



X-ray absorption near-edge spectroscopy (XANES) applied to the speciation of tungsten in Panasqueira mine debris*

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Nowadays considered a critical metal for the EU [1], tungsten has unique physical-plus-chemical properties blocking its replacement in relevant specialized industrial applications and turning it an essential commodity and a metal of high strategic importance. Tungsten mining at Panasqueira (Beira-Baixa district) rendered Portugal the main European producer, and an exploitation history of more than a century has produced a huge tonnage of debris (attaining 0.3% WO₃ [2]). In view of EU efforts to implement a sustainable retrieval of critical mineral resources, recovering tungsten from Panasqueira mine tailings is a prime objective.

An X-ray absorption spectroscopy approach using synchrotron radiation was addressed to W in those mine residues in 2013 [3] and obtained results encouraged a deeper study undertaken last June at the ESRF beamline BM 25-A (SpLine) through the experiment ES-128. An extensive X-ray absorption near-edge spectroscopy (XANES) study was performed at W L₁- and L₃-edges by irradiating materials sampled at the tailings deposit of Rio [4], both at the surface and in depth, along with reference minerals and model compounds, all previously characterized by X-ray diffraction (XRD) and fluorescence (XRF) laboratory techniques.

Comments are presented on the implications of the pre-edge absorption effect registered in the W L₁ XANES spectra (characteristic of W⁶⁺ in tetrahedral coordination) and of the white-line observed in W L₃ spectra (split when those ions fill distorted octahedra); these details are further discussed in relation to the crystal structures of tungsten carrier minerals and complement published data [e.g.,5]. Despite having been assigned fifty years ago in surface materials collected at Rebordões and Seladinho dump valleys [6], tungstite (crystalline WO₃·H₂O) could not be clearly identified in the studied Rio samples, indicating that tungsten stays essentially under its original mineral form. Possible impacts of this conclusion are addressed and briefly commented in relation to the arsenic content of those mining debris, having in view a future sustainable recovery of tungsten from the Panasqueira mine tailings.

References

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