



Eureka

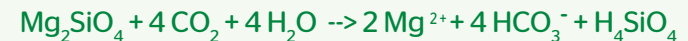
one stone
to kill two birds

Eureka - one stone to kill two birds

It seems so simple. And it certainly is. Nature shows us the way. A widely occurring mineral binds CO₂ chemically. This process can be accelerated. Finely ground olivine clears up this threat to our atmosphere. It offers companies a simple way to show their social responsibility, to reinforce their green image and to compensate their unavoidable CO₂ discharge. With overseeable costs.

Help is welcome. The Olivine Foundation aims to achieve the large scale application of this method of CO₂-reduction. It explores the possibilities with test and demonstration projects, and by seeking partners. It invites companies and scientific institutes to take part in this quest. With ideas, donations, participation in trials and adoption of key projects.

The method is proven. Olivine has kept the level of CO₂ worldwide in balance for millions of years. The mineral weathers and binds the carbon dioxide. Some water and warmth is all that is needed to get the process going. De chemical formula is:



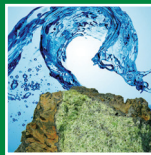
The result is harmless bicarbonate. Rivers take it to the sea where it forms, among other things, coral reefs and dolomites. The CO₂ has been permanently captured.



EARTH



WATER



FIRE



AIR



A brief overview : four projects

Earth. Olivine applications in agricultural products. As an ingredient of soil improvers. As a mixture with artificial fertiliser. Or combined with charcoal (biochar) applied to arable land.

Water. Olivine as beach covering round the new harbour of Rotterdam. Or tide-lines elsewhere. The action of ebb & flood accelerates the weathering. The project will show the effect of these conditions in different seasons. Also whether diatoms can be grown on the remaining silica : they are full of fatty acids and a possible source of biodiesel.

Fire. Serpentine is a clay-like mineral related to olivine. Serpentine mud seems to be very effective in extinguishing forest, heath and steppe fires. The heat of the fire bakes the clay. This forms an encapsulating layer which rapidly weathers after the fire and binds the CO₂. The initial trials were spectacular. This technique both prevents and captures carbon dioxide. In the US forest fires produce just as much CO₂ as all the cars there.

Air. Olivine in the battle against sick-building syndrome. In many offices and schools, the accumulation of CO₂ causes drowsiness and loss of concentration. The productivity falls. If the air is circulated over an olivine filter, not only is the CO₂ content reduced but also the level of pollen and allergen particles. Extra relief for asthma and hay-fever patients.

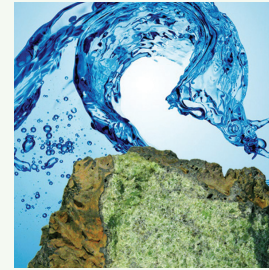


Olivine and earth

Olivine helps in agriculture. Adding it to arable land improves the soil structure and the water management. It corrects the acidity and provides more magnesium nutrients. And of course it also permanently binds CO_2 . In combination with biochar, another fertility improver and CO_2 -binder, it is very promising in theory. Practical trials are needed to prove this.

Pyrolysis of wood-waste and similar organic material produces bio-fuel and Biochar. This special charcoal remains intact in the ground for a long time. This results in good cultivation conditions and a slowing-down of the carbon cycle. Added olivine should immediately bind the liberated CO_2 . Forever. The applications are virtually unlimited. From grain and rice cultivation to grasslands.

- Soil improvement and CO_2 reduction
- Combination of olivine and Biochar
- Trial plots of different composition
- Monitoring of soil and crops
- Application on large and small scales
- Start-up costs: € 350.000,-

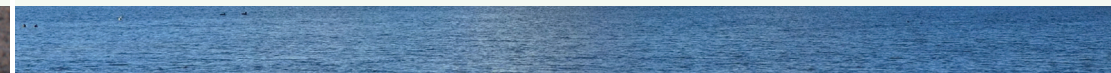
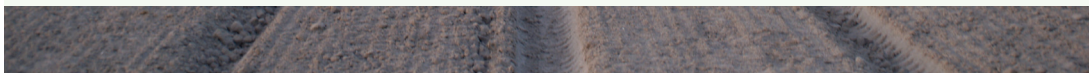


Olivine and water

Olivine reacts with water. Seawater is slightly more effective than freshwater. The construction of a simple test installation has been suggested. That could be possible in cooperation with the Port Authority of Rotterdam. It requires a long concrete trough with olivine sand. Perpendicular to the coast. By regular monitoring of the incoming and outgoing seawater, the reaction can be studied. More bicarbonate means more CO_2 capture.

