Waste not, want not: New approaches to alkaline Earth and transition metal resource recovery from mine tailings

SIOBHAN A. WILSON[1], JESSICA L. HAMILTON[2], BAOLIN WANG[1], NINA ZEYEN[1], JENINE MCCUTCHEON[3], CONNOR C. TURVEY[4], BREE MORGAN[5], DAVID J. PATERSON[6], ALASTAIR W. TAIT[7] AND GORDON SOUTHAM[8]

[1]University of Alberta, Edmonton, AB, Canada
[2]Monash University, Clayton, VIC, Australia
[3]University of Leeds, Leeds, UK
[4]The University of British Columbia, Vancouver, BC, Canada
[5]The University of Sydney, Camperdown, NSW, Australia
[6]Australian Synchrotron, Clayton, VIC, Australia
[7]University of Stirling, Stirling, UK
[8]The University of Queensland, St Lucia, QLD, Australia
(*correspondence: sawilson@ualberta.ca)

Reprocessing of mine tailings offers economic and environmental advantages given increasing demand for metal resources and the emerging use of Mg- and Ca-silicate and hydroxide minerals as a resource for Carbon Capture Utilization and Storage (CCUS).

Both atmospheric CO_2 and transition metals are sequestered within carbonate–Fe-(oxy)hydroxide cements during weathering and carbonation of ultramafic mine tailings [1] such that the metal resource cannot be recovered without releasing CO_2.

We are using laboratory, synchrotron and field experiments to test the feasibility of an alternative approach that separates the alkaline Earth metal resource from the transition metal resource, permitting recovery of both for CCUS and beneficiation, respectively. We have demonstrated this approach in awaruite-bearing serpentinite tailings and have promising results using kimberlite (diamond) tailings. This approach, modelled on Ni-laterite formation, employs heap leaching treatments to (1) concentrate Ni, Co and Cr within Fe-(oxy)hydroxides at a migrating neutralization front, (2) liberate magnetic alloy minerals such as awaruite from silicates, (3) produce a high-pH leachate rich in Mg and Ca that is optimal for mineral carbonation and (4) kickstart the earliest stages of soil formation.

[1] Hamilton et al. (2018) IJGGC, 71, 155–167.