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Assessment of CO_2 consumption from basalt amendments to soils.

ORAL PRESENTATION

Presented by Louis A Derry

Monday, 19 August 2024

10:15 - 10:30

Williford C (3rd floor, Hilton Chicago)

Subsession: 12eO1 - Geochemical perspectives on measuring, reporting and verifying carbon dioxide removal from the atmosphere

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Theme: Theme 12: Chemistry and Physical Processes of The Oceans and Atmosphere

Abstract

Concern over the impacts of anthropogenic greenhouse gas emissions has led to proposals to offset CO_2 emissions by mechanisms that could increase carbon storage in soils. Estimates of the potential efficacy of various strategies vary, but an issue common to all of them is how to verify the magnitude and stability of the results of interventions. Soil sinks are “out of sight” which contrasts with strategies like reforestation. Below-ground carbon sinks, whether they be organic or inorganic, pose substantially more challenging issues for quantification and monitoring.

ERW seeks to apply Ca, Mg-rich silicate rocks to enhance the consumption of CO_2 by weathering reactions. Measurement of base cation losses from soils is used for quantifying CO_2 uptake. Assessing CO_2 uptake this way requires assessment of small differences between heterogeneous end members. Geochemical tracers can be used to estimate basalt input assuming that the endmembers are distinct. To compensate for open system behavior normalization to an “immobile” element is necessary. The limitation is typically the highly heterogenous nature of soils. Data from these settings often have high covariances. We reanalyzed published data on amended soils using Monte Carlo uncertainty analysis. We find that in a number of cases the Ca and Mg differences in pre- and post-amendment soils are not significantly different from zero (1 s.e.). High soil chemistry variances makes quantification of small differences difficult.

Techniques for estimating relevant sample size and power for noisy data sets and modest effect sizes are well developed in other fields and can be appropriately applied to ERW problems. A simplified example using Lehr’s approximate rule for a two-sided test with s.d. for the pre- and post- data sets = 0.1 and the effect size (net change) = 0.03 yields a sample size $n = 178$ to obtain a sample power of 0.8 at the 95% CI, an optimistic estimate. Appropriate experimental design for ERW will require substantial sampling effort and rigorous *a priori* statistical assessment. The ocean ΔCO2/ΔALK ratio used to estimate CO_2 uptake is important and unlikely to be as high as most studies have assumed.

Presenting Author

D

Louis A Derry

Institut de Physique du Globe de Paris

Cornell University

Authors

C

Oliver Chadwick

University of California Santa Barbara

P

Stephen Porder

Brown University