

ERW Explained in Three Maps

Whitepaper



ZeroEx

March 25th, 2025

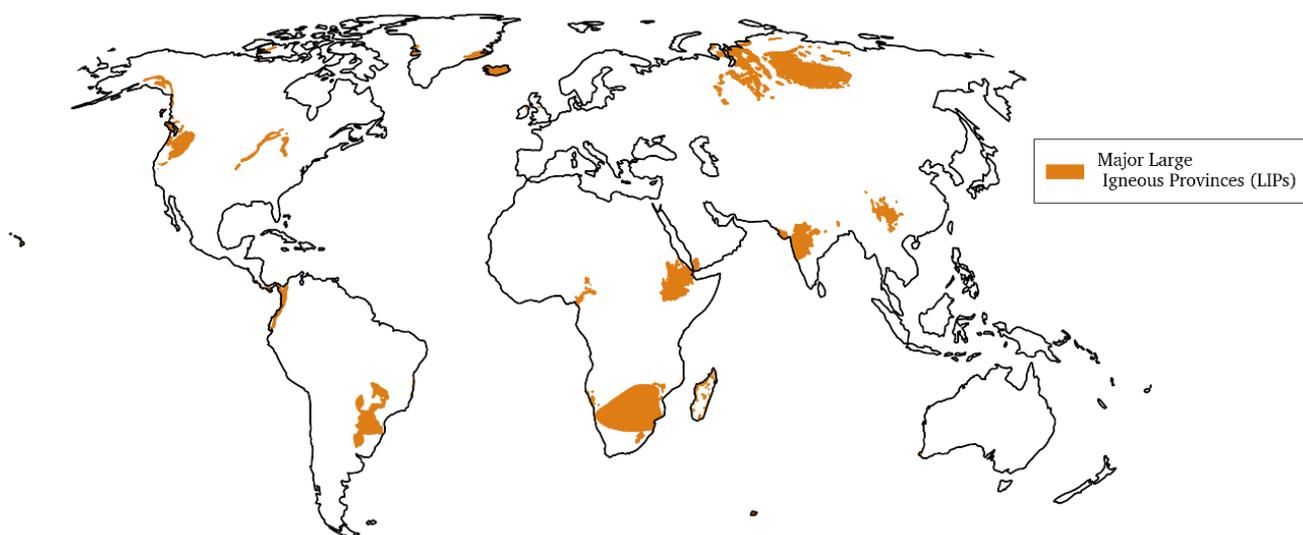
Introduction

The ingredients of enhanced rock weathering (ERW) are simple: rock powder, water, and time. Get the right ingredients together, and you have the perfect combination to permanently remove carbon from the atmosphere at low cost and high scalability.

Right Beneath Your Feet: Sourcing Weathering Feedstock

Some of the largest aggregations of mafic rock like basalt are large igneous provinces (LIPs), groupings of deposits generated from material emerging from the Earth's mantle through the crust. Some major continental LIPs are mapped below, showing that there are significant resources all over the world (in addition to many smaller deposits not shown).

The widespread nature of surface and near-surface basalt deposits makes it possible to source ERW feedstock near spreading sites, reducing the emissions associated with transportation. Testing enough potential rock sources to identify the ideal mineralogical recipe can take a long time and multiple rounds of testing, but finding feedstock with the maximum weathering potential pays off in the form of increased carbon removal.



The Charm Offensive: Farmer Co-benefits

The next component of ERW is agricultural land. Using farmland gives an ideal prepared surface for weathering and provides existing infrastructure for spreading powdered materials like fertilizers, reducing the amount of additional resources required.

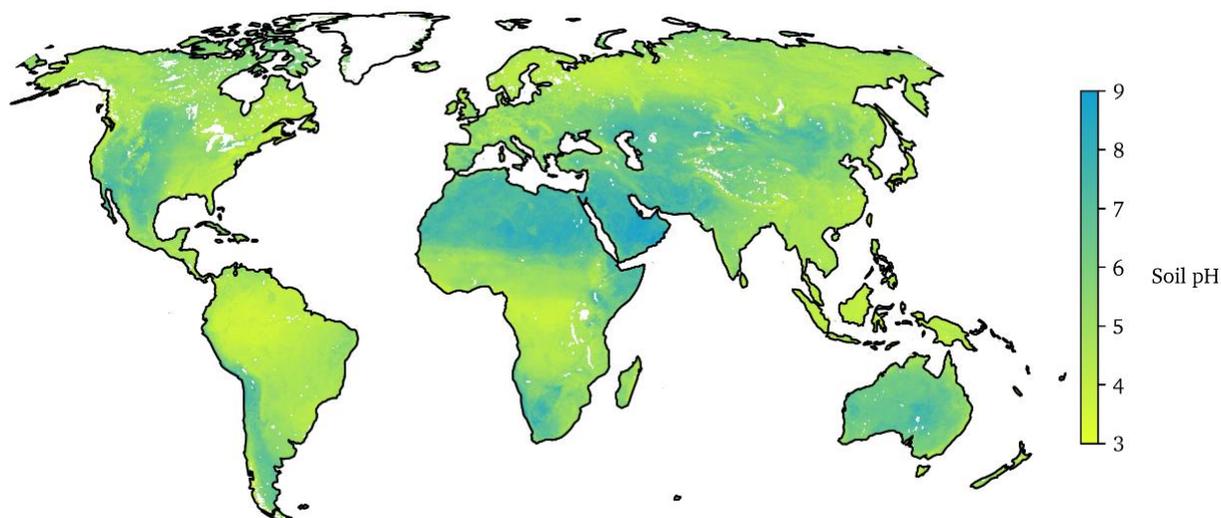
One source of public concern about enhanced weathering is the sense that it has the potential to hurt plants and animals and pollute water sources. Distrust in technology-based carbon capture as a whole may also be linked to a sense of betrayal by developments like fracking and other forms of resource extraction.

