Rhenium in waste material of the sulphur factory from the S. Domingos abandoned mine (Iberian Pyrite Belt, southern Portugal): an X-ray absorption spectroscopy approach

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Rhenium is a valuable but scarce metal (1 ppb average concentration in the Earth´s crust) of very high melting point occurring in nature. The main ore mineral is molybdenite (MoS2) the concentration of which has long been assumed to be related to the volatile transport and deposition of the refractory metals Mo, W, Re in high temperature magmatic fluids [1]. It is recovered as a by-product in the refinement of molybdenum concentrates from porphyry copper deposits because the flue dusts obtained from these metal concentrates are enriched in Re due to the high volatility of rhenium heptaoxide (Re2O7). Notably rare as a distinct mineral species, the first Re mineral (rheniite, ReS2) was identified as a condensate in the fumaroles of Kudriavy volcano, Kurila Islands [2] and recently also found in the Pagoni Rachi Mo-Cu-Te-Ag-Au prospect, northern Greece [3]. The formal valence of rhenium ranges from -1 to +7 and the prevalence of the high oxidation state renders it technologically relevant in the production of catalysts [4]. Due to its unique properties, actual applications of rhenium cover distinctive areas ranging from the biological and nuclear fields to the electrical and aerospace industries, particularly for the production of nickel-based superalloys used in jet engines. Because of the very low availability compared to demand, rhenium is nowadays one of the most expensive industrial commodities.

In the light of this demand, the discovery of Re (up to 3 ppm) in waste materials of the sulphur factory from the abandoned S. Domingos mine [5] is of interest, particularly in view of the current interest in exploring exhausted mine wastes in European ore deposits.

An X-ray absorption spectroscopy (XAS) study using synchrotron radiation was carried out on a sample of such waste material taking profit of an experiment focused on studying the binding state of rhenium in molybdenite*, recently approved for beamtime at the ESRF (European Synchrotron Radiation Facility, Grenoble/France). The X-ray absorption spectra collected at the L3-edge of Re clearly shows the rhenium binding to oxygen, by comparison to rhenium oxide model compounds after considering various formal valences and Re coordination environments. The results of this XAS study are described and discussed.

Further approaches to the problematic of recovering rhenium from mine wastes are advanced.

References

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