Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.19820

Quantifying CO_2 removal from enhanced weathering sites: A multi-proxy approach

WILLIAM J. KNAPP[1], EMILY I. STEVENSON[2], PHIL RENFORTH[3], PHILIPPA ASCOUGH[4], ALASDAIR C. G. KNIGHT[2], LUKE BRIDGESTOCK[2], MICHAEL BICKLE[1], YONGJIE LIN[5], ALEX L RILEY[6], WILLIAM M MAYES[6] AND EDWARD T. TIPPER[2]

[1]University of Cambridge, Department of Earth Sciences
[2]University of Cambridge
[3]Heriot-Watt University
[4]Scottish Universities Environmental Research Centre
[5]MNR Key Laboratory of Saline Lake Resources and Environments, Institute of Mineral Resources, Chinese Academy of Geological Sciences
[6]University of Hull

Presenting Author: wjk27@cam.ac.uk

Enhanced weathering is a carbon dioxide (CO_2) mitigation strategy that promises large scale and rapid atmospheric CO_2 removal. One of the main challenges associated with this carbon removal technology is monitoring, reporting and verifying the amount of carbon removed as a result of enhanced weathering dissolution and precipitation reactions. Here, we study a well-established CO_2 mineralisation site, the former steel works in Consett Co. Durham, UK, where steel slags comprising gehlenite ($Ca_2Al{-}SiO_7$), akermanite ($Ca_2Mg{-}Si_2O_7$) and portlandite ($Ca(OH)_2$) phases have been weathered in a landscaped spoil heap for at least 40 years. We have produced new radiocarbon, $\delta^{13}C$, $^{87}Sr/^{86}Sr$, and major element data in waters, calcite precipitates and soils to accurately quantify the rate of carbon removal at the Consett site. We demonstrate that measuring the radiocarbon activity of travertines deposited in waters draining the slag heap provides a robust constraint on the source of the carbon being sequestered (80 % modern, 2σ = 8 %), and use downstream alkalinity measurements to determine the proportion of carbon being exported from the catchment. Geochemical modelling reveals that the main phase dissolving in the slag are hydroxide minerals (e.g. portlandite), with minor contributions (<3 %) from the silicate minerals which constitute the majority of slag material. We propose a novel method for quantifying carbon removal rates at enhanced weathering sites, which is a function of the radiocarbon-apportioned sources of carbon being sequestered, and the proportion of carbon being exported from the catchment to the oceans.