Hydro-geophysical, thermal characterization and modeling of hydrological processes in mine tailings

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ABSTRACT

This study aims at developing novel non-invasive and modeling approaches for evaluating hydrological processes in mine tailings. The focus is set on the use of geophysical (electric and electromagnetic) and remote sensing (thermal imagery) approaches along with 2D numerical simulations. The Horne Smelter's Quémont-2 site of Glencore company, located in Rouyn-Noranda (Quebec, Canada), is targeted for data acquisition. This tailings pond covers approximately 102 ha and was used for the deposition of sulphurous tailings, slag and for co-deposition. The pond will soon reach it's full capacity and reclamation plans are being developed to mitigate long-term environmental impacts. Electrical resistivity surveys were realized using Schlumberger, Wenner, Dipole-Dipole, and Wenner-Schlumberger configurations in order to evaluate the stratigraphy and physical properties of tailings. Resistivity data were further used to assess spatial variations in tailings physical and hydraulic properties based on Archie's law and on the Kozeny-Carman formula. Ground penetrating Radar (GPR) profiles were acquired using a 100 MHz frequency and coupled to the acquisition of thermal images by drone to assess the integrity of dams surrounding the tailings ponds. Ultimately, these data are used to develop 2D numerical simulations of groundwater flow in SEEP/W to model actual and future hydrogeological conditions and assess the environmental risks associated with the tailings pond. The study provides key information on how to optimize the use of geophysical, remote sensing and modeling approaches to evaluate hydrological processes in mine tailings with the objective of proposing solutions for mitigating their environmental impacts.