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Laboratory simulations of weathering of Zn-Pb-bearing rocks: leachability of metal(loid)s and dissolution of minerals – the case of the Olkusz area, South Poland

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Study area is located in the Olkusz ore district, in the south Poland where Zn and Pb were recovered from sulfide and calamine ore bodies. The primary ore is composed mainly of sphalerite, galena, and marcasite/pyrite and was excavated from the so-called ore bearing dolomite of the Middle Triassic age. Studied rocks are mainly composed of smithsonite, cerussite, goethite, hemimorphite, anglesite and are considered as supergene ore derived from alterations of sulfides mainly during Miocene. The chemically-mediated weathering of sulfides has extensively been studied, whereas microbially-mediated weathering of calamines requires experimental research to be undertaken to improve our understanding on dissolution of such rocks. This study aimed: (i) to determine the bioleaching potential of Zn, Pb, Cd, and As from Zn-bearing supergene ores exposed to *A. thiooxidans*, native soil microorganisms, and root exudates; (ii) to assess the impact of mineral composition (goethite-bearing vs. hemimorphite-bearing samples) of the rocks on leaching of elements; (iii) to determine mineral dissolution under bioweathering conditions. Two supergene samples were investigated: first collected from the mining heap next to the abandoned "Bolesław" calamine open-pit in the Bolesław village (B), and second from the weathering site of the abandoned "Olkusz-Pomorzany" Zn-Pb underground mine (OP). Trace elements in solutions were measured using by ICP-QQQ whereas mineral composition of the fresh and weathered samples was determined using by XRD, SEM-EDS, EPMA, and DSC-TG methods. Results of the experiments revealed the highest leaching efficiency for Zn was found for both samples treated by *A. thiooxidans* (up to 125 000 and 14 000 mg·kg⁻¹ for OP and B, respectively) and Cd (up to 817 and 46.8 mg·kg⁻¹ for OP and B, respectively). The highest amounts of Pb (3840 mg·kg⁻¹ and 660 mg·kg⁻¹) were liberated from sample OP by root exudates and soil bacteria, respectively. As compared to other elements studied, arsenic revealed the lowest leaching efficiency under bioweathering conditions. In sample OP, dissolution of hemimorphite and cerussite caused the release of Zn and Pb, respectively. In sample B, goethite was found to weather intensively.