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Influence of soil organic carbon on basalt weathering efficiency

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The carbon dioxide removal (CDR) potential of basalt powder applied to soils with different organic carbon contents was investigated. In a lab experiment, columns were filled with basalt powder and two different soils, with low and high total organic carbon (TOC) content (1.3 and 7.2% wt-%, respectively) to evaluate the impact of soil organic carbon on the CDR potential by Enhanced Weathering. Total alkalinity (TA) was used to estimate CO_2 consumption. The soil with lower TOC exhibited a 100-200% higher CO_2 consumption than the organic-rich soil. Furthermore, from the low TOC soil, less organic carbon was mobilized than from the high TOC soil. Low DOC concentrations in the leachate from the low TOC soil, and small differences (~7%) between measured and calculated TA (based on pH and dissolved inorganic carbon), indicate little contribution of organic alkalinity to TA. Here, TA can be used to calculate CO_2 consumption. Opposed to this observation, DOC exports exceed TA fluxes from the organic rich soil by a factor of four, indicating a loss of carbon from this soil.The soils also react differently to elevated pCO2. Compared to ambient pCO2 codnitions, low TOC soil TA export increases by 2.5x and 3.3x, whereas high TOC soil TA export increases only by 1.2x and 1.8x, under 1.5% and 15% pCO2, respectively.

These findings imply that soils with a low organic carbon content are favorable application areas for carbon removal by Enhanced Weathering.