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Editorial

Editorial for Special Issue "Environmental Geochemistry in the Mining Environment"

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The demand for minerals has never been so high and is expected to increase in the coming decades. The extraction of base and critical minerals is key to the development of new technologies for ecological and energy transitions; however, as the number and the size of mines increase globally, so does the quantity of wastes produced. Despite many waste management and characterization advancements over recent decades, the mineral extraction sector is continuously facing new challenges associated with environmental biogeochemistry in the mining environment, from the forecasting of water quality as early as possible in the mine life cycle through to mine site reclamation/closure, water treatment, and long-term monitoring. Thankfully, researchers and experts from around the world focus on finding solutions to these problems and promoting a more responsible development of mineral resources. The myriad challenges faced by the mineral extraction industry are reflected in the broad range of papers included in this Special Issue. This Special Issue features some of the most recent and innovative approaches and new perspectives with practical applications related to the environmental geochemistry in the mining environment, including but not limited to: (bio)geochemical aspects of mine site reclamation, water quality forecasting, the effects of Arctic conditions on the biogeochemistry of mine wastes and mine water, emerging contaminants in mine water, geochemical modelling, and the microbial geochemistry of mining wastes. The featured papers include multiple perspectives and methodological approaches, from laboratory to field work and advanced numerical simulations. This Special Issue also presents case studies from various parts of the world, including North America [1–4], Asia [5–7], Africa [8] and Europe [9–11].

Some of the papers propose innovative approaches for the reclamation of mine waste management facilities. Specifically, Qureshi et al. demonstrate the promising use of desulphurized tailings in insulation covers with capillary barrier effects (ICCBE) in cold climates [2]. Dublet-Adli et al. showed that it is possible to valorize partially oxidized tailings in a cover system to reclaim an acid-generating mine site, but more work remains necessary to reach the water quality requirements after reclamation [9].

The advantages of numerical simulations in mine waste management are also addressed in this Special Issue. For instance, Yi et al. successfully captured the complex thermo-hydrological and geochemical processes occurring in a covered waste rock pile in Northern Canada by using reactive transport modelling [3]. Their study revealed the importance of thermo-hydrological properties when designing engineered cover systems in such regions. The effect of backfilling in underground mines on the improvement of pH and total iron concentration was studied using numerical simulations by Yamaguchi et al. [5]. Additionally, Toubri et al. demonstrated that the integration of numerical modelling and predictive kinetic testing during the development stages of mine projects can be highly relevant and facilitate proactive mine waste management [1].

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This Special Issue also features papers that provide new insights regarding the environmental geochemistry of mine wastes. Nyström et al. demonstrated the relevance of performing extensive geochemical and mineralogical characterizations to describe the occurrence and release potential of trace elements from waste rocks [10]. Karlsson et al. adapted the commonly used hydrogen peroxide–ammonium citrate extraction method from ore exploration practices to the characterization of mine waste rocks, and demonstrated that it can be efficient in the evaluation of the risks of sulphide-related element mobilities from waste rock material during the preliminary phase of a mining project [11]. Nishimoto et al. proposed using chemical and isotopic characterizations to discriminate the source and impacts of acid mine drainage from a closed mine on the surrounding groundwater [6].

Other papers studied the biodiversity and potential bioavailability of metals in revegetated mine areas, and the related aquatic ecological risks. Nguyen Quoc et al. studied the effect of commercially available amendments on the immobilization of arsenic, copper, and zinc in soils impacted by mining activities [7]. They also assessed the effect of these amendments on microbial communities and the potential uptake of arsenic, copper, and zinc from plant growth. Craw and Rufaut demonstrated that biodiversity can be enhanced during the rehabilitation of closed mine sites by subdividing the area into geoecological zones and by selecting or encouraging plant species tolerant to the local geochemical conditions [12]. Ouma et al. conducted an extensive review of the aquatic ecological risk of metal pollution associated with degraded mining landscapes of the river basins of Southern Africa [8]. In their paper, they discuss the approaches to assessing the ecological risks, inherent challenges, and potential for developing a much-needed integrated ecological risk assessment protocol for aquatic systems in the region.

Finally, the geochemical stability of reclaimed oil sands tailings was discussed by Cossey et al. [4]. They reviewed the geochemical mechanisms and identified the key considerations and knowledge gaps about the long-term geochemical stability of tailing landforms. They also discussed the biogeochemical implications of various treatment methods such as flocculant and coagulant addition.

These original research articles and review papers should be of the uppermost interest to all researchers and practitioners dealing with geochemistry in the mining environment.

A final word before you go about your reading. We would first like to thank all the authors who submitted their papers to this Special Issue, without whom it would not have been possible. Thank you also to the reviewers who greatly contributed to the improvements of the manuscripts' quality. Finally, a very special thank you to the *Minerals* editors who helped us with the publication process.

We wish you interesting reading!

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