EGU2020-19728
https://doi.org/10.5194/egusphere-egu2020-19728
EGU General Assembly 2020

Rainfall as the major driver of plant Si availability in gibbsitic Andosols

Charles Vander Linden, Zimin Li, Anne Iserentant, and Bruno Delvaux
Université catholique de Louvain, Earth and Life Institute, Soil sciences, Louvain-la-Neuve, Belgium
(charles.vanderlinden@uclouvain.be)

The amount of water available to leach solutes from soil is one of the major features determining mineral weathering, secondary mineral synthesis and soil properties. The occurrence of gibbsite in soils denotes strong desilication.

Here, we quantify the reservoirs of bioavailable Si and phytolithic Si in wet tropical Andosols rich in gibbsite along a topoclimosequence where mean annual rainfall (MAR) increases from 2650 to 4400 mm with increasing altitude (65-375m above sea level) in Basse-Terre, Guadeloupe. We assessed bioavailable Si through $CaCl_2$ extraction in soil and the pool of soil phytoliths through Na_2CO_3 extraction and heavy liquid (hl) separation (followed by XRD quantification). The Na_2CO_3 extraction was performed on both the bulk soil and oxalate–treated soil (ox-Na_2CO_3) cleared of its amorphous aluminosilicates.

The Andosols have reached an advanced weathering stage. Their secondary products included (Al, Fe)-humus complexes, ferrihydrite, gibbsite and aluminous allophanic substances. The contents of organic C, metal-humus, ferrihydrite and gibbsite increased in wettest conditions (>3000mm) whereas allophane content concomitantly decreased. Ox-Na_2CO_3 Si (2-7 g kg^{-1}) contents were below hl Si contents (2-22 g kg^{-1}), and were negatively correlated to each other (r = -0.88) suggesting the occurrence of two pools of phytoliths: (i) free and fresh phytoliths, (ii) aged phytoliths entrapped in soil aggregates. Yet, bioavailable Si content in soil decreased from 63 to 12 mg kg^{-1} with increasing MAR (r = -0.92), and was strongly correlated (r = +0.95) to that of phytolithic Si as assessed after ox-Na_2CO_3 extraction. The Si/Al ratio of the ox-Na_2CO_3 extract regularly decreased from 1.06 to 0.37 with increasing MAR, hence corroborating strongest desilication in wettest conditions. In these highly leached, gibbsitic Andosols, rainfall is thus the major driver of plant Si availability.