

Towards the Recovery of By-Product Metals from Mine Wastes: An X-Ray Absorption Spectroscopy Study on the Binding State of Rhenium in Debris from a Centennial Iberian Pyrite Belt Mine

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Abstract

Rhenium is a very scarce element, occurring in the Earth's crust mainly carried by molybdenite (MoS_2). Due to a very low availability comparative to actual industrial demand, rhenium is nowadays one of the most expensive mineral commodities and an increased interest is focused on exploring residues resulting from a long-term mining, particularly of sulphide ore deposits. It is therefore noteworthy to assign the presence of rhenium (in a concentration up to 3 ppm) in the waste materials from the old sulphur factory at the abandoned mine of São Domingos (Iberian Pyrite Belt, Southeast Portugal), exploited since the Roman occupation of Iberia. Aiming at a potential sustainable recovery of rhenium as a by-product, X-ray near-edge absorption spectroscopy (XANES) was applied to clarify the Re-binding and mode of occurrence by comparing Re L_3 -edge XANES spectra obtained from mine waste samples (previously fully characterized by X-ray laboratory techniques) with similar spectra collected from Re-rich molybdenites ($\text{Mo}_{1-x}\text{Re}_x\text{S}_2$) and from Re-O model compounds configuring various valences and coordination environments of rhenium ions. Obtained results are commented, ruling out a possible Re-S binding and rather conforming with the binding of rhenium to oxygen in the analysed mine waste materials.

Keywords

Mine Waste Materials By-Products; Iberian Pyrite Belt; Rhenium; XANES; Re L_3 -Edge

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