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Recovery of mining waste as source of raw material for the synthesis of tetrahedrite-tennantite materials

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The present study intents to demonstrate the feasibility of the direct incorporation of tetrahedrite-tennantite (td-tn) dump material as raw material in the processing cycle of td-tn materials ($Cu_{12-x}(TM)_x(Sb,As)_4S_{13}$, TM – transition metal) through mechanochemical synthesis (MCS). This was evaluated by preparing powder mixtures containing different mass ratios (20% to 80%) of td-tn dump material (collected in the waste dumps of the abandoned Barrigão copper mine, located in the Portuguese zone of the Iberian Pyrite Belt) and synthetic tetrahedrite (syn-td, prepared by MCS). MCS was done on a planetary ball mill at 340 rpm/ 2 h. Uniaxially pressed pellets from the MCS powders were heat-treated (HT) in vacuum between 350ºC – 450 ºC. Phase formation/chemical homogeneity was investigated using X-ray diffraction, transmission and scanning electron microscopy.

The MCS have led to an increase in the amount of the td-tn phase and to a complete dissolution of the dump material sulfides with the syn-td constituents resulting in the formation of a td-tn solid solution with Fe. Quartz was present in all MCS powders, while Cu_3SbS_4 was observed in the mixtures with 20% dump material. No phase decomposition was observed with HT. The obtained results are of major relevance in light of their potential environmental benefits and show that the approach followed represents an opportunity to recover valuable resources.

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