

## Climate mitigation and food production with glacial rock flour - A case for Danish agriculture

One potential climate mitigation solution could be to spread the fine (46 µm) glacial rock flour from Greenland on agricultural fields to enhance its weathering rate with resulting CO<sub>2</sub>-uptake from the production of alkalinity. The net climate mitigation potential of this process will depend on the weathering rate, but also the embedded greenhouse gas emissions of its lifecycle. This thesis aims to estimate the net greenhouse gas balance of application with glacial rock flour on agricultural fields in Denmark. The CO<sub>2</sub>-uptake from weathering of glacial rock flour in soil was estimated from the release rates of cations in a pot experiment with perennial ryegrass (*Lolium Perenne*) in Denmark. There was no significant difference in cation release rates across application rates of 10, 20, 30, 40 and 50 t ha<sup>-1</sup> of glacial rock flour, resulting in an uptake of 5.31 kg CO<sub>2</sub> t<sup>-1</sup> after 8.5 months across all five treatments. The effect on plant growth by the end of the experiment was non-significant but could potentially be due to temperature limitation. The greenhouse gas emissions from the lifecycle of glacial rock flour was estimated for a hypothetical "cradle-to-field" lifecycle using secondary emission data on CO<sub>2</sub>, and when possible also CH<sub>4</sub> and N<sub>2</sub>O, for activities which are expected to be the closest proxies. It was estimated that the most "climate-optimal" lifecycle emits 26.32 kg CO<sub>2</sub>e t<sup>-1</sup> or 39.32 kg CO<sub>2</sub>e t<sup>-1</sup> for glacial rock flour extracted on-land or in-water, respectively. The lifecycle greenhouse gas emissions are therefore not balanced by CO<sub>2</sub>-uptake from weathering after 8.5 months in Denmark, but it is expected that glacial rock flour eventually will lead to a net CO<sub>2</sub>-uptake of around 215 kg CO<sub>2</sub>e t<sup>-1</sup> and 200 kg CO<sub>2</sub>e t<sup>-1</sup> for land-based and water-based glacial rock flour, respectively, based on its geochemical composition. There is need for more long-term experiments to estimate the continued weathering rate and thereby evaluate the role of glacial rock flour in climate mitigation in this century.

**Forfatter:** Josefine Lysdal Wulffeld    **Type:** Report | Rapport    **Årstal:** 2021    **Emner:** Climate; Mitigation; Food; Rock flour    **Udgivelsessted:** Copenhagen    **Udgivelsesland:** Denmark

[Åben publikation](#)

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