To combat this, project developers must educate potential partners about the science behind ERW and dispel fears of contamination.

Using rock with low concentrations of toxic trace elements is a good way to build trust with farmers and ensure that there are no adverse effects on crops or downstream ecosystems.

Additionally, ERW brings numerous co-benefits in addition to carbon removal, and highlighting those benefits can help recruit farmers. For instance, basalt weathering raises the pH of soils, an important factor in regions which suffer from highly acidic (low-pH) soils, shown as bright yellow in the map below.

The benefits don't stop at deacidification: Some soil chemistry simulations indicate that basalt supplies enough phosphorus to replace the commercial additives used in regions like Europe and the US. Crops grown with basalt show statistically significant increases in yield relative to those without.



There is even some evidence that basalt increases activity of the beneficial fungi that help plants absorb nutrients, increasing plant and soil health.

One of the large advantages of ERW is that it does not require a change in land use—farmers can continue to use their fields as they would normally. Currently, much of the new farmland developed globally comes from cutting down forests, sacrificing an important climate resource. By adding a new use to land without pushing out the current, ERW avoids putting any extra pressure on already scarce arable land.

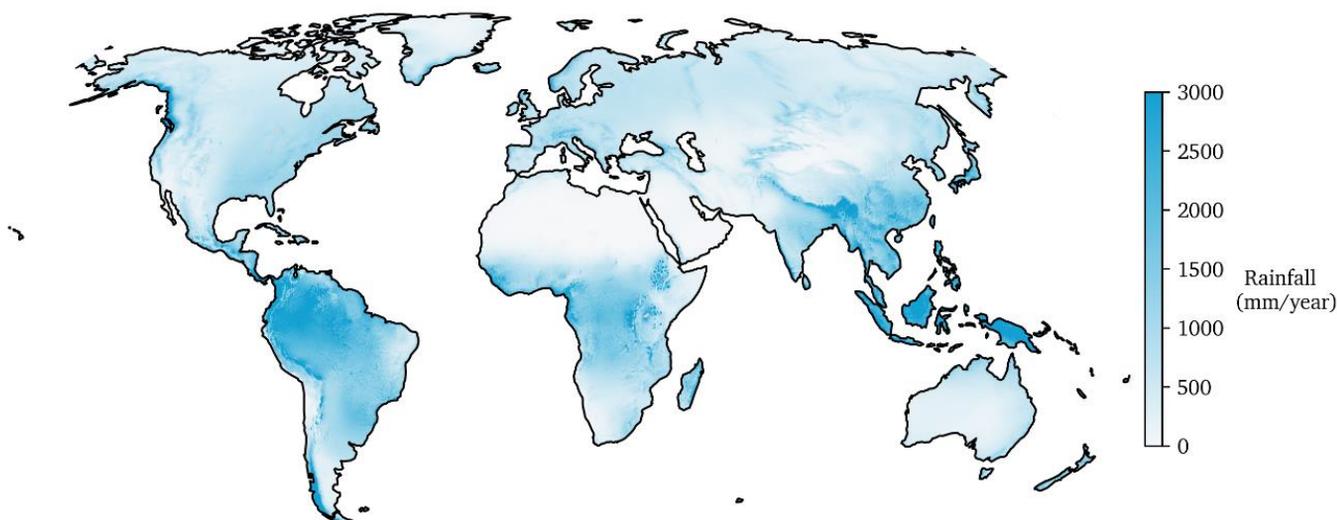
Stormy Weather: Finding the Right Climate for Weathering

A final contributing factor to ERW is water. Moisture, either from rain or irrigation, provides the molecular environment for weathering reactions to take place and flushes the resulting carbon into the ocean, where it is stably stored for thousands of years.

As a result, the best ERW conditions are regions with consistent, year-round rain with sufficient drainage to prevent waterlogging, producing moist, chemically active soil. As shown in the map below, regions with high annual rainfall are most common found in the tropics, as well as near rivers and tall mountain ranges.

The Perfect Package

The ingredients for ERW exist around the world—it's only a matter of finding the right combination in close proximity and designing a project to take advantage of the potential climate benefits. Proper planning to find the right feedstock, climate, and farms can lead to efficient, measurable, and scalable carbon removal.



Key Lessons

- ERW has the advantage of requiring resources that are widespread, including in regions with favorable climates for weathering
- Highlighting benefits for crops in a variety of agricultural settings can increase farmer interest
- Scaling ERW requires aligning necessary resources which focus on benefiting farmers and minimizing logistics

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Data Sources

LIPs:

1. Coffin, M.F. (2011) Digital LIPs database (version 2011). PLATES Project, UTIG University of Texas Institute for Geophysics;
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Rainfall:

2. Hersbach, H., Bell, B., Berrisford, P., Biavati, G., Horányi, A., Muñoz Sabater, J., Nicolas, J., Peubey, C., Radu, R., Rozum, I., Schepers, D., Simmons, A., Soci, C., Dee, D., Thépaut, J-N. (2023): ERA5 monthly averaged data on single levels from 1940 to present. Copernicus Climate Change Service (C3S) Climate Data Store (CDS), DOI: 10.24381/cds.f17050d7 (Accessed on 17-Mar-2025)

Soil acidity:

3. Hengl T, Mendes de Jesus J, Heuvelink GBM, Ruiperez Gonzalez M, Kilibarda M, Blagotić A, et al. (2017) SoilGrids250m: Global gridded soil information based on machine learning. PLoS ONE 12(2): e0169748.
<https://doi.org/10.1371/journal.pone.0169748>