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Quantifying carbon dioxide removal via enhanced rock weathering at an arable cropland field trial in the UK

FEIFEI DENG[1], RACHAEL H JAMES[2], SARAH DUNHAM[3], JAVIER HERNANDEZ[3], CHRISTOPHER HERBIN[3], JOANNA CARTER[3], IAN SHIELD[3], STEVE P MCGRATH[3], DAVID J BEERLING[4] AND CHRISTOPHER PEARCE[1]

[1]National Oceanography Centre Southampton
[2]University of Southampton
[3]Rothamsted Research
[4]The University of Sheffield

Presenting Author: feifei.deng@noc.ac.uk

Enhanced rock weathering (ERW) is a Greenhouse Gas Removal (GGR) technology that achieves atmospheric carbon dioxide removal (CDR) by applying crushed silicate rocks to soils to accelerate natural weathering processes. Models predict that ERW could remove up to 6 to 30 $MtCO_2$ yr^{-1} by 2050 when applied to UK arable croplands, contributing to up to 45% of CDR required to meet UK's net zero target [1]. There is therefore now a pressing need to verify these model estimates by conducting field trials of ERW under 'real world' conditions.

To address this, the UK Enhanced Rock Weathering Greenhouse Gas Removal Demonstrator (UK ERW GGR-D) has been conducting ERW field trials at three sites representative of difference land use types across the UK. Here we present preliminary results from Rothamsted Research field site in Harpenden. The site is typical arable cropland, featuring soil at pH = ~6.6 and rotation of crops (winter bean, barley and oilseed rape). Crushed basalt rock, consisting principally of fast weathering silicate minerals (e.g. plagioclase and augite) and with an average particle size of <2 mm, was applied at a rate of 40 t/ha/yr. Adjacent plots were left untreated to act as controls. Rates of weathering and CDR have been determined from analysis of the soil pore waters, and clear evidence for weathering of the applied basalt is provided by higher alkalinity, and major cation (Ca, Mg, Na) concentrations observed in basalt-treated plots relative to control plots. We find no evidence for increased levels of metals in soil waters and the soil exchangeable fraction relative to control plots, and concentrations are lower than UK national and international requirements for drinking water. The Sr and Li isotopic compositions of basalt rock dust, soil, soil porewater, rain and river are used to quantify the contributions of silicate versus carbonate weathering to alkalinity generation, and the extent of secondary mineral formation. Soil pore water data are combined with discharge data to estimate CDR as a result of ERW in the basalt treated plots over the 2-year timeframe of the trial.

References:

[1] Kantzas E et al. (2022) Nat. Geosci 15(5): 382-389.