During weathering silica is also released, an ideal growth nutrient for silica algae. These fast growing single cell organisms contain a lot of fatty acids. They are therefore a potential raw material for biodiesel. If trials are successful, this could provide a far more sustainable source than land-grown maize, oil palm or soya. The second phase of the project therefore includes an artificial lagoon with an olivine beach to study the algae growth. The Ecological Institute NIOO-KNAW and the algae experts from the Wageningen University will soon start an initial study.

- Test installation on seacoast
- Effect of ebb and flood
- Possible algae nursery for biogas
- Cooperation with scientists
- Start-up costs: € 750.000,-





Olivine and fire

Olivine has a geological sister: serpentine. Hot solutions have changed the olivine into a type of magnesium clay. When baked, this material reacts quickly with water and CO₂. Great ! But that doesn't help us, because the baking of serpentine results in extra CO₂. With an unwanted fire it is different. The use of serpentine in forest and steppe fires has potential. The first small scale trials have been successful.

When fighting wild fires it is important to reduce the temperature rapidly. Spraying the fire with a serpentine & water mixture seems a good method for all types of wild fires. Baking the clay requires a lot of heat. It creates an impermeable crust which prevents flammable gases escaping. Since the baked clay subsequently binds CO₂ it is even more effective. The CO₂ produced by the fire is compensated for straight away. The yearly outbreaks of wild fires in Southern Europe, Australia and North & South America make the study of this technique particularly worthwhile.

- Applicable to forest, peat and steppe fires
- Dilute serpentine/water mixture for fire-fighting
- Spraying from the ground or from the air
- Special reservoirs in threatened areas
- Cooperation with producers and fire-fighting institutes
- Start-up costs: € 500.000,-



Olivine and air

Olivine helps to eliminate illness. Offices and schools are increasingly stricken with sick-building syndrome. In heavily populated buildings the CO₂ level increases during the day. From 400 ppm to 1500 ppm. Resulting in drowsiness, loss of concentration and lower productivity. Opening doors and windows is not always possible or leads to unacceptable energy loss. A special filter technique can provide relief.

The concept is clear: all the air inside passes through a water filter containing finely ground olivine. Possibly connected to the existing air circulation system. Via small holes at the bottom of the filter, the air bubbles upwards. The intense contact with olivine binds the CO₂ for good. Pollen and allergen particles are also filtered out. Good for patients with asthma or hay-fever. The filter liquid can be discharged to a nearby lake or waterway. The additional magnesium and silica help the growth of reeds, bamboo and rushes.

- Useful for offices and schools
- Increased productivity
- Low-CO₂ management in buildings
- Cato-filter : Clean Air Through Olivine
- Coupled to air conditioning systems
- Start-up costs: € 1.000.000,-



Other inspiring possibilities and current projects

Better biogas.

Olivine improves the generation of biogas. Fermentation of organic material results in a gas consisting of 2/3 methane and 1/3 CO₂. By adding olivine powder less CO₂ is produced, the calorific value increases and the smell decreases.

Projects in preparation.

Sustaining sewers.

Olivine powder on the bottom of sewerpipes. That can contribute to CO₂ reduction and extend the life of the drainage system. It is relatively warm there and rich in CO₂. Good for reaction with olivine. The corresponding decrease in acidity results in reduced corrosion of the concrete. Saving millions. A double benefit. Applicable worldwide. Projects in preparation.

Projects in preparation.

Richer rice fields.

South-East Asia and China have some 80 million hectares of irrigated rice cultivation. The existing transport infrastructure is suitable for the distribution of olivine. A dream potential of 800 million tons of captured CO₂.

A subject of study.



Other inspiring possibilities and current projects

Mitigating materials.

Every little helps. Incorporation of olivine in all sorts of surfacing materials. For roads, roofs, dikes, airports, sports fields, gardens and railway tracks. All in all a multitude of small scale applications. Close to home. Various trials and measurements.

Various trials and measurements.

Miraculous mining.

Nickel mining is both notoriously energy-intensive and highly polluting. Luckily, nature has handed us a method of extracting the metal in a much environmentally friendlier way. Soils rich in olivine will sustain plants holding up to thirty times the amount of nickel found in mined ores. Once harvested these plants are burned to ashes containing concentrations of nickel as high as 10 percent. This way, each cultivated square kilometre will produce no less than nine to ten tons of nickel a year - worth over 200 thousand euros. In terms of CO₂ reduction, the effects are even more impressive. Olivine grains will weather extremely fast in these soils. Thus, each ton of nickel extracted from the olivine will capture 400 tons of carbon dioxide. The mining world is waking up!

