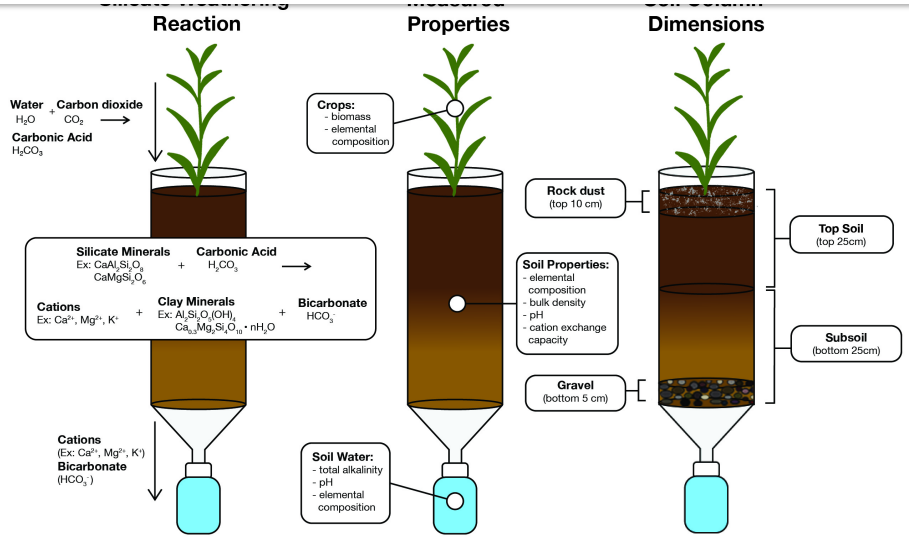
B35L-1560 - Greenhouse constraints on the inorganic carbon sequestration potential of enhanced silicate weathering in agriculture

Wednesday, 15 December 2021
16:00 - 18:00
Convention Center - Poster Hall, D-F

Abstract

Enhanced silicate weathering (ESW) is a natural climate solution that sequesters carbon dioxide (CO_2) by spreading crushed silicate rocks on the surface of the Earth. One of the primary applications of ESW is in agricultural settings, where the dissolution of silicate minerals sequesters CO_2 as alkalinity (bicarbonate) and releases cations (e.g., Ca^{2+}, K^{+}, Mg^{2+}) into the soil solution as nutrients for crops. Model estimates for ESW at scale suggest significant potential for ESW to offset carbon emissions while providing value to farmers through improved crop yields and soil fertility. However, carbon sequestration rates from ESW are poorly constrained and may be underestimated due to difficulties in accurately tracking the products of silicate mineral dissolution.

This project presents new constraints on carbon sequestration rates for ESW through detailed accounting of dissolution products in a controlled greenhouse setting. Our experimental design mimics growing conditions in Northfield, Minnesota with corn (*Z. mays*) being grown for 120 days in native silty loam soil sourced from a local agricultural field and watered to match average rainfall conditions for the area (~500 mL per week). We added crushed basaltic rock powders equivalent to 20 tn ac^{-1} to the upper 10 cm of soil for treatment plants (n = 6) versus control (n = 6, no rock dust added). To quantify weathering rates, we compare two methods: (1) a bicarbonate-based approach tracking soil inorganic carbon, soil pH, water pH, and alkalinity, and (2) a cation-based approach using conductivity and elemental analyses of soil, water, and plant tissue. Additionally, we assess the agricultural impacts of ESW from changes in corn biomass and elemental composition, as well as soil health indicators of pH, cation exchange capacity, and organic matter. The goal of our work is to help provide locally relevant constraints in order to promote ESW as a scalable natural climate



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