Goldschmidt2017 Abstract

A novel approach to quantify factors controlling silicate weathering rates from the Laboratory to the Field

BASTIEN WILD[1,*], GWENAËL IMFELD[1], EMILIE BEAULIEU[1] , FRANÇOIS GUYOT[2] AND DAMIEN DAVAL[1]

[1] LHyGeS, UMR 7517, Université de Strasbourg/CNRS,
1 rue Blessig, 67000 Strasbourg, France.
[2]IMPMC, UMR 7590, UPMC/CNRS/MNHN/IRD
61 rue Buffon, 75005 Paris, France.
*correspondence: bastien.wild@unistra.fr

Chemical weathering of silicate minerals impacts geochemical cycles, pedogenesis and global atmospheric CO_2 drawdown. Laboratory-defined mineral dissolution rates and those observed in the field often differ by several orders of magnitude. Bridging the gap between them constitutes a long-standing problem in water-rock kinetics. This field/lab discrepancy was suggested to arise from both intrinsic (i.e., related to the microstructural evolution of mineral surfaces) and extrinsic (i.e., related to the composition of the reacting fluids) factors. The exact nature and the relative contributions of intrinsic and extrinsic factors still remain poorly understood.

We present here a stepwise approach to elucidate the respective impact of both intrinsic and extrinsic factors on feldspar weathering rates. Intrinsic factors were first investigated separately in the course of labradorite feldspar dissolution by combining focused ion beam-transmission electron microscopy (FIB-TEM) observations with vertical scanning interferometry (VSI) and aqueous chemistry analyses. This approach enabled to point out the effect on silicate weathering rates of both textural and structural evolutions of amorphous silica-rich surface layers (ASSLs) formed at the reacting fluid/solid interface.

To quantify the effect of intrinsic factors, a novel method of *in situ* probing of biogeochemical weathering rates in the field was tested at the Strengbach critical zone observatory (Aubure, France). Absolute mineral weathering rates derived from this method were compared with the output of reactive transport code for the corresponding experimental plot. Our results highlight the significant contribution of extrinsic factors to the field-laboratory discrepancy. Combining these data with Illumina MiSeq-based metagenomic analysis of bacterial and fungal community diversity revealed that subtle reciprocal relationships are established between microorganisms and mineral substrates within the mineralosphere.