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Analysing the Carbon Dioxide Removal Potential of Agricultural Soils Amended with Various Silicate Rocks, and the Potential Co-benefits and Side Effects

JONATHAN SPENCE[1], SASHA WILSON[1], BENOIT RIVARD[1], JILU FENG[1], YI WAI CHIANG[2] AND RAFAEL M SANTOS[2]

[1]University of Alberta
[2]University of Guelph
Presenting Author: jspence2@ualberta.ca

Enhanced rock weathering (ERW) is a promising carbon dioxide removal (CDR) technology that has been developed to mitigate the damages of climate change. ERW is the spreading of ground silicate rock in agricultural settings to increase soil alkalinity and form secondary carbonate minerals, trapping CO2 [1]. While ERW has been shown to be an effective method of drawing down CO2, some challenges with this method remain. One issue is the emissions associated with mining and pulverising silicate rock amendments. Previous ERW trials used freshly mined rock for their amendments resulting in embedded carbon emissions; as such, using mine residues has been suggested [2]. Here we assess the carbon drawdown ERW potential of two mine residues (kimberlite, serpentinite) and three freshly mined agricultural amendments (basalt, metabasalt, wollastonite). Our growth chamber experiments used pea plants grown in soil amended with each of the rock types at four spreading rates. This trial ran for three months, with soil and leachate samples being collected throughout. Following the completion of the trial, each of the collected soil samples was analysed for TIC and TOC levels to determine the rate of CDR. This was then compared to geochemical modelling results.

Another issue addressed through this trial is the lack of knowledge surrounding the effects of silicate rock amendment on soil health, and plant and water contamination. PLFA and ICP-MS analyses were done on the soils to test for MBC and metal contamination. Further, the soil leachate samples were analysed for ICP-MS, TDS, EC, pH, and alkalinity. Lastly, the plants were analysed using ICP-MS. One final issue that was addressed through this trial is the difficulty of quantifying CDR. Since current techniques, such as TIC/TOC and XRD analysis are time consuming and expensive, we used remote sensing as a substitute. To do this, we measured the reflectance spectra of the soils throughout our growth chamber trials and calibrated these spectra with their TIC/TOC levels, and the spectra of soils with known mineral concentrations mixed into them.

[1] Paulo et al. (2021), Appl Geochem, 129, 104955.

[2] Stubbs et al. (2022), Int. J. Greenh. Gas Control, 113, 103554