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Editorial

Editorial for Special Issue: "Recent Trends in Phosphate Mining, Beneficiation and Related Waste Management"

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This Special Issue contains a series of selected papers concerning phosphate along with its mining and transformation life cycle. Phosphate extraction and beneficiation is one of the most vital mining industries in the world. Phosphorus derived from phosphate ores is a vital element of life and an exceptional component in fertilizers and food industries. However, many challenges are currently being faced in the extraction of phosphorus, one of the most strategic and critical raw materials [1]. Global high-grade phosphate reserves are known to be decreasing, and the need to explore low-grade ores, including former waste rocks and tailings, to extract apatite is becoming increasingly crucial.

In this regard, a recent review of the beneficiation techniques and reagents that can be used for the beneficiation of low-grade ores with high impurity contents was conducted by Ruan et al. [2]. The beneficiation process of a low-grade sedimentary phosphate ore (12 wt.% P_2O_5) from the Gafsa-Metlaoui sedimentary basin in southern Tunisia was investigated [3]. The researchers succeeded in reaching a recovery rate of 92.4% and improved the P_2O_5 grade of concentrate to 27.1%. Moreover, Matiolo et al. [4] investigated the possibility of recovering ultrafine apatite particles, usually lost within tailings, by comparing different column size flotation processes.

In addition, phosphate ores are known to contain other critical raw materials (CRMs), such as rare earth elements and uranium, that may represent valuable bonuses in phosphate ore trading. The recovery of these vital elements from phosphate wastes may help in developing the needs of green energy in the future and contribute to the achievement of the Sustainable Development Goals. The occurrence of rare earth elements (REEs) and their bearing phases within different streams of phosphate ore processing in China was discussed by Yang et al. [5], using mineral liberation analysis (MLA) coupled with electron probe microanalysis (EPMA). Apatite, allanite, monazite, pyrochlore, and gypsum were identified as the main REE-bearing phases in the different studied samples. Li et al. [6] investigated the geochemical and mineralogical characteristics of primary and weathered dolomitic phosphorites containing REEs from the Zhijin mining district in Guizhou Province, China. Novel polymer and chemical products were also used to recover REEs from acidic extracts of Florida phosphate mining materials [7].

Various types of waste streams are continuously produced by the phosphate industry such as carbonated and/or siliceous waste rocks, clayey sludge, and phosphogypsum. These wastes represent huge volumes, reaching a ratio between 5 and 10 tons of waste per ton of concentrated phosphate apatite. The management of these wastes is becoming an important issue in terms of public concerns and environmental and financial aspects. In the framework of sustainable mining and circular economy objectives, several ecofriendly and green solutions for the recycling and management of phosphate mine waste rocks, tailings, and phosphogypsum are highlighted in this Special Issue. Phosphate mine tailings coming from beneficiation plants were tested for their potential reuse as membrane filter products [8]. Also, it was proven by Amrani et al. [9] that phosphate mine waste rocks can be successfully used as potential alternative secondary raw materials in road construction. According to this study, the phosphate mine waste rocks were proven as natural aggregates similar to conventional materials commonly used for road construction applications. Phosphogypsum is the subject of two other papers in this Special Issue. It was demonstrated that phosphogypsum can be used in a sustainable way in cemented paste backfill applications [10,11]. The radioactivity of different industrial solid wastes, phosphogypsum among them, was assessed by Shen et al. [12]. The study provided a quantitative analysis for the safe use of the evaluated wastes in Guizhou building materials.

The published papers in this Special Issue highlight the opportunities related to the beneficiation, management, and recycling of low-grade phosphate ores as well as the numerous related by-products considered as wastes but that can be valorized/reused as secondary raw materials. These solutions can contribute to resource recovery from the growing amounts of mine wastes, finite natural resource conservation by recycling of these wastes, and environmental impact reduction.

Conflicts of Interest: The author declares no conflict of interest.

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