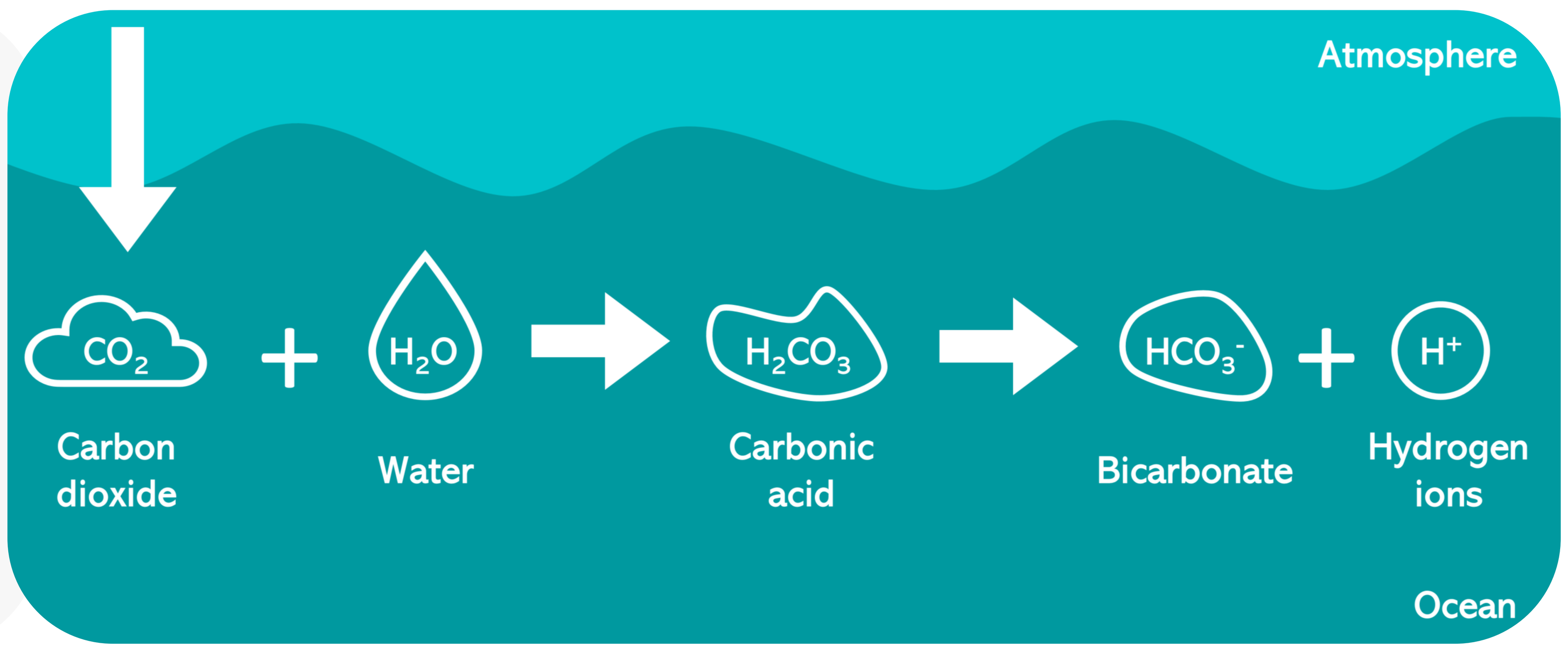
DEHEAT – Natural analogues and system-scale modelling of marine enhanced silicate weathering
What is the potential for global CO_2 removal?

