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OPPORTUNITIES FOR RECOVERING CRITICAL RAW MATERIALS FROM MINE WASTES: THE TYPE-CASE OF RHENIUM IN RESIDUES FROM THE EXPLOITATION OF OLD PORTUGUESE MINES

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ABSTRACT

Rhenium (Re) was one of the last naturally occurring elements to be discovered about a century ago and one of the rarest in terrestrial abundance, once its global availability in the Earth's crust amounts to a single-digit parts-per-billion. It is a singular metallic element with high melting point, high density, high modulus of elasticity and resistance to creep, high electrical resistivity, low friction and no ductile-to-brittle transition, and configures a critical commodity [1] in view of these unique properties. Rhenium does not occur specifically mineralized, being carried essentially by molybdenite (natural molybdenum disulphide, MoS2); accordingly, the world reserves of this very scarce metal are primarily encircled in molybdenite from porphyry copper deposits, turning rhenium into a by-product of the copper mining industry.

A first quick look is addressed to the availability of rhenium in mining residues from the exploitation of Portuguese massive sulphide ore deposits. The elemental analyses recently carried out under the EU-FP7 research project PROMINE* disclosed the occurrence of quite impressive Re contents in waste materials of the São Domingos abandoned pyrite mine (Iberian Pyrite Belt, southern Portugal): up to 3.4 ppm, that is, thousand times higher than the assumed mean concentration in the Earth's crust.

The high values now recognized for the mine wastes from an Iberian Pyrite Belt (IPB) massive sulphide ore deposit stimulate the implementation of a suitable analytical and quick methodology to ascertain the rhenium content and its carrier phase in those waste materials, as well as in molybdenite - a task to be carried out within an exploratory research project approved by the Portuguese Foundation for Science and Technology#. A recent X-ray absorption spectroscopy study [2] showed that rhenium occurs in the São Domingos mine wastes most possibly under the form of the stable molecular compound Re2O7; however, the Re-carrier mineral in the original IPB massive sulphide ore deposit is yet unidentified.

A summary of the results so far attained through the already developed minero-chemical studies will be presented, along with brief comments on the possible sustainability of rhenium recovery from old mine wastes.

[1] U.S. Geological Survey, 2012, Mineral commodity summaries 2012: U.S. Geological Survey, 198 p.

[2] M.O. Figueiredo et al. (2012). Rhenium in waste materials from the sulfur factory at São Domingos abandoned mine (IPB, southern Portugal): an X-ray absorption spectroscopy approach. 9th Int. Symp. Environmental Geochem. (ISEG), Aveiro/Portugal, 15-22 July 2012. Book of Abstracts, p. 209 (poster).

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* *PROMINE, Nano-particle products from new mineral resources in Europe,* FP7-NMP-2008-LARGE-2, 228559.

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