-tech thermoelectric applications – The case of START project in Iberian Pyrite Belt

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Europe aims to become the first climate neutral continent by 2050, which means rapidly implementing a green transition to which the European Union (EU) is strongly committed through the European Green Deal. This green transition leverages unprecedented pressure on the intensive use of mineral resources. In this context the START project “Sustainable Energy Harvesting Systems Based on Innovative Mine Waste Recycling” emerged with the objective to use mining waste as a source of raw materials for the development of advanced energy conversion devices. Thermoelectric materials (TE) are functional materials that can directly convert thermal energy into electricity. Tetrahedrite, a copper antimony sulfosalt, possesses such properties, and when antimony is replaced by arsenic, it forms tennantite ($\text{Cu}_{12}\text{As}_4\text{S}_{13}$). Portugal has a long mining history, resulting in large amounts of mining waste. In the Iberian Pyrite Belt in the south of the country, which is one of the world's largest repositories of massive sulphide deposits, VHMS and vein-type deposits contain significant quantities of tetrahedrite. Mineralogical and chemical quantification and metallogenetic studies are conducted on samples from Neves-Corvo (VHMS), Barrigão and Brancanes (vein-type) to characterise the quantities of minerals of interest. The major mineralogical phases identified were: (chalcopyrite ± pyrite ± quartz ± tennantite ± sphalerite ± stannite) in Neves-Corvo; (quartz ± dolomite ± chalcopyrite ± tennantite) in Barrigão; (dolomite ± chalcopyrite ± quartz ± tennantite) in Brancanes. Chemical analyses show in Neves-Corvo (0.3% As and 349 mg/kg Sb); Barrigão (1.7% As and 11549 mg/kg Sb) and Brancanes (0.3% As and 1069 mg/kg Sb). The Neves-Corvo samples show a high content in Ag (120 mg/kg) and Se (327 mg/kg) WHICH can be used as a sub-product.

Current data support the presence of tennantite-tetrahedrite group minerals in IPB mines, which can be exploited as a secondary resource. Previous data show that As has neither a beneficial nor a detrimental influence on the thermoelectric properties of tetrahedrites. More studies should be performed to evaluate the tetrahedrite volume in these and other deposits in Iberian Pyrite Belt for their application in TE materials.

Funding and Acknowledgments: START project (project number: 101058632) is co-funded by the European Union.