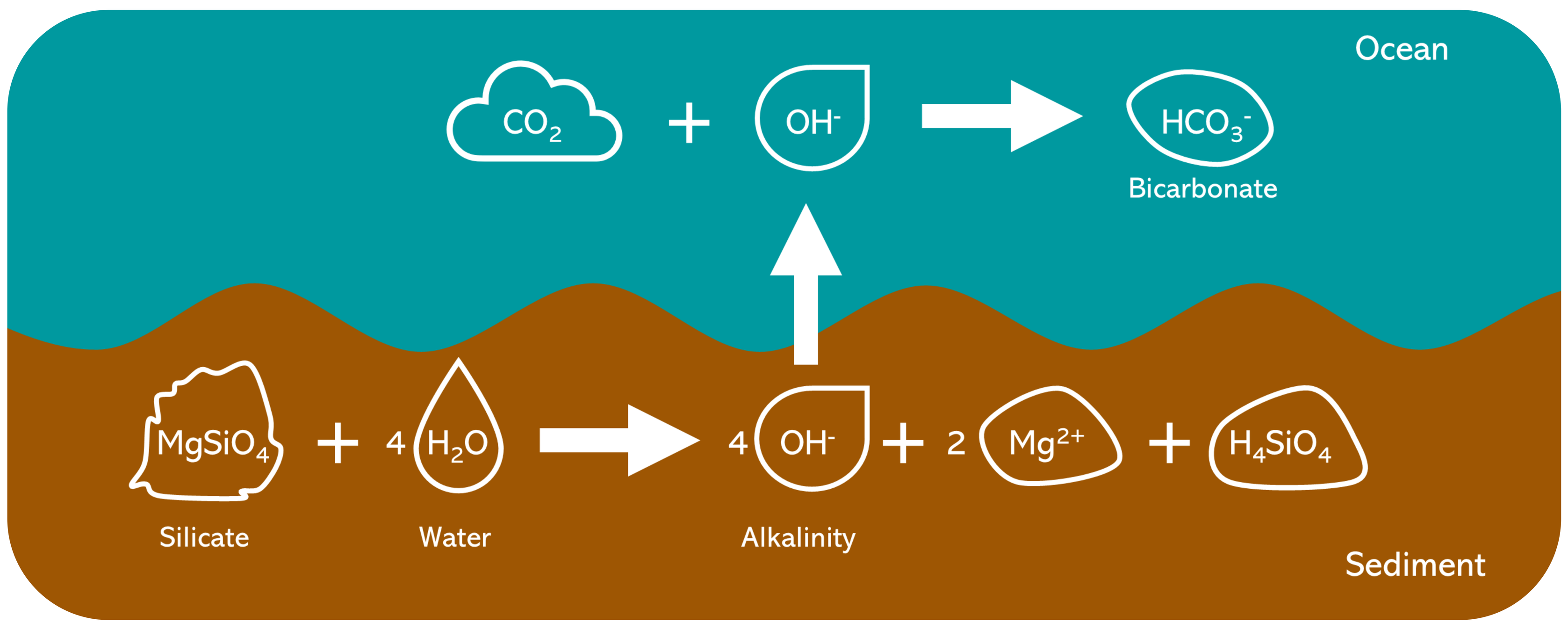
museum NATURALSCIENCES.BE

Can silicate weathering increase the ocean's CO_2 uptake?

At the water surface: ocean alkalinization drives atmospheric CO_2 uptake

1. When **alkalinity is added** to the surface ocean (in the form of OH- ions) this stimulates the conversion of dissolved CO_2 into another form (bicarbonate)
2. The concentration dissolved CO_2 is lowered in the surface ocean, and this hence drives a **transfer of CO2** from the atmosphere to the surface ocean.
3. The bicarbonate is stable for long term (> 100 years), and so **ocean alkalinization** provides long term CO2 sequestration.





In the seabed: Weathering stimulates ocean alkalinization

Silicate weathering in the seabed releases alkalinity to the pore water, which is subsequently transported to the overlying water. Because of this we expect that silicate weathering:

1. **Counteracts ocean acidification**
2. **Increases the CO_2 uptake** in the ocean by shifting the chemical equilibrium between CO_2 and water to the right

The need for speed: High weathering rates provide large CO_2 sequestration

To tackle the climate challenge, we need large-scale sequestration of CO_2. Yet silicate weathering is a intrinsically slow process. To speed up the weathering rate, we can:

1. **Select silicates** with **high intrinsic weathering rates** like olivine
2. Grind silicates to increase the **contact surface** between silicate and water
3. Apply silicates at **locations where the ocean amplifies weathering**

Is coastal enhanced silicate weathering truly inducing ocean alkalinization?

In the sediment pore water: detect the build-up of weathering products

- Analyze pore water and solid sediment chemistry to determine the **actual conditions at which weathering occurs**
- Monitor **concentrations of weathering products** with sediment depth and over time
- Verify whether new **secondary minerals** are formed during silicate dissolution

In the overlying water: monitor water chemistry and CO_2 uptake

- Quantify the exchange of weathering products between sediment and overlying water
- Determine the quantity of CO_2 sequestered at different rates of weathering
- Track the fate of critical weathering products (e.g., nutrients and trace metals) to evaluate ecosystem impacts

From measurements to models: simulating global potential and future scenario's

Ocean models: Assess CO_2 uptake and environmental risks at the global scale

Evaluate the impact of the released weathering products released on the **ocean's ecology** and determine the **ocean's CO_2 uptake capacity** for different **grain sizes and loading rates.**

Economic models: Calculating the feasibility: from mining to CO_2 credits

Investments of silicate weathering are highly dependent on **mining and grinding** costs. **Revenues** are driven by the **CO_2 credit price** and the **starting grain size** which determines the **weathering period.**

museum NATURALSCIENCES.BE

Universiteit Antwerpen

ULB UNIVERSITÉ LIBRE DE BRUXELLES

CLIMATE CENTRE