Olivine

THE PHILOSOPHER'S STONE

The green and revolutionary source against climate change

Practical applications

Olaf Schuiling

Contents

Hiking in the Dolomites or sailing past the cliffs of Dover. Time and time again you face the huge storage places where nature has warehoused the surplus of CO_2 sustainably.

Introduction

I will get straight to the point: this book is about the olivine concept to combat climate change and the acidification of the oceans.

I will not claim that I invented this concept but I have copied it. Copied from whom? I copied it from nature where the concept has been practiced successfully for 4.5 billions of years. If it had not been successful, there would have been no life on earth. Almost all the surplus of CO_2 emitted by volcanoes is captured from the atmosphere and safely stored through an ordinary geological process. The process is the weathering of rocks. In this process, minerals react with CO_2 and water forming bicarbonate solutions. Rivers transport these solutions to the sea where marine organisms turn them into limestone and dolomite.

If you are wondering where al this stuff is, go and hike in the Dolomites, or if you prefer sailing, take a look at the cliffs of Dover. They are all storage places of huge masses of CO_2. Approximately 1 million times more CO_2 is sustainably captured in lime stones than in all seas, the atmosphere and the biosphere together. It is firmly bound to calcium and magnesium in these rocks.

So why do we keep nagging about CO_2 emission? The problem is solved, right? No, we do not nag, because in a couple of centuries we will have burnt all the fossil fuels that have been formed in hundreds of millions of years. This will result in an enormous increase of CO_2 emissions and the natural process cannot handle these quantities.

This book will show that we can accelerate the natural

process in such a way that we create a new balance between emission and capture.

Asking nature for help is another way to handle environmental issues than we have been used to so far. A complicated technology was invented and some bright technicians started working on it, without any involvement from you or me. Apparently we fail to understand that nature has a simple solution for most environmental problems to which everyone can contribute. By making your contribution we can prevent a lot of misery to our globe. See what is useful to you.

Nature or Technique?

If you continue reading, you will notice that I hardly introduce technologies when providing solutions for climate change and acidification of oceans. This is a deliberate choice. I am going to speed up, of course without any technical support, the process that ensured that the surplus of CO_2 has been sustainably captured over the last 4.5 billion years.

If we want to tackle an (environmental) problem quickly, we choose technical solutions instead of letting nature do its work to make conditions as favorable as possible with some support. It is our freedom of choice what we do.

A new technology sounds great but it always means extra costs for investments, unknown risks, extra staff, maintenance, solving disturbances and extra energy. Ultimately, it will lead to extra CO_2 emissions.

That is why I will copy the natural process of CO_2 capture and storage as accurate as possible. I will mainly use the most common mineral on earth: olivine or its related product serpentine that is also found a lot at the surface of the earth.

Both silicates weather relatively quickly. The difference with the natural situation is, that the weathering process as it has always worked so far, works too slowly to process the larger amounts of CO_2 that occur these days due to the burning of fossil fuels.

That is why interferences are necessary to speed up the process like uncovering these rocks by removing their cover of weathering and by preventing them from having contact with water and CO_2.

It is even more effective to mine and grind the rocks, which increases the contact surface between olivine, water and air. By

taking such measures the effect of this natural technology can increase hugely without changing the existing process. This has the advantage that no unexpected negative consequences will occur or that they will be an uncertain factor with other solutions.

There are people who claim that the weathering of olivine goes slowly, which is based on the weathering of olivine in sterile labs. However, there is no measure for the weathering speed of olivine because it depends on the circumstances. Under natural circumstances the weathering of olivine goes 1,000 up to 10,000 times faster than in a lab. In a sterile lab, living nature plays no role but in nature living organisms (plants and animals) often play a crucial role in faster weathering. This will be further explained later.

There is another difference with lab conditions yet. If you make sure that the olivine grains keep moving, in a river or in the sea, the grains collide with one another, or they scrape past one another. Small flakes escape and disintegrate within a few days. This happens in sea water a little bit faster than in sweet water. We can learn from these things that olivine will weather quickly by choosing the right environment to spread the olivine.

The first time I realized that the weathering of olivine in nature takes place much faster than in a lab, was through the volcanism in the German region the Eifel. Immediately after volcanism began, sediments in the river Rhine, that flows through this region, contained minerals like augite and basaltic slate. The Rhine transported these minerals to the Netherlands. Although olivine is more present in the Eifel than the other two sediments, it was no longer found after being transported by this river for approximately 150 kilometers. It is obvious that weathering in nature goes much faster than under lab conditions but it is difficult to give hard figures for this effect.

A way to estimate the speed of weathering of a large olivine massif is the following:

In Guinea, West-Africa, is a large olivine massif. Basically, it is an upright plate 50 kilometers in length with a cross section of 5 kilometers. The plate is deeply weathered mainly with red iron oxides, portraying it on satellite photos as a red band.

In order to determine the speed of the weathering, you need to know when the rocks intruded there (the weathering of the rocks could only start from the moment they were there), the thickness of the weathering layer and what is left of the original rock when it is weathered.

The olivine massif is 195 million years old, the weathering layer is approximately 100 meters thick and no more than 10% of the original rock is still there as an iron-rich rest. This is because the remainder (especially magnesium and silicium) were solved and transported during the weathering. When there was only 10% left, the 100 meters of weathering floor was created from 1.000 meters of fresh rock, meaning the average weathering speed is 1.000m/195 million years= 5.1 micron/year. That is over ten times as much as the weathering speed in a lab.

Yet, I think the weathering speed of fresh dunite rock is even greater under tropical conditions. First of all, it is an intrusive rock meaning it is a melt in the crust of the earth and it can only weather if the rocks above have been removed by erosion. This must have lasted some tens of million of years, which makes the calculated weathering speed higher. Moreover, it is obvious that the weathering crust gets thicker and thicker when the weathering progresses. Then the weathering will slow down because the contact between the fresh rock, CO_2 in the air and water gets more and more difficult.

A reasonable estimate of these factors is that the weathering of olivine rock takes place with a speed of 20 up to 30 micron annually.