Goldschmidt 2026 Abstract
https://doi.org/10.46427/gold2026.37470

Impact of basalt addition on soil biogeochemistry and carbon fluxes: insights from a multi-decadal unintended experiment

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Enhanced Rock Weathering (ERW) promises to achieve large volume carbon dioxide removal (CDR) with millennium-scale storage and at competitive cost by distributing finely ground reactive (ultra)mafic rock, e.g. basalts, on agricultural soils. Models predict that ERW alone make substantial contributions to net-zero goals, but they lack empirical ground-truthing. A central issue is that the timescales of soil and ecosystem property responses are longer than most experimental setups, meaning we lack a proper demonstration ERW works over decadal timescales or longer, as well as a strategy for quantifying and certifying carbon drawdown. We also don't know the long-term impact on soil-plant systems – in particular on plant health or organic carbon dynamics – nor whether the short-term weathering rates derived from lab experiments can be sustained over longer timescales. Here, we investigate the long-term efficacy and impacts of ERW by exploiting an unintended experiment on German agricultural land where basalt has been applied as fertiliser for decades. We will use cation-budgeting approaches to assess basalt dissolution and the fate of the weathering products, as well as radiogenic and stable metal isotope geochemical tools to provide insight into the weathering processes.