

February 24, 2026

Enhanced rock weathering is not yet a reliable climate protection measure

Society and science are debating whether the weathering of rock powder can sequester atmospheric carbon in the long term. However, a team of researchers led by the Thünen Institute of Climate-Smart Agriculture and ETH Zurich has now shown that there are still too many unknowns involved. A perspective paper on this topic has now been published in *Nature Reviews Earth & Environment*.

Braunschweig (February 24, 2026). Most countries will not achieve climate neutrality through greenhouse gas emission reductions alone; carbon sinks are also needed to offset unavoidable emissions. Researchers are discussing technical solutions, such as applying silicate-rock powder to arable land. This process, known as *enhanced rock weathering (ERW)*, can bind carbon dioxide from the atmosphere. In a perspective paper now published in the journal *Nature Reviews Earth & Environment*, scientists led by the Thünen Institute of Climate-Smart Agriculture and ETH Zurich discuss whether ERW is ready for deployment and effective for climate-protection.

Accelerating natural processes

ERW is based on natural geochemical processes. Atmospheric carbon dioxide forms carbonic acid, which can weather silicates—rock-forming minerals rich in calcium, magnesium and sodium. In this process, carbon dioxide is converted into weathering products. When these products are leached from the soil, they flow into the oceans via streams and rivers, where they form stable carbonates. In this way, atmospheric carbon dioxide becomes long-termly bound in the sea, rendering it effectively climate-neutral. The mechanism mirrors natural rock weathering, but the natural process occurs on geological timescales. Grinding the rock accelerates the reaction considerably. So far, so simple.

However, is there enough material available to produce suitable rock powder in large quantities? In their study, the international research team led by lead author Dr. Marcus Schiedung from the Thünen Institute of Climate-Smart Agriculture investigated which rocks are suitable and available for ERW and how much carbon dioxide could be sequestered. The result: it is currently unclear whether enough silicate rocks are available to bind sufficient carbon dioxide. Ironically, the rocks that could bind a lot of carbon dioxide usually have a high content of toxic elements such as nickel and chromium. On the other hand, not enough suitable rock powder is being produced. Quarrying would have to be significantly expanded in order to sequester the amounts of carbon dioxide that are being discussed for climate-relevant effects. This, in turn, would have a considerable impact on society and the environment.

Thünen Institute

Federal Research Institute for Rural Areas, Forestry and Fisheries
Bundesallee 50
38116 Braunschweig
www.thuenen.de

Head of Communications:

Nadine Kraft
Tel: 0531-25 70 18 65
Mobile: 0151-15 29 08 50
pressestelle@thuenen.de

Too much rock powder could harm soils and the environment

Another aspect discussed by the international team of authors concerns the use of ERW in agriculture. In current considerations, researchers assume that approximately 40 to 100 tonnes of rock powder would have to be spread over one hectare of arable land in order to achieve climate-relevant effects. However, this is significantly more than is recommended for sustainable farming. As comparison, the use of rock powder is quite common in regenerative agriculture. However, less than one tonne per hectare is applied there. "Smaller amounts of rock powder can have positive effects on soil and plants in arable land," says Prof. Dr Sebastian Doetterl from the Department of Environmental Systems Science at ETH Zurich and co-author of the study.

However, the effects of large quantities of rock powder on soils, plants and aquatic ecosystems are still largely unexplored. "The unclarified risk argues against large-scale application," says Dr Marcus Schiedung, lead author of the study. In particular, there is a lack of reliable information about the geochemical processes that take place in soils, rivers and oceans when carbon dioxide is bound or released again. Furthermore, it is unclear if the bound carbon dioxide is stable, or how much is released during transport to the sea. At present, it is therefore not possible to quantify how much carbon dioxide is actually sequestered in practice. Marcus Schiedung: "However, this is crucial in order to recognise the large-scale use of rock powder as a safe and effective climate protection measure."

Original publication:

Schiedung, M., Harrington K.J., Dupla, X., Möller, B., Facq, E., Sweere, T., Don, A., Hilton, R.G., Doetterl, S. & Hemingway, J.D. (2026). Uncertainties of enhanced rock weathering for climate-change mitigation. *Nature Reviews Earth & Environment* <https://doi.org/10.1038/s43017-026-00761-7>

Further information:

[The Thünen Institute's thematic focus on soil](#)

[Project website of ETH Zurich](#)

[Soil Resources Group at ETH Zurich](#)

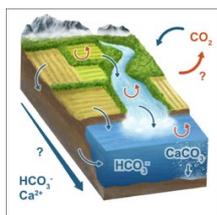
Contact:

Dr Marcus Schiedung

Thünen Institute of Climate-Smart Agriculture

Email: marcus.schiedung@thuenen.de

Photos are available for download in [the newsroom](#).



From left to right:

- Accelerated rock weathering is a process involving uncertainties across multiple ecosystems when weathering products are transported. © Valentina Arros
- There is a risk that dedicated mining for suitable silicate rocks is needed. © Benjamin Möller, ETH Zurich
- Dry rock powder application in a Swiss vineyard. © Xavier Dupla, ETH Zurich
- On a field in Germany. © Benjamin Möller, ETH Zurich