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Geoelectrical monitoring of hydrogeological processes to assess the efficiency of mine waste reclamation covers

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Mining activities generate large amounts of water rocks (solid and liquid) usually stored in waste rock piles and tailing impoundments. These waste rocks could lead to severe environmental issues due to mineral reaction with oxygen and water. Several reclamation cover designs, aiming to prevent acid mine drainage, have been proposed and evaluated by numerical simulations, in the laboratory and at pilot scale under field conditions over the past 25 years. Hydrogeological sensors (i.e. moisture and suction probes) are usually used to monitor hydrogeological processes occurring in the covers and calibrate numerical models. However, these sensors only provide information in a limited volume and might not be adapted for the monitoring of large-scale covers.
The authors present in this paper preliminary results carried out in several laboratory columns instrumented with both hydrogeological sensors and geophysical electrodes. The geoelectrical database provides continuous distributions of bulk electrical conductivity in the columns, that are converted into estimations of moisture content using appropriate petrophysical relationships. The calculated moisture content values are compared with hydrogeological sensors measurements at different depths with homogenous sand and mine tailings in both saturated and unsaturated conditions. The geoelectrical monitoring results are used to extend spatially traditional point measurements to track tracer flows in a sand medium and to evaluate water infiltration and evaporation in tailings with different covers.
This study presents an application of geoelectrical monitoring to recover hydrogeological processes in homogeneous media in the laboratory. Two parallel and simultaneous measurements, in point mode (hydrogeology) and continuous (geophysical) in the same column, validate the petrophysical relationship and evaluate the accuracy of the moisture calculation from resistivity measurement. This work will help define an appropriate methodology to apply geoelectrical method for large-scale reclamation monitoring issues.