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A proactive approach to sustainable management of mine tailings

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The reactive strategies to manage mine tailings i.e. containment of slurries of tailings in tailings storage facilities (TSF's) and remediation of tailings solids or tailings seepage water after the decommissioning of those facilities, can be technically inefficient to eliminate environmental risks (e.g. prevent dispersion of contaminants and catastrophic dam wall failures), pose a long term economic burden for companies, governments and society after mine closure, and often fail to meet community expectations.
Most preventive environmental management practices promote proactive integrated approaches to waste management whereby the source of environmental issues are identified to help make a more informed decisions. They often use life cycle assessment to find the "hot spots" of environmental burdens. This kind of approach is often based on generic data and has rarely been used for tailings. Besides, life cycle assessments are less useful for designing operations or simulating changes in the process and consequent environmental outcomes. It is evident that an integrated approach for tailings research linked to better processing options is needed. A literature review revealed that there are only few examples of integrated approaches.
The aim of this project is to develop new tailings management models by streamlining orebody characterization, process optimization and rehabilitation. The approach is based on continuous fingerprinting of geochemical processes from orebody to tailings storage facility, and benchmark the success of such proactive initiatives by evidence of no impacts and no future projected impacts on receiving environments.
We present an approach for developing such a framework and preliminary results from a case study where combined grinding and flotation models developed using geometallurgical data from the orebody were constructed to predict the properties of tailings produced under various processing scenarios. The modelling scenarios based on the case study data provide the capacity to predict the composition of tailings and the resulting environmental management implications. For example, the type and content of clay minerals in tailings will affect the geotechnical stability and water recovery. Clay content will also influence decisions made for paste or thickened tailings and underground backfilling.
It is possible by using an integrated assessment framework to evaluate more alternatives, including the production of additional saleable and benign streams, alternative tailings treatment and disposal, as well as options for reuse, recycling and pre-processing of existing tailings.