Towards a new balance. Due to the rapid increase in use of fossil fuels, which took hundreds of millions of years to form, the equilibrium has been disturbed. The earth is warming up. The Olivine Foundation wants to give nature a hand by rapid weathering of olivine and similar minerals. In a manner copied from Mother Earth.

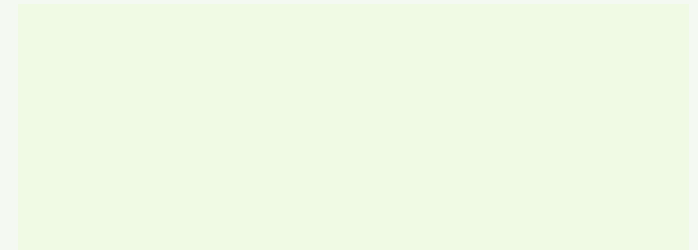
Simplicity is convincing. No complicated technology. Cheaper and safer than, for example, underground storage of liquefied CO₂. Scientists are now studying the possibilities, limitations and effects of the olivine-method. Wageningen and Utrecht are at the head of the field in The Netherlands. Various companies are using olivine in their production processes or in their products. And Sir Richard Branson's organisation has nominated the method for its Virgin Earth Challenge, with millions in prize money. The Olivine Foundation is one of the 11 proposals, out of 3000 worldwide, chosen for the final round. The only Dutch contender !

You are invited. The Olivine Foundation doesn't bet on only one horse. It is giving priority to four selected projects. It wants to obtain support for these from companies and institutes. A collaboration with national and international partners. In line with its environmental objectives the Foundation has chosen to concentrate on the themes: earth, water, fire and air. The projects are the start of a search for the holy grail of global applications. This is the concept, we are now in the gestation period.

The Olivine Foundation

The Foundation's aim is to achieve massive and sustainable capture CO₂ from the atmosphere by:

- promoting the method of rapid weathering of olivine and similar minerals
- building on the ideas of geochemist Prof. Dr. Olaf Schuiling
- stimulating scientific and applied research
- gaining recognition and public support for the application of olivine
- providing inspiration, drive, knowledge, contacts and support as a non-profit organisation with charity status





The Olivine Foundation

The Foundation provides information on olivine applications and projects. It stimulates studies and promotes debate, dialogue and cooperation. National and international. The money for these activities comes from donations from individuals and companies. Earmarked contributions are also very welcome.

Communication

- | | |
|--|-------------|
| • information material, brochures, video material | € 30.000,-- |
| • digital tools, presentations, website | € 15.000,-- |
| • public relations, public affairs, media information per year | € 20.000,-- |

Studies

- | | |
|--|-------------|
| • pre-study CDM-certificate
(Clean Development Mechanism) | € 15.000,-- |
| • development of measurement techniques olivine-effect | € 40.000,-- |

Cooperation

- | | |
|--|-------------|
| • national meetings and conferences | € 10.000,-- |
| • international travel & accommodation costs | € 20.000,-- |



The Olivine Foundation

**for more information
look at www.smartstones.nl**

Algemeen Nut
Beogende Instelling

ANBI

Olivine

- CO₂ is not only produced by human activity. Volcanoes and disintegrating rocks produce 2-2.5 billion tons per year. Olivine is one of the earth's defence mechanisms. Without it our atmosphere would long ago have become like that on Venus
- Human beings produce 30 billion tons of CO₂ each year. Nature can't cope with that amount. Spreading out enough olivine with a size of about 100 microns can help.
- One tonne of olivine can permanently remove 1.25 ton CO₂ from the atmosphere. There is enough of it to remove the excess of this greenhouse gas: on or just under the earth's surface there is a thousand times more than required.
- Olivine is the most widely occurring mineral on earth and in many places there are vast massives lying on the earth's surface. The Mars Explorers have also found it on that planet.
- In Europe olivine is abundant. It is mined in Norway, Sweden, Finland, Spain, Italy, Austria, Greece, Cyprus and the Balkans. Turkey also has olivine mines.
- Olivine is harmless. Even after reaction with CO₂ there are no signs of harmful effects. Olivine on the shoreline is also not a health risk.
- Weathering olivine binds CO₂. Sceptics think that it takes 700 years. However, the process is greatly accelerated by the action of heat, movement and water. And also by certain plant growth. Tests have shown that weathering then only takes a few years, rather than centuries.