Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23988

Using Geochemical Analyses and Remote Sensing to Understand the Carbon Dioxide Removal Potential and Contamination Risks Associated with the Use of Mine Residues for Enhanced Rock Weathering.

JONATHAN SPENCE[1], SASHA WILSON[1], BENOIT RIVARD[1], JILU FENG[1], IAN M. POWER[2], WYATT RUSSELL[1], EMILY YI WAI CHIANG[3] AND RAFAEL M SANTOS[3]

[1]University of Alberta
[2]Trent University
[3]University of Guelph

Presenting Author: jspence2@ualberta.ca

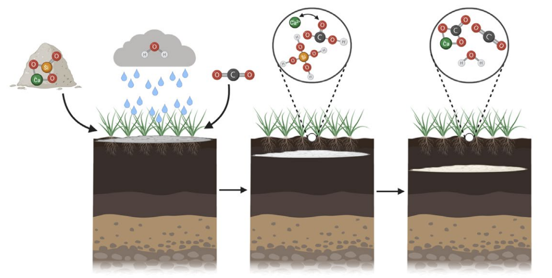
Enhanced rock weathering (ERW) is a promising carbon dioxide removal (CDR) technology that involves the spreading of silicate rock powder in agricultural and silvicultural settings to trap CO_2 through an increase in soil alkalinity and the formation of secondary carbonate minerals [1]. Previous ERW trials have used freshly mined rock for their amendments resulting in embedded carbon emissions. To avoid this, mine residues have been suggested [2]. Here we assess the ERW carbon drawdown potential of two mine residues (kimberlite, serpentinite) and three freshly mined agricultural amendments (basalt, metabasalt, wollastonite). We explore the use of geochemical analyses and remote sensing to monitor CO_2 drawdown and the introduction of potentially hazardous transition metals into soils, plants, and water.

In a growth chamber, pea plants were grown in acidic soil amended with each rock type at four spreading rates. This trial ran for three months, with leachate samples being collected throughout, and soil samples being collected at completion. Significant increases ($p < 0.01$) in the alkalinity of soil leachates were found for all rock types (compared to controls), with the largest increases seen at the highest spreading rates. Additionally, VNIR and SWIR scans of our soils were collected after the experiments and used to estimate the relative abundance of carbonate minerals within our soils.

Addressing transition metal contamination, our ICP-MS results indicated significant increases were only seen for nickel concentrations and only in leachates from soils amended with high amounts of serpentinite ($p < 0.01$). However, even at the highest concentrations found, nickel concentrations remained below the regulatory standard ($p < 0.01$).

Moving forward, we plan to complete more analyses to gain a more complete understanding of the results of this ERW trial. This will include taking TIC and TOC measurements on our soil samples to help determine CDR rates and validate our remote sensing results. Additionally, we will take ICP-MS and µXRF measurements of our plant and soil samples to help understand the concentration and distribution of contaminants within them.

[1] Paulo et al. (2021), *Appl. Geochem.*, 129, 104955.
[2] Stubbs et al. (2022), *Int. J. Greenh. Gas Control*, 113, 103554



1. $CaSiO_3 + 2CO_2 + 3\,H_2O \rightarrow Ca^{2+} + 2HCO_3^- + H_4SiO_4$
2. $Ca^{2+} + 2HCO_3^- \rightarrow CaCO_3 + CO_2 + H_2O$

Figure 1. Chemical reactions associated with capturing carbon through enhanced rock weathering with wollastonite skarn.