



Geophysical exploration of historical mine dumps for the estimation of valuable residuals

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Within the project ROBEHA, funded by the German Federal Ministry of Education and Research (033R105) the economic potential of different abandoned dump sites for mine waste in the Harz Mountains was investigated. Two different mining dumps were geophysically and mineralogically analysed in order to characterize the mine dump structure and to estimate the volume of the potential recycling material. The geophysical methods comprised geoelectrics, radar, and spectral induced polarization (SIP). One about 100-year old mining dump containing residues from density separated Ag- and Sb-rich Pb (Zn)-gangue ores was investigated in detail. Like most small-scale mining waste disposal sites this investigated dump is very heterogeneously structured. Therefore, 27 geoelectrical profiles, more than 50 radar profiles, and several SIP profiles were measured and analysed. The results from the radar measurements, registered with the GSSI system and a shielded 200 MHz antenna, show the near surface boundary layer (down to 3-4 m beneath surface) of the waste residuals. These results can be used as pre-information for the inversion process of the geoelectrical data.

The geoelectrical results reveal the mineral residues as layers with higher resistivities ($> 300 \text{ Ohm}\cdot\text{m}$) than the surrounding material. The SIP method found low phase signals ($< 0.5^\circ$) for the residues. To estimate the volume of the potentially reusable material we analysed each geoelectrical profile and interpolated between the single profiles using the BERT algorithm. Taking into account the wooded areas of the mine dump and other parameters we get a first estimate for the volume of the residues but the economical viability and the environmental impact of the reworking of the dump still needs to be evaluated in detail.

The results of the second mine dump, an abandoned Cu and Zn-rich slag heap, show that the slag residues are characterized by higher resistivities and higher phases. A localization of the slag residues which are covered by organic material could be realized applying these geophysical methods.