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In the humid tropics, soil weathering stage affects differently the soil-to-plant silicon cycle depending on land use

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Plants take up silicon (Si) from soil solution, and form biogenic silica bodies (phytoliths) that return to soil with plant debris. Since phytolith dissolution releases plant available Si, the soil-to-plant Si cycle tremendously influences the global Si cycle. Si plant uptake ranges from 2 to 1470 kg ha-1 year-1 among different terrestrial ecosystems according to soil properties and processes, climate, plant species and management practices. The humid tropics shelter a huge variety of soils. Many of them are strongly weathered and desilicated, and exhausted in plant nutrients. Nevertheless, these soils support evergreen forests with the greatest biodiversity and biomass because of an intense biological pumping of nutrients. This pumping involves non-essential Si, and further governs the soil-plant Si cycle, which is perturbed after converting forest area into cropland.
Here, we used literature data quantifying the Si soil-plant cycle in natural forest areas and croplands established on soils that differ in weathering stage. We particularly focused on comparing forest to Si-accumulating rice crop. We show that the impact of soil weathering stage on the soil-plant Si cycle markedly differs according to land use. In slightly or moderately weathered soils, cropped plant populations take up Si in larger amounts than forest communities do, likely because they are stimulated to pump nutrients and dissolved Si from less soluble lithogenic and pedogenic silicates. Unlike that, in highly weathered soils, Si plant uptake is larger for forest communities than for crops. Three factors may explain this discrepancy: (i) since they are more soluble than lithogenic and pedogenic silicates, phytoliths make the pool of plant available Si; (ii) deep rooting of forest trees enhances biological pumping and limits the leaching of dissolved Si; (iii) crop harvesting exports Si out of cultivated systems.