

Carbon-sequestering fertilizers for augmented carbon storage capacity of agricultural soils

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Project summary

The weathering of basic silicate minerals, and subsequent precipitation of stable Ca- and Mg-carbonates, is the main geological process removing CO₂ and controlling its concentration in the atmosphere. Enhanced weathering can sequester CO₂ at an accelerated pace, by exposing milled minerals to CO₂ in the air and within soils. Sequestration capacity is proportional to mineral application rate and land area coverage. To achieve the sequestration of meaningful amounts of CO₂, while keeping costs low and logistics simple, agricultural lands will be targeted for implementation. Agricultural activities require extensive areas and regularly apply large quantities of materials to the land. Hence, existing infrastructure for fertilizer application can be used to spread the novel fertilizer blends developed by this project, enabling widespread contact for CO₂ sequestration.

The permanent sequestration of CO₂ by minerals applied to agricultural soils will off-set anthropogenic emissions of CO₂, helping Ontario's agricultural sector reduce its carbon footprint and meet stricter environmental targets for greenhouse gas emissions. The technology will enable farmers to proactively participate in the efforts to curb climate change. In addition, the release of colloidal silica from the weathered silicate minerals has the potential to improve produce yield and health.

This project will formulate fertilizer blends that include basic minerals as carbon-sinks, test these fertilizers in laboratory and field trials, and validate enhanced weathering as a means to increase fixed carbon content of agricultural soils. The fertilizer blends will be tested to determine weathering rates, carbon sequestration capacity, and effects on nutrient uptake, plant growth and toxicity. Detection and accounting of sequestered carbon will aid the development of cap-and-trade carbon-credits policy.

Project Objective(s):

The overall aim is to help reduce the concentration of greenhouse gases in the atmosphere, by implementation of an innovative carbon-sequestering approach that will enable Ontario-based farmers and fertilizer producers to proactively participate in the efforts to curb climate change and preserve the health of our ecosystems, while supporting their main business models.

The objective is to assess the suitability of enhanced weathering for large-scale carbon sequestration in Ontario, its compatibility with the agricultural sector, and the feasibility of this approach. Key questions to be addressed in the research are:

- 1) What is the most suitable natural mineral additive (in its natural state or activated), and what is a viable mineral application rate as a fertilizer blend?
- 2) How much and how fast CO₂ can be stored permanently (as stable carbonates) in soils?
- 3) What is the projected long-term inorganic carbon capacity of treated soil?
- 4) How to quantify mineral carbon sequestration in soils to help set the policy on carbon-credits?
- 5) What is the impact of mineral additions on plant growth, produce yield, and soil chemistry?

The end result of this project will be the delivery of a new environmental protection tool for the agricultural sector in Ontario, the formation of new partnerships with regional industries and rural communities, and advancement of the state-of-knowledge on climate change mitigation.