

## The Mineralogy and Modelled Dissolution of Maalutu Glacial Rock Flour in relation to Enhanced Weathering

It is widely accepted that the anthropogenic emission of greenhouse gasses leads to global climate change. If global temperatures continue to rise, the frequency of extreme weather phenomena such as droughts and tropical storms will increase to a point of significant socio-economic impact. To mitigate such changes, several CO<sub>2</sub> removal strategies have been proposed, including enhanced weathering. Weathering reduces atmospheric CO<sub>2</sub> via the reaction of carbonic acid and the minerals constituting the continental crust. Glacial rock flour from Greenland may be utilized for enhanced weathering as it has a large surface area from the natural grinding process, increasing its reactivity. However, the lack of current knowledge on the material means its use as a climate mitigation technique is contentious. The aim of this project is to probe the mineralogy and chemical composition of the material and use this information to conduct a geochemical simulation of its dissolution.

28 samples were analyzed with X-ray diffraction (XRD) and Pair distribution function (PDF) analysis of synchrotron X-ray scattering data. The particle size distribution was determined with laser diffraction and the surface area of the material determined with the Brunauer-Emmett-Teller (BET) method. The results show that the mineral assemblage consists of quartz, plagioclase, microcline, albite, biotite, chlorite, muscovite, and epidote in proportions which corresponds to a granodioritic composition. The bulk material was separated gravitationally into four size fractions. XRD of these fractions show that the coarser is dominated by quartz, whereas the finest fraction consists mainly of phyllosilicates and amphibole.

The geochemical software PHREEQC was utilized to model the dissolution of the material. Comparison between modelled and experimental concentrations from dissolution shows that the model is able to reproduce observed Si concentrations. However, inconsistency between modelled and observed concentrations of Ca, Mg, Na and K indicate that fast, non-stoichiometric, dissolution is dominating the first 71 hours of reaction. The simulations indicate that precipitation of clay minerals alter the rate of ion increase in solution in the later stage; which is why the accumulation rate plateaus. Ca ions which could potentially precipitate as carbonate minerals, and sequester CO<sub>2</sub>, are kept from oversaturation due to the formation of Ca-rich secondary clays. The results indicate that GRF can increase the alkalinity of the local water and consume CO<sub>2</sub> at a relatively high rate in the short-term. However, in the long-term, the rate of cation release, and therefore CO<sub>2</sub> consumption, decreases.

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