

Field-scale ERW Trials in California - Lessons Learned and Future Directions

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Field-scale validation and quantification of Enhanced Rock Weathering (ERW) is essential for assessing its viability as a carbon removal strategy. While mesocosm and modeling studies highlight ERW's carbon drawdown potential, field trials in working agricultural systems are needed to determine (a) the soil and climate conditions under which ERW is effective, (b) the reliability of weathering rate quantification, and (c) its interactions with soil organic carbon cycling.

California, the USA's largest agricultural economy with diverse production systems, provides an ideal testbed for ERW. We present findings from two phases of ERW trials under the California Collaborative for Natural Climate Change Solutions (C4NS). In Phase 1, lysimeter data indicate weathering activity via increased water alkalinity, and soil organic carbon increases over three years, with variable effects from compost and biochar co-application.

Building on these insights, Phase 2, launched in October 2024, focuses on standardizing variables and measurement methods, enhancing baseline data collection, and increasing sampling density to distinguish weathering signals from background variability. Trials span rangeland and cropland sites, where we are implementing: (1) baseline soil property analyses (0–50 cm), (2) TiCAT mass-balance geochemistry to quantify weathering intensity, (3) density fractionation to assess organic carbon-mineral interactions, and (4) source-to-sink hydrological monitoring using Sr and Li isotopes and base cation changes.

This research, part of the Terraforming Soil Energy Earthshot Research Center at Lawrence Livermore National Laboratory, aligns with parallel field trials in Virginia and Minnesota, offering a broader assessment across diverse U.S. climates and soils. Our findings will refine ERW models and provide insights to guide farmers, land managers, and policymakers in adopting effective and scalable rock amendment strategies across diverse climate and soil conditions.