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Scalable, Efficacious ERW Unlocked by Mineral Conversion

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Current approaches to ERW focus on grinding and spreading basalt or olivine-rich feedstocks on agricultural lands. A key challenge is that these naturally abundant feedstocks exhibit very slow weathering kinetics, making MRV challenging and necessitating very high application rates and long timescales (10+ years). To address this fundamental problem, we have developed a thermal process that converts Mg-rich silicates (e.g. olivine) and limestone into a product composed of Ca-enriched orthosilicates (e.g., $CaMgSiO_4$, monticellite) and MgO. This ion-exchange reaction effectively transforms kinetically inert Mg-silicates into reactive Mg alkalinity (MgO) while retaining Ca alkalinity in the form of a reactive Ca-rich orthosilicate, resulting in the net production of kinetically competent alkalinity from Mg-silicates. Lifecycle analysis indicates that 1 ton of our feedstock can remove up to 1 net ton of CO_2.

Our feedstock is being evaluated alongside conventional ERW feedstocks under standardized high application rate conditions (40 t/ha) in a mesocosm experiment spanning 22 different soils. Over the first 6 months, the leachate DIC concentrations for all 22 amended pots with our feedstock is >12,000 µmol/L, compared to <2,000 µmol/L for control mesocosms. Based on cumulative leachate DIC, the mean amount of CO_2 removed and exported by our feedstock over six months across all soils corresponds to 2.7 tCO_2/ha (range 0.94 – 4.7 tCO_2/ha). By contrast, a basalt feedstock showed negligible DIC export above the control baseline (mean of 0.03 tCO_2/ha) and the mean DIC export observed for limestone was only 0.35 tCO_2/ha. The DIC and alkalinity export observed with our feedstock show no correlation with commonly measured soil properties including pH (from 5.2 to 7.5), cation exchange capacity, organic carbon content, clay content, etc.

Our process is drop-in compatible with existing rotary kilns used in the cement industry. With gigatonnes of projected spare capacity in the coming decades, no new infrastructure needs to be built to rapidly achieve meaningful scale. Beyond CDR, our feedstock releases plant-available Si, providing a valuable lever for improving crop yields and resilience. The ability to weather and export carbon rapidly by our feedstock, combined with agronomic value-add, unlocks a new path to affordable and scalable CDR.