Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29297

Minerals versus Biochar: challenges from combining pyrogenic and geochemical CDR in soils

MARIA-ELENA VORRATH[1], JOHANNES MEYER ZU DREWER[2,3], REINALDY POETRA[1], NIKOLAS HAGEMANN[2,3], THORBEN AMANN[4] AND JENS HARTMANN[5]

[1]University Hamburg
[2]Ithaka Institute
[3]Agroscope
[4]Planeteers GmbH
[5]Institute for Geology, University of Hamburg

Combined application of biochar and rock powder to soils, i.e. Pyrogenic carbon and enhanced Mineral weathering for Carbon Capture and Storage (PyMiCCS) seeks to leverage the strengths of both soil amendments and both underlying carbon dioxide removal (CDR) strategies. In soil, both amendments can greatly improve nutrient availability and retention, increase water holding capacity, and balance soil pH. However, quantifying CDR from rock weathering becomes a significant challenge, as the co-amendment results in a mixed signal of cation release, especially when minerals were already integrated into the biomass prior to pyrolysis (co-pyrolyis, in contrast to co-application of biochar and rock-powder). It is therefore a challenge to quantify whether PyMiCCS really leads to a synergy in terms of weathering, i.e. a quicker release of cations from the rock. It is essential to recognize that the assessment of CDR varies between the removal of anthropogenic CO_2 emissions through enhanced rock weathering (release of geogenic cations balancing bicarbonate) and the naturally occurring release of biogenic cations from biochar back into the nutrient cycle. Further, each addition of these materials represents a manipulation of the soil, allowing to improve e.g. soil fertility and hydrology, highlighting the critical significance of material selection in achieving optimal outcomes. In this context, we address the challenges associated with quantifying CDR, drawing on findings from a one-year soil column experiment conducted in the laboratory. The experiment was conducted in a sandy soil using different combinations of wood and soybean meal biochars (pyrolysis at 650 °C, for 15min.) together with dunite, basanite, steelslag and crushed concrete. We present observations of impacts on the soil organic carbon inventory, hydrology and alkalinity export.