Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.24187

Sensitivity of silicate rock weathering to climate and atmospheric CO_2

YVES GODDÉRIS[1], ALEXANDRE POHL[2], PIERRE J-Y MAFFRE[3], YANNICK DONNADIEU[4], JACQUES SCHOTT[5] AND SUSAN BRANTLEY[6]

[1]Géosciences Environnement Toulouse - CNRS
[2]Université Bourgogne Franche- Comté
[3]CEREGE
[4]CEREGE, Aix Marseille University
[5]GET-OMP-CNRS-Toulouse University
[6]Pennsylvania State University

Presenting Author: yves.godderis@get.omp.eu

Chemical weathering of silicate rocks has been credited with keeping the Earth's climate sufficiently constant over long timescales to support the development of life. On short time scales, there is renewed interest in silicate weathering as part of geoengineering operations.

Whether the timescale is long or short, the question remains: how sensitive is silicate weathering to climate? This climate dependence can be expressed by Arrhenius law calibrated on field data (Brantley et al., 2023), or by a power law of atmospheric CO_2, with the exponent *n* being a parameter (Penman et al., 2020).

To calculate a weathering law applicable on a large scale, data acquired at different CO_2 levels are required. This is what has been done in Iceland, for example, over long time series (Gislason et al., 2008). This approach is more rigorous than collecting data under variable climates, but long data series are rare.

To overcome this problem, we performed a study of the sensitivity of weathering to climate using the GEOCLIM numerical model, including a module coupling erosion and weathering and a 3D-climate model. The spatial resolution is 2.8° long x 1.4° lat. The main outcomes are :

1. the dependence of weathering on climate is geographically strongly variable. While mid- and high-latitude zones all show a positive dependence on CO_2, the response of the tropical zone is more dispersed. Some zones show a negative feedback (mainly arid zones, where rainfall increases as CO_2increases). Some hot, humid zones are unable to increase the rate of weathering because of a strong shielding effect of regoliths. Finally, areas that become arid are unable to exert a negative feedback on CO_2.
2. The overall sensitivity of weathering to CO_2 is dependent on the continental configuration. The exponent *n* reaches a value of 0.5 when continental configuration favors the presence of arid zones. Conversely, it halves in configurations that favor the absence of arid zones (e.g., small emerged areas in arid tropical zones).