RockFACE: Enhanced weathering by food and fuel crops under Free-Air Concentration Enrichment in the Midwest

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RockFACE is an innovative field trial using Free-Air Concentration Enrichment (FACE) technology to investigate the interactions between elevated CO_2 and enhanced weathering (EW) with important Midwest food and fuel crops under field conditions. Our goal is to investigate the potential for elevated atmospheric CO_2 to interact with crops, soils and rock grain biogeochemistry to affect EW, CO_2 removal (CDR) and nitrous oxide emissions. The trials were established in 2021 with eight fully instrumented full size (20-m diameter) FACE rings (four at 600 ppm CO_2, four at ~420 ppm CO_2). Each ring is divided into an EW treatment zone (40t/ha crushed Pioneer Valley basalt), and a control zone (no rock dust) separated by a 2m buffer zone. First year trial results for maize gave initial EW CDR rates estimated using a soil-based mass balance approach of 9 ± 0.8 t CO_2 ha^{-1} and 9.5 ± 0.7t CO_2 ha^{-1} in elevated CO_2 and ambient CO_2 rings, respectively, following the unusually dry summer 2023 conditions. The marginally lower CDR rate in elevated CO_2 may reflect a crop-CO_2 feedback in which surface soils are drier due to the maize having a larger canopy with elevated CO_2. Future trial years will assess the evolution of these crop-CO_2 feedbacks on EW and CDR with typical corn/soybean rotations for Midwest agriculture.

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