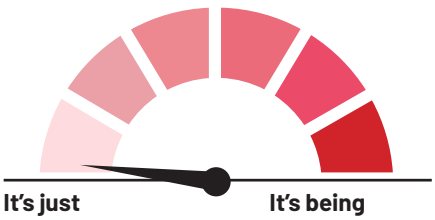
Enhanced Weathering

POINT OF INTERVENTION

ENHANCED WEATHERING ON LAND (TERRESTRIAL)

Mined olivine (magnesium iron silicate) is ground to a powder and either dumped on beaches where wave action disperses it into water or is spread on land. The idea is to control levels of atmospheric CO2 through natural chemical weathering processes[1] that draw CO2 out of the atmosphere (referred to as carbonation) and sequester it in newly-formed rock mineral, magnesium carbonate. Carbon uptake levels are still relatively unknown, as are the effects of large-scale dumping on marine, terrestrial and freshwater environments. The chemical effects of adding this mineral to other ecosystems are also unknown. Massive mining operations to extract olivine, possibly thousands of times larger than the current scale of production, would exacerbate the already disastrous effects of mining on the world's ecosystems and local populations.

REALITY CHECK



Weathering is a theoretical process of sequestering carbon by scattering mined minerals over vast areas.

ENHANCED WEATHERING IN THE OCEANS (MARINE)

This technique, similar to treating acidic agricultural lands with lime, proposes adding chemical carbonates to the ocean to theoretically increase alkalinity and therefore carbon uptake. The rate at which these minerals would dissolve, as well as the expense involved in amassing and dispersing enough of them to make an impact, is a major practical concern, as is the effect on the complex ocean ecosystem.[2] The increased demand for minerals would also translate into increased mining activities, with the above-mentioned impacts.[3]

ACTORS INVOLVED

The Leverhulme Centre for Climate Change mitigation in the UK is conducting enhanced weathering field trials in the USA, Australia and Malaysia. They have identified expansive crop areas where they may add crushed basalt. In Malaysia, quarried and crushed basalt is added to oil palm plantations and is studied

for its impacts on crop yield and carbon sequestration.[4]

Other developments in the field of enhanced weathering are limited to research projects, such as the Oxford Geoengineering Programme[5] and University of Utrecht/The Olivine Foundation, in the Netherlands.[6]

IMPACTS

A study on enhanced weathering lists the following possible problematic side effects: Change in pH of soils and surface waters (streams, rivers, lakes), affecting terrestrial and aquatic ecosystems; change in silicon concentration of surface waters, affecting ecosystems via altered nutrient ratios; release of trace metals associated with target minerals (particularly Nickel and Chromium in the case of olivine application); generation of dust; socioeconomic and socio-political consequences for agricultural communities of a new, large-scale industrial and financial enterprise; and the environmental costs of up to three orders of magnitude increase in olivine mining globally.[7]

While olivine fertilization of the ocean "mimics" a natural process, it is not natural at all. Olivine would be delivered to ecosystems at rates far higher than normal, which could lead to negative consequences for ecosystems where it is introduced, such as phytoplankton blooms and anoxic dead zones, and other unknown effects on deep-sea life and thus on biogeochemical processes. At such a large scale, enhanced weathering could change the ecology of the oceans.[8] Such changes could lead to an increase in the microbial organisms that produce other greenhouse gases such as methane and nitrous oxide, which have much higher warming impacts than CO2.[9]

The amount of olivine necessary for these applications is extremely large

Weathering could have profound negative effects on ecological systems in the air, land and oceans.

The Nullarbor Plain (Heiko Volland)

– comparable to present day global coal mining,[10] which would bring serious and vast mining impacts. When energy inputs such as mining, processing and transportation are included, the overall energy requirement for enhanced weathering is huge.[11]

The oil and gas company Shell funded a small company called Cquestrate (run by Tim Kruger, who now manages The Oxford Geoengineering Project[12]) in the UK to conduct feasibility studies in to adding limestone to the oceans. Although this project never got off the ground, it is a good example of the potential impacts of this kind of geoengineering approach. The project developer suggested that

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to offset current global carbon emissions, 10.5km3 of limestone could be mined each year from the "sparsely populated" Nullarbor Plain in Australia and dumped into the ocean.[13] Significantly less than 10.5km3 of hard coal is mined globally each year. Large scale mining operations would be required to implement this kind of scheme, and the process would harm ecosystems and communities. Further, the Nullarbor Plain is home to the aboriginal Wangai people, who were forcibly removed from their ancestral lands once before for nuclear testing in the 1950s and have since received compensation for the injustice and have reoccupied the plain. The Nullarbor Plain was also given formal Wilderness Protection Status in 2011 to protect its unique environment, which contains 390 species of plants and many habitats for rare species of animals and birds.[14]

REALITY CHECK

While field-scale trails adding crushed basalt to cropland are

being conducted, other research into enhanced weathering is purely theoretical, and based on modelling exercises.

FURTHER READING

ETC Group and Heinrich Böll Foundation, "Geoengineering Map." map.geoengineeringmonitor.org

The Big Bad Fix: The Case Against Climate Geoengineering, http://etcgroup.org/content/big-bad-fix

SOURCES

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6. The Olivine Foundation, "Let the Earth save the Earth," http://smartstones.nl/

A limestone quarry. (Thomas Bjørkan)

7. Jens Hartmann et al., "Enhanced chemical weathering as a geoengineering strategy to reduce atmospheric carbon dioxide, supply nutrients and mitigate ocean acidification," *Reviews of Geophysics*, Vol. 51, 2013, pp. 113–149
Sallie Chisholm et al., "Dis-Crediting Ocean Fertilization," *Science*, Vol. 294, 2001, pp. 309-310

8. Sallie Chisholm et al., "Dis-Crediting Ocean Fertilization," *Science*, Vol. 294, 2001, pp. 309-310

9. Jesse Abrams, "An Investigation of the Geoengineering Possibilities and Impact of Enhanced Olivine Weathering," University of Bremen, 2001, http://www.iup.uni-bremen.de/PEP_master_thesis/thesis_2012/Thesis_Jesse-Abrams.pdf

10. Peter Köhler et al., "The geoengineering potential of artificially enhanced silicate weathering of olivine," *Proceedings of the National Academy of Sciences of the United States of America*, Vol. 107, 2010, pp. 20228-20233

11. Pete Smith et al., "Biophysical and economic limits to negative CO2 emissions," *Nature Climate Change*, Vol. 6, 2015, pp. 42-50

12. Kruger was one of the authors promoting a set of principles for governance that have been influential among the geoengineering proponents, including the astonishing notion that geoengineering is a public good. See http://www.cquestrate.com and http://www.geoengineering.ox.ac.uk/

13. Cquestrate, "Detailed description of the idea," http://www.cquestrate.com/the-idea/detailed-description-of-the-idea/

14. Wikipedia, "Nullarbor Plain," https://en.wikipedia.org/wiki/Nullarbor_Plain