Management of Mine Wastes in an Environmentally Sustainable Manner: Lessons Learned

C.J. PTACEK[1,*], D.W. BLOWES[1], J.G. BAIN[1], D. WILSON[1], R.T. AMOS[2], AND M.C. MONCUR[3,1]

[1]Department of Earth and Environmental Sciences, University of Waterloo, Waterloo, ON, Canada (*correspondence: ptacek@uwaterloo.ca)
[2]Department of Earth Sciences, Carleton University, Ottawa, ON, Canada
[3]InnoTech Alberta, Calgary, AB, Canada

The development of mineral resources is associated with the generation of large volumes of waste rock and mill tailings. Weathering of these wastes can lead to long-term generation of low-quality drainage due to sulfide mineral oxidation and subsequent mineral dissolution reactions, and pervasive damage to local ecosystems. As new steps are developed to improve metal extraction rates and generate value-added byproducts, opportunites to alleviate the release of toxic substances from residual materials also arise. Changes to metallurgical processes may result in production of residual materials that vary in mineralogical and geochemical composition and the weathering may differ greatly from wastes generated through traditional practices. Techniques are required for characterization of these modified residuals to determine their long-term potential to release contaminants to the environment. Conventional testing methods used to predict the potential for contaminant release typically consist of static acid-base accounting and short-term dynamic humidity-cell test methods that are applied to fresh mine wastes and are often limited in their effectiveness. This study integrates the results of conventional, modified and alternative test methods on fresh and partially-oxidized wastes with numerical modelling to assess mine waste weathering reactions and contaminant release at the field scale. The results are applied to sites where no management activities have been applied and to those where a range of management activities have been implemented. The results of this analysis show that the information gained from applying a complex suite of testing methods, combined with mechanistic numerical analysis, provide improved predictions of the long-term release of contaminants from mine wastes and enhances the effectiveness of management strategies. As new practices are adopted in the mining industry comprehensive testing programs can aid in the prevention of contaminant release from residual materials.