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Reconstruction of the inner structure of small scale mining waste dumps by combining GPR and ERTdata.

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Two abandoned small waste dumps in the west of the Harz mountains (Germany) were analysed using ground penetrating radar (GPR) and electrical resistivity tomography (ERT). Aim of the project (ROBEHA, funded by the German Federal Ministry of Education and Research (033R105)) is the assessment of the recycling potential of the mining residues taking into account environmental risks of reworking the dump site. One task of the geophysical prospection is the investigation of the inner structure of the mining dump. This is important for the estimation of the approximate volume of potentially reusable mining deposits within the waste dump.
The two investigated dump sites are different in age and therefore differ in their structure. The older residues (< 1930) consist of ore processing waste from density separation (stamp mill sand). The younger dump site descends from comprises slag dump waste. The layer of fine grained residues at the first dump site is less than 6 m thick and the slag layer is less than 2 m thick. Both sites are partially overlain by forest or grassland vegetation and characterized by topographical irregularities.
Due to the inhomogeneity of the sites we applied electrical resistivity tomography (ERT) and ground penetrating radar (GPR) for detailed investigation. Using ERT we could distinguish various layers within the mining dumps. The resistivities of the dumped material differ from the bedrock resistivities at both sites. The GPR measurements show near surface layer boundaries down to 3 – 4 m. In consecutive campaigns 100 MHz and 200 MHz antennas were used. The GPR results (layer boundaries) were included into the ERT inversion algorithm to enable more precise and stable resistivity models. This needs some special preprocessing steps. The 3D-Position of every electrode from ERT measurement and the GPR antenna position on the surface require an accuracy of less than 1cm. At some points, the layer boundaries and radar wave velocities can be calibrated with borehole stratigraphic data from a mineralogical drilling campaign. This is important for a precise time-depth conversion of reflectors from GPR measurement. This reflectors were taken from radargram and have been adopted as resistivity boundary in the start model of the geoelectric inversion algorithm.