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Quantifying carbon dioxide removal by enhanced weathering of wollastonite in acidic forest soils

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Figure 1. Photograph of wollastonite skarn application test on a trail in Haliburton Forest



Figure 2. Photo of wollastonite skarn application in Haliburton Forest ERW plots

Enhanced rock weathering (ERW) is rapidly being developed as a carbon dioxide removal (CDR) strategy in agricultural fields. Forest ERW has enormous CDR potential but remains understudied, partly due to challenges in applying alkaline rock powders. Trail networks used for selective harvesting (Fig. 1) provide an opportunity to expand ERW in managed forests. This study aims to accurately quantify CDR through forest ERW field experiments and assess the scalability of ERW in managed forests. The wollastonite skarn amendment used has two major minerals, wollastonite ($CaSiO_3$) and diopside ($CaMgSi_2O_6$), with a maximum CDR potential of 380–430 kg CO_2/t. Wollastonite is a fast-dissolving silicate with very low concentrations of heavy metals, making it a desirable ERW amendment. Applying wollastonite skarn to acidic forest soils can further accelerate amendment weathering for CDR while deacidifying and supplying base cations to soils that benefit forest health and promote tree growth [1]. In the field, sixteen 12 × 12 m plots were established in Haliburton Forest, Ontario, Canada and applied with varying dosages of wollastonite skarn (0, 5, 10, 20 t/ha × four replicates, Fig. 2). In the first year after application, the concentrations of major cations (Ca^{2+} and Mg^{2+}), dissolved Si, and dissolved inorganic carbon in soil water draining the upper, 15 cm, and 30 cm soil horizons increased compared to baseline and the control plots, representing CDR. The amount of CDR was positively correlated with amendment dosage and negatively correlated with soil water depth. The exchangeable Ca^{2+} concentrations in the soil organic horizon and the mineral horizons at both 0–10 cm and 10–20 cm depths increased after one year of treatment. Short- and long-term forest health, changes in organic carbon pools, and ecological responses are being evaluated following the application of wollastonite skarn. Significant spatial heterogeneity in dosages was observed in an application test on a Haliburton Forest trail (Fig. 1), indicating that verifying amendment dosages and establishing appropriate monitoring sites are critical for accurately quantifying CDR in future forest ERW studies [2].

References:

[1] Taylor et al. (2021) *Biogeosciences*, 18: 169-188.

[2] Guo et al. (2025) *Journal of Environmental Management*, 394, 127335.