

EGU2020-1585

<https://doi.org/10.5194/egusphere-egu2020-1585>

EGU General Assembly 2020

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Development of a sampling protocol for the resource definition of sulphidic Cu-Zn-Pb tailings in an industrial tailings storage facility

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Fine-grained residues of ore processing, known as tailings, are an inevitable product of metal production. Such tailings are typically stored in dedicated Tailings Storage Facilities (TSF). The sedimentary-style deposition of tailings within the TSF results in a structure of sub-horizontal, internally graded layers which heterogeneously concentrate the minerals comprising the residues. Primary depositional structures may be overprinted by subsequent chemical redistribution of minerals and elements during chemical reactions and metal mobilisation. Sulphidic tailings are problematic in terms of the potential for generation of Acid and Metalliferous Drainage, while providing interesting prospects for extraction of recoverable metals. However, efforts to build accurate and reproducible geospatial models of TSFs are hampered by a lack of understanding of how to sample heterogeneous tailings materials in a way that allows the effective characterisation of both the horizontal and vertical variability. This study introduces a sampling protocol for the resource characterisation of TSFs, following the Theory of Sampling. The Davidschacht TSF in Freiberg, Germany, was used as a case study. The Davidschacht TSF was deposited between 1944 and 1969; it contains around 760,000 m³ of Cu-Zn-Pb sulphidic flotation residues originating from the processing of polymetallic hydrothermal vein ores of the Freiberg mining district. A historical drilling campaign of 10 drill holes through the whole depth of the tailings provided a basis for the study. A second drilling campaign of 68 drill holes to a depth of 3 m was carried out on a 30 m grid, and nested grids of 15 m and 7.5 m in the centre of the TSF. The drill cores were logged and a bulk sample was collected for each 1 m section. Representative samples, with 10% randomly selected for duplication, will be analysed with X-Ray Fluorescence for chemical composition and sieving and laser diffraction for particle size distribution. The modal mineralogy, mineral associations and mineral liberation of selected samples will be assessed with the Scanning Electron Microscope-based Mineral Liberation Analyser. A detailed geospatial model of the surface zone of the tailings will be constructed to assess the intrinsic horizontal variability of the TSF. Comparison with the 3D model produced by the previous deep drilling campaign will determine if the sampling and modelling was sufficient to account for the variability of the tailings.