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Transition Metal Mobility and Recovery from Weathered Serpentinite and Serpentinite Skarn Tailings from Lord Brassey Mine, Australia and Record Ridge, British Columbia, Canada

MAKOTO HONDA-MCNEIL[1], SIOBHAN WILSON[1], BENJAMIN MILILLI[2], NINA ZEYEN[3], BAOLIN WANG[1], CONNOR TURVEY[4], COLTON VESSEY[1], AVNI PATEL[1], ANDREW LOCOCK[1], JESSICA HAMILTON[5], DAVID M. PATERSON[5], GORDON SOUTHAM[6], JORDAN POITRAS[6], THOMAS JONES[6] AND SIMON JOWITT[7]

[1]University of Alberta
[2]BHP
[3]University of Alberta - EAS
[4]University of British Columbia
[5]Australian Synchrotron
[6]The University of Queensland
[7]University of Nevada, Las Vegas

Presenting Author: hondamcn@ualberta.ca

As mineral resources become scarcer, companies are lowering their ore cut-off grades and resorting to exploring deeper underground and in more isolated areas. Incorporating tailings storage facilities and tailings reprocessing as part of the ore processing circuit can potentially extend the lives of mines and save on future exploration costs.

Ultramafic and mafic mine tailings host resources including first and second row transition metals, such as nickel (Ni), cobalt (Co), and platinum group elements (PGE), whose high value and recovery could serve as a motivator for existing mines to reprocess their tailings. Many of these target metals are initially hosted by olivine, are repartitioned during serpentinization to form sulfides, oxides and alloys, and then are remobilized during weathering to form authigenic carbonates, sulfates and oxyhydroxides. Reprocessing tailings may further provide environmental benefits, including a reduction in waste output and the ability to offset greenhouse gas emissions by enhanced silicate-weathering and carbonation reactions.

Here we use powder X-ray diffraction, scanning electron microscopy, electron probe micro-analysis and synchrotron X-ray fluorescence mapping to demonstrate how first and second row transition metals are mobilized to their final sinks. Samples of serpentinite, skarn and weathered tailings from the historical Lord Brassey nickel mine in Tasmania, Australia and weathered outcrops of serpentinite ore from the proposed magnesium mine in Record Ridge, BC, Canada are analyzed and compared. Preliminary results from these climatically similar localities indicate clear transition metal dissemination patterns across alteration zones and distinct partitioning behavior (ex. homogenous distribution of Ni within sulfides) in weathering products. By developing an understanding of the sinks for metals across the mining lifecycle, we aim to cultivate an economically viable framework for tailings reprocessing that capitalizes on metal mobility during tailings weathering.